national highways

Connecting the country

Our long-term strategic plan to 2050

May 2023

Foreword
Our long-term vision

The road ahead

Roads will continue to be the most common mode of travel through to 2050 and beyond. They provide a convenient and practical way to see family and friends, commute to work and deliver goods across the UK. They are fundamental to our economy and the wider transport system, hosting almost nine out of ten passenger miles and 79% of freight travel.

The strategic road network (SRN) is a shared national asset and it will continue to play a crucial role in connecting the country. We know that national and global expectations of our network and our organisation are growing, and we are already changing to make sure we meet them.

We recognise that, as journeys don't begin or end on our roads, it is vital that we connect seamlessly with other transport networks, particularly around the urban interface and at our rail hubs, ports and airports.

We also understand that, societally, we are facing unprecedented challenges around decarbonisation and biodiversity - while at the same time needing to sustain the economy. We see huge opportunities to meet these challenges through a step change in environmental stewardship and leveraging the best of new and emerging technologies.

As the use of fossil fuels declines, our customers are turning to sustainably-powered vehicles, a change we are working hard to support. Vehicle connectivity and levels of autonomy will also grow, paving the way for safer, stress-free journeys.

Our role as network builder and traditional asset operator is already changing. This advancement will be crucial as our older major assets become worn out and need replacement, having served constant traffic since their construction in the 1960s.

Our network is reaching maturity in its extent. Our long-term future focus will transition from building new network capacity to optimising our operational efficiency, leveraging digital technologies and deepening our relationship with a diverse customer base who expect safe, connected and reliable journeys.

As the third road period (2025-2030) approaches, we are well placed to embrace the future with a strong identity and clear purpose. We will continue our journey, serving our customers, the economy and the environment and welcome your views on our long-term strategic plan to continue to develop our vision.
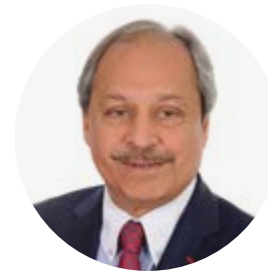
Dipesh Shah OBE
Chairman

Nick Harris
CEO

Elliot Shaw
Chief Customer and Strategy Officer

Our long-term vision

The SRN is part of a seamlessly-integrated transport system that meets our customers' needs by connecting the country safely and reliably, delivering economic prosperity, social value and a thriving environment.

Foreword
Introducing our plan

Guiding our direction

Our long-term plan sits at the centre of our business planning. It brings together our existing strategies, including Route strategies, *Net zero highways: our 2030 / 2040 / 2050 plan, Digital Roads* and our *Customer service strategy*. Crucially, it draws on wider government aspirations, using them to align and inform our business planning and investment decision-making processes.

We know that the future is uncertain. Since publishing our first long-term plan in 2017, much has changed and, in accepting such uncertainty, we know that our plan will evolve over time. We will keep our plans under review, working alongside the Department for Transport (DfT), the Office of Rail and Road (ORR) and Transport Focus to put our customers first.

We recognise that realising our vision will be reliant on collaboration with local, regional and national stakeholders. Our plan has been informed by their priorities, and is intended to sit coherently alongside their respective future plans, including those of sub-national transport bodies, city regions, local authorities, Network Rail, port and airport operators and government.

Together, we believe that this document represents a starting point for the future development of our network and provides a framework against which we can gauge our future activities.

Before we publish the final version of Connecting the Country, we are seeking your feedback to further refine and shape our long term strategic plan, with a clear recognition that your input will help strengthen the plan, which potentially impacts upon how the SRN may evolve over the next three decades.

Future Planning

This document sets out our 2050 vision for the SRN to be part of a seamlessly-integrated transport system that meets our customers' needs by connecting the country safely and reliably, delivering economic prosperity, social value and a thriving environment. It describes the short, medium and long-term steps needed to make our vision a reality over successive road periods. Our plan has been informed by horizon scanning, foresight analysis and engagement with key stakeholders across 9 focus areas. It outlines the vision for the categorisation of the SRN to provide a consistent level of service. These cover the national corridors, inter-regional routes and regional connections.

Connecting the Country underpins our *SRN Initial report, Strategic business plan* and *Delivery plan* for each *Road investment strategy* (RIS) to ensure delivery towards the 2050 vision. Each RIS outlines a long-term programme for the SRN with the funding needed to plan ahead on a five-year cycle. This plan also underpins our Route strategies, one of the key steps of research required by DfT to inform the setting of each RIS. Their route objectives, which respond to the needs of stakeholders, road users and communities, and the locations for further consideration to achieve these objectives are aligned with our 2050 vision and how we will deliver across the 9 focus areas.

Foreword
Introducing our plan

This plan sets the long-term vision for the SRN. It helps us identify the potential challenges and opportunities that lay ahead and, crucially, sets out how we will navigate them to realise our 2050 vision through nine focus areas:

How much our customers will travel

Growth and levelling up

Car travel

Freight and logistics

How our customers will experience travel

Safety

Digital

Decarbonisation

How we will manage our network

Customer experience

Sustainable network development

Asset resilience

Executive summary
How much our customers will travel

Our network will play a critical role in supporting growth as part of an integrated transport system.

Focus area	What is changing?	Our ambition	Our delivery
Growth and levelling up	**Government's priority is on growth and levelling up** following the Covid-19 pandemic, placing infrastructure as a pillar of recovery. The *Levelling up the United Kingdom* White Paper has also set out how government intends to spread opportunity more equally across the UK.	**Regardless of which region our customers are travelling through, they will receive the same high level of service and connectivity.** We will have defined service levels across our roads and will work with stakeholders to remove regional disparities in performance and connectivity, affording equal opportunity to all.	▪ **Increasing productivity and competitiveness** through delivery of nationally-significant infrastructure ▪ Improving **performance monitoring**, visibility and targeted enhancements ▪ **Enabling businesses to grow** through close collaboration with SRN-reliant sectors ▪ **Unlocking sustainable growth and productivity** by working in partnership with other network operators and the private sector
Car travel	**Demand for our network is growing and, while there are uncertainties, we expect this to continue to 2050.** Commercial and housing growth on urban fringes are likely to increase network pressures around major towns and cities.	**Network optimisation and modal integration will enable fast and reliable journeys.** We will optimise the SRN and create a fully-integrated national transport network, working with partners to deliver seamless multi-modal travel. We will help customers choose the right mode for their journeys and support viable alternatives to short hop journeys on our network.	▪ Effective **network optimisation improvements** to bring tangible local benefits, such as reduced incidents and congestion ▪ Seamless **network integration** with other roads, modes and hubs ▪ Supporting **modal shift** by making it easy for customers to choose the right mode(s) for their journeys, including active travel ▪ Increased visibility and management of **live network performance**
Freight and logistics	Growth in e-commerce has been identified as a key factor impacting the freight system over the long-term. Reflecting the accessibility and flexibility it provides, **it is assumed that the majority of future freight will rely on road transport**[1].	**Our network will provide unimpeded access to domestic and world markets, driving national competitiveness.** Freight will move freely across the SRN, enabled by network improvements on key freight corridors, around international gateways and at major consolidation centres. High-quality corridors will serve autonomous freight movements and we will work with partners to create a national multi-modal freight network that maximises the efficiency of movements.	▪ High-quality **freight corridors** to all major ports of entry and hubs ▪ Targeted **modal shift** of freight to short-sea shipping and rail ▪ **Consolidation** of freight, particularly where the SRN meets urban areas ▪ Accelerated delivery of infrastructure to facilitate **autonomous freight** ▪ Improved freight facilities

Foreword   **Executive summary**   Our strategic planning approach   Trends shaping the future   Our vision   How we will deliver   Next steps

national **highways**

Executive summary
How our customers will experience travel

Travel on our network will be safe, sustainable and increasingly connected.

Focus area	What is changing?	Our ambition	Our delivery
Safety	**Total road fatalities have fallen over time, but incremental rises are now becoming increasingly challenging.** Technological advances to vehicles, adaptation of our physical infrastructure and the way we manage our network will bring radical change and opportunity.	**Our roads will be the safest in the world. No one will be harmed when using or working on the SRN.** Our focus on safety will avoid physical, mental and emotional harm to individuals. A safer network will also improve journey time reliability, providing economic benefits.	▪ **Safer roads**, targeting every part of our network to be rated iRAP three-star or above, where possible ▪ **Safer people and vehicles** through driver education and campaigns, minimum standards of vehicle connectivity and dynamic network management ▪ **Safer speeds**, improved **post-collision response** and **road safety management** ▪ Digital design and construction to reduce risk associated with road works and **maintenance activities**
Digital	**Digital services will bring opportunities to transform how we manage our network.** This will range from digital design, intelligent asset management, connected and autonomous plant (CAP) and vehicles (CAV) through to how we generate and use our data.	**National corridors will be CAV-enabled, providing congestion and safety benefits. Freight automation will be established on routes to major international gateways.** Our customers will travel on digitally-enabled roads, making their journeys safer, more efficient and environmentally sustainable. Our design, construction and operational activities will be fully digitised and automated.	▪ **Digital design and construction** by default, with greater automation as well as modular and off-site construction to drive productivity gains ▪ Increasingly **digital operations** by leveraging data to support increasingly pre-emptive interventions ▪ Delivering **digital for customers** through increased visibility and management of the live network to keep customers better informed and in control
Decarbonisation	**Transport must decarbonise.** In 2019, government amended the Climate Change Act to introduce a legally-binding commitment to reducing all greenhouse gas emissions to net zero by 2050.	**The SRN will be decarbonised, placing roads at the heart of the UK's net zero future.** We will remove carbon from our operations (by 2030), our construction activity (by 2040) and support the transition to carbon-free travel on our network (by 2050).	▪ Achieving **net zero operations** by decarbonising our fleet, estate and operational activities ▪ Achieving **net zero maintenance and construction** through zero-carbon materials and construction innovation ▪ Achieving **net zero travel** through electrification of our network and supporting the provision of low carbon fuel options for HGVs

Executive summary
How we will manage our network

We will deliver stress-free customer journeys while also acting 'beyond roads' to improve the quality of life in local communities.

Focus area	What is changing?	Our ambition	Our delivery
Customer experience	While journey time reliability continues to be a key determinant of journey satisfaction, new technologies, such as electrification of the network and our transition to Digital Roads, **present exciting opportunities to enhance customer experience.**	**We will provide a trusted and stress-free end-to-end experience for our customers, with accurate and personalised journey information and attractive rest areas that offer rapid and reliable low-carbon fuelling.** Safe and reliable journeys will be the foundation for our 'whole journey' approach, which will make using the SRN, adjoining roads, modes and hubs more enjoyable.	▪ Delivering **reliable journey times** through consistent route and service standards tied to our future network plans, including rapid incident response and optimised roadworks ▪ Collaboration with private sector to transform **roadside facilities**, providing ample reliable and rapid charging provision for electric vehicles ▪ **Connecting customers** through personalised, multi-modal journey information transmitted to vehicles through a choice of digital platforms
Sustainable network development	The protection and enhancement of our shared natural environment is recognised as a key responsibility of infrastructure owners and operators. **Wide-ranging interventions will be needed to halt and reverse the loss of biodiversity and to use the SRN and our estate to promote wider environmental and social value.**	**Our network and wider estate will support a thriving environment, enabling healthier and safer communities and a richer, more biodiverse natural environment.** Our physical network will be largely complete and our enhancements focused on localised optimisation schemes. We will be an established force for good in communities, balancing network improvements with wider impacts and creating value beyond our roads.	▪ Applying **PAS 2080** and increasing environmental standards for our enhancement and construction works ▪ Using our network and wider estate to support **nature** and deliver biodiversity net gain ▪ Significant investment in the protection and promotion of health and wellbeing in **communities** ▪ Ensuring interventions support **active travel**
Asset resilience	**We are responsible for a growing, ageing and increasingly complex asset base.** Increased frequency and severity of climate-related weather events also pose a risk to the condition and performance of our assets.	**Asset and operational resilience will be maximised through an intelligent, data-led approach.** Assets will be digital by default, providing real-time updates of condition and performance to support predictive, data-led decisions that keep our network open, safe and serviceable. Where roadworks are needed, customers will know well in advance of their journeys, allowing them to compare alternative routes, modes and departure times.	▪ **Connected assets** by default to allow for vehicle-to-infrastructure communication ▪ Using data to maximise whole-life asset value and plan our **asset renewals** ▪ Making our network **resilient to the impacts of climate change**, for example to extreme heat or flood events ▪ Modernising operational technology, control centres and cyber security to ensure **digital resilience**

Executive summary
Introducing our future network

In support of our vision, we will investigate the benefits of categorising our network and defining the associated levels of services our customers can expect from them. The following categories and levels of service are conceptual only and require further development:

National corridors

National corridors will continue to be the vital spine of our network, supporting the highest levels of demand. These routes will be the key long-distance corridors, connecting major urban economies, acting as major freight routes and linking international gateways.

Inter-regional routes

Inter-regional routes will be high-demand, multiple-lane roads. These routes will connect regional economies and carry significant levels of freight and goods.

Regional connections

Regional connections will link local economic centres, both to each other and the national network.

On the following pages, we provide an overview of our vision for consistent levels of service that customers could expect for each category.

National corridors

Inter-regional routes

Regional connections

Please note this map is conceptual only
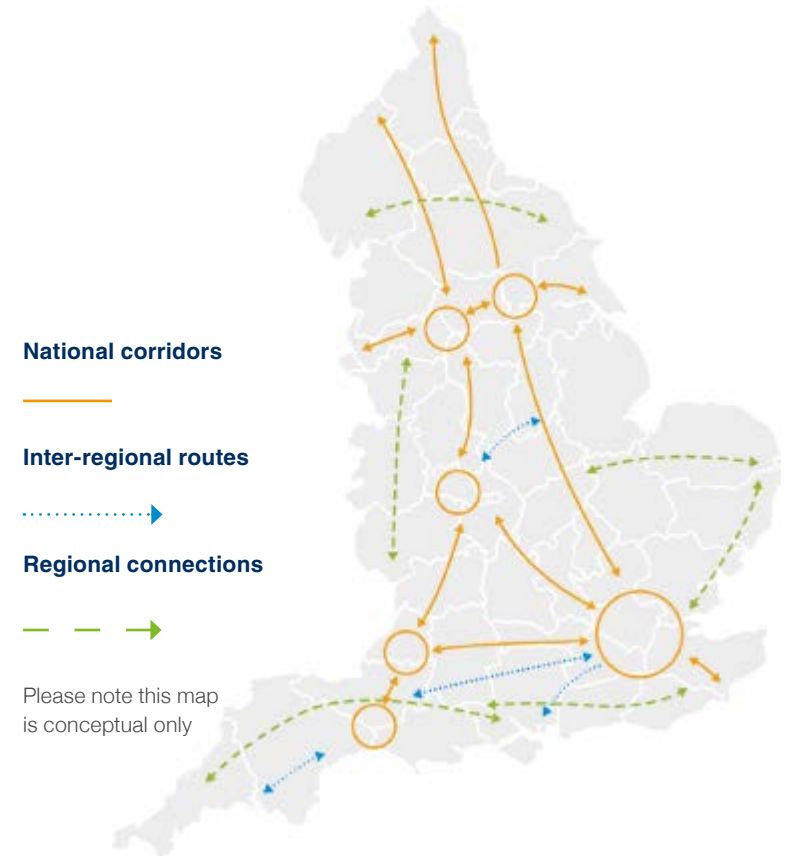
We know that our customers value reliable journeys on roads that provide a consistent level of service. We want them to experience exceptional service regardless of which part of our network they are on. To help guide the long-term development of our network, we have established aspirational levels of service across the SRN.

Executive summary
How customers will experience our future network

High standards for safety, environmental performance and operational management will continue to exist across the entirety of the SRN. In forthcoming road periods, we will take a customer-centric view to define the service levels customers can expect on different parts of our network.

Focus area	National corridors	Inter-regional routes	Regional connections
Safety	← Safe roads as standard (targeting minimum iRAP three-star) with consistent geometric standards. →		
Digital	In-vehicle management: supporting data sharing between vehicles, infrastructure and our control centres to enable high levels of compliance and journey reliability.		In-vehicle communication: including information and advice on traffic, incidents, roadworks and weather, as well as status updates from multi-modal hubs and interchanges.
Decarbonisation	Electric and alternative fuel provision for all private and light vehicles plus heavy freight vehicles.		Convenient and high-quality electric charging provision for all private and light vehicles.

Executive summary
How customers will experience our future network

Focus area	National corridors	Inter-regional routes	Regional connections
Customer experience	Highest pre-defined levels of on-road resource and monitoring enable rapid incident response.	Monitoring of routes, with automated incident detection and response to pre-defined service levels.	Monitoring of key junctions, local network interfaces and mobility hubs, with pre-defined levels of service.
	← High-quality and consistent service provision at motorway and all purpose trunk road service areas for private use and light vehicles, as well as at freight service and rest areas. →		
Sustainable network development	← Use of nature-based solutions, particularly in Areas of Outstanding Natural Beauty. Targeted mitigation of air quality, noise and plastics through real time and increased monitoring and response. An efficient and optimised physical network, integrating with local roads, the major road network, rail, light rail, ports and airports. →		
Asset resilience	Majority of assets are digitally connected, providing real-time condition data and insight to minimise disruption to customers.	← Our key assets are digitally connected, providing real-time condition insight and minimising disruption to customers. →	

Contents

Our strategic planning approach

This plan sets the future direction for our organisation. It identifies challenges and opportunities, setting out how we will navigate them to ensure that the SRN safely, sustainability and efficiently connects the country between now and 2050. It also outlines our vision for the categorisation of the SRN, supported by consistent levels of service. These categories cover national corridors, inter-regional routes and regional connections.

We have applied a 'futures-thinking' approach to guide the creation of this plan, recognising that we need to progressively identify the long-term issues and challenges shaping the future of road and transport policy.

This plan underpins our *SRN Initial report, Strategic business plan* and *Delivery plan* for each *Road investment strategy* (RIS). The RIS outlines a long-term programme for the SRN, detailing the funding needed on a five-year cycle. This plan also underpins our Route strategies, one of the key steps of research required by government to inform the setting of each RIS. Their route objectives, which respond to the needs of stakeholders, road users and communities, and the locations for further consideration are aligned with our 2050 vision and delivery priorities.

Creating our long-term plan

Recognising uncertainty

We know that the future is uncertain. Since publishing our first long-term plan in 2017, much has already changed. The Covid-19 pandemic, geopolitical instability and volatile energy markets have demonstrated just how quickly and profoundly shocks and stresses can affect daily lives. They have underlined the importance of ensuring that an adaptive approach is built into our organisational planning.

Clear evidence of climate change impacts and heightened awareness of the decline in our natural environment also show the need for us to continually review societal challenges and our response to them. Flexibility will be critical to ensuring the systems and infrastructure we provide are not only fit for the future, but also help to actively shape it.

Deciding our future

Our strategy is vision-led. We have moved to a 'decide and provide' approach, whereby we are increasingly proactive in shaping the future we want for our customers and network. We will continue to forecast to understand possible future scenarios, but we have a clearer sense than ever before of our preferred vision for the future and the steps needed to make this a reality.

In developing our vision, we have considered the potential trends that will likely shape the SRN and influence our operations over the next 30 years and beyond.

The vision we set out is challenging, aspirational and achievable. It is based on pathways for change, both on our network and through collaboration with associated sectors and partners.

We will evaluate our progress in line with the road investment cycles and, where appropriate, adjust and realign our response. We will work closely with our customers and stakeholders throughout, drawing on their perspectives to guide us.

Our approach

We have developed plans against our nine focus areas through 'futures-thinking'. Our approach can be broken into three stages:

Trends
Horizon scanning to create a bank of ideas on trends and possible events which will shape the future

Visioning
To define our ambitions for the future of our network and the service we provide to customers

Delivery planning
Using road-mapping techniques to understand how trends combine over time and to determine the steps we will take to realise our vision

Foreword   Executive summary   **Our strategic planning approach**   Trends shaping the future   Our vision   How we will deliver   Next steps

national highways

How our plan integrates with the strategic planning cycle
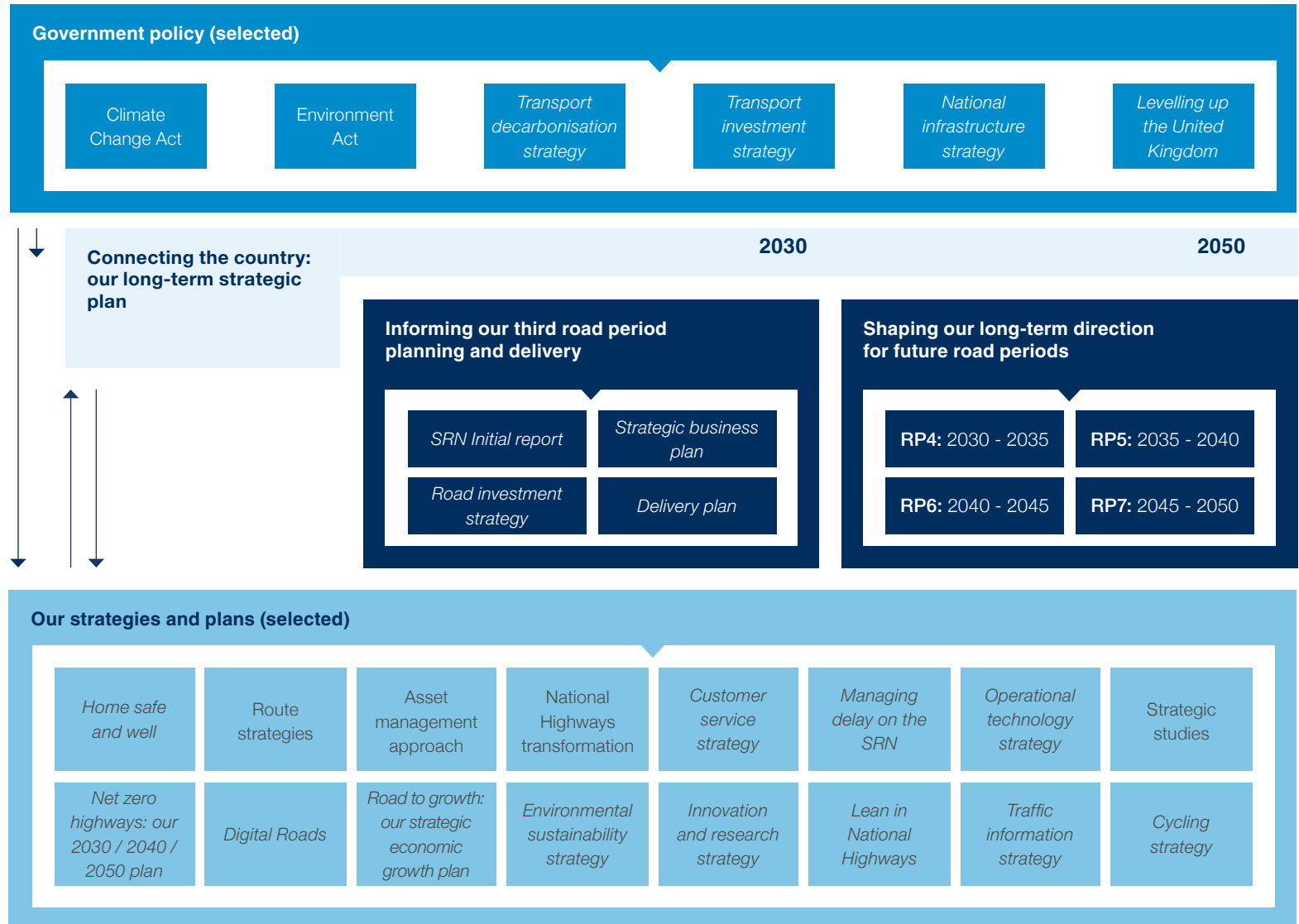
Future planning

Our long-term plan sits at the centre of our future planning approach. It responds to government aspirations and policy, identifying the implications for the SRN and its management. Crucially, our plan also brings together our range of existing organisational strategies into a single integrated plan.

Guiding us across multiple road periods

We work alongside government to plan the investment and management of the SRN in five-year cycles, known as road periods. Our long-term plan is designed to look beyond a single period, guiding us across multiple road periods.

The third road period, which covers the period from 2025 to 2030, is the next step on this journey. Our plan is already playing an important role in shaping the priorities contained within our *SRN Initial report*. These priorities will also be reflected in our subsequent business and delivery plans for the third road period.

Government policy (selected)

| Climate Change Act | Environment Act | *Transport decarbonisation strategy* | *Transport investment strategy* | *National infrastructure strategy* | *Levelling up the United Kingdom* |

Connecting the country: our long-term strategic plan

2030   2050

Informing our third road period planning and delivery

| *SRN Initial report* | *Strategic business plan* |
| *Road investment strategy* | *Delivery plan* |

Shaping our long-term direction for future road periods

| **RP4:** 2030 - 2035 | **RP5:** 2035 - 2040 |
| **RP6:** 2040 - 2045 | **RP7:** 2045 - 2050 |

Our strategies and plans (selected)

| *Home safe and well* | *Route strategies* | *Asset management approach* | *National Highways transformation* | *Customer service strategy* | *Managing delay on the SRN* | *Operational technology strategy* | *Strategic studies* |
| *Net zero highways: our 2030 / 2040 / 2050 plan* | *Digital Roads* | *Road to growth: our strategic economic growth plan* | *Environmental sustainability strategy* | *Innovation and research strategy* | *Lean in National Highways* | *Traffic information strategy* | *Cycling strategy* |

Italicised text indicates document title

Foreword   Executive summary   Our strategic planning approach   **Trends shaping the future**   Our vision   How we will deliver   Next steps
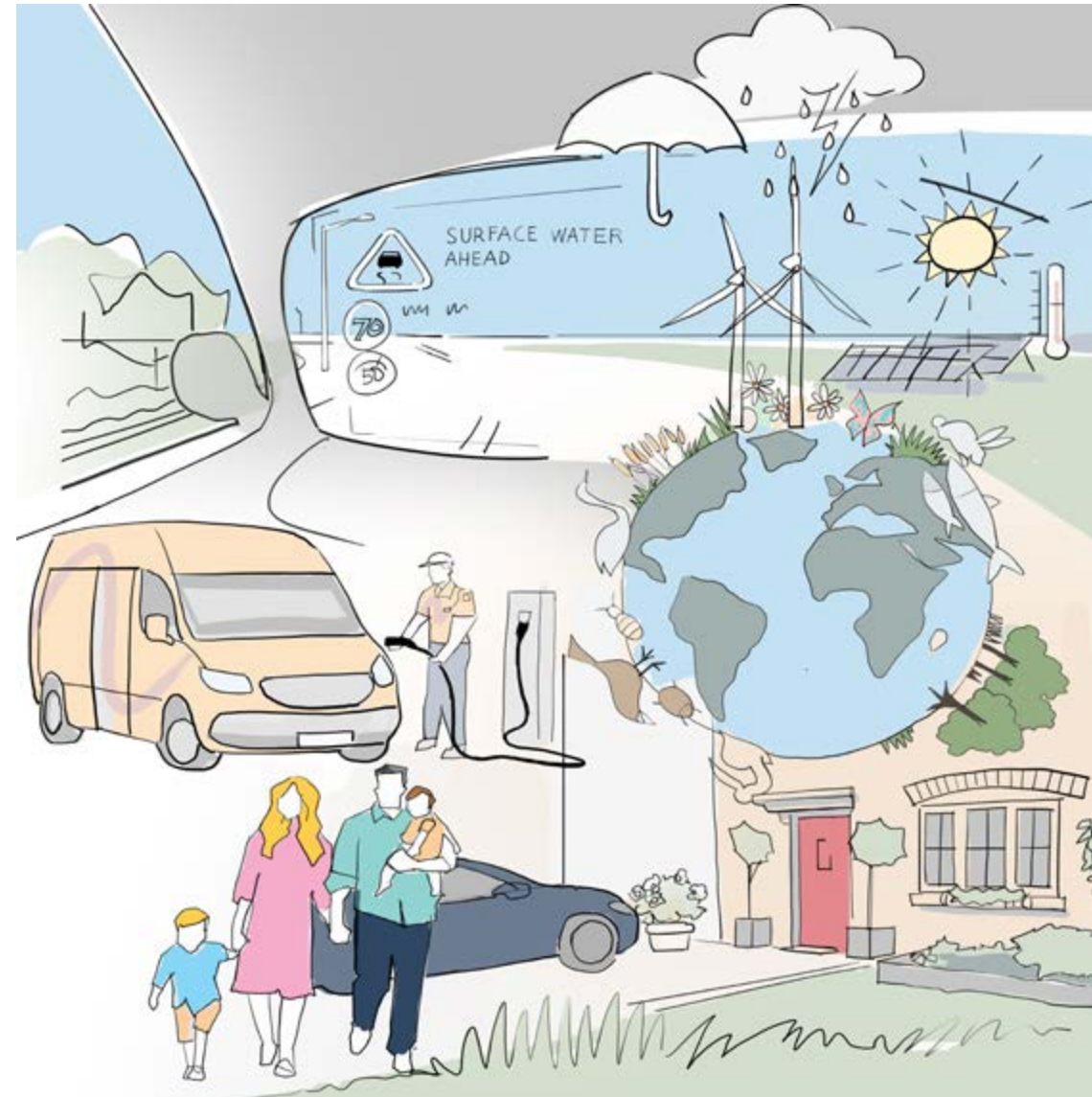
national highways

Trends shaping the future

Mapping the future for the next 30 years and beyond is a difficult task. There are known uncertainties, such as population and economic growth, but also the potential for wider disruption, be it through technological advancement, environmental shock events, pandemics or societal change.

While handling this level of uncertainty is a common problem when forecasting in any industry, the long-term planning of the SRN is particularly complex. To guide us on our path to 2050, we have analysed evidence to understand both historic and future trends, grouping our nine focus areas under three core themes:

- How much our customers will travel
- How our customers will experience travel
- How we will manage our network

While no-one can predict with certainty what the future will hold, we believe that these trends will shape the SRN and influence our future operations.

Foreword   Executive summary   Our strategic planning approach   **Trends shaping the future**   Our vision   How we will deliver   Next steps

national highways

How much our customers will travel

The demand for travel is likely to increase over the long term

Our network will play a critical role in supporting growth as part of an integrated transport system.

Growth and levelling up

Supporting economic growth:

£410bn

GVA of sectors reliant on our network[2]

90%
of the population live within 6 miles of the SRN

By 2030

government is targeting increases in pay, employment and productivity in every area of the UK

every part of England that wants one will have a devolution deal with powers at or approaching the highest level of devolution

91%
of businesses are located within 9 miles of the SRN

Car travel

The ONS forecast an increasing UK population[5]:

67m
2020 → # 71m
2050

Cars are the usual method of travel to work for

68%
of commuters in England

Car demand for the SRN has already returned to

~95%
of pre-pandemic levels

40+
garden communities planned

Delivering up to

16,000
homes per year from 2025

Increased demand for the SRN predicted by 2050, with growing pressure where it meets urban areas

Freight and logistics

Our network carries over

two-thirds
of lorry miles

Increasing HGV trips:

2-4%
increase between 2025 and 2030[4]

Goods vehicle demand for the SRN is now regularly

>100%
of pre-pandemic levels

The National Infrastructure Commission's 'business as usual' scenario for the Future of freight demand assumes e-commerce will account for

65% of total retail sales in 2050[3]

Foreword   Executive summary   Our strategic planning approach   **Trends shaping the future**   Our vision   How we will deliver   Next steps

national **highways**

Growth and levelling up
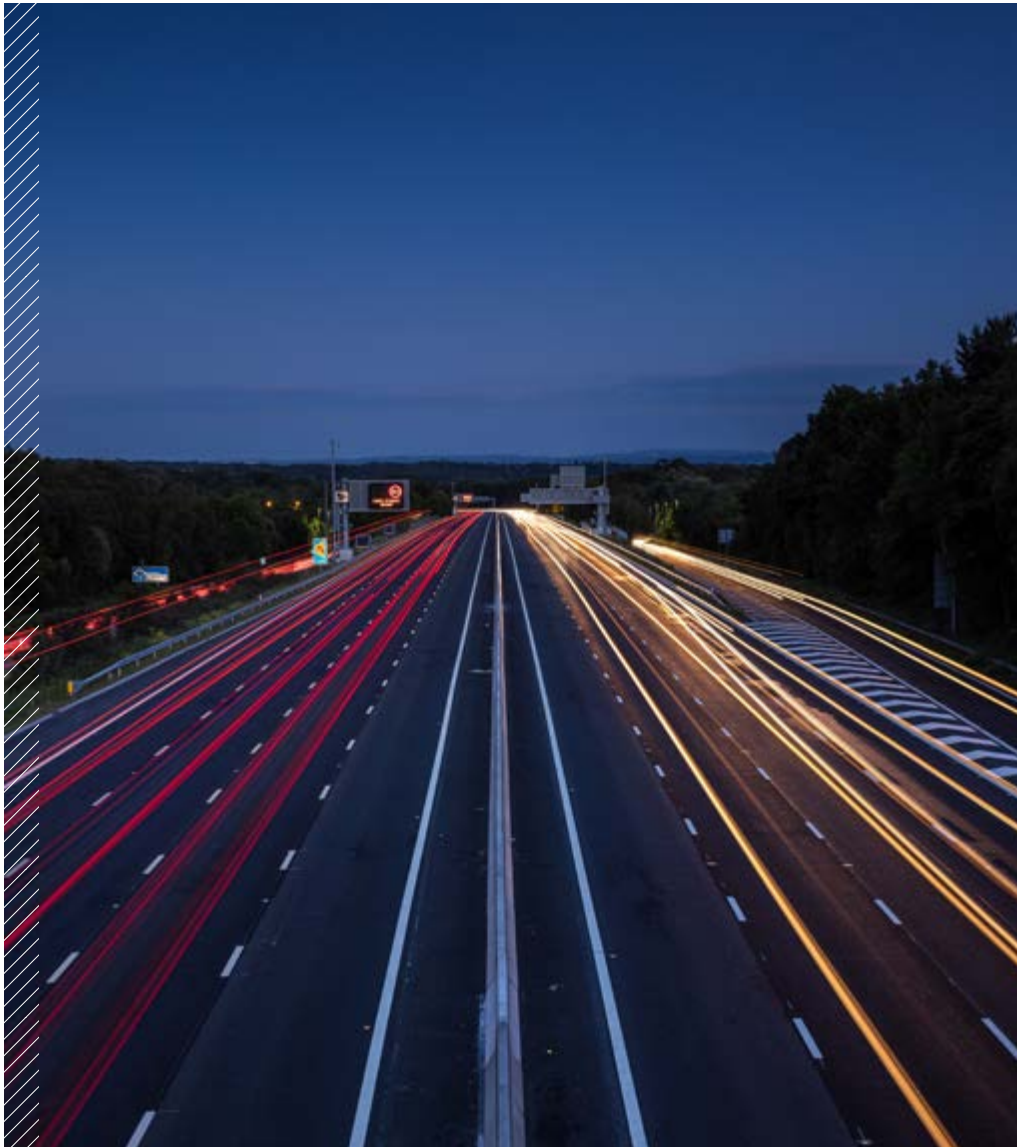
Our network is vital to the success of the national economy.

Our network stimulates economic growth across the country, creating jobs, supporting businesses and unlocking development. The success of the economy is underpinned by a safe, effective and efficient SRN, and the connectivity it provides is attractive to communities and businesses alike. 90% of the population live within 6 miles of the SRN, while 91% of businesses are located within 9 miles.

It is particularly important for road-reliant sectors, which include logistics, manufacturing and construction, and which collectively account for 7.6 million employees and £410 billion in Gross Value Added (GVA).

Beyond the transport of goods, the people-driven service sector is typically attracted to major centres and their opportunities for agglomeration (the clustering of economic activity). In 2050, areas of high productivity are likely to correspond to areas of high employment density and our network will play a key role in supporting and shaping sustainable multi-modal development.

Foreword   Executive summary   Our strategic planning approach   **Trends shaping the future**   Our vision   How we will deliver   Next steps

national highways

Growth and levelling up

As the economy has become more productive over time, it has relied on roads to accommodate more journeys.

Historically, the demand for road travel has tracked economic growth.

GDP growth is reflected in increased levels of business travel, commuting and the transportation of materials and goods. Historically, more economic activity has resulted in more personal and business travel and increased movement of goods.

People are increasingly able to enjoy accessibility for services or employment through digital connectivity and not solely the physical mobility provided by transport systems. Therefore, while it is likely that the positive relationship between GDP and the demand for travel will continue, the rise of the digital economy and new ways of working could affect the strength of the relationship.

CRITICAL UNCERTAINTY

Demand for our network is expected to increase to 2050. But economic pressures and demographic changes have introduced new uncertainties, meaning that demand could grow more slowly in the medium-term.

In addition to GDP, the cost of travel has traditionally had a direct influence on the level of demand. Major events that have caused fuel price spikes, such as the Suez oil crisis, have temporarily suppressed the demand for travel.
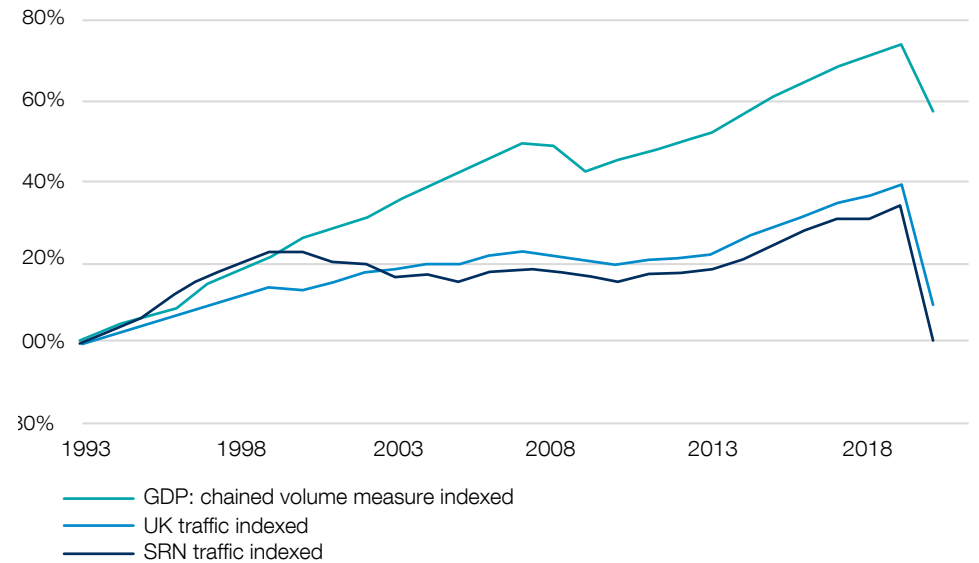
More recently, fuel costs have seen rapid increases, highlighting uncertainty in global energy markets and demonstrating just how quickly unforeseen shocks can change the cost of travel.

Personal incomes are another determinant of demand. In broad terms, the higher the income of an individual the more likely they are to own a car, increasing their likelihood of travelling further. Current inflation and challenges to personal incomes could slow the pace of demand growth.

We have developed and continue to evolve a range of forecasts informed by national road traffic forecasts. These scenarios suggest an uplift in demand for the SRN, though uncertainty introduced by recent events has meant that further adaptive development of these forecasts will be key.

Historic GDP and vehicle miles (indexed)

Legend:
— GDP: chained volume measure indexed
— UK traffic indexed
— SRN traffic indexed

Office for National Statistics, DfT road traffic statistics

Foreword   Executive summary   Our strategic planning approach   **Trends shaping the future**   Our vision   How we will deliver   Next steps

national highways

Growth and levelling up

Productivity and socioeconomic outcomes are not distributed equally.

The UK has larger geographic disparities than many other developed countries.

Regional variations in productivity have persisted throughout the last century, becoming entrenched and difficult to redress. Where variations have narrowed, this has proved to be temporary, with disparities now re-widened to levels comparable to the beginning of the 20th century.
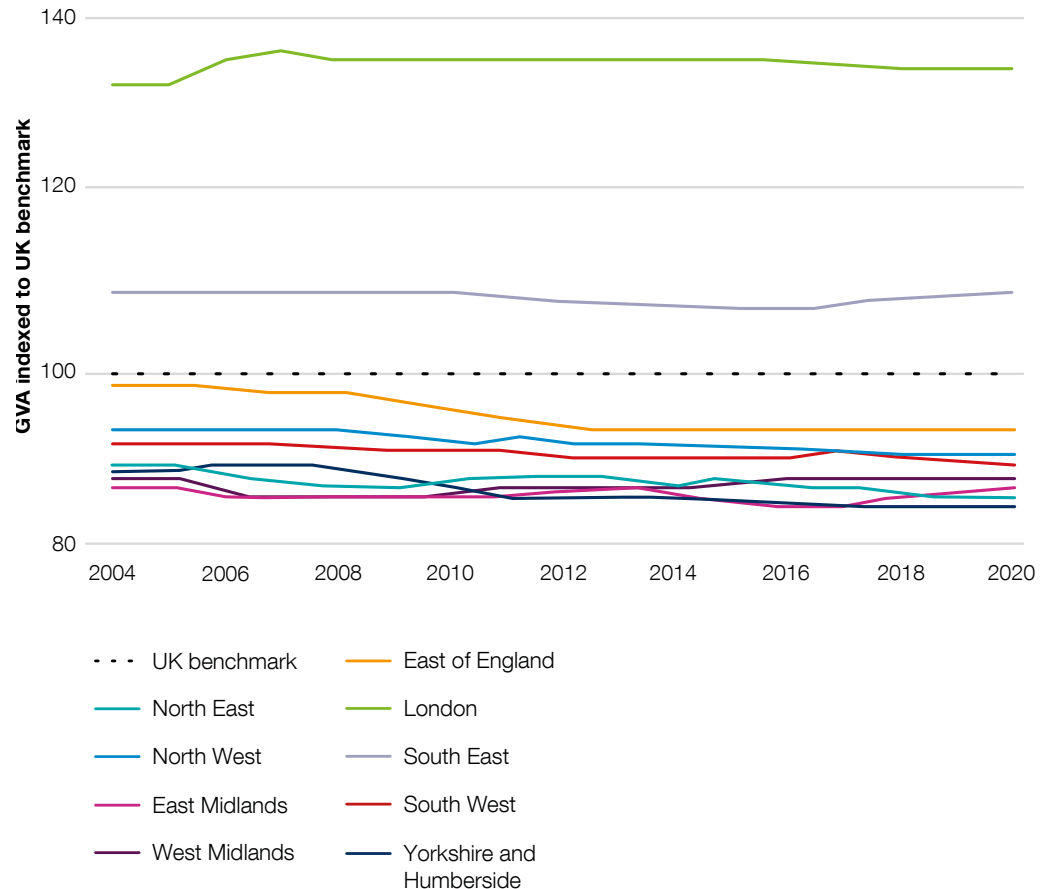
In line with historical trends, growth in productivity to 2050 is expected to be concentrated in cities, with the highest GVA per employee forecast to be found in the South of England.

Productivity within regions is not uniform, with higher productive regions having pockets of lower productivity and lower productive regions having pockets of higher productivity. While some of these pockets of higher productivity are major regional cities, it is worth noting that productivity in places such as Birmingham and Sheffield lie below the national average.

Places that tend to have poor socioeconomic outcomes share similar geographic features, including coastal communities previously associated with tourism and parts of the North and Midlands with industrial legacies.

There are also distinct differences in car usage and travel patterns between rural and urban areas, with people living in rural areas more reliant on roads to access employment.

Comparative regional GVA over time

Office for National Statistics

79%
of commuters in the North East use their car to get to work

Foreword   Executive summary   Our strategic planning approach   **Trends shaping the future**   Our vision   How we will deliver   Next steps

national highways

Growth and levelling up

The SRN plays a critical role in enabling job and productivity growth as part of an integrated transport system.

Connectivity will need to be improved within and between urban, rural and peripheral areas.

The *Levelling up the United Kingdom* White Paper sets out the government's missions to ensure that pay, employment and productivity are elevated in every part of the UK and that local transport connectivity across the country will have improved services, closer to the standards of London. Now and in the future, cities, towns and communities must be physically and digitally connected if they are to thrive.

The SRN is a catalyst for investment and growth, in particular supporting road-reliant businesses to connect to international gateways and areas of economic activity. We can play a major role in supporting regional growth and opportunity through our investment in the SRN, our role as an employer and procurer and through our role as a statutory consultee in the planning system.

This extends to supporting place-based outcomes through complementary regional and local transport investment. This enables improved connectivity with local public transport systems, another key levelling up mission for government.
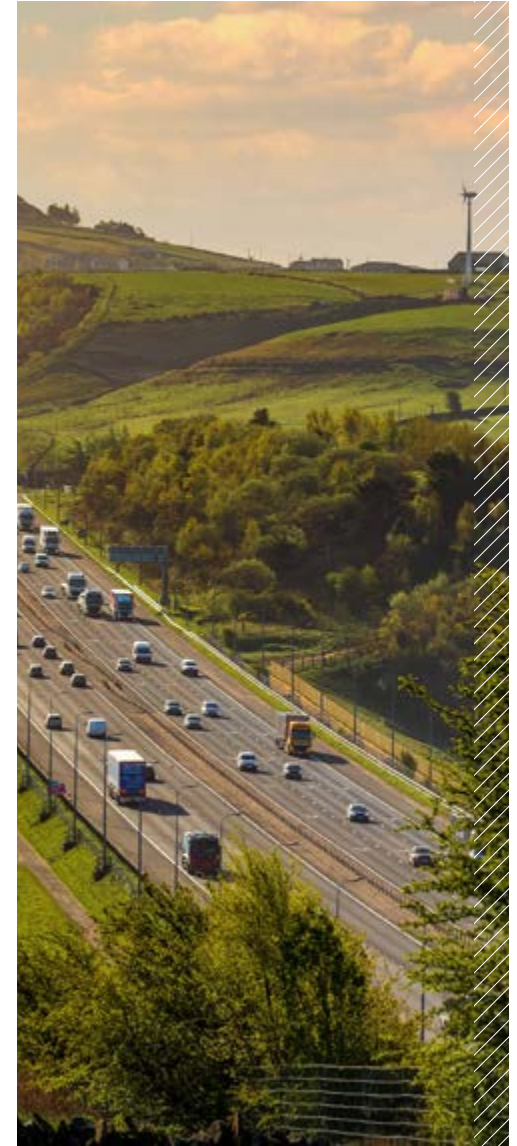
By 2030, every part of England that wants one will have a devolution deal with powers at or approaching the highest level of devolution. This will include £5.7 billion in city region sustainable transport settlements and £5 billion for buses, cycling and walking networks.

Changes to these local networks will also affect the SRN. For example, Birmingham, Bath and Portsmouth have all joined London in introducing clean air zones. City traffic restrictions could see re-routing that will likely impact the interfaces between urban roads and the SRN, which are already the most pressured parts of our network.

Major urban centres and areas with high population and employment densities will therefore continue to require strong SRN connectivity and integration with other transport modes.

£5.7bn

in city region sustainable transport settlements

£5bn

for buses, cycling and walking networks

Foreword   Executive summary   Our strategic planning approach   **Trends shaping the future**   Our vision   How we will deliver   Next steps

national highways

Car travel

Population growth will impact demand for road travel.

The UK's population is projected to rise to 71 million by 2050, an increase of 3.8 million people.

Population is a key driver of road traffic demand. As population continues to increase, there is a logical link to an increase in the aggregate level of road traffic.

A number of factors contribute to overall population change, including births, deaths and migration. Population estimates show that net migration was a major component of population growth over the past two decades, making up 56% of population growth from 1991 to 2018[7,8].

Recent census figures reveal that between 2011 and 2021 the population in England and Wales grew by 3.5 million people, an increase of more than 6% in ten years. Current estimates suggest that this trend is expected to continue in the longer term, but at a slower rate than previously forecast.

Changes to the demographic structure of the population could also shape demands on our network. For example, the number of people over 70 holding a driving licence increased from 45% in 2002 to 67% in 2019. New technologies will likely support this trend.

Paired with wider drivers of demand, even under the most conservative forecasts we still expect demand for personal and business journeys on our network to grow and for road travel to remain the most common mode of transport.

Projected UK population
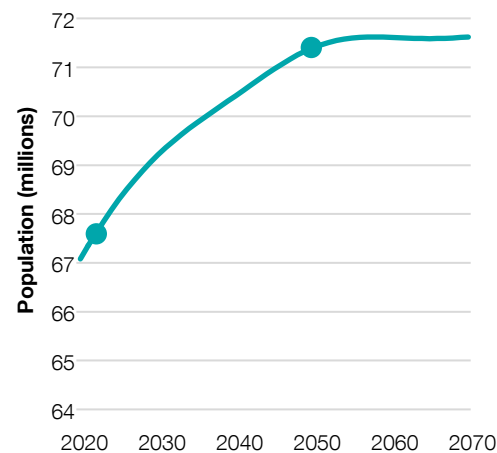
Office for National Statistics

Over the last 20 years, the UK's population has become progressively more urbanised.

Cities and major urban areas have grown faster than smaller towns and rural areas[6].

In 2019, more than 56 million people in England lived in urban areas, equivalent to almost 83% of the population. Almost half of this urban population live in the wider urban conurbations outside towns and cities.

At these urban and sub-urban fringes, car dependency and reliance on the SRN is typically much higher. Many of the most congested parts of our network are in these locations, typically where it joins with local networks near towns, cities and within urban conurbations.

Without careful future joint planning across a range of stakeholders, forecast population growth in wider urban conurbations, including new garden communities, could present operational challenges to the SRN. This underlines the need for sustainable, multi-modal approaches in the future.

In some of these congested areas, there may be opportunities to support increased active travel. Although highly location-specific, historically more than 60% of journeys made on SRN A-roads have been under 5 miles and 33% are under one mile. Interventions to increase the attractiveness of active travel could help move short-distance trips from the SRN to active modes such as walking, cycling and micro-mobility. In doing so, these interventions would also provide wider health and environmental benefits.

56m people in England lived in urban areas in 2019

Trip lengths on SRN A-roads:

60% under 5 miles

33% under 1 mile

Foreword   Executive summary   Our strategic planning approach   **Trends shaping the future**   Our vision   How we will deliver   Next steps

national highways

Car travel

CRITICAL UNCERTAINTY

Energy and technology transitions could lead to radical changes in demand and driving patterns.

Technologies that fundamentally change how people drive will be present on our roads in the next decade.

The shift to electric vehicles could affect the overall cost of travel and, consequently, the demand for travel. Over time, considerably cheaper operating costs could lead to an increase in the number of trips and the amount of travel. The Climate Change Committee (CCC) estimates that 10-30% of energy savings would be offset through additional mileage[9]. However, this may be influenced by any future road funding mechanisms introduced by government.

New technologies such as automated vehicles and shared services present a greater variation in how the SRN is used. Depending on usage models and pricing, these modes could radically increase or decrease demand. As such, we need to consider how best to promote positive outcomes from these services to increase network efficiencies.

The pathway towards autonomy will be progressive, and it is possible that the incremental introduction of new vehicle functionality will affect the desirability of car travel. For instance, automated lane keeping systems are the first approved system designed to perform the dynamic driving task instead of the driver under certain conditions. This is an important first step towards the development of systems with higher levels of autonomy. Given the already high level of technical readiness, automated lane keeping systems could be improving driver experiences in the next decade.
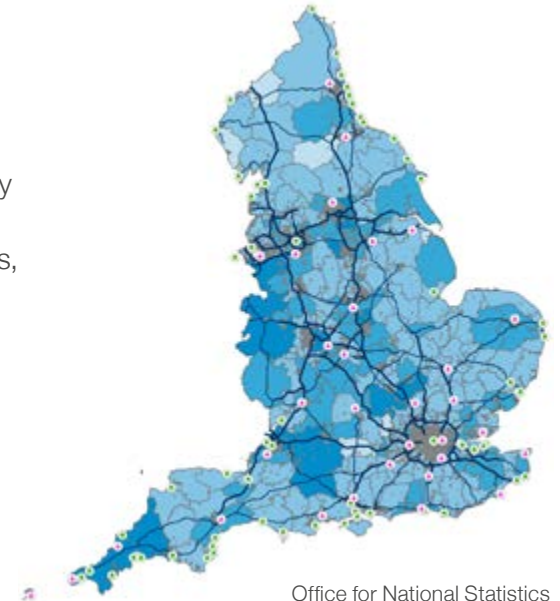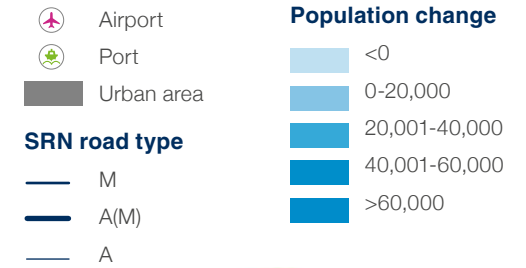
Variations in regional population growth may create different pressures on the SRN.

Four areas of the country are forecast to grow above the national rate of 5.8% by 2043.

Above average growth is forecast in: South West; North West; Yorkshire and Humberside; and the Midlands.

The Midlands, for example, is expected to experience the highest levels of regional population growth. Population-induced travel demand, coupled with freight demand driven by the Midlands' high density of national freight and logistics distribution centres, may increase the overall demand for travel on the SRN in this region.

Projected population growth by English local authority districts (2019-2043)

- ✈ Airport
- ⚓ Port
- ▮ Urban area

SRN road type
— M
— A(M)
— A

Population change
- <0
- 0-20,000
- 20,001-40,000
- 40,001-60,000
- >60,000

Office for National Statistics

⬆ **5.8%** **average population growth to 2043,** though growth is forecast to be higher in the South West, North West, Yorkshire and Humberside, as well as the Midlands

Foreword   Executive summary   Our strategic planning approach   **Trends shaping the future**   Our vision   How we will deliver   Next steps

national highways

Car travel

Covid-19 has had the biggest single-year impact on road traffic since records began in 1949.

But car traffic on the SRN is now back to around 95% of pre-pandemic levels, with road travel remaining the most used mode of transport.

While the onset of Covid-19 and the associated travel restrictions initially decreased demand for both public and private transport, the impact has continued to be felt more strongly on public transport. Private vehicle travel was the first mode to rebound.

Homeworking has not noticeably reduced overall car demand on the SRN. It is estimated that 43% of UK jobs can be done entirely from home[9], but nearly two-fifths of businesses expect 75% of their workforce to eventually return to their normal place of work.

It is unclear if the scale of homeworking will continue or how it will affect long-term travel patterns. For the short term, transport flow data has generally shown that traffic peaks have become flatter but broader, with traffic more evenly spread across the day, suggesting some behaviour change. Continued hybrid working could see a redistribution of demand, flattening the daily morning and evening peaks and instead creating a mid-week peak.
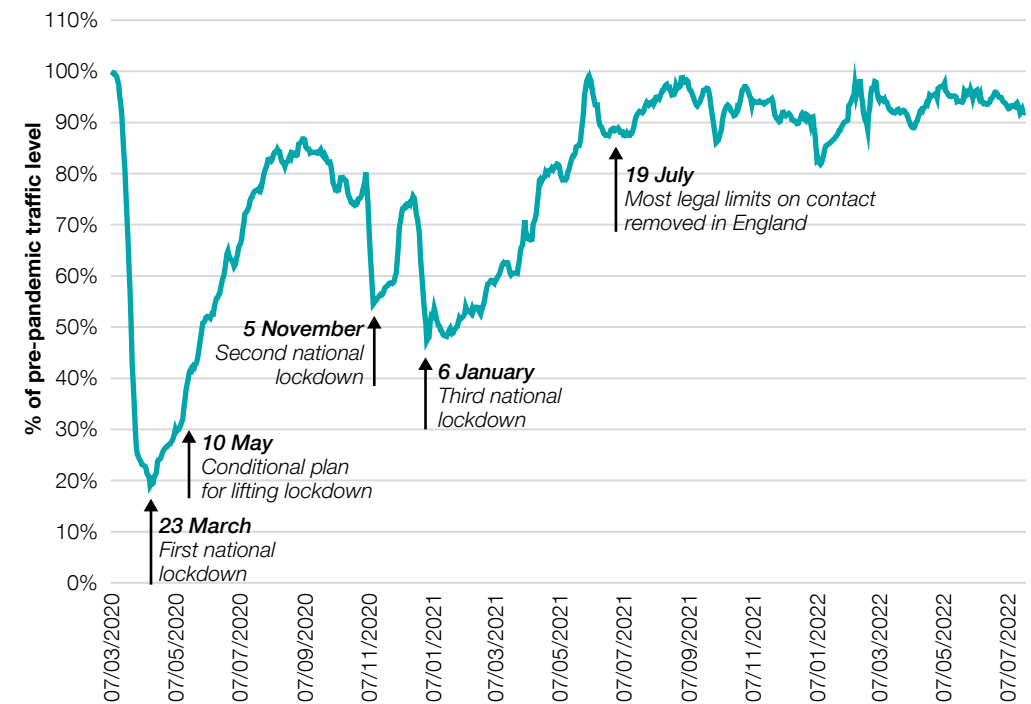
The pandemic has also brought wider uncertainties, such as whether loosened physical ties to employment locations could see increases in suburban living, as workers that are more 'knowledge-based' than 'location-based' take advantage of greater geographic mobility across the country. This could lead to longer but less frequent commutes. However, it is unclear if this trend will continue as some research suggests that demand for homes and offices in big cities has recently returned.

Changes in leisure trends caused by the pandemic could also have implications for the SRN, such as changing demand for high street retail or choices around domestic versus overseas holidays[10].

Figures suggest that national parks and coastal towns are continuing to see record numbers of visitors following the easing of Covid-19 travel restrictions. As we continue to plan the future of our network, it will be important to understand whether these patterns become more permanent, enduring over the longer term.

SRN car traffic since the Covid-19 pandemic

Chart: % of pre-pandemic traffic level, 07/03/2020 to 07/07/2022.

- **23 March** First national lockdown
- **10 May** Conditional plan for lifting lockdown
- **5 November** Second national lockdown
- **6 January** Third national lockdown
- **19 July** Most legal limits on contact removed in England

National Highways

Foreword   Executive summary   Our strategic planning approach   **Trends shaping the future**   Our vision   How we will deliver   Next steps

national highways

Freight and logistics

The majority of future freight will continue to travel on the SRN[1].

Road transport accounts for 79% of freight movement, and two-thirds of lorry miles is carried by the SRN.

Supply chains, logistics and the effective movement of freight are critical to a functioning and growing economy. A cross-modal network is needed to transport goods across England, from ports to warehouses, businesses and consumers. Between distribution centres and goods destinations, road freight transport dominates, offering flexible and cost effective haulage.

In the future, while rail and short sea shipping will be able to shift demand from the SRN, the magnitude of these shifts is likely to be modest and will require careful targeting.

The capacity for the rail network is constrained by its infrastructure, including permitted train lengths and axle loads, electrification and the need to balance passenger and freight traffic with the availability of diversionary routes.

Reflecting the DfT's wider efforts to understand, identify and develop a multi-modal national freight network, in 2021 we released the first phase of the *Solent to the Midlands multimodal freight strategy*, developed in collaboration with Network Rail. It sets the blueprint for how to consider key freight corridors from a cross-modal perspective. We are committed to continuing collaboration with Network Rail and other partners to explore opportunities to deliver a fully integrated freight network.

While modal shift to rail could support the long-term decarbonisation of freight, it will likely take longer to completely remove diesel from rail freight than for zero-emissions HGVs to become widely available[9].

79%
of freight movements are by road
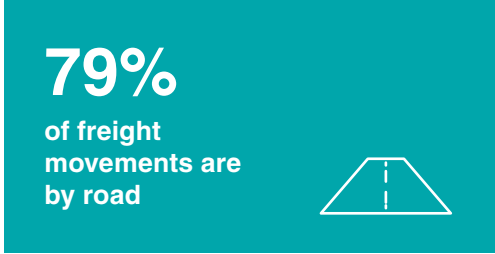
Freight and logistics

CRITICAL UNCERTAINTY

In the decade prior to the pandemic, HGV travel distance increased by 14% on the SRN.

In the next decade, HGV growth and its reliance on the SRN is expected to continue[4].

Since 2014, the total HGV miles have broadly reflected the growth of the national economy, covering between 9.2 and 10.6 billion miles per annum. The majority of this is travelled on our network, underlining its importance to the freight and logistics sectors and the national economy.
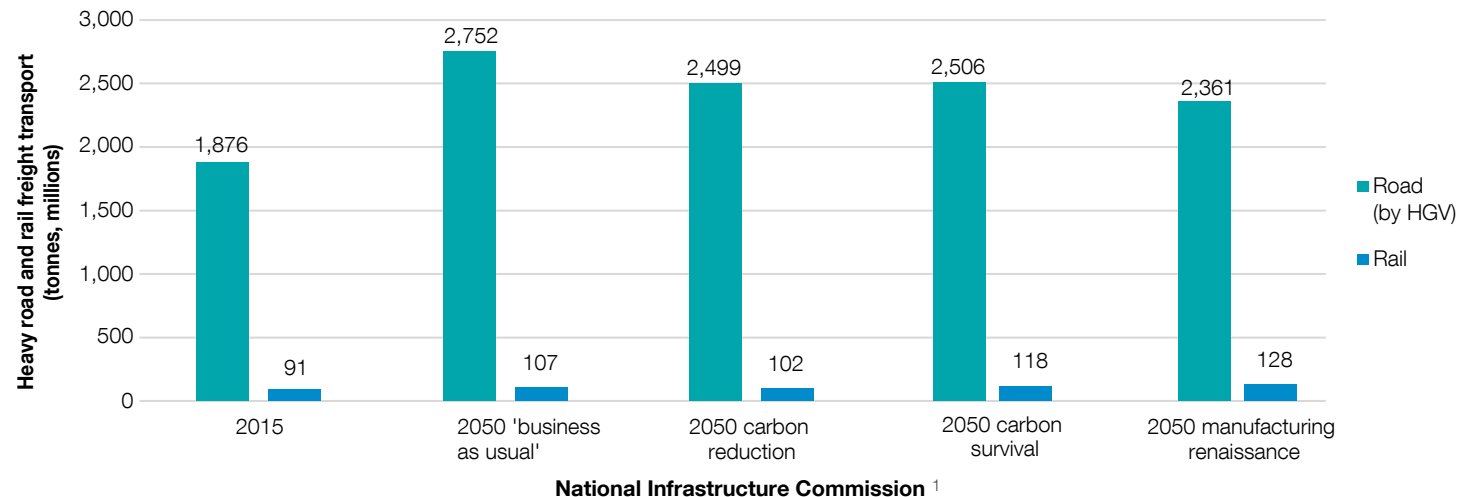
In the *Future of freight demand*, the National Infrastructure Commission models the freight tonnage carried by HGVs and identifies the potential for an increase of 25% to 47% from 2015-2050. They note that associated increases in HGV movements will rely on the same SRN links that are already intensively used[1].

While forecasts provide important insight, longer term freight predictions remain uncertain. There are factors, such as rising population, growing material consumption and the advent of high levels of autonomy, which could all lead to increased freight movements. Conversely, downward pressures such as wider sustainability concerns, system efficiencies, technological improvements and improved collaboration could also have a considerable impact on freight movements.

Freight demand scenarios by mode

National Infrastructure Commission

Chart: Heavy road and rail freight transport (tonnes, millions)

Scenario	Road (by HGV)	Rail
2015	1,876	91
2050 'business as usual'	2,752	107
2050 carbon reduction	2,499	102
2050 carbon survival	2,506	118
2050 manufacturing renaissance	2,361	128

National Infrastructure Commission [1]

Foreword   Executive summary   Our strategic planning approach   **Trends shaping the future**   Our vision   How we will deliver   Next steps

national highways

Freight and logistics

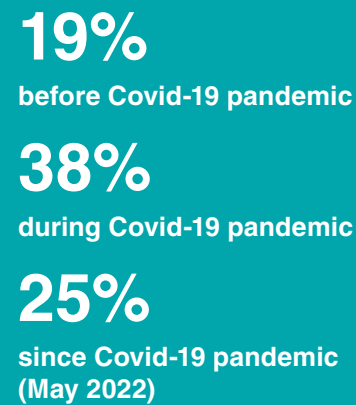## Rises in online sales are expected to increase levels of freight and logistics.

Light commercial vehicle (LCV) movements are likely to further increase as internet sales continue to rise over the long term[4].

Internet sales had been steadily increasing over the last 10 years, before surging during the pandemic and nearly doubling from 19% of total retail sales in February 2020 to a peak of 38%. While this has fallen, the internet still accounted for 25% of total sales in May 2022.

The National Infrastructure Commission's 'business as usual' scenario assumes that, by 2050, e-commerce will account for 35% of all food retail and 65% of general merchandise. Even under a 'carbon reduction' scenario, e-commerce is still assumed to account for 20% of food retail and 45% of general merchandise[3].

Over the long term, the LCV fleet, heavily used for internet sales, is likely to continue its upward trajectory. The LCV fleet has seen its mileage more than double since 1993, with an expected 2022 figure of close to 55 billion miles.

Internet retail sales:

19%
before Covid-19 pandemic

38%
during Covid-19 pandemic

25%
since Covid-19 pandemic
(May 2022)

New HGVs will need to be zero emission by 2040[11].

33% of carbon emissions from our network currently come from HGVs.

By 2050, road freight and logistics will be decarbonised. Hydrogen will be fundamental to achieving the full decarbonisation of transport, serving areas that batteries cannot reach and facilitating long journey distances, heavy payload requirements and the need for fast refuelling.

The cost of producing hydrogen is expected to decrease considerably over time as the 'hydrogen economy' is established and benefits come from economies of scale. The government is also funding an electric road system trial that we are supporting to test charging electric lorries via overhead cables on a 20km section of the M180.

Given the lead times for infrastructure and vehicle stocks, it will be important to establish how HGVs will be decarbonised by the second half of the 2020s. We aim to develop a preferred investment plan for HGV charging by 2028, ready for implementation from 2030.

Foreword   Executive summary   Our strategic planning approach   **Trends shaping the future**   Our vision   How we will deliver   Next steps

national highways

Freight and logistics

Goods vehicle traffic on the SRN has rebounded post-pandemic.

Despite an initial drop of 40% at the start of the pandemic, it is now regularly exceeding pre-pandemic demand.

Covid-19 dramatically impacted how people travelled for a period of time. In terms of freight and logistics, commercial vehicle use now exceeds pre-pandemic levels, both for HGVs and LCVs. In June 2022, HGV demand on our network was above pre-pandemic levels for all six of our regions. For four of these, demand was more than 105% of pre-pandemic levels (in the North West, South West, Midlands and Yorkshire and Humberside).

We are exploring if patterns in commercial vehicle use have stabilised and whether peak hour demand may be broader, flatter and vary by location, which could suggest a shift in behaviours. Even with significant investment in other transport and ways of working, most journeys will still be made by road in 2050.

Congestion imposes significant costs on road freight companies, which may increase in the decades ahead. Figures suggest that congestion across all road types could delay HGV journeys by as much as 23%, rising to 35% in 2050 without mitigating interventions[12].

Both road and rail capacity are under pressure from high levels of demand. In response, the DfT's *Future of freight strategy* is already considering how freight could be moved more efficiently through system-level shifts, helping reduce costs to businesses and the economy.
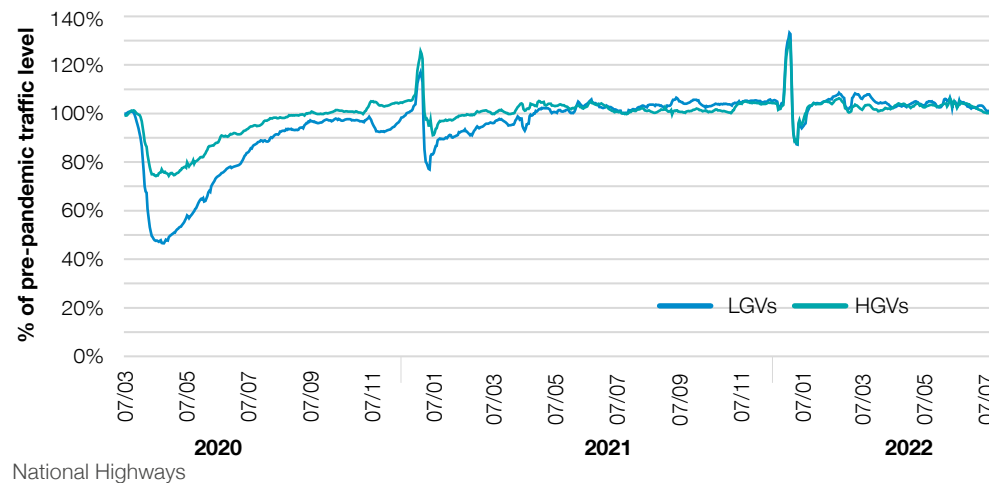
Analysis suggests that the typical sequencing of freight distribution, from point of production to a primary consolidation centre and then onwards to a regional distribution centre before reaching a retailer or customer, has the potential to add freight miles to the SRN and local networks[12].

The UK's average length of haulage movements is high by international terms and has risen by around 25% between 1990 and 2017[12]. Approximately 20% of vehicle kilometres are empty, with this unused capacity representing movement inefficiencies[13]. This does not include unused capacity in semi-loaded vehicles, suggesting further efficiency opportunities.

The CCC note that there is potential to reduce freight miles through measures such as expanded use of consolidation centres, extended delivery windows and higher loading. The location of more decentralised distribution centres, particularly in urban areas, could help to streamline movements. Where appropriate, these changes could be combined with network optimisation and strengthening to tackle existing or anticipated pinch points.

SRN LGV and HGV traffic since the Covid-19 pandemic

National Highways

Foreword   Executive summary   Our strategic planning approach   **Trends shaping the future**   Our vision   How we will deliver   Next steps

national highways

How our customers will experience travel

Technology will transform how people experience travel

Travel on our network will be safe, sustainable and increasingly connected.

Safety

Safer journeys:

0.9 England
1.7 Germany
2.2 France

motorway fatality rate per billion vehicle kilometres (2018)

41% reduction in fatalities on the SRN in 2019, compared to 2005-09 baseline

CAV adoption could account for **~25%** **>40%** reduction in motorway traffic conflicts[14]

A safer SRN:

95% reduction in traffic officer injuries since 2015

50% reduction in supply chain injuries since 2015

Digital

Connectivity:

75% of new cars will have some level of autonomous and data sharing capability by 2050[16]

A study suggests that **>50%** CAV adoption could account for **7%** reduction in delays on the SRN, and for a fully automated fleet, delays reduced by up to **40%**[15]

Construction sector efficiency:

£ up to **£200bn** in benefits by 2040 from the introduction of connected and autonomous plant across the sector from 2020-2035

By 2025 government aims to have self-driving in testing and operation

UK CAV market will be worth up to £42bn by 2035, creating 38,000 jobs in the sector[17]

Decarbonisation

Emissions:

Surface transport accounts for 27% of total GHG emissions in the UK[45], and our *Net zero highways* plan outlines how we will reduce SRN emissions to zero by 2050

6,000 high-powered, open-access charge points across England's motorways and major A-roads by 2035

Sustainable travel:

2030 sole internal combustion engine car sales banned

2035 all new cars zero emission at tail pipe

2040 zero-emission HGVs

Foreword   Executive summary   Our strategic planning approach   **Trends shaping the future**   Our vision   How we will deliver   Next steps

national highways

Safety

Our roads are some of the safest in the world.

Compared to the amount of traffic carried, collisions on our motorways result in proportionately lower fatal and serious injuries than other types of roads[18].

While our national road safety record stands the test of international comparison, we know that every death or serious injury on our roads is a tragedy. Improving safety on our roads reduces physical, mental and emotional harm to individuals. A safer network also improves journey time reliability, providing economic benefits.

We have achieved significant reductions in the number of people killed or seriously injured on our network in recent decades. Compared to a 2005-2009 baseline, the number of people killed or seriously injured on the SRN in 2019 had fallen by over 16%, while deaths on the SRN fell by more than 41% over the same period.

Our long-term ambition is to achieve zero harm on the SRN.

To realise this, we will need fundamental change and renewed focus on investment.

We have set ourselves the ambitious target that no one should be harmed when travelling or working on the SRN. To support this, we use a 'safe systems' approach, aimed at reducing collision frequency and severity as well as managing incidents more effectively.

To help us measure our progress, we had a first road period target of achieving 40% reduction in the number of people killed or seriously injured by 2020, against a 2005–09 baseline average – which we have met. We now have a stretched target of achieving a 50% reduction by the end of 2025, measured against the same baseline.

In the past decade, incremental rises in our road safety performance have become increasingly challenging. Since 2012, the number of people killed or seriously injured on the SRN has fluctuated following many years of falling numbers. This is a pattern reflected across the rest of the road network in England.
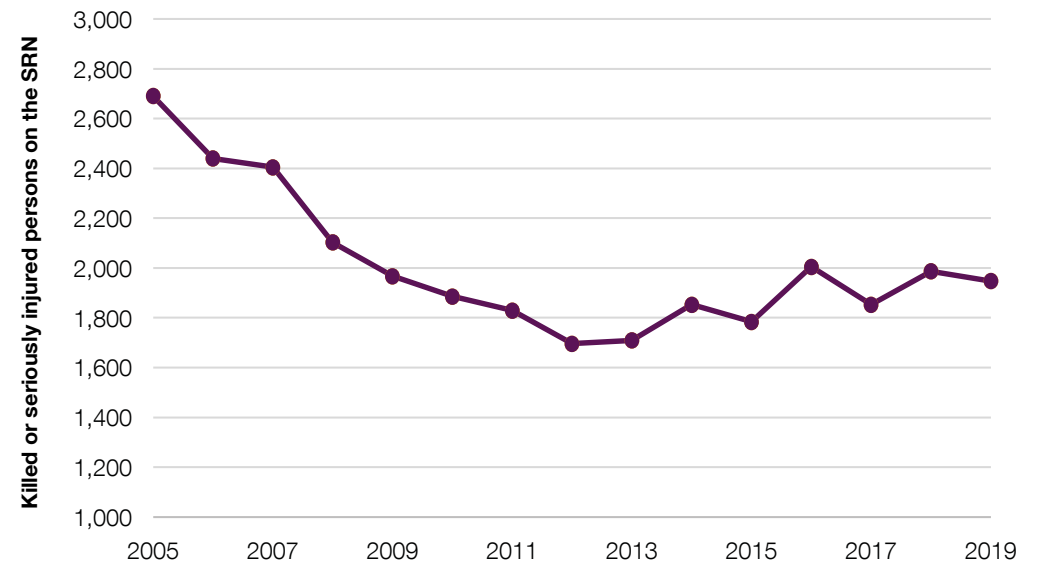
Safety improvements have been made more challenging by factors such as people travelling further, more vehicles on the road and a wider mix of the type of vehicles and customers using our network.

Based on our current projections, we believe significant focus will be needed to support our ambition for zero harm. Simply maintaining our current safety performance will not be enough; we must invest across every aspect of our safe systems approach, from infrastructure and technology to education and behavioural change campaigns.

50% target to reduce the number of people killed or seriously injured on the SRN by the end of 2025

Historic SRN safety performance

Killed or seriously injured persons on the SRN

Department for Transport

Foreword   Executive summary   Our strategic planning approach   **Trends shaping the future**   Our vision   How we will deliver   Next steps

national **highways**

Safety

We aim to reduce the likelihood of incidents occurring, and the severity if they do.

Targeted physical highway improvements will be a key component of our continued safe systems approach.

We assess the 'star' rating of our network, using the International Road Assessment Programme (iRAP) model. The star rating approach provides an objective assessment of the safety risk of our roads.

We are proud that we have exceeded our *Delivery plan* target that at least 90% of travel on our network was on roads which were rated three-star or better in 2020. This means that most people, most of the time, are travelling on some of the safest roads in the world.

But we know we need to do more. We have an ambition to improve our one and two-star rated roads to a three-star standard or higher where possible. Our 2020 results show that travel on our one and two-star roads reduced by around a fifth between 2015 and 2020, but we know there is more work to be done.

Road workers provide an essential service in a high-risk environment.

We want everyone who works on our network to return home safe and well.

The SRN could not function without the dedication and skill of our road workers, including those from our supply chain partners. Workers are exposed to a range of risks in their daily roles, underlined by the reality that between 2017 and 2020 there were 6,500 incursions into roadworks, an average of 175 per month.

Since 2015, we have reduced the total number of people injured by 18%. More specifically, the accident rate among our traffic officers and control centre colleagues has reduced by 95%, and for our supply chain by over 50%.

Our zero harm aspirations include those working on our roads. While our current trajectory shows that we are broadly on track to achieve a zero RIDDOR accident frequency rate by 2040, there remains much to be done to address wider road worker safety to realise zero harm.

Our *Home safe and well* approach builds on our achievements since publishing our *Health and safety five-year plan* in 2015. It sets our overarching strategy and the culture under which all health, safety and wellbeing activity is undertaken. It will be the foundation on which future actions to achieve zero harm will be built.

6,500
incursions into roadworks between 2017 and 2020, placing our road workers at risk

Foreword   Executive summary   Our strategic planning approach   **Trends shaping the future**   Our vision   How we will deliver   Next steps

national highways

Safety

Connected and autonomous construction techniques will become the norm across UK construction.

Major safety benefits can be realised.

Construction workers are 3.5 times more likely to be injured at work than those in other sectors. Emerging technologies, such as connected and autonomous plant, will be increasingly introduced in construction, automating many of the activities that currently require human intervention.

It is estimated that connected and autonomous plant could support around a 37% reduction in the number of fatalities in the construction sector.

Our Digital Roads programme and wider industry *Connected and autonomous plant roadmap* are paving the way for digital construction, design and operation of our network to unlock these benefits for road workers and road users.
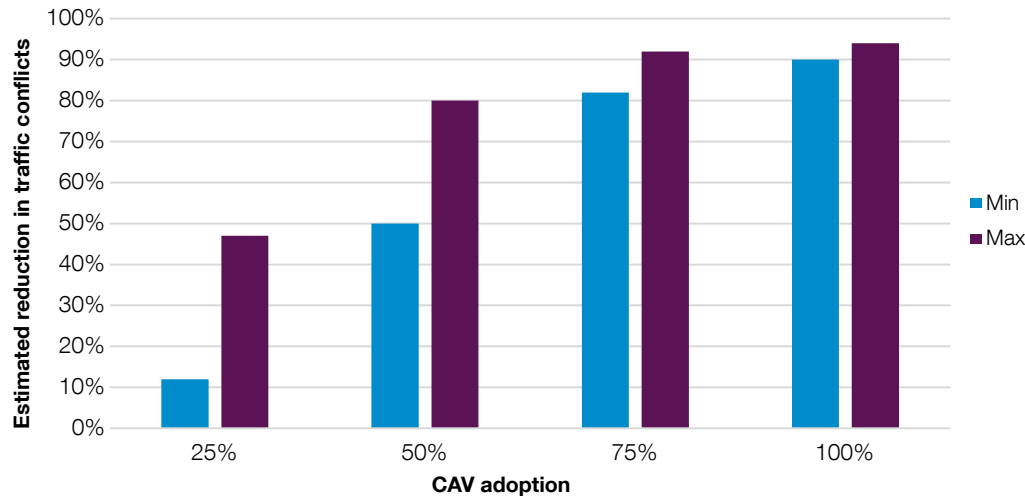
CRITICAL UNCERTAINTY

CAVs promise significant safety benefits.

Adoption of just 25% could reduce traffic conflicts by up to 47%[14].

The introduction of CAVs present an opportunity to prevent potentially significant proportions of collisions, in particular by removing the potential for human error. Drivers failing to look properly or judge another vehicle's path or speed are the most commonly reported factors in casualty collisions.

With this potential comes a number of uncertainties. Firstly, the level of connectivity and autonomy will play a direct role in the magnitude of benefits that are possible. While increased information provision is likely to offer some benefit, the majority of safety (and efficiency) benefits are likely to be derived from coordinated vehicle movement and collaborative driving.

The pace of uptake will be key to realising these benefits. The government's Centre for Connected and Autonomous Vehicles has projected that vehicles capable of automated driving may account for 40% of all new car sales in the UK by 2035[19]. In addition, a study evaluating the safety impact of CAVs predicts a potentially compelling road safety impact, with traffic conflicts (for example rear-end, lane changes and vehicle crossings) significantly reduced even at relatively low adoption rates[14].

By introducing these new technologies, we know that new safety challenges will emerge. These could range from managing a technologically-mixed fleet to understanding the implications these vehicles have on driver behaviour and acceptability.

Safety impact of connected and autonomous vehicles on motorways[14]

Bar chart. X-axis: CAV adoption (25%, 50%, 75%, 100%). Y-axis: Estimated reduction in traffic conflicts (0%–100%). Min (blue) and Max (purple) series: at 25% Min ≈12%, Max ≈47%; at 50% Min ≈50%, Max ≈80%; at 75% Min ≈82%, Max ≈92%; at 100% Min ≈90%, Max ≈94%.

Papadoulis et al

75% of the contributory factors associated with most causality collisions are those falling within the driver/rider error or reaction category

Foreword   Executive summary   Our strategic planning approach   **Trends shaping the future**   Our vision   How we will deliver   Next steps

national highways

Digital

Wider adoption of digital design and automated, off-site construction will improve safety, quality and productivity during construction.

The introduction of connected and autonomous plant could deliver significant benefits to the economy.

The government's *Construction sector deal* aims to support a highly skilled and innovative sector, focusing on three strategic areas: digital; off-site manufacturing; and whole-life asset performance.

Wider adoption of digital design techniques and enhanced data capture are expected to improve productivity during construction, optimise the performance of infrastructure assets and improve end-of-life outcomes. It is estimated that greater data sharing could release an additional £7 billion per year of benefits across the UK infrastructure sector[21].

The government has tasked the Centre for Digital Built Britain with developing a national digital twin, a virtual model of assets that simulates their interconnections and external environments. Functions range from supporting road design and maintenance to easing congestion, creating safer environments and lowering emissions and pollutants[20].

As part of this, an Information Management Framework will be developed to support secure and resilient integration of data across the built and natural environments at a national level. Growth and roll out of this framework is planned between 2023-2025[20].

Off-site manufacturing, modularisation and mass customisation techniques, similar to those used in car manufacturing, will likely become more commonplace in construction, helping reduce waste and minimise delays.

For our network, we have already committed to cost effective, faster construction. This means making standardised, modular construction the default by 2030 and moving to automated construction by 2040. Through innovation, we are targeting 50% cheaper total cost per km of road construction and maintenance in 2040, when compared with a 2015 baseline.

The construction industry's levels of productivity have historically lagged behind other sectors, such as manufacturing and retail, which have been revolutionised by digitisation and robotics. Working with partners, we are leading the transformation in construction. Our *Connected and autonomous plant roadmap*, launched in June 2020, identifies the challenges, opportunities and workstreams needed to support a goal of making automation business as usual in construction.

Potential benefits of accelerated connected and autonomous plant adoption

Y-axis: Cumulative saving (£bn)
£100bn saving
— Accelerated year one
— Adopt now
— Delayed adoption
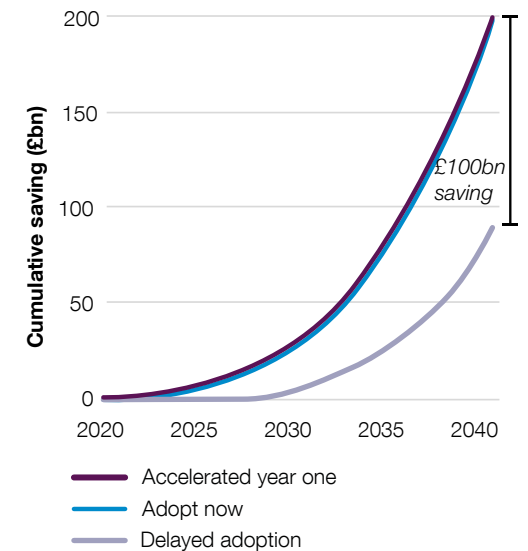
National Highways, i3P & TRL

2030: standardised, modular construction by default on the SRN

2040: automated construction on the SRN

Foreword   Executive summary   Our strategic planning approach   **Trends shaping the future**   Our vision   How we will deliver   Next steps

national **highways**

Digital

Enhanced data capture and processing will be essential to maximising existing assets.

In 2020-21, our annual maintenance and renewal costs for the SRN were £760 million. These costs will increase in real terms through to 2050 as the assets that make up our network age.

Smart infrastructure will provide opportunities for efficiency gains on future maintenance and renewal expenditure. Prolonging the useful life of assets, reducing congestion, removing carbon emissions and limiting the need to build new will require improvements to the availability, capacity and resilience of networks and systems.

Data availability on location, asset condition and performance will support effective strategic and operational decision making to enable proactive, as opposed to reactive, maintenance, inspection and renewals. Increased connectivity and data availability will require the roll out and improvement of sensing technology.

In turn, this will support the development of a network-wide digital twin, which will initially enable consistency across all strategic, tactical and delivery decision making. Digital twin capability will also enable better control of network operation and more informed long-term planning.

£760m

SRN's annual maintenance and renewal costs in 2020-21

Foreword   Executive summary   Our strategic planning approach   **Trends shaping the future**   Our vision   How we will deliver   Next steps

national highways

Digital

The path to vehicle autonomy will be phased.

Before full automation, new vehicle technologies will bring fundamental changes to how customers travel on the SRN.

Digital connectivity offers the most immediate opportunities to develop and improve customer experience.

Speeds and coverage are set to expand by 2030, and the UK will have nationwide gigabit-capable broadband, with 5G coverage for the majority of the population. This means faster wireless connectivity, which will enable real-time information to be shared between users and operators through increasingly sophisticated traffic management and in-car information systems.

These connected services will be a key focus for us as we become an early adopter and play our role in driving innovation, understanding future connectivity needs and informing new standards for our sector. These services will aim to provide better experiences and capabilities for our operations and customers.

While transitioning to autonomous and machine-driven miles will be a gradual process, in the immediate term our customers' vehicles will use a range of driver assistance systems. These systems, such as autonomous emergency braking and other advanced driver assistance systems, are already at high levels of technical maturity and are expected to evolve and become commonplace over the next decade.

Automated lane keeping systems, in particular, have the potential to fundamentally change how people travel on the SRN, allowing drivers to disengage from some driving tasks for the first time. Under certain conditions, such as low speeds on motorways, the system is in primary control of the vehicle and performs the driving task instead of the driver.

The DfT has recently consulted on the safe use of these systems and has identified the next steps before adoption. These include how best to provide driver information and education, consulting on changes to the highway code, continued discussions with insurers and manufacturers and research to scope the technical requirements for wider use on the nation's roads[22].

With the advent of these new technologies, our Digital Roads vision sets out how we can continue to harness data, technology and connectivity to improve the way the SRN is designed, built, operated and used.

Automation levels

1 2 3 4 5

Automation levels are used to differentiate future vehicle capabilities

At level 4, we assume vehicles will be highly capable on the SRN, able to undertake the entire driving task on the majority of our roads.

Foreword   Executive summary   Our strategic planning approach   **Trends shaping the future**   Our vision   How we will deliver   Next steps

national highways

Digital

CRITICAL UNCERTAINTY

Highly autonomous vehicles are expected to increasingly account for vehicle sales during the 2030s.

Significant connected and autonomous mileage could realise greater operational resilience for the SRN.

In the shorter term, stepped deployment of autonomous vehicle technology will result in heavily mixed traffic with different degrees of autonomy. This could present initial challenges to 'driverless' travel and the supporting infrastructure it requires, such as compatible junction designs. Low levels of CAV deployment could even reduce network performance, especially in high-speed, high-flow situations, such as the SRN[15].

In time, digital connectivity and developments in sensing and computing technology will pave the way for fully automated vehicles. By 2035, 40% of new cars in the UK could have self-driving capabilities (level 3 and above). But it will take a significant amount of time before driven mileage reaches these levels.

By 2050, it is estimated that 75% of new cars will be capable of some intelligent decision-making and cooperation with other road users[16].

It remains important to recognise the inherent uncertainty in predicting the relative uptake of highly autonomous mileage. Vehicle ownership attitudes and wider polices could play an influencing role. This is due to vehicle and technology costs, new travel pricing, the types of vehicles developed or other factors such as demand responses, new business models or phased vehicle updates over time.
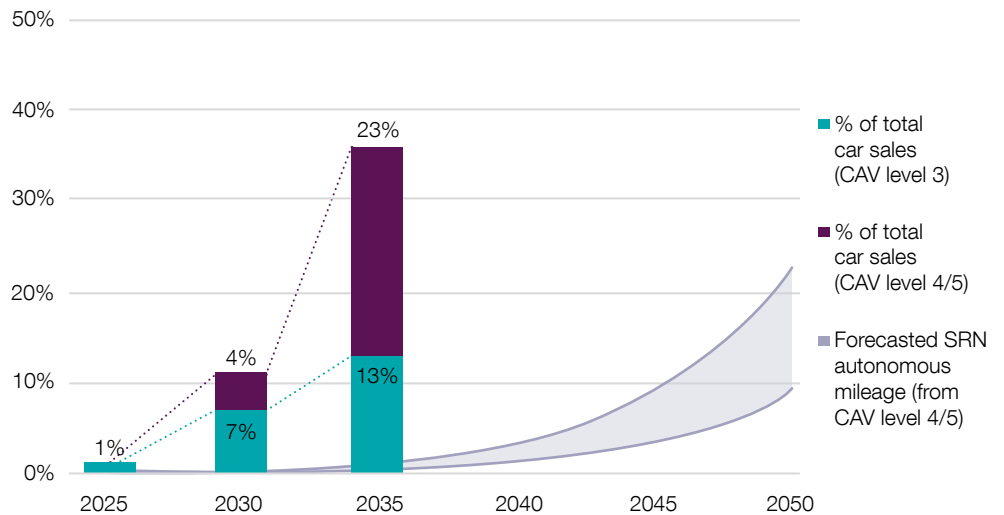
It should also be recognised that autonomy alone is unlikely to solve congestion, even with higher uptake, as research suggests that additional capacity enabled by these technologies is soon saturated by new demand. This means that wider policy approaches to incentivise higher occupancy trips or capacity reservation for other modes might be required.

Digital connectivity will also increasingly influence journey choices, including how people plan and pay for mobility services. These services will likely develop into more demand-responsive options such as buses that provide

a flexible and shared transport service, with routes based on users' desired location and time of pick-up and drop-off.

Potential UK CAV uptake for sales and SRN mileage[19]

Legend:
- % of total car sales (CAV level 3)
- % of total car sales (CAV level 4/5)
- Forecasted SRN autonomous mileage (from CAV level 4/5)

Connected Places Catapult

Foreword   Executive summary   Our strategic planning approach   **Trends shaping the future**   Our vision   How we will deliver   Next steps

national **highways**

Decarbonisation

Human activity is changing our climate.

Collective action is needed to limit further global warming.

Greenhouse gas emissions from human activity are at their highest level in human history[24]. The latest Intergovernmental Panel on Climate Change (IPCC) report on climate mitigation explains how this is no longer a challenge for tomorrow. The impacts of these emissions on our climate are already being seen and felt today, with increased incidence of events such as extreme heat, floods and wildfires across the globe[26].

While growth in the UK's greenhouse gas emissions has slowed in the last decade, the coming years will be critical, with immediate and significant reductions needed to limit further global warming[27]. The landmark 2015 Paris Agreement agreed to hold the increase in the global average temperature to well below 2°C above pre-industrial levels, and to pursue efforts to limit it to 1.5°C.

In 2019, government amended the Climate Change Act to introduce a legally-binding commitment to reduce all greenhouse gas emissions to net zero by 2050.
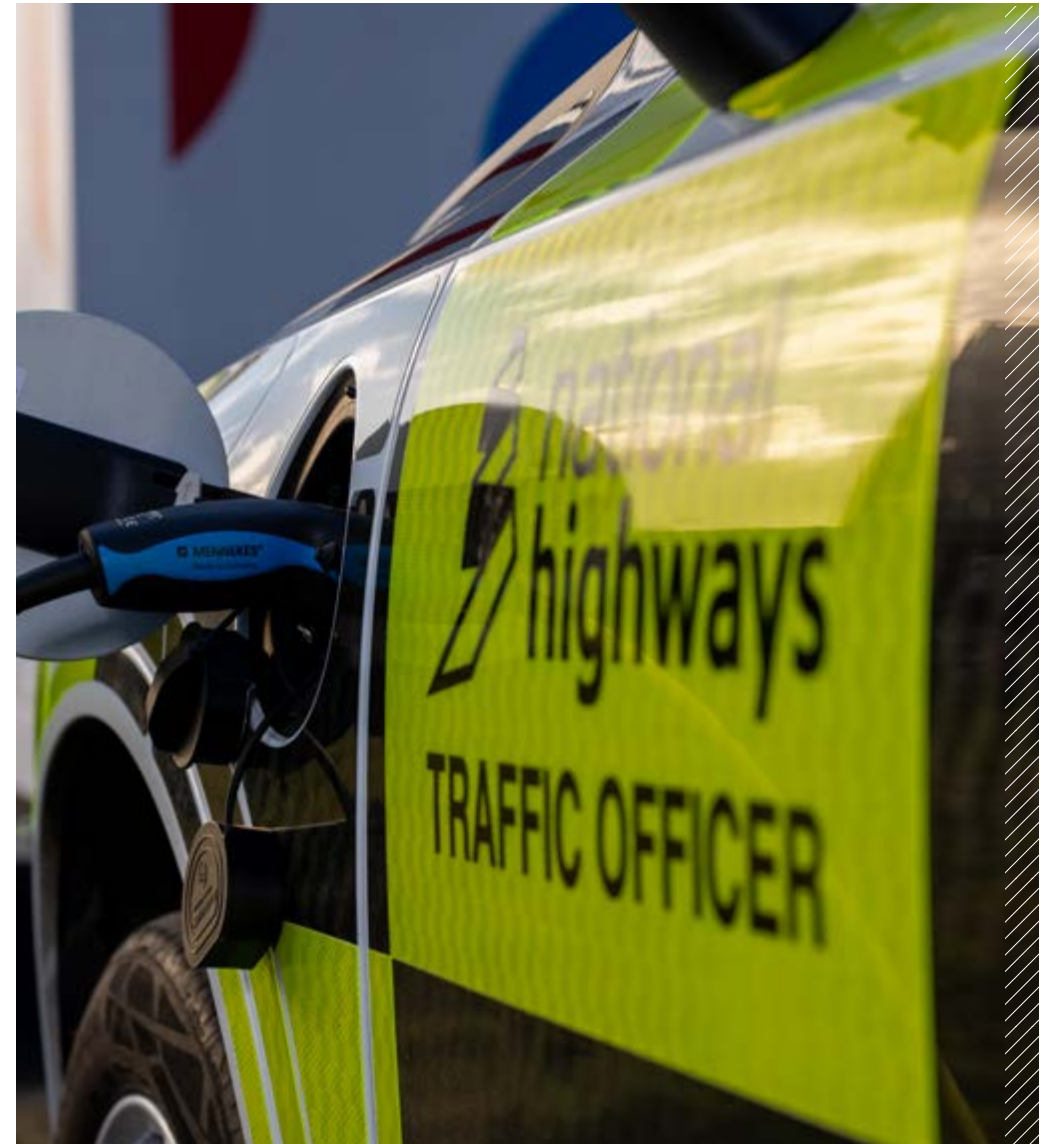
1.5 - 2°C

The Paris Agreement goal to limit global warming to well below 2°C, and preferably to 1.5°C, compared to pre-industrial levels[25]

2019

Government amended the Climate Change Act, making a legally-binding commitment to reduce all greenhouse gas emissions to net zero by 2050

Foreword   Executive summary   Our strategic planning approach   **Trends shaping the future**   Our vision   How we will deliver   Next steps

national highways

Decarbonisation

While road travel represents a higher carbon way to travel in the UK today, this is changing fast.

A net zero Britain will still travel by road in 2050.

Most journeys are made by road, whether passenger or freight. While this will continue into the future, the way people travel by road must change at pace.

To achieve net zero, the CCC has advised that the UK's Sixth Carbon Budget requires a 78% reduction in emissions (relative to 1990) by 2035. Meeting this world-leading commitment will require major nationwide investment in zero-carbon solutions to reduce emissions and mitigate impact on climate[27].
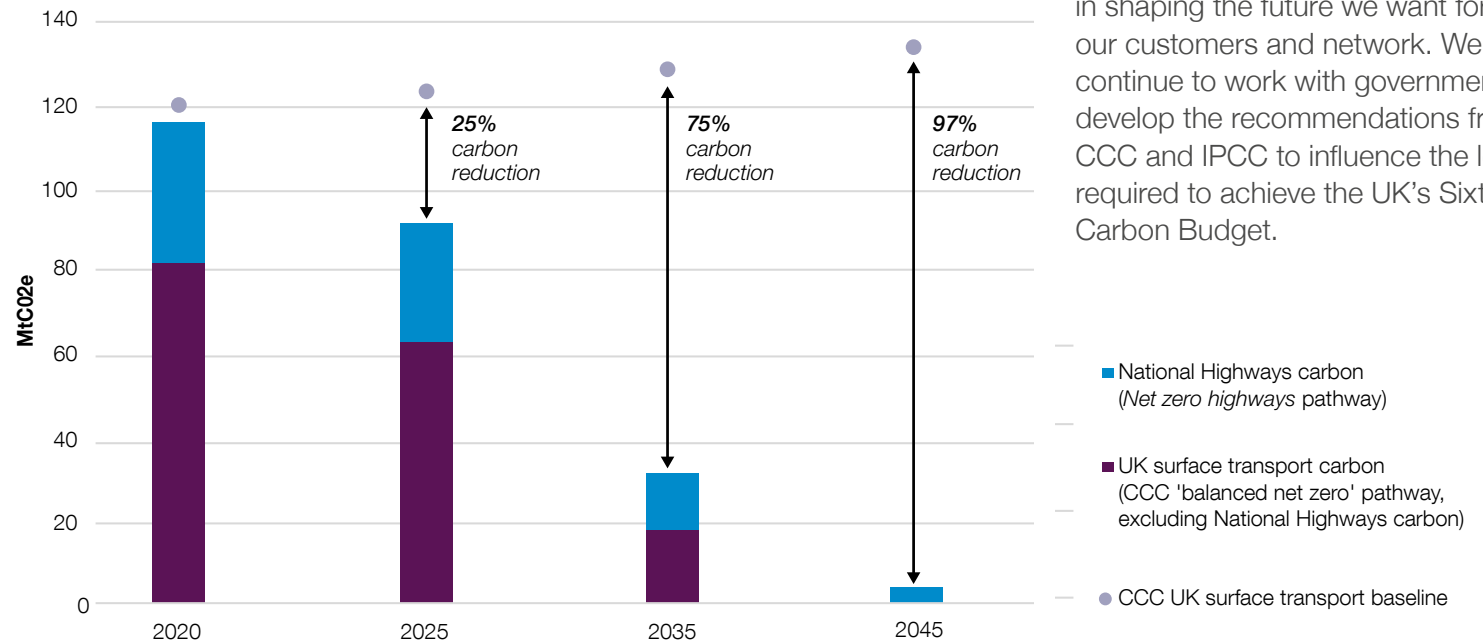
In 2019, surface transport accounted for 113 million tonnes of carbon emissions (MtCO2e). The majority of these emissions were from road transport, with approximately 30% attributed to the SRN[27].

By 2050, these emissions will need to reduce to near zero[27]. To achieve this, we are already working hard to decarbonise not only vehicle travel across the SRN, but also our own organisational operations and activities.

Pathways for the reduction of surface transport carbon[27, 28]

Climate Change Committee, National Highways

Our approach is laid out in our ambitious *Net zero highways: our 2030 / 2040 / 2050 plan*. Changes to infrastructure planning and adoption of zero-carbon technologies will account for the vast majority of our targeted reductions. Our plan also

reflects both the CCC's and IPCC's recommendations that reducing surface transport emissions will require behavioural changes to encourage modal shift, increase vehicle occupancy and help manage overall demand[27]. Our plan assumes that we use a decide and provide approach to influencing demand, whereby we are increasingly proactive in shaping the future we want for our customers and network. We will continue to work with government to develop the recommendations from CCC and IPCC to influence the levers required to achieve the UK's Sixth Carbon Budget.

Foreword   Executive summary   Our strategic planning approach   **Trends shaping the future**   Our vision   How we will deliver   Next steps

national highways

Decarbonisation

Decarbonisation of our network will deliver better transport for everyone.

The transition will provide wider benefits beyond carbon.

We know that emissions from vehicles on our network are by far the largest contributor to our overall carbon emissions and that cleaner vehicles are only part of the solution.

Fossil fuels have historically dominated transport, but advances in battery, fuel cell and hydrogen production and supply, accompanied by the forecast reductions in costs, are already changing this.

Coupled with the government's commitment to accelerating the transition to zero-emission cars and vans, including banning the sale of pure internal combustion engine cars from 2030 and transitioning to zero-emission HGVs by 2040, the vehicles our customers drive are changing fast.

Office for Budget Responsibility's forecasts in 2022 noted that the shift to electric vehicles is progressing more quickly than they had previously anticipated. Citing Norway, a country that has led the world in electric vehicle sales and market share, the report suggests that the UK could follow a similar trajectory. Assuming a lifespan of 8-12 years, non-electric cars could be significantly reduced by 2040, with the majority of the UK transitioning to fully electric vehicles.

While 95% of our network is already within 20 miles of an electric charge point, we are playing a leading role in the planning and delivery of the infrastructure required to enable the mass roll-out of zero-carbon travel.

Many of the measures used to decarbonise transport will also deliver wider benefits. These include direct network and community impacts, such as improved air quality and reduced engine noise. The measures will also support economic opportunity as the UK plays a lead role in associated sectors, including green technology, science, innovation and research.

We need to reduce the whole-life carbon impact of infrastructure.

Over time, continued decarbonisation efforts will need to shift focus from operational to embodied emissions[29].

Construction, and the resulting infrastructure, represent critical economic sectors and enablers, as well as significant consumers and producers of both resources and emissions[30].

For example, concrete is the most commonly used human-made material, accounting for around 6-8% of global CO_2 emissions.

As the grid begins to decarbonise and operational emissions decrease, the relative impact of infrastructure is projected to increase in significance from 53% of total emissions in 2010 to potentially 90% in 2050[29].

Projected growth in EV sales
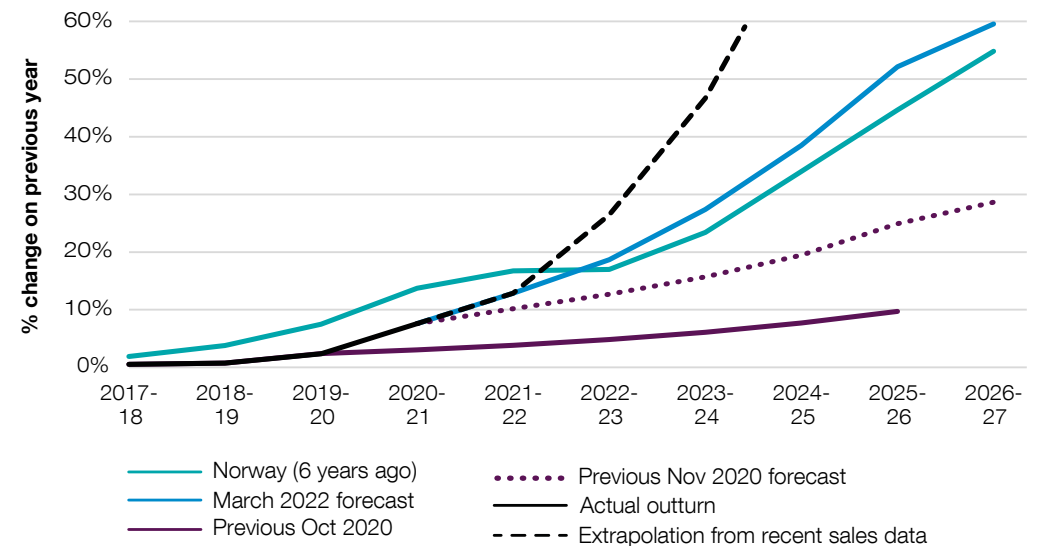
Office for Budget Responsibility, DfT, Society of Motor Manufacturers, Traders and European Alternative Fuels Observatory

How we will manage our network

The way we manage our network is evolving

We will enable stress-free customer journeys and act 'beyond roads' to help the environment and communities thrive.

Customer experience

Journey time is the number one driver of satisfaction:

9.5s
average delay per vehicle per mile on the SRN in 2019[32]

4.1s
due to demand being higher than available capacity

1.5s
due to roadworks

1.2s
due to incidents on our network

2.7s
other causes

Electrifying the network - electric vehicle sales:

1 in 30
of new cars sold in 2019[31]

1 in 4[31]
sold in 2022

99%
future target for charge point reliability on the SRN

Sustainable network development

By 2030, the national Clean air strategy is targeting:

46% reduction in particulate pollutants (PM2.5) emissions

73% reduction in Nitrogen oxides emissions

Noise:

up to £10bn[46]
the estimated social cost of urban road noise in England

Environment Act 2021
Government consulting on legally-binding, longer term targets across air quality, biodiversity, water and resource efficiency

Biodiversity:

60%
decline in the abundance of UK priority species since 1970

By 2040
net gain across all our activities

Asset resilience

Ageing assets:
Large parts of our network were built in the 1960s and 1970s.

~70%
of concrete road km are over 35 years old

Coping with extreme weather:

35%
wetter winters by 2070

5.4°C
increase in max temperature by 2070

Design, build, finance and operate (DBFO):

10%
increase in network under our direct control in the third road period from the return of sections previously managed through DBFO

Foreword   Executive summary   Our strategic planning approach   **Trends shaping the future**   Our vision   How we will deliver   Next steps

national **highways**

Customer experience

Journey time is the number one determinant of overall customer satisfaction[32].

Our customers tell us that, over the period to 2050, 'delivering the basics' will remain a top priority.

We have developed a strong understanding of what matters most to our customers today. Reliable journeys and the absence of unexpected delays continue to be the foundations of a positive customer experience.
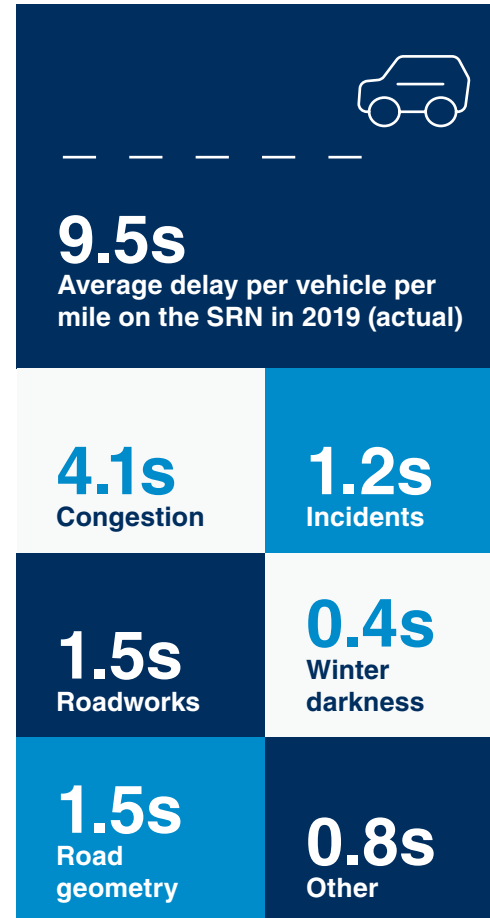
Analysis of the *Strategic roads user survey* (SRUS) has found that satisfaction with journey time has the strongest relationship with overall satisfaction[32]. In May 2022, SRUS figures revealed that 68% of customers were very/fairly satisfied with journey time overall and 69% were very/fairly satisfied overall[33].

In the immediate term, we have an ambition that average delay on our network will be no worse in 2025 than it was in 2020. This is a challenging target due to external factors and the complexity brought about by the need to renew and modernise our network.

Our analysis shows that the largest cause of delay is congestion, which occurs when levels of demand approach and exceed network capacity. Beyond this, roadworks and incidents are two major causes of delay where we can exert influence in the future as we explore opportunities to increase our operational effectiveness to improve customer journey times.

Causes of delay on the SRN in 2019

62.1s

Average time to travel a mile on the SRN in 2019 (actual)

9.5s
Average delay per vehicle per mile on the SRN in 2019 (actual)

4.1s Congestion	**1.2s** Incidents
1.5s Roadworks	**0.4s** Winter darkness
1.5s Road geometry	**0.8s** Other

Foreword   Executive summary   Our strategic planning approach   **Trends shaping the future**   Our vision   How we will deliver   Next steps

national highways

Customer experience

Improved technology and digital connectivity will bring users closer to network operators.

Customers will expect more seamless and interconnected mobility services.

In an increasingly digitally-enabled age, there are new and exciting ways to capture, interpret and share information to empower customers and help them feel fully in control of their journeys.

Higher bandwidth connectivity and growing vehicle and asset sensor technology maturity are expected to combine to support the systematic harnessing of data to create informed and optimised journeys across different transport networks and modes.

We are already seeing increasing levels of communication and connectivity between vehicles, infrastructure and the wider environment. Estimates suggest that, in 2019, there were at least 3 million vehicles with internet connectivity on UK roads, and the number of sensors in motor vehicles and public transport systems is continuing to grow.

The combining of rich, shared datasets between network operators and mobility service providers has the potential to radically improve the experience customers receive. For example, Transport for London has a partnership in place with wayfinding service 'Waze'. In return for traffic data, they provide Waze with information on London road closures and delays.

In the future, growing collaboration between operators and third parties could increase the breadth and accuracy of the near real-time information that customers receive, as well as the choice of digital platforms available to them.

£3m

vehicles with internet connectivity on UK roads in 2019
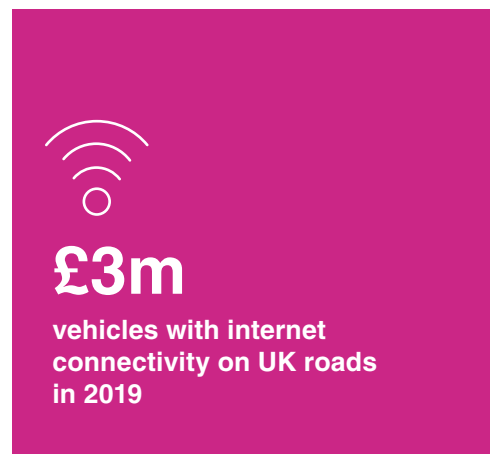
Our freight, bus and coach customers have a heightened need for clear and accurate journey information[34].

Our network plays a key role in delivering optimised, just-in-time freight movements.

Delay is the single most important metric for our freight customers due to the implications it has on their businesses. While freight customers and other key industry groups accept that some delays are inevitable, they want to be able to plan for them and want alternative routes to provide resilience[34].

In the future, there will be opportunities to transform the services these customers receive through greater digital connectivity and the real-time sharing of personalised journey intelligence.

Some operators in Europe are already providing increasingly rich journey data. In France, concessionaires provide a combination of planning tools (including comparing costs and personalisation based on vehicle size), real-time information, dedicated radio channels and service area information. The future phasing of new information services to provide timely customer benefit will be key.

Foreword   Executive summary   Our strategic planning approach   **Trends shaping the future**   Our vision   How we will deliver   Next steps

national highways
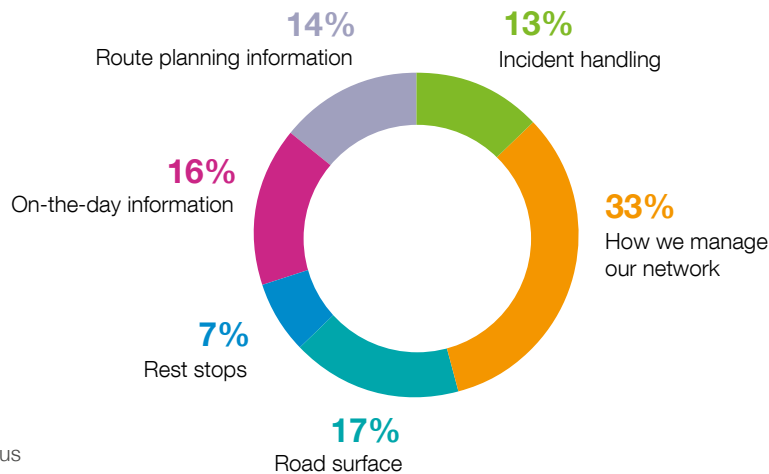
Customer experience

Improvements to rest facilities are needed to elevate the experience of freight drivers.

This includes the spacing, distribution and offering of facilities.

Our freight stakeholders, such as the Road Haulage Association, Logistics UK and DHL, have told us that in the future they would like national improvements to driver facilities prioritised. This includes parking as well as the provision of sustainable charging and vehicle fuelling[34].

Stakeholders have also raised the importance of improving services in wider discussions regarding international lorry driver shortages and the need to make the industry attractive, particularly to a new, younger generation of workers. While there is the potential for autonomous operations to change the workforce requirements over the longer term, there is a current shortage of HGV drivers in the UK. This is due to the economic recovery from the pandemic, the ageing workforce and lack of diversity in the industry and the reliance on overseas labour.

Drivers of satisfaction for logistics and coach customers[34]

14%
Route planning information

13%
Incident handling

16%
On-the-day information

33%
How we manage our network

7%
Rest stops

17%
Road surface

Transport Focus

The SRN can help set the standard for customer-centric charging infrastructure.

Provision of reliable, high-quality charging services will be key to supporting the transition to electric vehicles.

95% of our motorways and A-roads are within 20 miles of a charge point. As the sale of new petrol and diesel vehicles, and subsequently hybrid vehicles, are phased out, we will require many more. We are supporting delivery of government's Rapid Charging Fund to enable 2,500 high-powered charge points across our motorways and major A-roads by 2030, rising to 6,000 by 2035.

How customers experience the transition to this new technology is crucial to its success. To encourage drivers to make and enjoy the switch to electric vehicles from petrol or diesel vehicles, the charging experience must be equal to or better than refuelling a petrol or diesel vehicle.

We know that our customers do not want to have to wait a long time to charge, and they want to do this comfortably. They want confidence that the charging network is reliable, a priority reflected in DfT's consultation on experience at charge points.
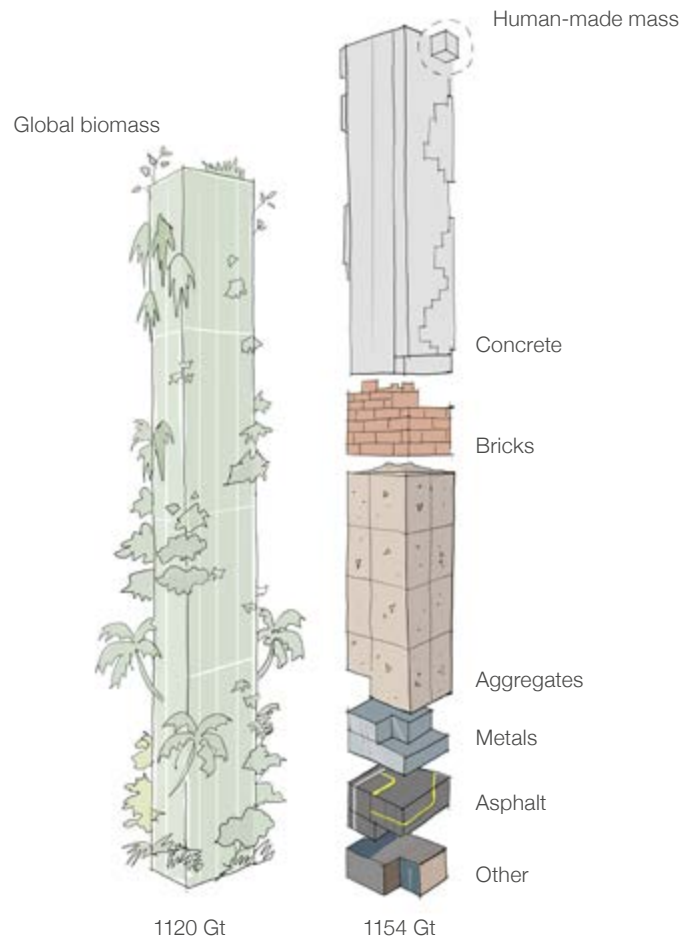
We will continue to work with government, motorway service areas, and equipment and service providers to put customer experience first. This means ensuring modern, user-friendly and reliable charging infrastructure is rolled out and in place ahead of customer demand, supporting early adoption and removing range anxiety.

1 in 4 new cars sold in 2022 was an electric vehicle, which is a significant increase from 1 in 30 in 2019[31]. On the SRN, our traffic officers are already preparing to safely support, and where necessary, recover electric vehicles as they become increasingly common on our network.

Foreword   Executive summary   Our strategic planning approach   **Trends shaping the future**   Our vision   How we will deliver   Next steps

national highways

Sustainable network development

There is a need to consider the environment as a whole in an integrated way[36].

Comparing the scale of human-made and natural materials

Human-made mass

Global biomass

Concrete

Bricks

Aggregates

Metals

Asphalt

Other

1120 Gt   1154 Gt

Elhacham et al

In 2020, human-made materials exceeded the weight of global living biomass for the first time[36].

Future use of the circular economy principals, minimising energy usage and fully reusing and recycling our existing construction materials will be crucial to our long-term sustainability.

In the last century, human-made mass has increased rapidly, doubling approximately every 20 years. These materials come predominantly from building and construction activity, and consist of concrete, aggregates, bricks, asphalt and, increasingly, plastics[36].

Globally, economies are seeking to decouple economic growth from the use of finite resources. We recognise that the SRN will also need to play its part, supporting sustainable national economic growth[35].

One of the ways that industries, including the highways industry, are looking to do this is by implementing the principles of a circular economy. This involves a regenerative system in which resource input and waste, emissions and energy leakage are minimised by slowing, closing and narrowing material and energy loops. This will be achieved through long-lasting design, maintenance, repair, reuse, remanufacturing, refurbishing and recycling.

While recycling and the use of recycled materials are becoming more commonplace, the infrastructure sector will need to go further. For the SRN, this will mean a shift in focus from developing new capacity to renewing and optimising our existing network, designing for disassembly, constructing modular components off-site and enhancing data and information to enable reuse and in-situ recycling.

We want to lead the industry in creating a roadmap for the use of low-carbon construction products, playing a key role with our supply chain in delivering near zero/net zero construction for asphalt, cement and steel by 2040.

Foreword   Executive summary   Our strategic planning approach   **Trends shaping the future**   Our vision   How we will deliver   Next steps

national highways

Sustainable network development

The abundance of UK priority species has declined by 60% since 1970.

Wide-ranging interventions are needed to halt and reverse the historic decline in biodiversity.

Over time, changes in land use have had a significant negative impact on biodiversity[38]. While the majority of land use in England is attributed to agriculture (62.8%), transport and utilities account for 4.8%, the largest proportion of developed use. With a soft estate of 30,000 hectares, we have an important contribution to make to the protection and enhancement of biodiversity in England.

Land use will also have to respond to both climate change mitigation and adaptation, with the negative impacts on the country's biodiversity expected to increase in line with the magnitude of climate change[37].

The government has announced a 'state of nature' target aimed at halting the decline in nature in England by 2030. In terms of land use and plastic pollution, environmental policies include establishing local nature recovery strategies and embedding a 10% 'biodiversity net gain' principle for developments including housing and infrastructure. They also include supporting nature-based solutions to climate change, like tree planting and protecting peatland, and significantly reducing or where possible preventing all kinds of marine plastic pollution.
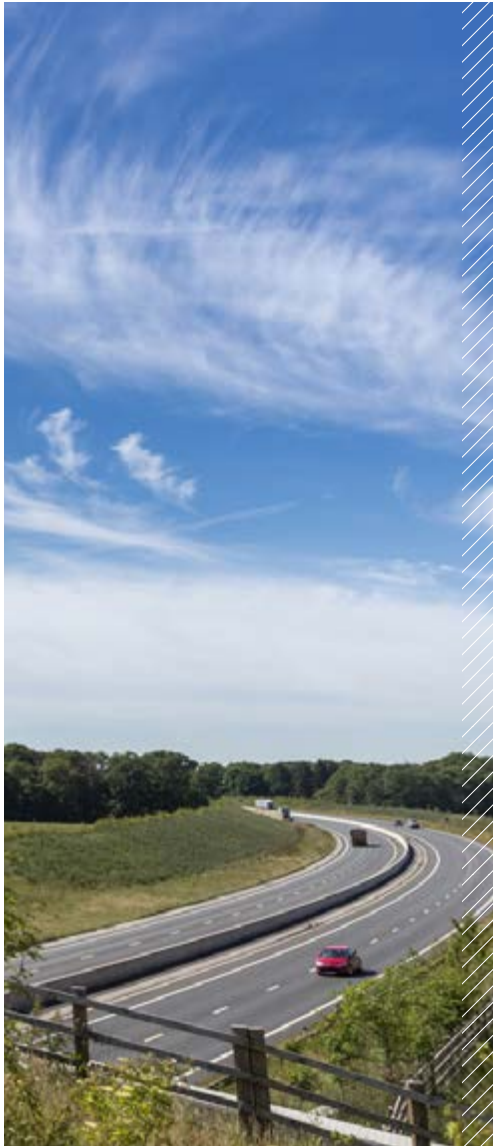
Achieving an improved environment will require a systematic approach. This starts by seeking to avoid and minimise damage, taking measures to rehabilitate or restore biodiversity, before finally offsetting any residual, unavoidable impacts[39].

We are working hard to ensure there is no net loss of biodiversity across our activities by 2025, with a focus on increasing biodiversity from 2025 onwards.

30,000
hectares of soft estate

By 2025,
achieve no net loss of biodiversity across all our activities

From 2025,
focus on increasing biodiveristy

Foreword   Executive summary   Our strategic planning approach   **Trends shaping the future**   Our vision   How we will deliver   Next steps

national highways

Sustainable network development

Economic growth should go hand in hand with protecting the environment and improving safety and quality of life for current and future generations.

In England, the total combined cost to the NHS and social care as a result of emissions of particulate matter (PM2.5) and Nitrogen oxides could reach £18.6bn by 2035.

Concerns around the impact of fossil fuel combustion are often presented in the context of CO_2 and climate change. However, various harmful pollutants are co-emitted with greenhouse gases. This is one reason that the environment needs to be considered in an integrated way, including through engaging with communities to understand their needs.

Nitrogen dioxide, which comes from diesel vehicles, is one of the most widespread pollutants. Where we identify that the concentration of NO_2 exceeds 40μg/m3 on the SRN, we forecast when we can return that link (road section) to compliance. We develop a range of mitigation measures, including speed limit trials, traffic management measures and barriers.

Noise pollution has also been flagged as a major physiological stressor, linked to high blood pressure, cardiovascular disease, obesity and diabetes[40]. A study from 2010 estimated the annual social cost of urban road noise in England to be £7-10bn. Through our designated funds, we are reducing noise for communities close to specific noise 'hotspots' on our network, with a target to help 7,500 households through noise mitigation schemes by 2025.

Beyond 2030, measures to reduce the concentrations of, and exposure to, fine particulate matter will likely expand. The Environment Act 2021 has also introduced a legally-binding duty on the government to set at least two air quality targets, one of which must be long term.
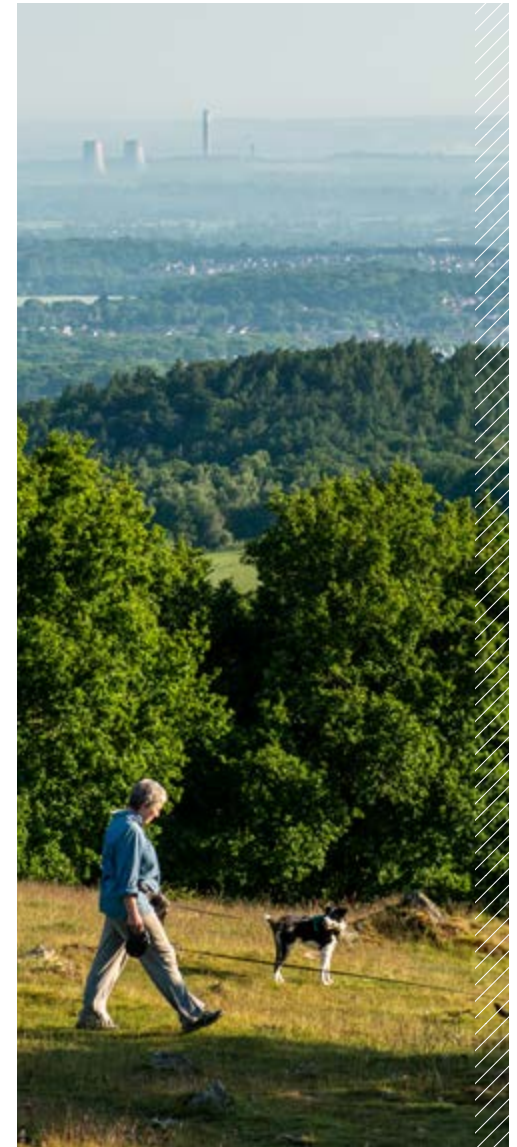
Up to

£18.6bn

potential cost of air pollution (PM2.5 and NO_2) to NHS and social care by 2035

Through our designated funds, we aim to help

7,500

households through noise mitigation schemes by 2025

Foreword   Executive summary   Our strategic planning approach   **Trends shaping the future**   Our vision   How we will deliver   Next steps

national highways

Sustainable network development

Once road user carbon emissions are net zero, action will still be needed to reduce wider pollutants.

The majority of particulate emissions from road journeys are non-exhaust emissions.

While electrification will rapidly reduce exhaust-emissions, most PM2.5 and PM10 emissions attributed to road transport are non-exhaust. In other words, they are generated by brake and tyre wear, road surface abrasion and the resuspension of road dust.[43]

Data from the UK National Atmospheric Emissions Inventory indicates that non-exhaust emissions respectively account for 60% and 73% of primary PM2.5 and PM10 road emissions (by mass). Car tyres are a major source of ocean microplastics, with the average tyre losing 1-1.5kg during its lifetime.

The scale of the problem is not yet fully understood and there are some notable uncertainties in the prediction of future non-exhaust emissions. For example, emissions could further worsen if increases in vehicle weight are not balanced by decreases in brake wear or the uptake of PM reduction technologies, such as low-emission tyres.

In a future where relative costs-per-mile may be lower than today and UK population higher, there are also wider uncertainties associated with the size of the vehicle fleet and total distance driven.

Other pollution, including 'road run off' and plastic pollution entering water courses are specific challenges that we will need to address, including through direct communication with road users.

Links (road sections) in exceedance of air quality targets (average concentration of NO_2 exceeds 40μg/m3 in a calendar year)
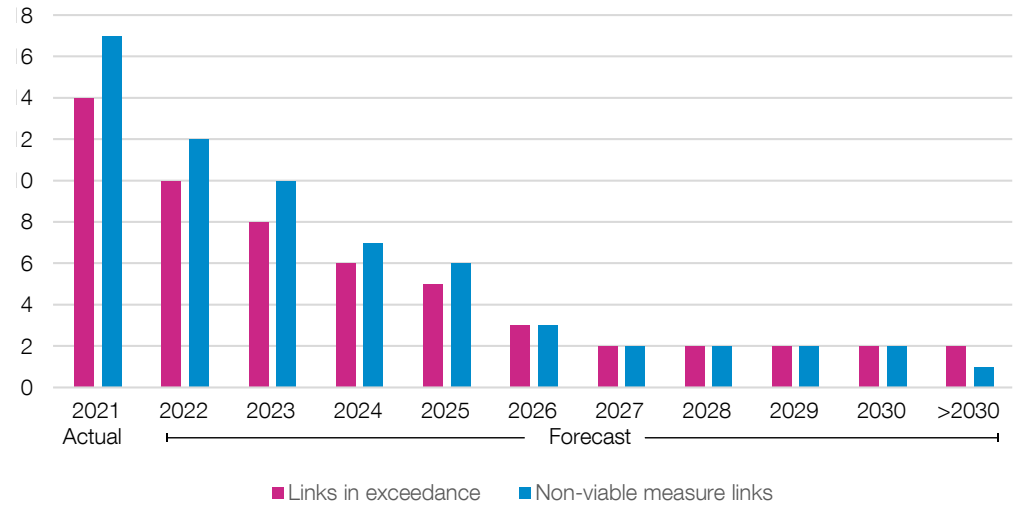
National Highways

1-1.5kg
of mass lost by an average tyre during its lifetime[42]

Particulate matter:

60% of PM2.5
73% of PM10
emissions are non-exhaust

Foreword   Executive summary   Our strategic planning approach   **Trends shaping the future**   Our vision   How we will deliver   Next steps

national highways

Asset resilience

>20,000
bridges and other structures

1,900
miles of road with fibre optic cable

4,500
miles of motorway and major A-roads

8,000
safety barriers

>120,000
lights

>8,000
miles of geotechnical assets

12
road tunnels

1.35 million
drainage points

Foreword   Executive summary   Our strategic planning approach   **Trends shaping the future**   Our vision   How we will deliver   Next steps

national highways

Asset resilience

Much of our network was constructed in the 1960s and 1970s.

In the coming decades, we will need to deliver an increasing renewals programme.

We are the second biggest custodian of government infrastructure assets by value, responsible for a wide and increasingly complex range of ageing assets. In the future, there will be a growing need to intervene as our assets continue to approach the end of their useful lives.

Meeting this challenge will be key to how customers experience our network. Proactive asset renewals will help reduce the need for reactive maintenance and interventions, preventing customer journeys from being adversely impacted. This includes, for example, asset failure and associated safety, reliability and cost implications.

The number of assets we manage will also increase by approximately 10% over the coming road periods due to design, build, finance and operate (DBFO) transfers. This relates to parts of our network previously managed by third parties which are coming back under our control and responsibility.

As we look to the future, we also know that the nature of our interventions, from asset renewals to network operation, will become more diverse. Changes across digital technologies, the type of vehicles that use our roads and increasingly connected assets will create new operational demands and require different skills and approaches across our organisation.
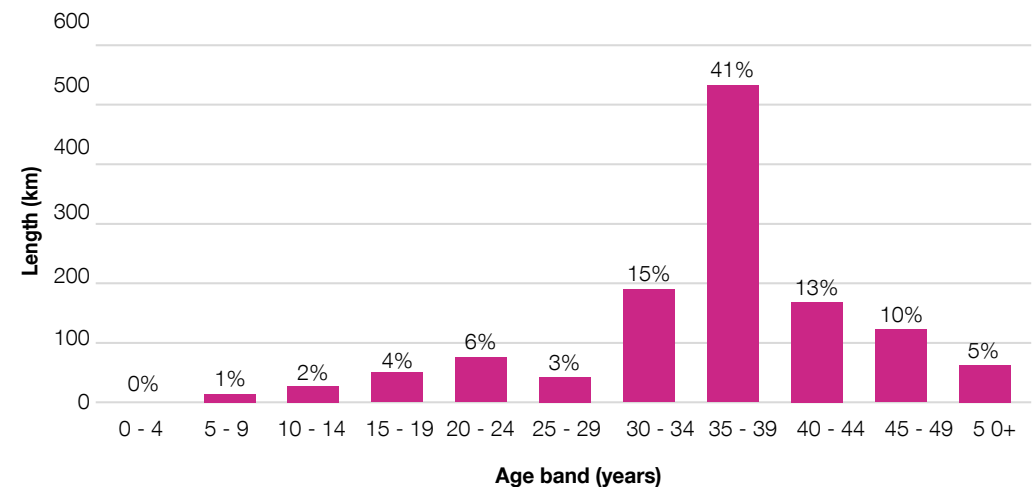
We will need to accomplish a larger renewals programme during a period of continued demand for travel, transitions in personal mobility and increased environmental pressures, particularly with respect to carbon.

In response to these growing needs and wider challenges, we are already producing a set of asset class strategies and handbooks for each of our key assets. The strategies set out our objectives, while the handbooks provide guidance to enable consistent decision making across our end-to-end asset management lifecycle to support on-the-ground delivery.

We are also exploring innovations in asset design and construction, particularly those that require lower levels or frequencies of intervention.

Greater use of asset condition and service-level modelling will help both our strategic and operational planning, allowing us to optimise when and how we intervene to maximise whole-life value and our cost efficiency.

Age distribution of our concrete road surfaces (rigid pavement)

National Highways

Foreword   Executive summary   Our strategic planning approach   **Trends shaping the future**   Our vision   How we will deliver   Next steps

national highways

Asset resilience

Climate change will impact our network.

The impact of climate change on many ecosystems and human systems worldwide is inevitable.

In 2022, we published *Preparing for climate change on the SRN: third adaptation report under the Climate Change Act*. This set our vision for the SRN to be "resilient to climate change and incidents, such as flooding, poor weather conditions, blockages on connecting transport networks".

The SRN includes assets with varying lifespans. As longer life assets such as bridges, tunnels, drainage and earthworks endure for many decades, it is critical that we take account of not just today's weather but long-term climate change.

The most recent Met Office scenarios indicate that, by the 2070s, the UK can expect an increase in summer temperatures, an increase in winter rainfall, more intense rainfall events in the summer, rising sea levels and a potential increase in wind speed. These changes could lead to extreme weather such as flooding, storms and heatwaves happening more frequently[44].

The SRN is already sensitive to the weather, particularly rain, extreme temperatures and high winds. For instance, one severe rainfall event in October 2021 led to significant flooding on the M25, A3 and M23.

Changes to the frequency and extent of weather events, such as extreme temperatures, could cause rutting and deformation of roads and warping of slabs, increasing asset deterioration and the potential for customer disruption.

For structures, excessive expansion of bridge bearings in heatwaves can cause damage, high river flows can erode river beds affecting bridge foundations and saturation of slopes can affect their stability.

Extreme weather may also have an impact on incidents, increasing the risk of vehicles breaking down due to overheating, fires, flying debris and collisions linked to reduced skid resistance caused by flooding.

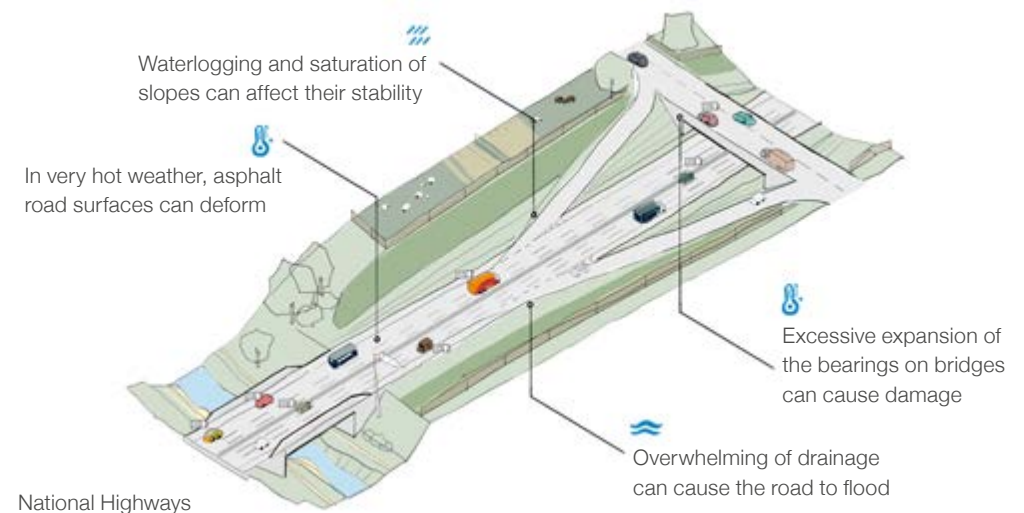These risks extend beyond the SRN. The increased frequency of extreme weather events will likely highlight critical interdependencies between infrastructure networks.

For example, extreme rain could overload the drainage capacity of adjacent land and cause flooding on the SRN, while significant weather-related disruption on the rail network could increase demand on the SRN. A holistic approach will be required to assess and understand these interdependencies.

We will increasingly need to develop measures to mitigate and build resilience against climate change. By 2070, we could be experiencing[44]:

5.4˚C increase in max temperature

35% wetter winters

How climate change affects the SRN

Waterlogging and saturation of slopes can affect their stability

In very hot weather, asphalt road surfaces can deform

Excessive expansion of the bearings on bridges can cause damage

Overwhelming of drainage can cause the road to flood

National Highways

Foreword   Executive summary   Our strategic planning approach   **Trends shaping the future**   Our vision   How we will deliver   Next steps

national highways

Asset resilience

The emergence and reliance on technology and information will require digital resilience, both for vehicles and our network.
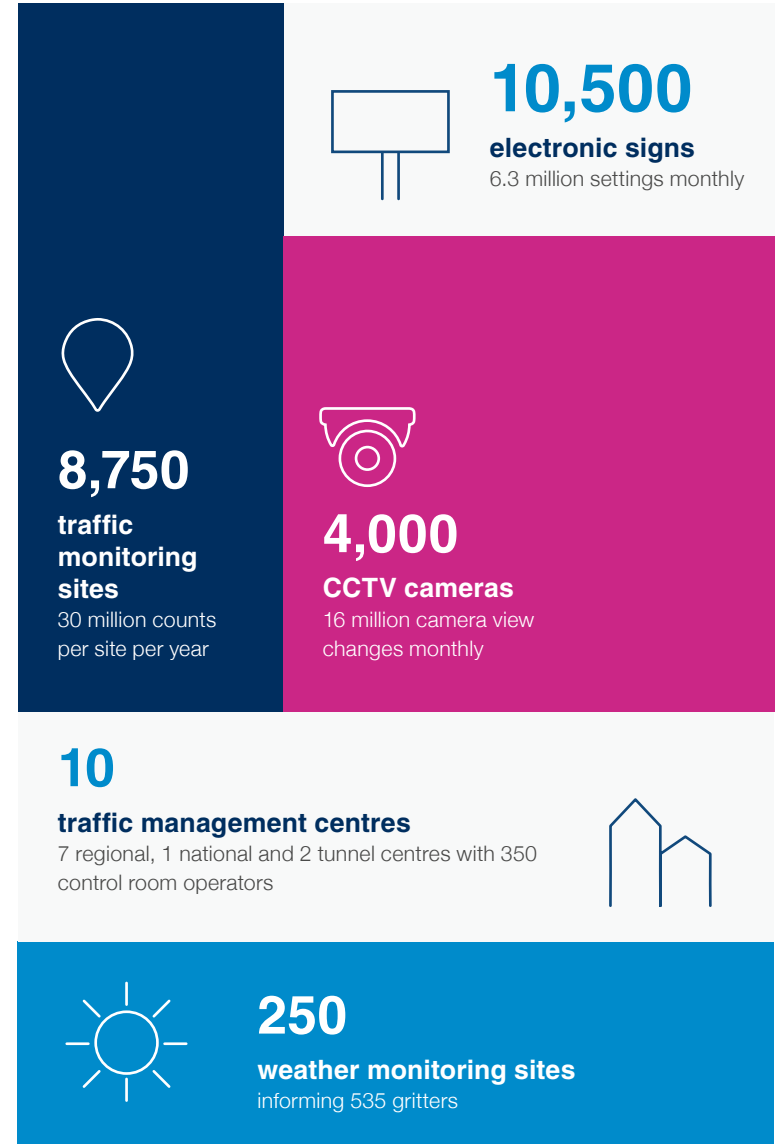
This will only increase over time, bringing challenges of cyber risk and increased complexity.

We need to continue to build cyber resilience in our technology systems from both malfunction and attack. The importance of this resilience will increase as we operate an increasingly connected set of systems.

Vehicles will need to be cyber secure and able to receive alerts about cyber risks, while cyber vulnerability assessments will need to be integrated into the design of new infrastructure projects and the operation of all our assets.
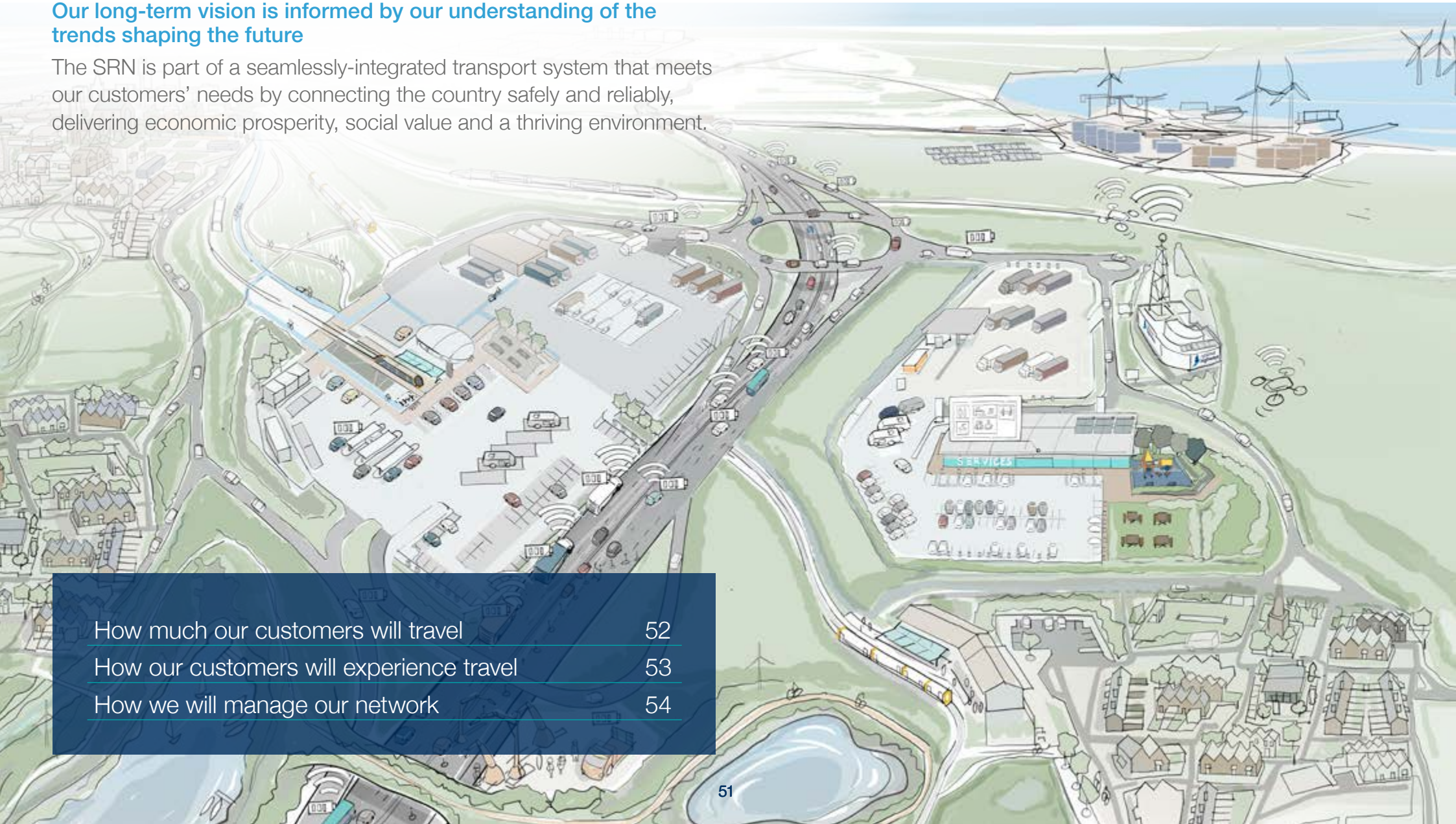

10,500
electronic signs
6.3 million settings monthly

8,750
traffic monitoring sites
30 million counts per site per year

4,000
CCTV cameras
16 million camera view changes monthly

10
traffic management centres
7 regional, 1 national and 2 tunnel centres with 350 control room operators

250
weather monitoring sites
informing 535 gritters

Foreword   Executive summary   Our strategic planning approach   Trends shaping the future   **Our vision**   How we will deliver   Next steps

national highways

Our vision

Our long-term vision is informed by our understanding of the trends shaping the future
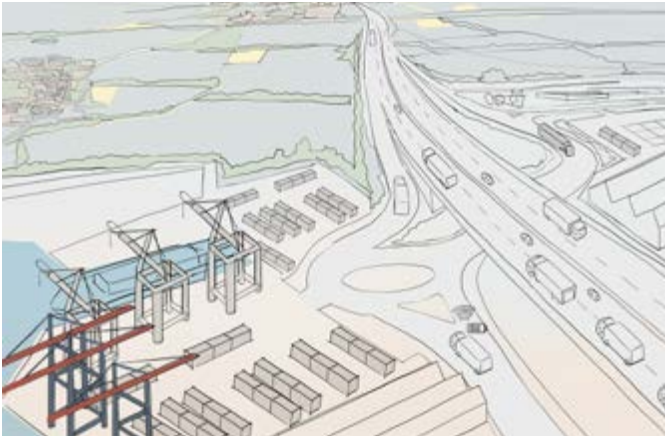
The SRN is part of a seamlessly-integrated transport system that meets our customers' needs by connecting the country safely and reliably, delivering economic prosperity, social value and a thriving environment.

Foreword   Executive summary   Our strategic planning approach   Trends shaping the future   **Our vision**   How we will deliver   Next steps

national highways

How much our customers will travel

Our network will play a critical role in supporting growth as part of an integrated transport system.

Growth and levelling up

Regardless of which region our customers are travelling through, they will receive the same high level of service and connectivity.

The SRN will help deliver improved productivity and support regional and sub-regional aspirations for sustainable, inclusive growth. To ensure that our network gives equal opportunity to all, we will investigate the benefits of categorising our network and defining the associated levels of services our customers can expect from them. We will be increasingly active in influencing plans for development, supporting government plans for growth and addressing network constraints. We also want to use our position to support the highways industry, investing in new skills, funding research and creating wider value through innovation.

Car travel

Network optimisation and modal integration will enable fast and reliable journeys.

We will need to support and stimulate economic growth in a sustainable way. This means exploring a wider range of levers than ever before to manage demand as part of our 'decide and provide' approach.

We will target improvements to create a fully-integrated national transport network, working with partners to deliver seamless multi-modal travel. By harnessing digital technology we can also help customers make more informed decisions about if, when and how they travel, and manage the SRN more efficiently in real-time.

Freight and logistics

Our network will provide unimpeded access to domestic and world markets, driving national competitiveness.

The freight and logistics sector is critical to the national economy, and is set to grow. To succeed, it requires efficient links to international gateways, supporting unimpeded access to world markets. This means preparing high-quality, freight-friendly corridors that are able to serve connected and autonomous freight movements. In more urban locations, we will work with partners to exploit increased consolidation and deliver greater integration with rail and short sea shipping, allowing for the targeted removal of road freight to other modes.

Foreword   Executive summary   Our strategic planning approach   Trends shaping the future   **Our vision**   How we will deliver   Next steps

national **highways**

How our customers will experience travel

Travel on our network will be safe, sustainable and increasingly connected.
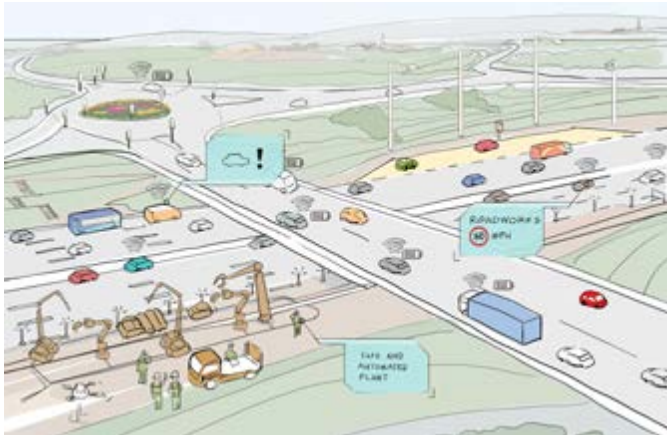
Safety

Our roads will be the safest in the world. No one will be harmed when using or working on the SRN.

Safety is, and will remain, our first imperative as an organisation. It is our legal and moral responsibility. We see a future where the level of harm to those travelling or working on our network is reduced to zero. This will only be possible with a holistic safe systems approach. Technology will have an increasing role to play, but it will only be one part of the solution. We will also target complex physical improvements to our highest risk roads, particularly all purpose trunk roads.

Digital

National corridors will be CAV-enabled. Freight automation will be well established on routes to major international gateways.

Digital technology will transform how our network is designed, built, operated and used. We will exploit advances in technology, connectivity and data to improve the experience of our customers and our road workers, delivering better communications, reduced disruption and improved safety. A key part of our future service to customers will be preparing our physical and digital infrastructure for connected and autonomous travel, ensuring all our national corridors will be CAV-enabled by 2050.
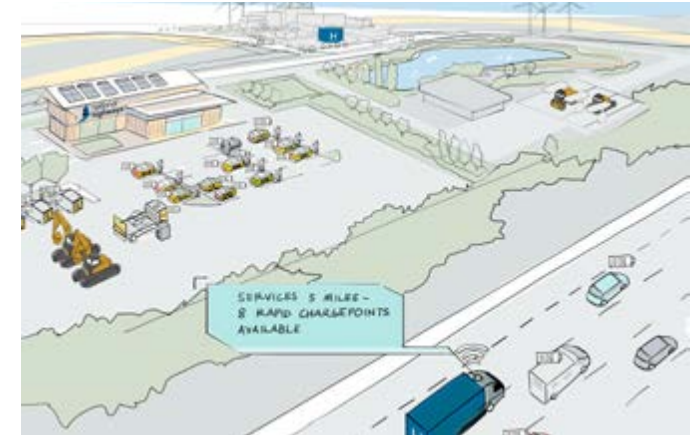
Decarbonisation

The SRN will be decarbonised, placing roads at the heart of the UK's net zero future.

As we collectively face the climate crisis, roads will be a vital part of zero-carbon travel. Our *Net zero highways: our 2030 / 2040 / 2050 plan*, published in 2021, makes clear our commitment to act. Our ambition is to be net zero for our own operations by 2030, with our maintenance and construction emissions net zero by 2040. In the coming decades, we will support transformation in the energy systems that power our transport networks as we deliver our commitment to net zero travel on our network by 2050. These milestones will shape our actions and provide us with clear indicators of progress.

Foreword   Executive summary   Our strategic planning approach   Trends shaping the future   **Our vision**   How we will deliver   Next steps

national highways

How we will manage our network

We will enable stress-free customer journeys and act 'beyond roads' to help the environment and communities thrive.

Customer experience

We will provide a trusted and stress-free end-to-end experience for our customers, with accurate and personalised journey information and attractive rest areas that offer rapid and reliable low-carbon fuelling.

We know that our future customers will rely on us to deliver reliable and safe journeys above all else. This will continue to be the foundation of everything we do. But we also see a future where customer journey quality is viewed holistically, ranging from more consistent network standards and transformed pre-journey and in-vehicle information provision to modern on-route services at service and rest areas. By improving these facilities, we can support customers to not only take a break for a better, safer journey, but also help them to enjoy and embrace their transition to electrification and alternative fuels.

Sustainable network development

Our network and wider estate will support a thriving environment, enabling healthier and safer communities and a richer, more biodiverse natural environment.

The natural environment is one of our most valuable shared assets. We know that we have an important role to play in its future through the way we manage our network and wider estate. As we look to the future, our enhancements will be increasingly targeted, local and integrated with active travel provision. But, more than this, we will play a much bigger role in addressing the historic decline of our natural environment. As outlined in our *Environmental sustainability strategy*, our ambition is to move beyond protection and preservation towards active promotion and restoration of these environments and the communities we serve.
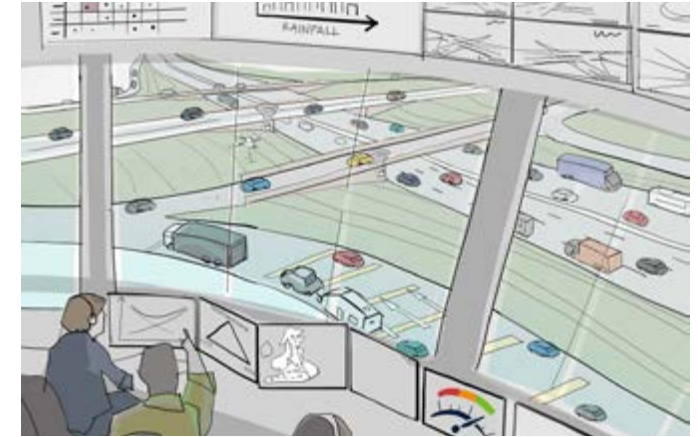
Asset resilience

Asset and operational resilience will be maximised through an intelligent, data-led approach.

The way we care for our assets will be critical over the coming decades. We know that we will need to respond to an ageing asset base through an expanded asset renewals programme. Our assets will be digital by default, providing real-time updates of condition and performance to support proactive, data-led decisions that keep our network open, safe and serviceable. Where roadworks are required, new standards of planning and communication will help us put customers in control. This means customers will be able to make timely decisions about alternative routes, modes and departure times.

Foreword   Executive summary   Our strategic planning approach   Trends shaping the future   Our vision   **How we will deliver**   Next steps

national highways

How we will deliver

This chapter sets out the journey to deliver our preferred future for our customers. It outlines our aspirational targets over the short (2030), medium (2040) and long term (2050). This will be underpinned by the categorisation of our roads and supported by consistent levels of service, covering:

National corridors

National corridors will continue to be the vital spine of our network, supporting the highest levels of demand. These routes will be the key long-distance corridors, connecting major urban economies, acting as major freight routes and linking international gateways.

Inter-regional routes

Inter-regional routes will be high-demand, multiple-lane roads. These routes will connect regional economies and carry significant levels of freight and goods.

Regional connections

Regional connections will link local economic centres, both to each other and into the national network.

As we navigate change and uncertainty over forthcoming road periods, how we deliver our vision will evolve. We will use and adapt our plan to ensure that everything we do remains anchored by our long-term priorities.

How much our customers will travel

Growth and levelling up

2030

We will take a targeted approach to enhancing our network and increase visibility of its performance.

Increasing productivity and competitiveness:

- Subject to the continued robustness of scheme business cases, we will progress identified enhancements, including those committed in RIS1 and RIS2.
- This includes the A122 Lower Thames Crossing, an essential component in the UK's future transport infrastructure. The scheme will improve journeys for millions of people.

Regional performance:

- We will develop a deeper understanding of the comparative performance of our network across different regions, including through our Route strategies.
- Regional priorities, linked to the objectives of our Route strategies, will remain high on our agenda, such as improving connectivity across the North and reducing the impacts of holiday season traffic in the South West.
- We will work with regional partners to co-develop investment plans and bring forward integrated programmes of local transport interventions, including improvements to the SRN.

Enabling businesses to grow:

- Collaboration with SRN-reliant business sectors will help inform our plans to increase connectivity to customer, supplier and labour markets, as well as international gateways. This includes improving how we communicate with these sectors.

Unlocking sustainable growth and productivity:

- We want to play a more proactive role in shaping local plans and spatial development strategies in places where our network can have a significant role in enabling sustainable economic growth.

2040

Equity and sustainability will be at the heart of our network development, as we continue to drive national and regional growth.

Increasing productivity and competitiveness:

- As we support a future with widespread electric vehicles and zero-carbon travel, we want to enhance our network in a sustainable way.
- We will understand where SRN connectivity to main centres of population is weakest and work to increase connectivity and multi-modal mobility options in these places.

Regional performance:

- We want to improve our network and give our customers a more consistent experience, in line with our future vision for categorisation of our roads. This will give customers greater certainty and control over their journeys.
- We will work with stakeholders to ensure that our investment creates regional and local economic value.

Enabling businesses to grow:

- We will work directly with SRN-reliant business to help them thrive, supporting information provision through focused channels, providing real-time and ahead-of-time network insights.

Unlocking sustainable growth and productivity:

- Cities and towns are the engines of the economy. We will continue to engage with the planning system to support their regeneration and growth.
- Our ambition is to work with partners to support the transformation of ports and airports, including enabling their role as hubs for freight distribution and green energy generation.

2050

The SRN will offer the same high levels of performance across the country, supporting an evolving economy.

Increasing productivity and competitiveness:

- We will have the ability to optimise traffic flows on our network which best support economic activity, while ensuring we retain equitable access.
- New schemes supporting strategic movements will only be considered where there is a need to connect new infrastructure, underpinned by a strong case and partner support. These schemes would be subject to the highest environmental standards and requirements.

Regional performance:

- Regardless of where our customers are travelling, they will enjoy the same, defined, high levels of service in line with our future vision for categorisation of our roads.
- The SRN will continue to play a key role in supporting regional ambitions, as identified through the objectives for each Route strategy, reflecting the needs of stakeholders, road users and communities.

Enabling businesses to grow:

- We want to support a fit-for-purpose and autonomous freight network that creates competitive advantage to the sectors most reliant on the SRN.
- By this time, we expect a significant portion of traffic on our network to be highly autonomous. We will work with partners and the planning system to unlock regeneration and growth opportunities tied to autonomous operations.

Unlocking sustainable growth and productivity:

- We will work with regional partners to support the adoption of new and emerging technology innovations across transport, energy and accessibility when we develop transport plans for housing and employment sites.

Foreword   Executive summary   Our strategic planning approach   Trends shaping the future   Our vision   **How we will deliver**   Next steps

national **highways**

How much our customers will travel

Car travel

2030

We will continue to address known issues on our network while establishing much closer relationships with other network operators.

Network optimisation:

- In addition to our existing pipeline of larger scale enhancements dependent on funding, we want to target more smaller schemes (£2 to £25 million) to improve network performance and safety, particularly focused on pinch points, the all purpose trunk roads and the edges of our network.

Network integration:

- We plan to develop and implement schemes that integrate our network with other transport infrastructure, including walking routes and public transport hubs.
- Together with partners, we will consider opportunities to identify where hubs integrating the SRN with local transport networks could be feasible.
- Subject to local and national government support, we want to work with partners to support the development of network integration proposals, noting that organisational roles and responsibilities would need to be agreed.

Modal shift:

- We will put greater emphasis on purposefully supporting active travel, and explore opportunities to reduce the number of short journeys on the SRN, particularly around towns and cities.
- We aim to use our Route strategies to identify how we can improve and integrate active travel routes, and work formally with partners such as Active Travel England to identify opportunities and review priorities.
- In line with government, we will accommodate current and emerging forms of micromobility, helping to widen customer choice.
- In 2023, we aim to publish our plan to improve public transport on the SRN and outline what this means for future road periods.

Live network performance:

- We aim to develop greater visibility of live network performance, communicating this to customers through a variety of channels to help their journey planning and improve their journey experiences.

2040

We will focus on delivering greater modal integration, improving urban network interfaces and increasing the standard of our all purpose trunk road network.

Network optimisation:

- In line with our future vision for categorisation of our roads, we will continue to focus on improving customer experience, particularly on our all purpose trunk road network through more consistent standards and wider application of technology.

Network integration:

- Tied to regional ambitions, we see opportunity to work with local and national government to support public transport and active travel proposals aimed at better linking city regions with the SRN.

Modal shift:

- By this time, our aspiration is that shorter distance trips on our network have shifted to more appropriate modes where viable. While multi-modal hubs in urban areas will see much focus, we plan to support this transition with improvements to enable public transport and active travel across our network.

Live network performance:

- Advances in our live monitoring could enable dynamic on-network management to help keep traffic flowing freely.
- This could include the development of new strategies to manage the pressure placed on our roads.
- We plan to deploy robust, evidence-based measures to minimise disruption caused to customers by roadworks.

2050

The SRN will be integrated with public and active modes, enabling seamless end-to-end journeys for our customers.

Network optimisation:

- By this period, we want to have alleviated the most acute congestion and safety issues on our network.
- There is likely to be a continual need to optimise our network, addressing pinch points and areas where customer experience requires improvement.
- Localised network improvements could also be required as we further integrate our network with other modes.

Network integration:

- We foresee multi-modal hubs being the norm where the SRN meets major towns and cities, offering fast and reliable onward travel by mass transit and active travel.
- Our integrated network will not only focus on high-quality physical connections to destinations and links to other modes, but also digital integration through the provision of multi-modal information.

Modal shift:

- In line with emerging Route strategy objectives, the multi-modal hub model could also be extended to other types of destinations, such as national parks and tourist resorts, where they align with stakeholder ambitions.

Live network performance:

- New technologies and approaches offer the potential for heightened control of live network performance. We foresee that our ability to optimise network movements will be greatest on our CAV-enabled national corridors.
- Customers will have well-established and trusted live and ahead-of-time visibility of network performance. We want to use information captured by our digitally-enabled network to actively inform our investment planning decisions, while always protecting customer data and privacy.

Foreword   Executive summary   Our strategic planning approach   Trends shaping the future   Our vision   **How we will deliver**   Next steps

national highways

How much our customers will travel

Freight and logistics

2030

We will work with partners to identify a national freight network and develop multi-modal freight corridor strategies.

Freight corridors:
- Informed by our Route strategies and wider insights, we want to target improvements on strategic freight corridors and increase connectivity to international gateways such as ports and airports.
- We will work with the DfT to support its *Future of freight: a long-term plan* and develop a cross-modal national freight network.

Modal shift:
- We will explore targeted opportunities to shift freight from the SRN to rail and short-sea shipping.
- We will also work with other operators to develop specific cross-modal freight corridor strategies, building on the recommendations of the *Solent to the Midlands multimodal freight strategy*, jointly developed with Network Rail.

Consolidation:
- Working with partners, we will consider opportunities to improve the efficiency of freight movements across both the SRN and other modes.
- We would like to play our part in supporting new and innovative approaches to shorter distance freight trips, particularly around urban areas where new models such as freight consolidation could be viable and efficient, for example in first and last mile transit.

Autonomous freight:
- We will continue to work with a range of stakeholders to support early adopters in taking advantage of increasing connectivity, while also ensuring that our network continues to run effectively for all our customers.

2040

We will deliver the physical infrastructure needed to maximise the connectivity of our cities, ports and airports.

Freight corridors:
- We will continue to work with partners to develop a multi-modal national freight network, exploring opportunities to coordinate freight movements across different modes.
- We will assess and respond to changes in freight patterns, such as those related to Free Ports and, where appropriate, continue to strengthen connectivity to key gateways and hubs through improvements to physical infrastructure and customer communications.
- We will support the transition to sustainable goods vehicle fuelling, ensuring there is reliable, high-quality provision on key freight corridors.

Modal shift:
- We will continue to collaborate on joint delivery plans to target the transfer of freight to other modes, where there is a robust case and mutual support.

Consolidation:
- In support of local ambitions for reduced traffic in cities, we see an opportunity to support city regions and other partners in the delivery of urban freight consolidation centres.
- During this period, we expect increased use of consolidation centres to support more efficient and community-friendly last mile freight distribution.
- With partners, we want to further joint understanding of where consolidation works best, and identify possible future locations across our network.
- Informed by our Route strategies, we will consider the need for targeted investment to protect and improve accessibility at these hubs.

Autonomous freight:
- We will work with partners to support improved freight efficiency and fuel savings, for instance through the use of signals, junction layout changes, night time operation and dedicated freight lanes.
- We also expect that commercial hub-to-hub automated freight services will begin to emerge.

2050

Strategic corridors will support automation and link international gateways, industry, consolidation centres and modal hubs.

Freight corridors:
- We see a future where established strategic corridors link sustainable freight movements between international gateways, key industrial clusters, urban freight consolidation centres and multi-modal interchanges.

Modal shift:
- We will continue to work in unison with freight operators and other modes to improve the efficiency of freight travel across the country, playing our part in an increasingly seamless and free-flowing multi-modal network.

Consolidation:
- In this period, we expect freight hubs and consolidation centres to be more widely used, including efficient use of the most sustainable modes for localised freight distribution.
- We will work with partners to support major consolidation centres in all city regions, offering reliable and sustainable first and last mile connectivity and significantly reducing use of HGVs inside urban areas.

Autonomous freight:
- By this period, we expect autonomous freight operations to be well established on our strategic freight network, including on our national corridors and routes linking to major international gateways.

Foreword   Executive summary   Our strategic planning approach   Trends shaping the future   Our vision   **How we will deliver**   Next steps

national highways

How our customers will experience travel

Safety

2030

We will improve our higher risk roads, influence safety culture and trial methods of off-site construction and maintenance.

Safer roads:
- We want to lower the safety risk of our roads and aim to begin improvements on existing iRAP one and two-star roads, where possible.
- We will take forward all Transport Select Committee recommendations to further improve the safety of smart motorways, including providing more places to stop in an emergency on areas of all-lane running..

Safer people and vehicles:
- We will continue to invest in communication campaigns to help educate drivers and change behaviours.
- We will continue to protect our non-vehicle network, including by providing more dedicated, protected and well-lit cycle lanes and footways.
- We want to work with vehicle manufacturers to collectively achieve safer vehicles, including aspects of autonomy.

Safer speeds:
- We will consider implementing enforcement cameras on our network where there is an identified safety need.

Post-collision response:
- We will continue to work with emergency services to improve incident response times.

Road safety management:
- Emerging forms of vehicle power will present new safety challenges. Our traffic officers will be fully trained in the safe recovery of these vehicles.
- We will increase our detection and enforcement of mobile telephone and seat belt violations.

Working environments:
- We want to increase use of remote monitoring and maintenance equipment, such as drones and connected and autonomous plant.
- We will influence design to mitigate the wider hazards faced by our road workers, for example through increased off-site construction.
- By 2025, we aim to have halved a range of working environment metrics, including the number of service and bridge strikes.

2040

We will prepare for the implications of a mixed fleet, improve compliance and vehicle standards and scale remote solutions for asset inspection and monitoring.

Safer roads:
- We want our physical network to offer customers a safer, more consistent and higher standard of road environment through targeted investment.
- We will aim for 98% of all travel to be on roads externally benchmarked as low risk (iRAP three-star or better) and to segregate all vulnerable users from motorised traffic.

Safer people and vehicles:
- We want to work with vehicle manufacturers to ensure that safer vehicles (specifically CAVs) can be accommodated on our network and will continue to prepare our physical network for higher levels of vehicle connectivity and autonomy.
- We will target improved data and connected services to provide real-time personalised information that increases customer safety.

Safer speeds:
- We will improve our understanding of how to control the risks associated with vehicle speeds.

Post-collision response:
- We intend to use increased levels of network visibility and control to deliver faster incident response times.

Road safety management:
- We will continue efforts with enforcement bodies and third parties to improve compliance and vehicle standards on our network.

Working environments:
- Through remote solutions, we will target no human involvement in asset inspection and monitoring by 2040, establishing new standards of risk mitigation for our workers.

2050

We will be approaching zero harm on our network.

Safer roads:
- We will target 100% of travel on our roads to be externally benchmarked as low risk (iRAP three-star or better). This ambition is dependent on a number of different factors including evolving standards, cost and environmental impacts and, as such, will be periodically reviewed.
- We envisage a network where future road standards fully integrate physical and digital infrastructures, creating safer environments for all users.

Safer people and vehicles:
- Not only should our customers receive accurate, near real-time in-vehicle information that makes their journeys safer, but higher levels of connectivity and autonomy could reduce the opportunity for driver error.
- By 2050, our ambition is that all national corridors will be CAV-enabled, and autonomous freight will operate on our major international gateway routes.
- A variety of vehicle capabilities may still be present at this time. Our role will be to recognise how to safely manage a mixed fleet and to understand the physical, technological and behavioural implications for maintaining a safe and secure environment.

Safer speeds:
- We will continue to focus on controlling the risks associated with vehicle speeds

Post-collision response:
- As our network becomes more connected, we anticipate fewer collisions. Where they occur, they will be less severe and our high levels of visibility and control will help to manage them, leading to significantly reduced risk.

Working environments:
- Digital design and construction will help to drastically reduce the need to put our road workers in high-risk situations, and digital construction, maintenance and renewal of our network will be the norm.

Foreword   Executive summary   Our strategic planning approach   Trends shaping the future   Our vision   **How we will deliver**   Next steps

national highways

How our customers will experience travel

Digital

2030

We will use digital to deliver cheaper, faster construction and prepare our network for emerging new vehicle technologies.

Digital design and construction:

- We will adopt a digital by default approach to design and construction, with activities becoming increasingly automated, modular and conducted off-site.
- We will incentivise our supply chain to use these techniques, supporting digital rehearsals and embedding the use of connected and autonomous plant in construction processes. This will help improve efficiency, enhance safety and protect the environment.

Digital operations:

- We plan to extend our investment in sensor technology, such as flood sensors, bridge sonar, embankment slip warnings and movement sensors/strain gauges, enabling assets to report their condition to trigger pre-emptive maintenance.
- When the unexpected does happen, increased connectivity of assets will help improve the pace and effectiveness of our incident response. We will use remote access fault resolution capabilities to reduce roadworker exposure to live traffic and equipment downtime.

Digital for customers:

- We want our customers to be better informed and trust our information. We will continue to develop infrastructure to offer close to real-time information across a range of digital channels, while considering how to avoid digital exclusion.
- We will plan for the deployment of the infrastructure, systems, equipment and physical improvements required to connect to in-vehicle technology, including the transition from communications outside the vehicle to in-vehicle.
- We will continue to assess the readiness of our network for safe and efficient CAV operation, including understanding CAV failure scenarios. Innovations, such as automated lane keeping systems, could be deployed in this period, and we will work with government and partners to support safe adoption.
- We will prepare to become a truly digital organisation, including training, capability, recruitment and retainment.

2040

We will draw on live and historical data to transform in-vehicle information and optimise customer travel patterns.

Digital design and construction:

- Our research, innovation and supply chain partnerships aim to achieve automated construction at all stages of the asset lifecycle by 2040, improving delivery timescales and cost while reducing disruption. This will allow us to achieve a 50% reduction in total cost per km of road construction and maintenance, when compared to 2015.

Digital operations:

- Drawing on live and historical information, we plan to apply our growing digital twin capability to predict and influence customer travel patterns, giving customers informed choice.
- We plan to increasingly incorporate data points on asset performance, noise and air quality into digital twins to help monitoring and data-driven decision making.

Digital for customers:

- Our ambition is to have clearly defined our role as network operator of an increasingly connected network. Our capabilities will continue to mature in line with our responsibility for an increasingly connected, intelligent and self-monitoring asset base. This will include having implemented a strategy for our future control centres.
- We want our network to be capable of connecting with vehicles by 2035, accommodating increasingly automated operation. Initial focus will be on preparing the physical and digital infrastructure needed to deliver the most mature digital offering on core parts of our network, before wider roll-out.
- We will undertake significant engagement programmes to educate and reassure customers regarding the adoption of new technologies, including increased vehicle autonomy.
- Our aspiration is to provide real-time in-vehicle information at scale, gradually replacing physical signage. The sharing of data between transport providers will allow better management and use of the wider transport network.

2050

We will mature our role as a network operator and further develop our capabilities in digital design and construction.

Digital design and construction:

- Further development of our digital design capabilities and modular construction will allow for fully autonomous off-site manufacture of SRN repairs.
- This will increase construction efficiency, when compared with manual processes, while also reducing road worker exposure to live traffic, helping to increase their safety.

Digital operations:

- We will be prepared to realise the opportunities that new technologies may bring. By this point, we aim to have matured our role as a network operator and expect that our assets will support dynamic services across our entire network.

Digital for customers:

- By 2050, we expect a significant proportion of mileage travelled on our network will be highly autonomous, or supported by connected systems. Our national corridors will be fully CAV-enabled.
- We want to use digital services to provide users with fast route and modal choices based on real-time and ahead-of-time traffic data, as well as macro-level travel trends, provided either by us or in collaboration with third parties.
- We aspire to be a truly data-centric organisation, capturing, interpreting and applying high volumes of near real-time data from assets and vehicles to keep our network available and operating at previously unachievable levels of efficiency.
- By this period, we aim to have the ability to optimise traffic flows on our network, while ensuring we retain equitable access.

Foreword   Executive summary   Our strategic planning approach   Trends shaping the future   Our vision   **How we will deliver**   Next steps

national highways

How our customers will experience travel

Decarbonisation

2030

We will reduce our own corporate carbon emissions to net zero and help our customers decarbonise their journeys.

Net zero operations:
- We are committed to reducing our corporate carbon emissions to net zero by 2030, without purchased offsetting.
- Our fleet will decarbonise. By 2027, 100% of our non-traffic officer light vehicles will be electric. By 2030, our traffic officer vehicles will be 100% electric; the three year difference is due to the lack of electric vehicles that meet our traffic officer safety requirements. We have set an interim target of 75% of the fleet to be electric or hybrid by 2025.
- We will also buy high-standard green tariff energy, roll out network-wide LED lighting, plant three million trees to offset carbon and trial renewable energy generation on our land.

Net zero maintenance and construction:
- We aim to reduce maintenance and construction emissions by 40-50% against a 2020 baseline.
- We will transition all construction plant and compounds to zero emission, and deliver the UK's first near-zero road scheme between 2025 – 2035.
- We will also integrate net zero into our purchasing decisions from 2022 and our standard contracts and design codes by 2025.

Net zero travel on our roads:
- We will support the transition to sustainably-powered transport by facilitating technology trials and publishing a blueprint for network-wide electric vehicle charging services and energy storage.
- We will support the DfT and Office for Zero Emission Vehicles in reinforcing the electrical power network to allow for high-speed electric vehicle charging at motorway service stations.
- We aim to develop a preferred investment plan for decarbonised HGV charging and refuelling by 2028. We are also supporting DfT to assess the feasibility of an electrical overhead charging cable (catenary) system for HGVs on the M180.

2040

We will reduce carbon emissions from our maintenance and construction activities to net zero.

Net zero operations:
- We aim to have changed all our gritter fleet over to hydrogen or electricity by 2040.

Net zero maintenance and construction:
- By 2040, our target is to reduce carbon emissions from our maintenance and construction activities to net zero.
- We will only undertake new construction projects where there is a clear issue that is best addressed by changes to infrastructure. Prior to the delivery of new infrastructure we will assess alternatives in line with PAS 2080.
- Where construction is unavoidable, we will use our carbon management system to embed approaches that minimise emissions from the manufacture, transport and use of materials.

Net zero travel on our roads:
- We want to incentivise our supply chain to be early adopters of zero-carbon HGV technologies by only supplying our construction sites with zero-carbon vehicles from 2040.
- During this period, we will also continue to support the development of appropriate fuelling capability and implement the preferred solution for HGVs on our network.

2050

All travel on the SRN will be net zero for carbon emissions.

Net zero operations:
- 100% of our vehicles will be decarbonised.

Net zero maintenance and construction:
- Our aim is that 100% of our schemes will be net zero and, where there are residual emissions, these will be offset using certified 'removal' offsets.
- Zero-carbon HGVs will deliver to our sites.

Net zero travel on our roads:
- By 2045, we aim to reduce road user emissions to between 5-1 MtCO2e. By 2050, road user emissions across our network will be net zero. This will be delivered by technology that directly decarbonises the vehicles travelling on our roads.
- As the UK's fleet has transitioned to net zero vehicles, we will need to continue to focus on wider environmental challenges. Non-exhaust emissions generated by brake and tyre wear, road surface abrasion and the resuspension of road dust will continue to require action regardless of how vehicles are powered.

Foreword   Executive summary   Our strategic planning approach   Trends shaping the future   Our vision   **How we will deliver**   Next steps

national highways

How we will manage our network

Customer experience

2030

We will focus on increasing our operational efficiency and identifying new customer touch points.

Reliable journey times:
- We will continue to transform our organisational capability through programmes such as Operational Excellence 2025.
- Through these programmes, we will continue to improve the efficiency of our planning and programme optimisation, increase maintenance productivity and reduce the need for network occupancy.
- We will also use an expanded and more sustainable winter fleet to deal with severe weather.

Roadside facilities:
- We will use our influence to work with partners across the public and private sectors to improve the experience of roadside facilities for car and freight customers.
- We will work with partners to support improvements to parking, refuelling and welfare facilities, while also identifying where there are gaps in provision.
- We are working with government to enable the installation of c.2,500 high-powered charge points by 2030 at motorway and major A-road service areas to promote uptake of electric vehicles. In doing so, we want to support positive customer experiences of electrification, reflecting government priorities around equipment reliability and ease of use.
- We will continue to support government's zero-emission HGV trials and developing policy, and will support the promotion of our preferred investment plan for HGV charging provision from 2028.

Connecting customers:
- We want to work closely with third parties such as wayfinding services to improve the availability and quality of our current information channels, while also developing new channels.
- We will gain more granular, real-time insights into customer journeys and plan for the transition to connected in-vehicle communications. By 2030, we expect to support >1,000,000 direct to customer/vehicle information links.

2040

We will progress defined levels of service across our network and roadside facilities to drive consistency for customers.

Reliable journey times:
- Tied to our future vision for network categorisation, we want to establish more consistent standards for customers, including safety, digital services and availability of sustainable power.
- Our Digital Roads programme will pave the way for more efficient network construction and maintenance, helping us to better balance major programmes of network improvements with customers' immediate need for reliability.
- Our increasingly connected asset base will help us improve operational availability by enabling pre-emptive maintenance. We also expect to deepen our traffic management collaboration with local highways authorities.

Roadside facilities:
- We will support the delivery of c.6,000 high-powered charge points across our motorways and A-roads by 2035, and will continue to work with partners to assess the need for additional charging and alternative fuelling facilities.
- We will support the roll-out of the preferred plan for HGV charging and fuelling, putting positive customer experiences high on the agenda.
- By this time, we want the quality of service offered at motorway services and rest stops to be noticeably increasing, with clear plans in place alongside partners to develop a world-class level of service.

Connecting customers:
- We will begin to deploy in-vehicle provision of real-time information at scale, which will gradually replace physical signage. By 2035 we expect to support >10,000,000 direct to customer/vehicle information links.
- We want to make it easier for both domestic and foreign freight customers to manage their journeys by supporting high-quality information to help logistical planning and decision making.

2050

Journeys will be reliable, enjoyable and stress-free.

Reliable journey times:
- In line with our future vision for road categorisation, we want our network to offer consistency across physical and digital standards.
- Large parts of our network will also be CAV-enabled. This will give increased visibility and control on our network, helping make journeys safer and more efficient.

Roadside facilities:
- We will continue to work with partners to make our roadside facilities amongst the very best in the world. Gaps on parts of our network will be addressed, and services will be located where both private and freight customers require them.
- Focus will be on delivering the highest standards of charging, fuelling provision and welfare facilities to make these places genuinely restful and enjoyable places to visit, and in some cases destinations in their own right.

Connecting customers:
- In this period, we foresee fully personalised, dynamic digital services delivered at scale. Customers will receive route and modal choices based on real-time service data through a range of channels.
- They will also benefit from wider interpretation of macro-level travel trends, provided either directly by us or through us in collaboration with third parties.
- Multi-modal journey information will be transmitted into vehicles through a choice of digital platforms, and we will be capable of linking directly with all customer vehicles.

Foreword   Executive summary   Our strategic planning approach   Trends shaping the future   Our vision   **How we will deliver**   Next steps

national highways

How we will manage our network

Sustainable network development

2030

We will promote sustainable development and aim to achieve no net loss in biodiversity.

Balanced portfolios:
- We are committed to reducing carbon emissions through our balanced portfolios aligned to PAS 2080, meaning that before we construct new assets we will seek to find alternate and more sustainable solutions.
- Where we do construct, we will put carbon reduction at the heart of every stage from options development and early design onwards.
- We will prioritise schemes through a rigorous assessment process, balancing overall benefits with wider safety, environmental and social impacts.

Nature:
- We want to increase biodiversity and look for opportunities to create new habitats and support the government's *25 year Environment Plan*.
- Previously managed through operational and maintenance spend, we will establish soft estate as its own asset class and develop low-maintenance carbon absorption.
- We want our landscape-scale interventions to include new green bridges to reconnect habitats, rewilding of water courses and mitigation of high-risk outfalls to protect rivers.

Communities:
- Working with stakeholders, we aim to extend our noise policy to include teaching spaces, as well as residential properties and improve tranquillity in national parks.
- Trialling technology and stakeholder initiatives to bring all parts of our network into compliance with the government's national air quality limits on NO_2.
- We will implement digital innovations in air quality monitoring and the feasibility for dynamic control of speed limits to improve air quality, informed by our trials on the M1 Rotherham, M5 and M6 Birmingham and M602 Manchester.
- We will improve access to heritage assets within our ownership and promote with the local community.

2040

Our focus will increasingly be on the active creation of environmental and social value, not simply mitigating our impact.

Balanced portfolios:
- We will continue to apply stringent criteria for the development of schemes, which will gradually become more local and targeted in their extent as we move to nationally-consistent levels of service and safety across the country.
- We will implement Lean construction practices and the principles of a circular economy, using modular construction techniques and standardised components to reduce waste.
- As one of the country's largest consumers of construction materials, we want to use our influence to catalyse the industry towards sustainable practices.

Nature:
- We will maintain a steady state position of no net loss of biodiversity across our soft estate and will target net gain opportunities.
- We aim to be recognised as an industry leader in the capture of data and the transparency of our biodiversity reporting.
- All Sites of Special Scientific Interest in our ownership will be in favourable status and we will maintain this status in perpetuity. We aim to ensure 75% of our soft estate is classed as moderate or good condition.

Communities:
- We will use best practice and ensure a comprehensive approach to noise management across the SRN, including for households, teaching spaces and national parks.
- We will target air quality benefits by delivering measures such as dynamic speed reduction and wider advances in tyre technologies to improve quality of life for those living next to the SRN.
- By this period, we will be working to a fully developed and embedded suite of metrics and natural capital accounting that reflect a more holistic view of environmental sustainability. We will use these to inform our management decisions.
- We will collaborate with partners and local communities to drive wider improvements to national heritage assets.

2050

We will be seen as a force for good in communities and use our influence to address wider environmental and societal challenges.

Balanced portfolios:
- Our network will become increasingly stable. While we will continue to strengthen it to maximise modal and local network integration, significant network building will only take place where new, strategically-important infrastructure requires incorporation into our network, or where the economic, social, and environmental cases for development are robust.
- Our target is that, by 2050, we will no longer produce any avoidable material waste and virtually all construction aggregate used on site will be recycled.
- We will observe significant reductions in the amount of plastic waste in our monitored watercourses as we work towards eliminating plastic waste by 2042.

Nature:
- We will be recognised as a leader in the management of our soft estate supporting healthy habitats and acting as a backbone for connectivity and richer biodiversity in the wider landscape.
- We will integrate the SRN within the surrounding landscape or urban areas, with a focus on character improvements on a wide scale.

Communities:
- We will continue to focus on addressing the wider environmental and societal challenges from road transport.
- We will actively develop and be routinely applying new approaches to mitigate community impacts, such as real-time air quality monitoring and dynamic network management.
- In communities, we want stakeholders to benefit from a greater role outside the limits of the SRN, as we work with partners to support local regeneration, placemaking and improved experiences of people and businesses that neighbour our network.

Foreword   Executive summary   Our strategic planning approach   Trends shaping the future   Our vision   **How we will deliver**   Next steps

national highways

How we will manage our network

Asset resilience

2030

We will deliver major programmes of renewal to keep our network safe and available.

Connected assets:
- We see opportunity to invest in sensor technology to support vehicle-to-vehicle and vehicle-to-everything communication, reducing the need for manual inspections and improving our operational resilience.
- We plan to expand deployment of flood sensors, bridge sonar, embankment slip warnings, movement sensors and gauges.
- We will undertake a network-wide assessment of current and future asset connectivity. Roadmaps will be developed to define the architecture and approach to putting digital at the heart of our vision.
- We will complete our transformation programme to improve and future-proof our telecommunications services.

Asset renewals:
- We will need to focus on renewals to keep our assets safe and available. This includes tackling the backlog of technology assets that are at end-of-life.
- We also plan to deliver significant investment in structures and road surfaces, including legacy concrete pavement assets, both full renewals and condition improvements. We will also bring DBFO routes back under our direct management.
- We will establish a multi-road period renewals programme to address the long-term needs and potential service impacts of our assets to improve our network's resilience. This will build industry confidence to invest in the required skills and capabilities.

Climate change resilience:
- We will invest in new drainage design standards to ensure our drains are capable of coping with increased rainfall, as well as exploring road surfaces more resistant to extreme temperatures.
- Following successful trials, we want to increasingly adopt nature-based solutions, particularly natural flood management to improve biodiversity, landscape and resilience to flooding.

Digital resilience:
- As an 'Operator of Essential Services', we will ensure the SRN is secure by design across all digital services, systems and assets to protect our critical national infrastructure.
- We also want to attract new talent, growing our breadth of skills in technology and cyber security.

2040

We will increasingly focus on growing our digital asset management capabilities.

Connected assets
- Our ambition is that our capable assets will be increasingly sensor-enabled, reporting back condition and related data to our control centres.
- We plan to carefully phase out redundant roadside technology assets, reducing the number of new roadside equipment deployed on annual basis by >75%. In coordination with this, we will also implement our strategy for future control centres.

Asset renewals:
- We will renew our assets in line with our multi-road period renewals programme and our long-term asset class strategies, translating our strategic objectives into tangible plans for managing our assets.
- Continued programmes of renewal investment will be required across our key assets, including structures, safety barriers, geotechnical assets, tunnels and road surfaces.
- This includes completing our programme of reconstructive renewal of 1,000 lane km of legacy concrete pavement asset using innovative ways of working to minimise customer disruption.

Climate change resilience:
- Working with partners, we want to mitigate the majority of flooding hotspots through a combination of engineering and nature-based solutions such as planting and creating natural barriers to water flow.
- We would like to lead and establish initiatives with stakeholders to improve network and community resilience to flooding, using climate and asset data more accurately to identify parts of our network that require strengthening.

Digital resilience:
- Disruption caused by a cyber event will become less tolerable as our network becomes increasingly dependent upon data, technology and connectivity. We will build capabilities such as new engineering techniques, proof of concept solutions and strategies so we can withstand cyber attacks and rapidly recover to maintain a fully operational SRN.

2050

New technologies will transform how we manage our network, placing data at the heart of our decision making.

Connected assets:
- Our ambition is that the majority of our assets capable of being sensor-enabled will be reporting back condition and related data to our control centres.

Asset renewals:
- We will renew our assets in line with our multi-road period renewals programme, first established in the third road period.
- By this period, we anticipate that our renewals investment will continue to focus on our key asset classes, particularly our structures and road surfaces. As most of our assets become connected, we will also be responsible for a growing number of technology assets.

Climate change resilience:
- Working with partners, we want to have mitigated the impact of flooding on our network through a combination of engineering and nature-based solutions.
- By this time we expect to be actively monitoring our network for changes in risk, planning adaptively and benefiting from the highest levels of asset and network visibility.

Digital resilience:
- As our assets communicate in real-time with vehicles and control centres, digital trust will be key. We will build public confidence and develop open and transparent solutions that protect customer data and privacy, while optimising movements across our network.

national
highways

Next steps

This plan is just the first step in the journey towards our long-term vision. We have set out an ambitious view of the future and want to work with government and partners to make it a reality.

This means playing our part in addressing some of the most pressing challenges ahead and seizing new opportunities to serve our customers, the economy and the environment. As well as setting our long-term vision to 2050, this plan will help inform our future capability requirements to ensure we continue to respond to evolving customer need. This includes informing our culture and behaviours and how we define our future methods of working, our processes and the measures we will target. This will be achieved alongside our Transformation programme, which focuses on embedding the right culture, skills and behaviours within National Highways across multiple road periods.

Next steps

Informing third road period planning

In this document, we have set out how we believe we can make the SRN work for the people who use it, neighbouring communities and the wider economy over the long-term. Based on our research, we have set out how we can harness the power of our existing network, building on the planned and committed programme of schemes, while developing and improving for the future.

We have worked through the practical next steps we expect to undertake over the short, medium and long term, including likely planning decisions and changes to operations and practice. Safety, customer and delivery remain our strategic imperatives, and these have been our guiding principles.

Continuing to evolve our analysis

This document has been developed through horizon scanning, foresight analysis and engagement with key stakeholders. However, we understand that research and evidence continually develop and we appreciate the inherent uncertainty in long-term

planning. As such, we recognise that our view of the SRN will evolve over forthcoming road periods and we look forward to engaging widely to support our analysis and planning.

As with our *Route strategy initial overview reports*, there will be an opportunity for stakeholders, road users and communities to provide their feedback on this document. These views will be considered when finalising this document, supported by further work to develop our future vision of road categorisation and linked levels of service covering the proposed National corridors, Inter-regional routes and Regional connections.

The first version of *Connecting the Country* will be published in 2023. A feedback period will follow and the final version will be published by 2025, the end of the current road period, informing our *Strategic Business plan*, *Delivery Plan* and the finalised *Route Strategy overview reports*.

For further information please contact NetworkStrategyTeam@nationalhighways.co.uk

Our immediate focus will be on working closely with government to support their development of the next *Road investment strategy* for the third road period (2025-2030). We have used the findings in this plan to inform our *SRN Initial report*. Published separately, our *SRN Initial report* represents the first step towards turning our long-term plan into reality, specifically:

Improving safety for all

Making the most of our network

Evolving our customer and community services

Driving decarbonisation and environmental sustainability

Taking a targeted approach to enhancing our network

Foreword   Executive summary   Our strategic planning approach   Trends shaping the future   Our vision   How we will deliver   Next steps

national highways

Glossary of terms

Term	Definition
All purpose trunk roads	Roads within the SRN without motorway classification, i.e. major A-roads managed by National Highways
Biodiversity net gain	An approach to development and land management that leaves the natural environment in a measurably better state than it was before a given intervention
The Climate Change Committee (CCC)	An independent, statutory body, established under the Climate Change Act 2008
Carbon Budget	A restriction on the total amount of greenhouse gases the UK can emit over a five-year period
Circular economy	The World Economic Forum's definition of a circular economy is an industrial system that is restorative or regenerative by intention and design. It replaces the end-of-life concept with restoration, shifts towards the use of renewable energy, eliminates the use of toxic chemicals which impair reuse and return to the biosphere, and aims for the elimination of waste through the superior design of materials, products, systems, and business models.
Connected and autonomous plant (CAP)	Construction plant with embedded intelligent digital technologies that can transfer data between the equipment and its surroundings to conduct works with a varying degree of autonomy
Connected and autonomous vehicles (CAVs)	A broad definition of a connected vehicle can mean any vehicle capable of wireless connectivity to the internet, local wireless networks, other vehicles, infrastructure or control centres and personal devices. Autonomous vehicles are the result of combining this connected technology to the software and hardware necessary to take control of the vehicle to varying degrees. This can range from driver assistance to fully autonomous 'driverless' vehicles that can independently perform all driving functions.

Term	Definition
Conurbation	A large urban settlement that was formed by previously independent towns, cities or urban areas growing and joining together
Cross/multi-modal freight	Freight distribution networks across or between several modes of transport (e.g. road, rail and maritime)
Decarbonisation	The process of reducing carbon emissions
Department for Transport (DfT)	A UK governmental department responsible for planning and investing in transport infrastructure
Design, build, finance and operate (DBFO)	A project delivery mechanism whereby a private sector party is contracted to design, construct, finance and operate an asset
Devolution	The decentralisation of governmental power, for example by central government to local or regional administrations
Digital Roads	The combination of digital twins, smart assets, data science and robotics to create an intelligent road infrastructure system, as outlined in our *Digital Roads vision*
E-commerce	Retail services conducted over the internet, often involving delivery of a physical product to an address
Electric vehicle	A vehicle that is fully powered by electric battery cells
End-to-end asset management	A systematic, whole-life asset management approach that considers all impacts and opportunities throughout design, construction, operations, maintenance, renewals and end of life
Environmental stewardship	The responsible management and use of land with the aim of protecting or enhancing the natural environment, often referring to improving/retaining habitats, minimising waste and other forms of pollution

Foreword   Executive summary   Our strategic planning approach   Trends shaping the future   Our vision   How we will deliver   Next steps

national highways

Glossary of terms

Term	Definition
Greenhouse gas (GHG) emissions	The atmospheric gases responsible for causing global warming and climate change. The major GHGs are carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O).
Gross Added Value (GVA)	An economic productivity metric which measures the value generated by any unit engaged in the production of goods and services
Heavy goods vehicle (HGV)	A large truck, lorry or van, weighing in excess of 3.5 tonnes
Hybrid vehicle	A vehicle that uses two or more power sources. This is usually a combination of a conventional petrol/diesel powered combustion engine and an electric motor.
Hydrogen fuel cell	An electrochemical cell that carries electricity derived from hydrogen electrolysis, meaning low-carbon energy can be stored and transported to power road vehicles
Internal combustion engine	A conventional vehicle engine which generates power through the burning of petrol, oil or other fuels
International gateway	Hubs providing access for freight and transport to countries outside of the United Kingdom, e.g. ferry ports, airports and international railway terminals
In-vehicle traffic management	Communication technology to give road users network updates without the need for physical signage
iRAP standards	The International Road Assessment Programme (iRAP) is a global road safety organisation that provides a star rating system (one to five) that objectively and independently assesses the safety standard of a road. iRAP collaborate with road authorities, NGOs and other governmental bodies to provide an evidence-based approach to reducing road deaths and injury.

Term	Definition
Last-mile freight delivery	The delivery of goods from a fulfilment centre to the end-customer, usually a business or residential address
Levelling up agenda	A government-wide socioeconomic programme aiming to spread opportunity more equally across the country
Light commercial vehicle (LCV) / light goods vehicle (LGV)	A small-to-medium sized truck or van, weighing up to 3.5 tonnes
Local plan	A strategic document produced by local authorities to convey its planning priorities, often covering topics like housing, transport infrastructure and environmental enhancement
Major road network	The middle tier of the country's most economically-important local authority A-roads, sitting between the SRN and the rest of the local road network
Modularisation	A construction technique whereby components are designed and prefabricated off-site before being transported and installed on-site
MtCO2e	Metric tons of carbon dioxide equivalent, a universal measurement for greenhouse gas emissions
Multi-modal travel/ freight	When two or more modes of transport are used to satisfy one journey, for example through services like park and ride
National digital twin	Digital twins are realistic digital representations of physical things. These create a digital model of national infrastructure which will be able to monitor infrastructure in real-time, and to simulate the impacts of possible events.
Office for Rail and Road	A non-ministerial government department responsible for the economic monitoring and performance of National Highways and rail services

Foreword   Executive summary   Our strategic planning approach   Trends shaping the future   Our vision   How we will deliver   Next steps

national highways

Glossary of terms

Term	Definition
Operational emissions	All emissions associated with activities required to operate the SRN, including maintenance and renewals activities. However, operational emissions do not include emissions associated with construction (which fall under capital emissions).
PAS 2080	The global standard for managing carbon in building and infrastructure, examining the entire value chain from cradle-to-grave for all assets and operations
PM10 and PM2.5	Fine particulate matter suspended in the air, with PM2.5 and PM10 measuring 2.5 and 10 micrometers in diameter respectively. These microparticles can be hazardous to health when ingested.
Rapid charging points	High-power electric vehicle charging infrastructure
Real-time traffic data	Congestion and accident data that can be collected with little to no delay using remote technology, creating a more accurate understanding of current network conditions
Third road period	Five-year National Highways investment planning period from 2025 to 2030, following on from the second road period (2020 to 2025)
Rebound effect	A phenomena observed in behavioural economics, where an intervention launched to improve efficiency of a certain activity results in an unintended response that dilutes or negates the intended beneficial outcomes of the original intervention. For example, improving the fuel efficiency of vehicles, intended to reduce emissions, could result in drivers choosing to drive further due to reduced costs, ultimately failing to reduce overall emissions.
Road investment strategy (RIS)	Government setting out its strategic vision for the SRN, objectives for National Highways and the funding it will make available for delivery in a specific road period

Term	Definition
RIDDOR	The Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 2013 is a UK health and safety legislation. It puts duties on employers, the self-employed and people in control of work premises (the Responsible Person) to report certain serious workplace accidents, occupational diseases and specified dangerous occurrences (near misses).
Shared mobility	A user-centric model of mobility, where multiple individuals or groups share vehicles or infrastructure to meet their travel needs, challenging the conventional private ownership model
Site of Specific Scientific Interest (SSSI)	An area under statutory protection due to important or rare flora, fauna or geology
Social value	Criteria used to measure and amplify people-centric, usually non-monetary, benefits of a given organisation or activity
Socioeconomic outcomes	An umbrella term used to categorise the social and economic impact of an intervention, often in relation to defined groups or sectors of society
Soft estate	All the grass, trees and green space under our control
Strategic road network (SRN)	All motorways and A-roads managed by National Highways
Transport Focus	The statutory watchdog for transport and road users in the UK, responsible for collecting user data and insight
Trunking and detrunking	A process to review the extent of the SRN. Trunking is the act of transferring a section of road performing a nationally-strategic role from the management of local highway authorities to National Highways, and vice versa for trunking.

Foreword   Executive summary   Our strategic planning approach   Trends shaping the future   Our vision   How we will deliver   Next steps

national highways

References

Reference number	Reference
1	National Infrastructure Commission. (2019) National Infrastructure Commission: Future of Freight Demand. Available at: https://nic.org.uk/app/uploads/Future-of-Freight_Future-of-Freight-Demand_MDS-Transmodal.pdf
2	National Highways. (2016) The Road to Growth discussion paper. Available at: https://highwaysengland.citizenspace.com/he/strategic-economic-growth-plan/supporting_documents/The_Road_to_Growth_discussion_paper__FINAL__high_res.pdf
3	National Infrastructure Commission. (2019) Better Delivery: the challenge for freight. Available at: https://nic.org.uk/app/uploads/Better-Delivery-April-2019.pdf
4	Innovate UK. (2021) UK Transport Vision 2050: investing in the future of mobility. Available at: https://www.ukri.org/wp-content/uploads/2022/01/IUK-110122-UK-Transport-Vision-2050.pdf
5	Office for National Statistics. (2022) National population projections: 2020-based interim. Available at: https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationprojections/bulletins/nationalpopulationprojections/2020basedinterim
6	Government Office for Science. (2021) Urbanisation Trends. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/994570/GO-Science_Trend_Deck_-_Urbanisation_section_-_Spring_2021.pdf
7	Office for National Statistics. (2020) Population estimates for the UK, England and Wales, Scotland and Northern Ireland: mid-2018. Available at: https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates/bulletins/annualmidyearpopulationestimates/mid2018
8	University of Oxford: Migration Observatory. (2019) The Impact of Migration on UK Population Growth. Available at: https://migrationobservatory.ox.ac.uk/resources/briefings/the-impact-of-migration-on-uk-population-growth/
9	The Climate Change Committee (CCC). (2020) The Sixth Carbon Budget: Surface Transport. Available at: https://www.theccc.org.uk/wp-content/uploads/2020/12/Sector-summary-Surface-transport.pdf
10	Andrew Hook, Victor Court, Benjamin K Sovacool and Steve Sorrell. (2022) A systematic review of the energy and climate impacts of teleworking. Available at: https://iopscience.iop.org/article/10.1088/1748-9326/ab8a84/pdf
11	Department for Transport. (2021) UK confirms pledge for zero-emission HGVs by 2040 and unveils new chargepoint design. Available at: https://www.gov.uk/government/news/uk-confirms-pledge-for-zero-emission-hgvs-by-2040-and-unveils-new-chargepoint-design#:~:text=and%20electric%20vehicles-,UK%20confirms%20pledge%20for%20zero%2Demission%20HGVs%20by%202040%20and,within%20the%20next%202%20decades.&text=All%20new%20heavy%20goods%20vehicles,today%20(10%20November%202021).
12	Vivideconomics. (2019) The value of freight: Report prepared for the National Infrastructure Commission. Available at: https://nic.org.uk/app/uploads/Future-of-Freight_The-Value-of-Freight_Vivid-Economics.pdf
13	Eurostat. (2022) Annual road freight transport vehicle movements, loaded and empty, by reporting country (Mio Veh-km, 1 000 Jrnys). Available at: https://ec.europa.eu/eurostat/databrowser/view/ROAD_GO_TA_VM__custom_2712778/default/table
14	A. Papadoulis, M. Quddus and M. Imprialou. (2019) Evaluating the safety impact of connected and autonomous vehicles on motorways. Available at: https://www.sciencedirect.com/science/article/pii/S0001457518306018?via%3Dihub
15	Department for Transport. (2016) Research on the Impacts of Connected and Autonomous Vehicles (CAVs) on Traffic Flow. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/530091/impacts-of-connected-and-autonomous-vehicles-on-traffic-flow-summary-report.pdf

Foreword   Executive summary   Our strategic planning approach   Trends shaping the future   Our vision   How we will deliver   Next steps

national highways

References

Reference number	Reference
16	Innovate UK. (2021) UK Transport Vision 2050: Investing in the future of mobility. Available at: https://www.ukri.org/wp-content/uploads/2022/01/IUK-110122-UK-Transport-Vision-2050.pdf
17	Department for Transport. (2022) Connected & Automated Mobility 2025: Realising the benefits of self-driving vehicles in the UK. Available at: Connected and automated mobility 2025: realising the benefits of self-driving vehicles - GOV.UK (www.gov.uk)
18	National Highways. (2021) 2019 Road safety performance overview. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1014128/Road_Safety_Performance_-_Update.PDF
19	Connected Places Catapult. (2021) Market Summary for Connected and Autonomous Vehicles. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/919260/connected-places-catapult-market-forecast-for-connected-and-autonomous-vehicles.pdf
20	Centre for Digital Built Britain. (2020) The approach to delivering a National Digital Twin for the United Kingdom. Available at: https://www.cdbb.cam.ac.uk/files/approach_summaryreport_final.pdf
21	Centre for Digital Built Britain. (2021) The Gemini Principles. Available at: https://www.cdbb.cam.ac.uk/system/files/documents/TheGeminiPrinciples.pdf
22	Centre for Connected and Autonomous Vehicles. (2021) Safe Use of Automated Lane Keeping System (ALKS): Summary of Responses and Next Steps. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/980742/safe-use-of-automated-lane-keeping-system-alks-summary-of-responses-and-next-steps.pdf

Reference number	Reference
23	Connected Places Catapult. (2020) Connected Places Catapult: Market summary for connected and autonomous vehicles. Available at: Connected and Automated Vehicles: market forecast 2020 - GOV.UK (www.gov.uk)
24	IPCC. (2022) The evidence is clear: the time for action is now. We can halve emissions by 2030. Available at: https://www.ipcc.ch/2022/04/04/ipcc-ar6-wgiii-pressrelease/#:~:text=GENEVA%2C%20Apr%204%20%E2%80%93%20In%202010,%C2%B0C%20is%20beyond%20reach.
25	United Nations. The Paris Agreement. Available at: https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement
26	IPCC. (2021) Climate Change 2022: Impacts, Adaptation and Vulnerability . Available at: https://www.ipcc.ch/report/ar6/wg2/downloads/report/IPCC_AR6_WGII_SummaryForPolicymakers.pdf
27	The Climate Change Committee (CCC). (2020) The Sixth Carbon Budget: The UK's path to Net Zero. Available at: https://www.theccc.org.uk/wp-content/uploads/2020/12/The-Sixth-Carbon-Budget-The-UKs-path-to-Net-Zero.pdf
28	National Highways. (2021) Net zero highways: our 2030/ 40/ 50 plan. Available at: https://nationalhighways.co.uk/media/eispcjem/net-zero-highways-our-2030-2040-2050-plan.pdf
29	UK Green Building Council. (2017) Delivering Low Carbon Infrastructure. Available at: https://ukgbc.s3.eu-west-2.amazonaws.com/wp-content/uploads/2017/09/05153000/Delivering-Low-Carbon-Infrastructure.pdf
30	Chatham House. (2018) Making Concrete Change: Innovation in Low-carbon Cement and Concrete. Available at: https://www.chathamhouse.org/sites/default/files/publications/research/2018-06-13-making-concrete-change-cement-lehne-preston.pdf
31	Zap-Map. (2022) EV Charging Statistics 2022. Available at: https://www.zap-map.com/statistics/

Foreword   Executive summary   Our strategic planning approach   Trends shaping the future   Our vision   How we will deliver   Next steps

national highways

References

Reference number	Reference
32	Transport Focus. (2020) Strategic Roads User Survey: Analysis of key drivers of overall satisfaction. Available at: https://d3cez36w5wymxj. cloudfront.net/wp-content/uploads/2021/07/04095324/SRUS-drivers-of-satisfaction-2.pdf
33	Transport Focus. (2022) Transport Focus Data hub. Available at: Transport Focus data hub
34	Transport Focus. (2021) Logistics and Coach Survey: Strategic Roads – 2021-22. Available at: https://d3cez36w5wymxj.cloudfront.net/wp-content/uploads/2022/05/25120723/Transport-Focus-Strategic-Roads-Logistics-and-Coach-Survey-FINAL.pdf
35	C. Scheel, E. Aguiñaga, B. Bello. (2020) Decoupling Economic Development from the Consumption of Finite Resources Using Circular Economy. A Model for Developing Countries. Available at: https://www. mdpi.com/2071-1050/12/4/1291
36	E. Elhacham, L. Ben-Uri, J. Grozovski, W. Bar-On, R. Milo. (2020) Global human-made mass exceeds all living biomass. Available at: https://www. nature.com/articles/s41586-020-3010-5
37	UKRI. (2015) Biodiversity Climate Change Impacts: Report Card 2015 . Available at: https://www.ukri.org/wp-content/uploads/2021/12/101221-NERC-LWEC-BiodiversityClimateChangeImpacts-ReportCard2015-English. pdf
38	House of Commons Environmental Audit Committee. (2021) Biodiversity in the UK: bloom or bust?. Available at: https://committees.parliament.uk/ publications/6498/documents/70656/default/
39	House of Parliament: Parliamentary Office of Science and Technology. (2011) Biodiversity Offsetting. Available at: https://www.parliament.uk/ globalassets/documents/post/postpn_369-biodiversity-offsetting.pdf

Reference number	Reference
40	BBC. (2021) Why noise pollution is bad for your heart. Available at: https:// www.bbc.com/future/article/20210315-why-noise-pollution-is-bad-for-your-heart
41	Department for Environment Food and Rural Affairs. (2019) Clean air strategy 2019. Available at: https://assets.publishing.service.gov.uk/ government/uploads/system/uploads/attachment_data/file/770715/clean-air-strategy-2019.pdf
42	T. Grigoratos, et al. (2018) Experimental investigation of tread wear and particle emission from tyres with different treadwear marking. Available at: Experimental investigation of tread wear and particle emission from tyres with different treadwear marking	Elsevier Enhanced Reader
43	Department for Environment, Food and Rural Affairs. (2020) Impacts of Net Zero pathways on future air quality in the UK. Available at: https://uk-air. defra.gov.uk/assets/documents/reports/cat09/2006240802_Impacts_of_ Net_Zero_pathways_on_future_air_quality_in_the_UK.pdf
44	Met Office. (2021) UK Climate Projections: Headline Findings. Available at: https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/ research/ukcp/ukcp18_headline_findings_v3.pdf
45	Department for Transport. (2021)Transport and Environment Statistics 2021 Annual report. Available at https://assets.publishing.service.gov. uk/government/uploads/system/uploads/attachment_data/file/984685/ transport-and-environment-statistics-2021.pdf
46	Department for Environment, Food and Rural Affairs. (2014) Noise pollution: economic analysis. Available at: https://www.gov.uk/guidance/ noise-pollution-economic-analysis#:~:text=It%20is%20estimated%20 that%20the,%C2%A31%20to%204%20billion

Picture credits

Page	Details
Cover, 4, 5, 6, 7, 9, 10, 12, 15, 51, 52, 53, 54, 55, 65	© National Highways, Illustrations
3	© National Highways, M11, Cambridgeshire
14	© National Highways, M11, Cambridgeshire
17	© National Highways, M27, Hampshire
20	© National Highways, M62, West Yorkshire
24	© National Highways, M621/J7, West Yorkshire
25	© National Highways, A1(M), North Yorkshire
26	© National Highways, A14, M6, Northamptonshire
30	© National Highways, Traffic Officer vehicle
33	© National Highways, M60, Greater Manchester
34	© National Highways, M25, Kent
36	© National Highways, Traffic Officer electrical vehicle
40	© National Highways, Diversion route, Greater Manchester
44	© National Highways, A556, North West
45	© National Highways, Beacon Hill, Leicestershire
47	© National Highways, M6/J6, West Midlands
50	© National Highways, Circuit board