At a glance...

Transport Decarbonisation Strategy

December 2021

TRANSPORT FOR THE NORTH

Contents

This document provides an overview of our Transport Decarbonisation Strategy, available from www.transportforthenorth.com/decarbonisation. The figures and footnotes have been replicated from the full strategy and renumbered for ease of readi within this at a glance document.

Introduction

The science is conclusive - the world is facing a climate emergency.

In the UK, surface transport is the largest contributing sector to greenhouse gas emissions, accounting for 22% of all emissions in 2019[1], of which more than 95% are from road transport.

Furthermore, transport emissions have actually grown overall since 2013, despite modest falls in the last few years[2].

In our Strategic Transport Plan, published in 2019, Transport for the North (TfN) committed to scoping, developing and implementing a 'Pathway to 2050' setting out the challenge of decarbonising surface transport and the need for road transport emissions to be near-zero and rail to be decarbonised by 2050.

We and our partners believe that an acceleration towards a zero-carbon transport network must be at the heart of public policy-making and investment decisions. Our ambition for the North of England is to travel faster and further than national policy and maximise the clean growth opportunities that decarbonisation can provide.

22%
surface transport sector's contribution to total UK emissions in 2019

95%
of surface transport emissions come from road transport

Through our Transport Decarbonisation Strategy, we're committing to a regional near-zero carbon surface transport network by 2045.

To achieve our region's ambitious decarbonisation goal we need a clear understanding of the policies and measures required to bridge the gap between the expected levels of future emissions, and the targets for future emissions. Our strategy lays out the North's minimum expectations for both local and national decarbonisation policy ambitions, and provides a framework for our partners and other organisations across the region to help them meet their decarbonisation responsibilities and ambitions.

[1] This relates to surface transport and does not include emissions from aviation and shipping.
[2] https://www.gov.uk/government/statistics/final-uk-greenhouse-gas-emissions-national-statistics-1990-to-2019

The role of Transport for the North (TfN)

Through its statutory powers, TfN acts as 'one voice' for the North, communicating pan-Northern priorities to the Secretary of State for Transport.

Our vision is of a thriving North of England, where modern transport connections drive sustainable economic growth and support an excellent quality of life.

Our remit is to identify the transport infrastructure required to support transformational economic growth and help our people and businesses realise their ambitions by transforming connectivity. Setting out decarbonisation targets and how we can achieve them is a key part of creating a sustainable transport network fit for the future.

The Decarbonisation Trajectory within our Transport Decarbonisation Strategy provides a tool to robustly benchmark how our Investment Programme (IP) is performing in this respect. A planned programme of assessments will help determine how to sequence those investments and set out the mitigations that may be needed to deliver transformational economic growth in line with decarbonisation ambitions.

While most of the responsibility for policy implementation lies with national and local Government, TfN operates at a geographical and institutional level that allows us to facilitate a regional approach to decarbonisation measures and research – something that has never been done before.

We believe that TfN has an important role to play in achieving transport decarbonisation in the North.

Demonstrating:

Evidence-building, running pilots and collating and sharing best practice.

Facilitating:

Working for consensus, ensuring consistency, co-ordinating cross-sectoral partnerships and teams, as well as representing our partners as a single, strong unified voice in national forums.

Supporting:

Developing regional strategy to support local objectives and provide a basis for effective and co-ordinated influencing of government.

Decarbonisation within TfN

We need to lead by example. While the focus of the strategy is on understanding, measuring and reducing the emissions from surface transport, and from the construction and operation of the proposed schemes within our Investment Programme, it is important that we also look to reduce the organisational emissions resulting from TfN directly as a result of our everyday business.

TfN is committed, by 2022, to understanding the carbon footprint of its organisational emissions and agreeing a target date for reducing these emissions to net-zero. In the following years we will extend this to look at emissions from our supply chain. This will reflect data availability, our environmental goals and the sources we can influence.

TfN's Decarbonisation Trajectory

Our route to a decarbonised transport system is illustrated by a measurable, evidence-based and time-bound carbon emissions reduction curve. This starts with 'where we are now' and travels towards alignment with the objectives of the Paris Agreement, i.e. deep emissions reductions over the coming decades towards a zero-emissions transport system before 2050.

That journey is called our Decarbonisation Trajectory. The shape of the curve is dictated by a series of interim emissions reduction milestones aligned to the Climate Change Committee's Carbon Budgets as a minimum

Our agreed Decarbonisation Trajectory is shown in Figure 1, with the headlines being:

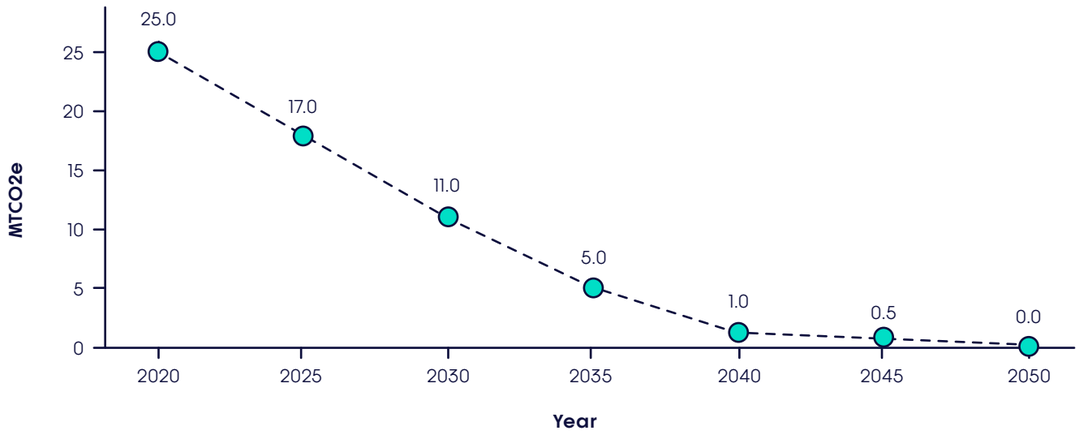
⇒ A 56% reduction in emissions from 2018 to 2030, achieved mostly through mode-shift and demand reduction.

⇒ A 96% reduction in emissions from 2018 to 2040, reflecting longer-term decarbonisation measures, such as a high proportion of zero-emissions vehicles in the vehicle fleet.

⇒ A close to zero date of 2045 for carbon emissions from surface transport in the North. This is a challenging benchmark reflecting the ambition of our partners and their desire to push further and faster than current national policy.

⇒ A total carbon budget of approximately 290 mega-tonnes of CO_2 from 2018 to 2050.

Figure 1: TfN's Decarbonisation Trajectory



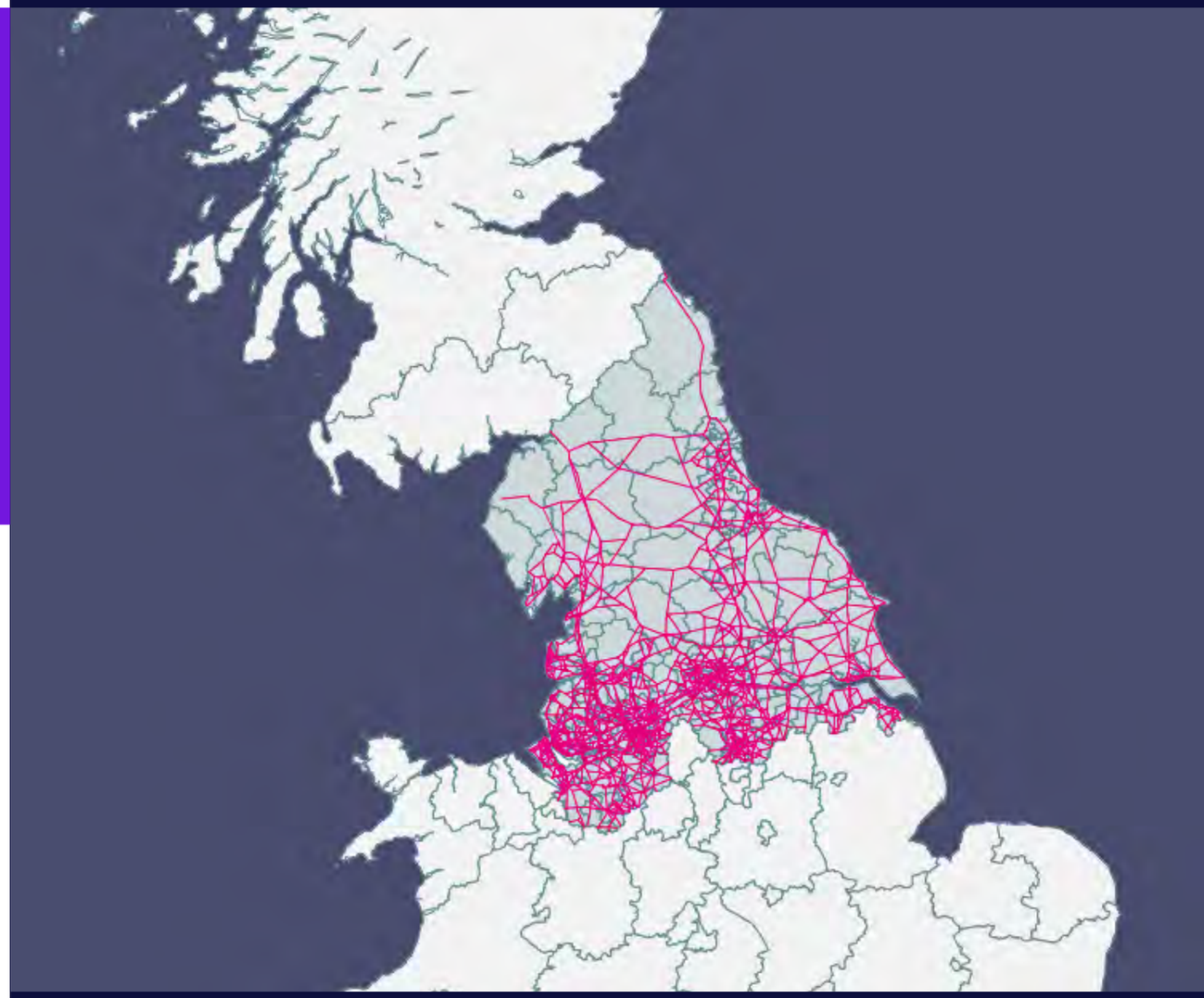
The **interim points** represent an average for the region, with some areas' local transport systems decarbonising more quickly and others more slowly. All will need to make significant progress both prior to 2025 and after. The **end point** means that by 2045, emissions from surface transport in the North will need to be close to zero.

Our Decarbonisation Trajectory comprises emissions from surface transport sources. This includes cars, vans and Heavy Goods Vehicles (HGVs), as well as bus and rail.

Other forms of transport, such as aviation and shipping (both domestic and international), together accounted for 11% of the UK's total emissions in 2019[3]. Although these are not currently included within our current or future emission baselines, TfN is committed, in the near-term, to developing a version of the baseline emission trajectories incorporating these. This will form part of the evidence base for the planned Strategic Transport Plan revision in 2024.

In recognition of TfN's remit, the Decarbonisation Trajectory relates to emissions from vehicle mileage that takes place on the transport network within the North, including through trips (e.g. Scotland to the South of England), as illustrated by the pink roads on the map.

Figure 2: Map of the Northern boundary in which TfN operates. The blue section represents the areas that TfN covers and the pink roads represent the key roads within this boundary



[3] https://www.gov.uk/government/statistics/final-uk-greenhouse-gas-emissions-national-statistics-1990-to-2019

Estimating current and future emissions

We need to understand our current and likely future emissions in the absence of our strategy and action plan, and compare that to our Decarbonisation Trajectory, to understand the level of emissions reductions required. This gap in emissions between where we are now and where we need to get to is called the 'policy gap'.

Current emissions

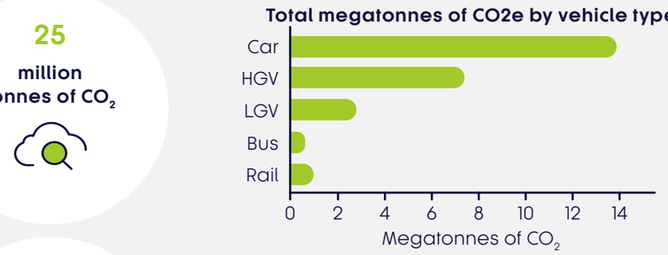
In estimating our current emissions, we developed the Northern Carbon Modelling Tool (NoCarb) taking in historic demand, fleet, and emissions data.

Shown here are the headline figures related to baseline surface transport emissions in the North in 2018.

At 25 mega tonnes of CO2, surface transport emissions in the North represented nearly one-quarter of UK road emissions and 6% of total UK emissions. Over half of those emissions were generated by cars, with HGVs and vans producing 28% and 11% respectively. Bus and rail, on the other hand, represented just 5% of emissions.

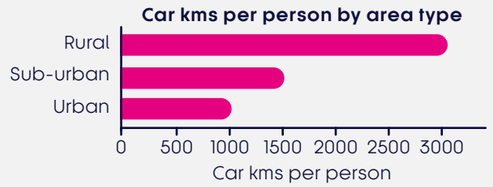
Figure 3: Headline figures related to surface transport emissions in the North in 2018

25
million tonnes of CO_2



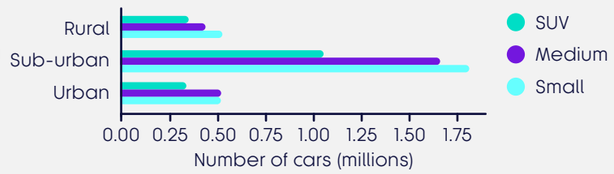
6%
of total UK emissions –
23%
of UK road emissions

126
billion vehicle kms



23%
of vehicle kms in the UK (cars, LGVs and HGVs)

8
million registered cars



23%
of registered cars in the UK

Some 70% of emissions in the North were on the Major and Strategic Road networks, indicating that a high proportion of emissions from private road vehicles is generated by longer distance regional-level trips.

The majority of car emissions in the North related to non-employment related travel, with 67% generated by 'other' travel, 24% generated by commuting, and the remaining 9% by business travel.

Medium and long-distance trips made up the majority of car emissions, with trips over 10 kilometres generating 54% of car emissions. Trips over 50 kilometres, while only representing 1% of car trips, were responsible for 14% of emissions.

Figure 4: Percentage of car emissions in the North by trip purpose

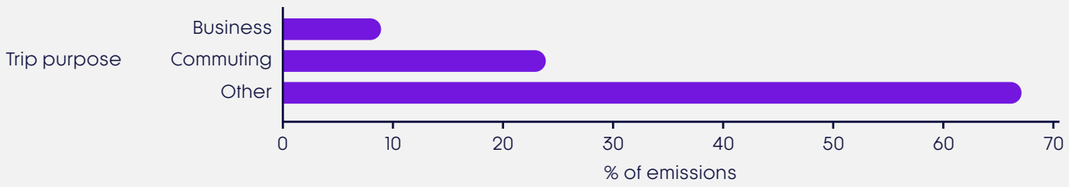


Figure 5: Percentage of car trips by distance

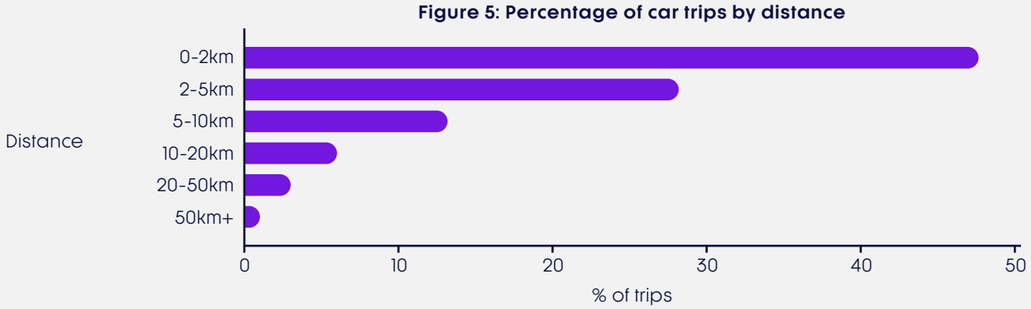
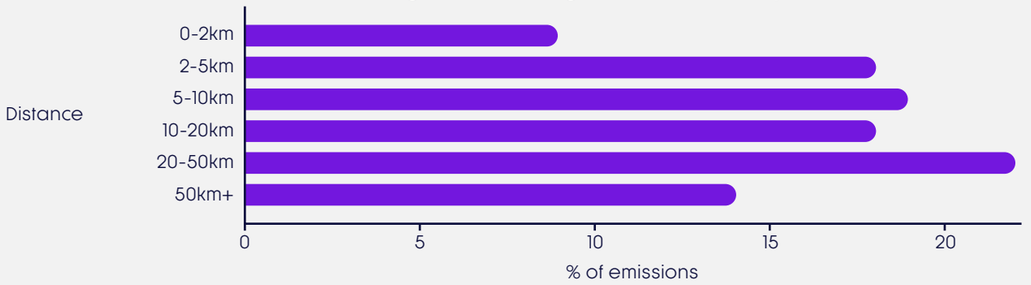


Figure 6: Percentage of car emissions by distance



Future emissions

We estimated future vehicle emissions in the North in the absence of the measures and recommendations made within our strategy. Recognising that we can never be certain about the drivers of travel demand in the future, we utilised our Future Travel Scenarios to explore how trends in society, the economy, and national policy could influence the level and distribution of travel demand in the future[4].

Using the four scenarios helps to futureproof our decision-making as much as possible, making it resilient to wide-ranging and cross-sector uncertainties.

The Future Travel Scenarios were developed in partnership with local authority partners, national delivery partners, and academic experts, and informed by local strategies and priorities. The scenarios represent uncertainty across five external factors:

1. Growth in the population and economy;
2. Spatial planning policy and economic distribution;
3. National policy on environment and sustainability;
4. Technological change and advancement; and
5. Social and behavioural change.

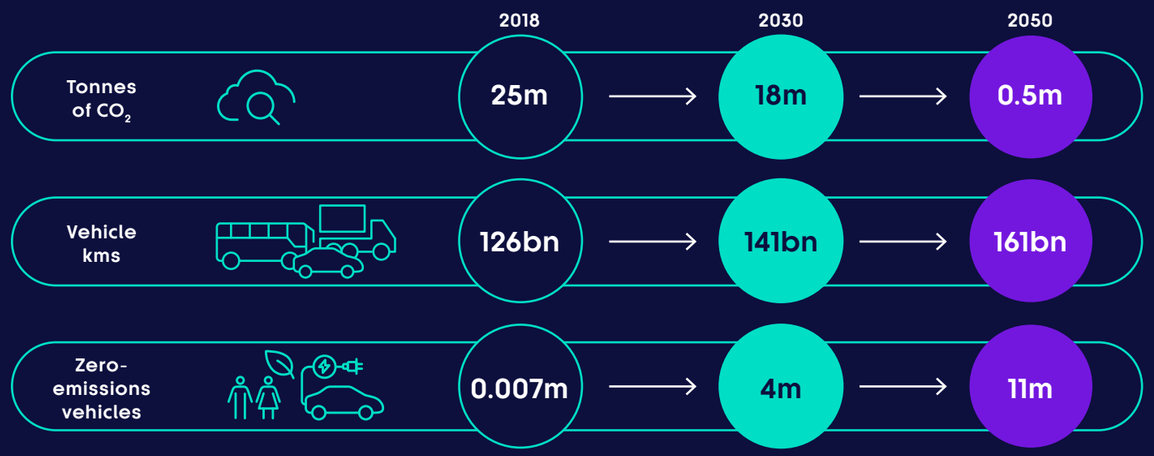
Estimates of kilometres travelled by different vehicle types under each of the scenarios were produced using our travel demand modelling tools, and the NoCarb model was then used to estimate future emissions.

All the scenarios have incorporated existing national decarbonisation policy ambitions as set out in the Government's Transport Decarbonisation Plan.

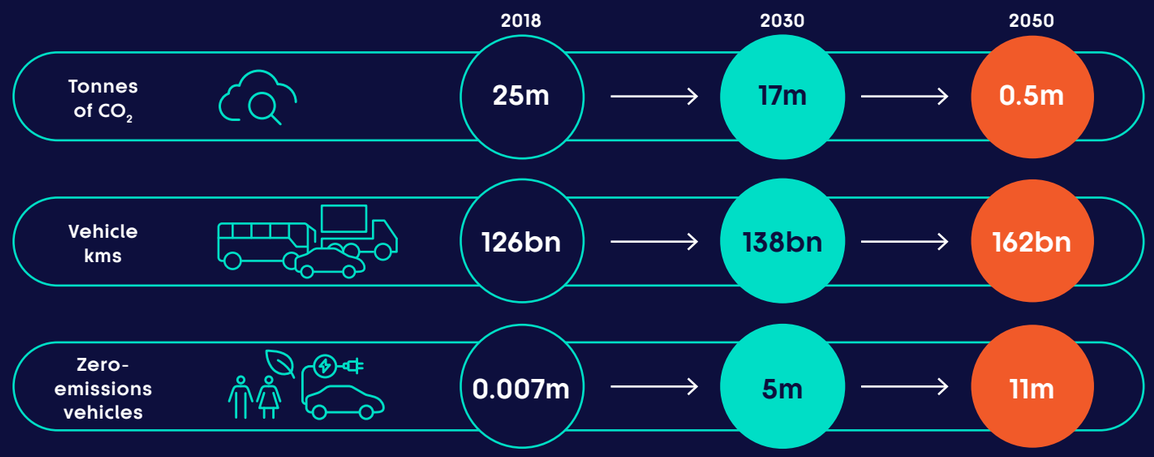
[4]Key national policy changes up to December 2020 are reflected within the Scenarios.

Our four Future Travel Scenarios

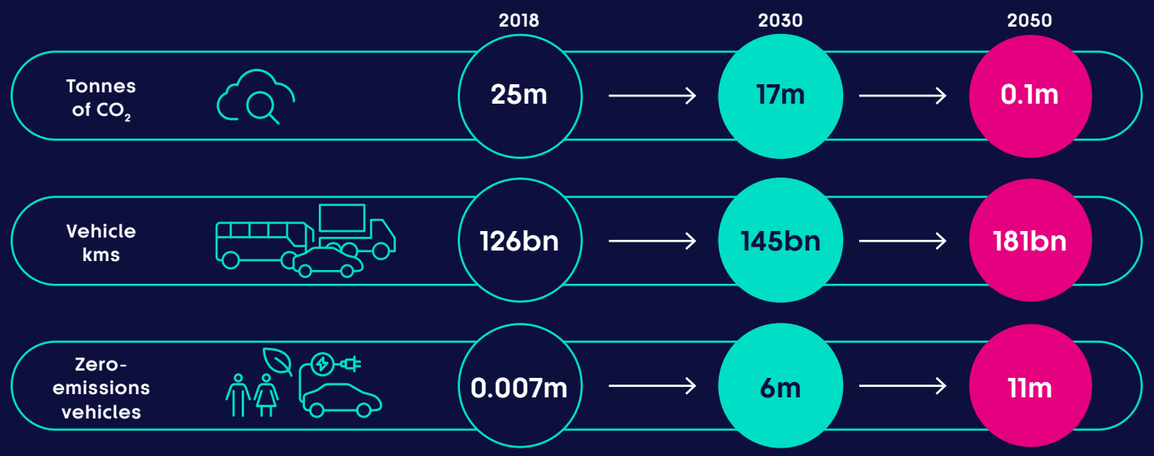
Just About Managing - What if society keeps developing broadly following existing trends? This scenario sees a gradual shift in lifestyles and travel, public and political behaviours do not alter, and we don't give up certain 'luxuries', leaving major developments and change to be shaped by market forces.



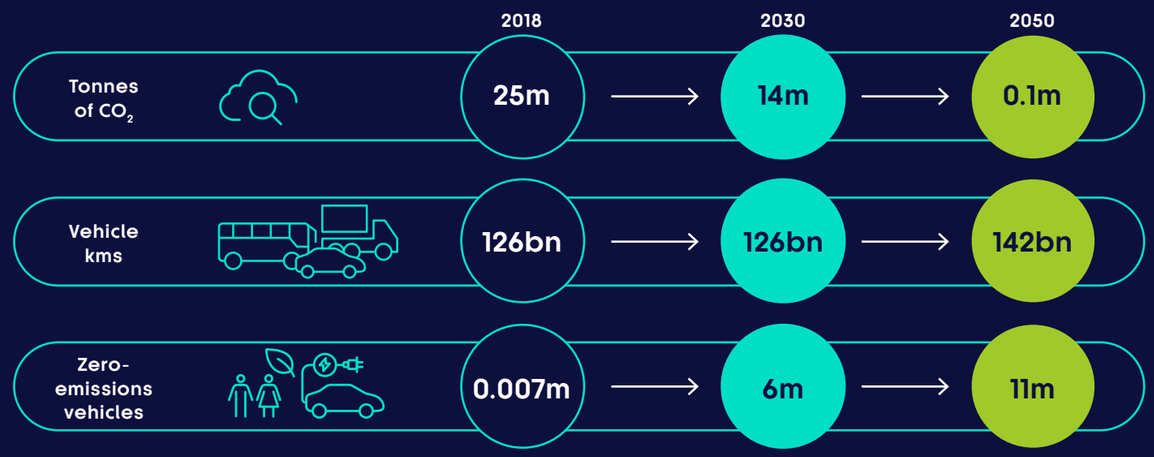
Prioritised Places – What if society becomes focused on quality of life, place-making and community, rather than primarily economic growth? This scenario is led by a change in priorities, with its biggest driver being the push for a fairer redistribution of economic prosperity.



Digitally Distributed – What if Northern Powerhouse ambitions[5] are realised by using technology solutions to create connections and agglomeration across towns and cities? This scenario is led by technology and some policy influence, as we fully embrace technological change, work remotely, and use an accessible service-based transport system with connected and autonomous shared mobility options.



Urban Zero Carbon – What if society achieves Northern Powerhouse ambitions by using policy interventions to maximise energy-efficient city growth and urban densification? This scenario is led by public and political attitudes to climate action and urban place-making, with the biggest drivers being strong Government policy, resulting in fast action on zero-emission transport systems and places, with integrated planning across energy, spatial and other sectors.

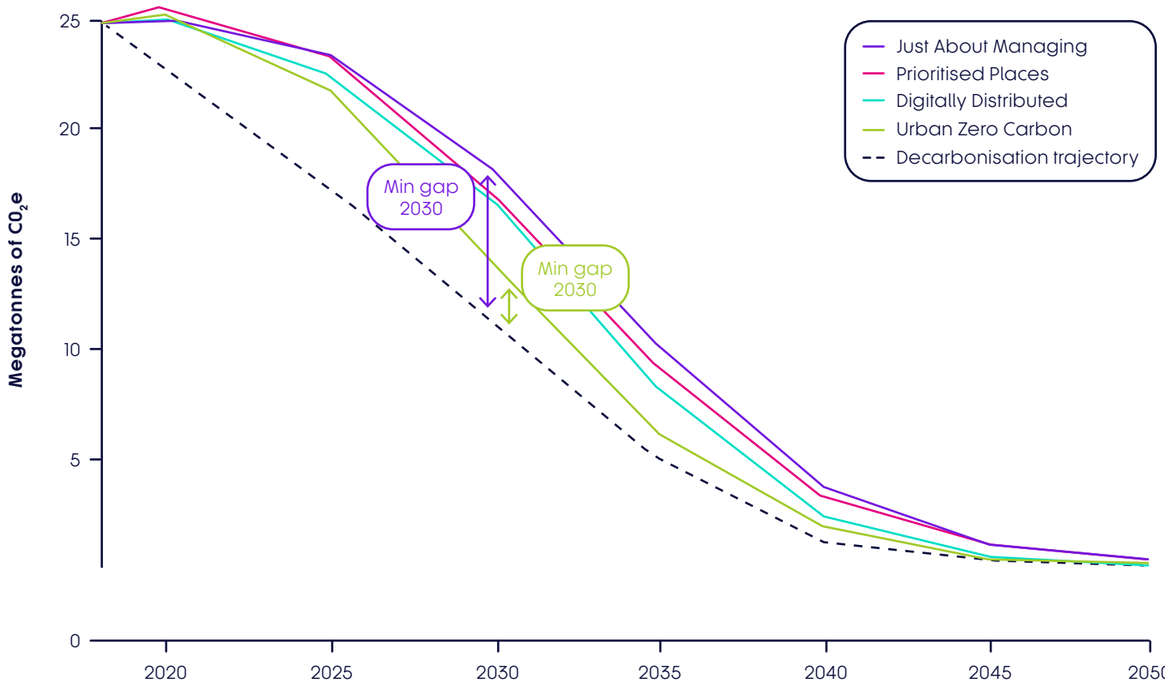


[5]As set out in the Northern Powerhouse Independent Economic Review.

Just About Managing sees the highest emissions overall as public transport use and active travel remains largely unchanged from today's levels and there is a slower uptake of zero-emissions cars and vans in the short-term. Urban Zero Carbon sees the lowest emissions in all years and exceeds the carbon budget by the least.

The graph shows the Decarbonisation Trajectory alongside the four baseline trajectories, with our estimated minimum and maximum scale of the policy gap in 2030 shown as an example.

Figure 7: Total emissions by scenario compated to the Decarbonisation Trajectory



Residual emissions in 2050 across all scenarios are near zero, but all scenarios still significantly exceed the 2018-2050 carbon budget by about 2030, reflecting the critical challenge of embracing alternative technologies in the near future and also the need to start reducing road vehicle mileage immediately.

Decarbonisation Pathways

Bridging the emissions gap between where we're likely to be in the future without increased decarbonisation action (our future emission baselines) and where we need to be to achieve our ambitions (our Decarbonisation Trajectory), will involve a combination of policies and regulations that target vehicle sales, mode-shift, demand reduction, and improved fuel efficiency. As a first step in assessing how the gap can be closed, we have established some broad-brush 'rules of thumb' on the scale of change needed in the vehicle fleet and in road transport demand.

Table 1: Scale of change required (relative to a given year) to reduce emissions in line with the Decarbonisation Trajectory

		2025	2030	2035	2040	2045
Zero-emissions share of sales[6]	Cars	55%	100%	100%	100%	100%
	Vans	40%	100%	100%	100%	100%
	HGVs	26%	44%	95%	100%	100%
BEV high mileage CO_2 reduction[7]	Cars	20%	20%	20%	20%	20%
Public transport CO_2 reduction on baseline	Bus	15%	40%	70%	90%	100%
	Rail	0%	25%	75%	100%	100%
Reduction in distance travelled relative to baseline growth	Cars	1-4%	3-14%	3-14%	3-14%	3-14%
	Vans[8]	5%	10%	10%	10%	10%
	HGVs	3-5%	11-15%	6-15%	6-15%	6-15%
Conventional vehicle efficiency CO_2 reduction[9]	Cars and vans	3.6%	3.6%	3.6%	3.6%	3.6%
	Artic HGVs	22%	22%	22%	22%	22%
	Rigid HGVs	13%	13%	13%	13%	13%
Share of car sales	Large cars[10]	27%	22%	17%	10%	10%

The scale of change identified in this table highlights the decarbonisation challenge which is faced everywhere. The changes shown here are not policies set in stone, but show that rapid action will be required across mode-shift, technological change, and demand reduction on a significant scale.

[6]Apart from public transport CO_2 reductions, all of the measures outlined in this table are relative to the baseline in a given year (i.e. they are not cumulative or related to 2018). For example, the BEV high mileage CO_2 reduction in 2030 relates to emissions that have been projected in 2030 under each scenario.
[7]Rapidly transitioning the most intensively used vehicles in the fleet to battery electric will lead to a relatively larger amount of vehicle miles falling within the BEV segment. We express this as a reduction in CO_2 - in this case, an additional 20% reduction in emissions from cars.
[8]The next stage of analysis will consider scenario-specific variation in van demand. However, it is worth noting that van emissions are notably smaller than cars and HGVs, meaning that a variation in van reduction across scenarios would have a small effect on overall emissions.
[9]Relative to the baseline in a given year. This means that the efficiency measures will have a decreasing effect on absolute emissions as the fleet transitions to ZEV vehicles, where efficiencies will translate to less demand on the electricity grid.
[10]Large cars are defined as a collection of the Euro Car Segments categorisation, which can be found here: https://en.wikipedia.org/wiki/Euro_Car_Segment. This is used to allow a mapping to the categorisation used in COPERT for speed-emission curves. While these measures seek to target conventional vehicles in the short-term, smaller electric vehicles also support reduced demand for electricity in the medium and long-term.

Policy analysis

The decarbonisation commitment identified in our Decarbonisation Pathways will only be achieved through robust policies from both national government and local authorities, and by progressing actions 'on the ground'.

Policies and actions are grouped into three themes:

1. Modal shift and demand management
2. Zero Emission Vehicles (ZEVs)
3. Improvements to conventional vehicle efficiency

Each theme is accompanied by an evidence-led high-level summary of policies and actions to help achieve the commitment, as well as proposals on the distribution of responsibility.

It's important to note that the measures identified for consideration at a local level are intended as guidance for our partners, to help them consider the most effective mix of measures and actions applicable to their individual places. We recognise that local policy makers are best placed to understand what will and won't work for the communities within their own areas.

Modal shift and demand management

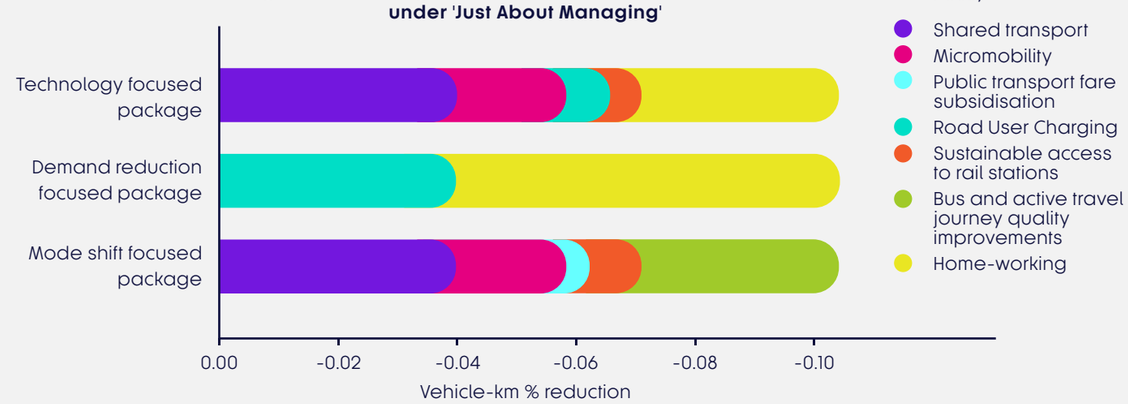
As it will take time for new ZEVs sales to translate into a substantial proportion of the fleet, it is essential to shift journeys away from private cars to sustainable modes and find ways to avoid journeys.

In the long term, as the fleet becomes predominantly electrified, even if running on energy generated through renewable sources, a ZEV will still have a significant carbon footprint through the emissions embodied in its manufacture.

Travel demand reduction also provides a range of other co-benefits, even with a predominantly electrified fleet, such as improving local air quality and safety, reducing congestion, and avoiding potential transport-related social exclusion issues. A shift to active travel also has the potential to improve peoples' physical and mental wellbeing.

This analysis shows that significant policy changes will be required. Choices are available to policy makers who prefer different types of intervention, but leaving out any particular policy lever will require more radical policies in other areas. Our view is that a balanced approach that implements policies in all areas will be most likely to succeed.

Figure 8: Achieving a 10% reduction in car demand in 2030 under 'Just About Managing'



To achieve reductions in vehicle mileage, significant behavioural change is needed – we must move from a culture focused on personal car use to one that embraces shared mobility and active travel – and a comprehensive set of policies and supporting infrastructure are required to facilitate this. Our recommendations are categorised into five key areas:

1. Encouraging mode shift to walking, cycling, micro-mobility34 and public transport
2. Disincentivising car use and avoiding unnecessary travel
3. Encouraging the uptake of shared mobility
4. Improving freight efficiency
3. Ensuring transport and land-use planning processes encourage sustainable choices

Zero Emission Vehicles (ZEVs)

As long as vehicles use fossil fuels, it will not be possible to achieve near-zero emissions in the North's surface transport network. The typical life of a car is around 15 years, with some lasting longer in the fleet, meaning it will take roughly this long for ZEVs to tip the balance and deliver the emissions reductions required to meet decarbonisation targets. It is therefore critical to introduce policies that will rapidly increase ZEV uptake as soon as possible.

Our strategy sets outs policies to meet the ambitious sales share targets proposed within our pathways, covering:

1. Cars and vans
2. Heavy Goods Vehicles (HGVs)
3. Rail
4. Buses

ZEV policy in action: In Sweden, an increase in EV usage can be traced to the government's recently adjusted incentive scheme that sees a tax increase for vehicles with high emissions. In addition, cars with low CO_2 emissions can receive up to €5,700 as a grant.

In Sweden, cars with low CO_2 emissions can receive a grant up to €5,700

Improvements to conventional vehicle efficiency

In the Sixth Carbon Budget, the Climate Change Committee (CCC) set out several measures that can reduce emissions from internal combustion engine (ICE) vehicles.

Enforcing speed limits and eco-driving could reduce car and van emissions by 3.6%. Additionally, large cars now make up nearly one-third of new car sales in the North. As emissions intensity for these vehicles is higher than smaller cars, there is an opportunity to reduce emissions by discouraging the purchase of large ICE vehicles in the short-term. This can be achieved through changes to taxation on new vehicles, such as Vehicle Excise Duty, which the Government is considering restructuring to increase the upfront costs on the most polluting vehicles[11].

More fuel-efficient driving can also support CO2 reductions in HGVs. Alongside more aerodynamic designs and retrofitting of drag reduction devices, these measures can offer efficiency savings up to 13% for rigid HGVs and 22% for articulated HGVs.

Our analysis suggests these measures must be taken up to maximum effect from 2025.

The full list of recommendations on modal shift and demand management, Zero Emission Vehicles, and improvements to conventional vehicle efficiency, are set out within our strategy and Annex A (Detailed Policy Recommendations) – available at transportforthenorth.com/decarbonisation.

[11] https://www.gov.uk/government/publications/vehicle-excise-duty-call-for-evidence

Co-benefits and potential adverse consequences

Whilst measures that decarbonise transport will help to reduce the level of climate change and the effects of global warming on both our global and local environment, it is important to understand how those measures might affect our local environment and local communities in other ways. The co-benefits and also potential adverse consequences of these measures are important considerations when developing the policy mix and timescales relevant to the different place typologies in the North. Some of the key policy areas leading to wider effects include:

Low Emission Vehicle uptake:

- ⇒ Local air quality effects both beneficial and adverse
- ⇒ Lower operating costs for users
- ⇒ Trade and investment opportunities.
- ⇒ Labour market opportunities in relation to manufacture and installation of electrification infrastructure
- ⇒ Perpetuating congestion
- ⇒ Potential to increase TRSE in low income areas and areas of low home charging potential
- ⇒ Impacts upon public realm
- ⇒ Local grid capacity

Modal shift and demand management:

- ⇒ Reduced congestion
- ⇒ Local air quality benefits
- ⇒ Reduced TRSE in low income areas and areas low home charging potentials.
- ⇒ Improvements in physical and mental health
- ⇒ Increased spending in local neighbourhoods
- ⇒ Home working could shift emissions to different sectors
- ⇒ Impacts upon viability and productivity of city and town centres

Further detail in relation to all these potential wider effects are contained within the full strategy document.

Transport-related social exclusion (TRSE) and distributional impacts

The use of cars by lower income groups is often driven by accessibility and affordability challenges:

- ⇒ The need to travel to work 'out of hour' shifts (e.g. cleaners, post office workers, warehouse workers).
- ⇒ Due to disabilities that mean using shared modes of transport or active modes is not possible.
- ⇒ Those who live or work in areas of low public transport accessibility, which can be exacerbated by the correlation between high access and high house prices.
- ⇒ Public transport costs for some journeys can be prohibitive and therefore private car travel offers a cost-effective alternative.

For these groups, demand management measures that increase the cost and decrease the convenience of car use could result in increased levels of TRSE. Similarly, the higher purchase price of ZEVs may mean that policies to increase the speed of uptake may lead to uneven distributional impacts on lower income groups who are least able to afford them.

Public transport and shared transport modes can be essential for groups who have no access to private vehicles for financial or accessibility reasons (for example, those living in flats or terraced housing with no parking facilities). Whilst these groups may benefit from polices to enhance public transport provision; policies to encourage the uptake of ZEVs have the potential to impact upon public transport provision (e.g. use of bus lanes by ZEVs and other shared modes, increased congestion in low emission zones).

It will be important that policy makers at a local and national level understand and take actions to mitigate the risk of adverse consequences arising as a result of decarbonisation policy and measures.

Examining the relationship between transport-related social exclusion and transport decarbonisation measures is the subject of one of TfN's priority actions to 2025.

Assessing TfN's Investment Programme

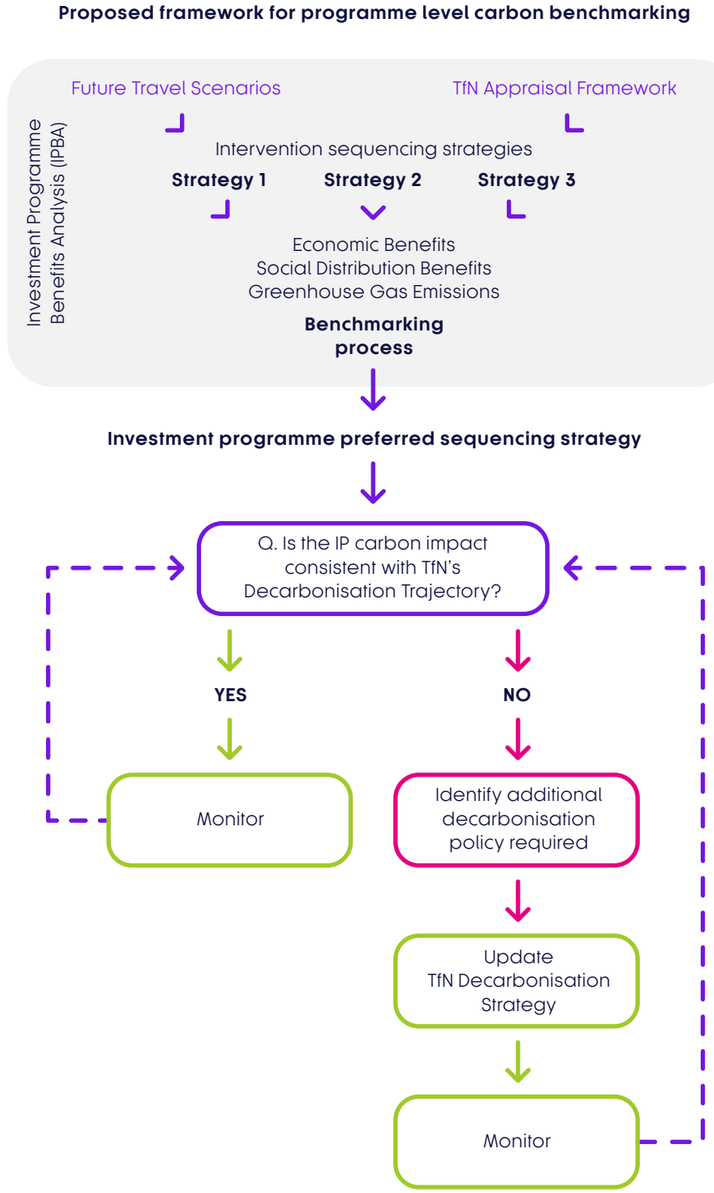
Establishing our future emission baselines in relation to our agreed Decarbonisation Trajectory is essential in helping us identify the level of additional local and national policy commitment required. At a strategic level, we also need to understand how our Investment Programme (IP) affects the future projected emissions from surface transport in the North.

Changes to surface transport emissions generated in the North as a result of the schemes contained within our IP will be modelled as part of the Investment Programme Benefits Analysis, to be concluded in 2022. Any increase or reduction in emissions will be layered on top of our baseline emission trajectories, so that we understand the ramifications for the policy gap.

Resulting changes to the policy gap will provide an insight into the local and national decarbonisation policy commitment required at different points in the future to allow the schemes to be delivered within the parameters of our Decarbonisation Trajectory. Ultimately, we will be asking the question: "What needs to be true, if the North is to effectively decarbonise its surface transport as well as enjoy the significant connectivity, economic and environmental benefits that our IP will deliver?"

If it is not possible to reduce the carbon impacts of our IP through reasonable increases to decarbonisation policy commitments, to a level that is consistent with our Decarbonisation Trajectory, the recommended delivery of certain projects within the IP may need to be re-sequenced in consultation with our partners. For example, a particular road project may be re-scheduled to a point when the majority of additional traffic generated is by Zero Emission Vehicles.

Figure 6: Framework for assessing TFN's Investment Programme against TfN's Decarbonisation Trajectory



Consideration of embodied carbon

The 'embodied carbon' component of a project refers to the emissions of greenhouse gases arising from:

- ⇒ Sourcing and extracting the raw materials needed to build the project
- ⇒ The energy needed to process those raw materials in construction components (i.e. the manufacturing stage)
- ⇒ Transporting the building materials
- ⇒ The construction activities themselves, from construction plant, through to worker accommodation and transport

Every infrastructure development will use embodied carbon. For example, the embodied emissions associated with a new road might include the emissions associated with sourcing and processing raw materials, transport of materials, and the construction of the road itself, while the operational emissions would include those generated by the vehicles that end up using the scheme throughout its operational life (including maintenance related emissions).

The accounting principles for carbon mean that embodied emissions from constructing transport projects do not count as 'transport emissions' but as part of industrial emissions. It is also difficult to robustly calculate the likely embodied carbon footprint of major infrastructure developments at a conceptual level of design or when the scheduled design and construction of the infrastructure is many years or decades in the future.

Equally, it can be problematic to forecast the extent to which embodied carbon may be reduced on future schemes through careful design, responsible sourcing of construction materials, and innovative construction techniques.

For these reasons, the consideration of embodied carbon is outside of the scope of our trajectory and pathways, however, it is not outside the scope of the strategy. TfN is clear on the significance of embodied carbon in the North's future transport system and across the projects that make up TfN's Investment Programme.

The Rail Safety and Standards Board (RSSB) estimates that in the reporting year 2019/2020, the UK rail industry generates approx. 3.5 million ktCO_2e in relation to traction energy (i.e. operational emissions) but that its embodied carbon emissions are closer to 5.2 million ktCO_2e - 48% higher[12].

[12]RSSB DECARB: Carbon Measurements (T1197) https://www.rssb.co.uk/en/research-catalogue/CatalogueItem/T1197

What we are doing at a strategic level

We want to better understand the level of emissions likely to be generated by the construction of schemes included in our Investment Programme (IP), and also explore how we can start reducing that profile at the earliest point.

As part of our proposed actions we will undertake a strategic embodied carbon footprint study of schemes in our IP scheduled for delivery up to 2033. This will provide a benchmark of the potential maximum and minimum embodied carbon footprints of the schemes, allowing us to better understand the potential implications on the North's carbon budget for surface transport.

What we are doing at a project level

We will set a supply chain carbon reduction target for each TfN-led major infrastructure project. To do this we will:

- ⇒ Embed the consideration of embodied carbon within our upstream project appraisal processes.
- ⇒ Support the development of an embodied carbon database for major transport infrastructure development.
- ⇒ Set a supply chain carbon baseline for each TfN-led project.
- ⇒ Use a Carbon Management Process (PAS 2080[13]).
- ⇒ Optimise opportunities for carbon sequestration.

Climate change adaptation and resilience

Changes to global climate, as a result of the release of carbon dioxide and other greenhouse gases into the atmosphere, are already happening and are visible through the increased prevalence of heatwaves, floods, droughts and fires.

Less visible effects, but equally as worrying, include damage to marine ecosystems leading to fisheries failing, sea level rise, increased risk to water supplies, and a rise in global food insecurity, as well as an unprecedented loss of biodiversity.

Although we can't be certain of what our future climate will be in the North of England, it's important that we understand the potential changes that may occur within the limits of uncertainty, how these changes might affect the viability of our transport systems, and how our transport infrastructure might exacerbate or reduce the effects of climate change on our communities.

While climate change mitigation, the main focus of our strategy, refers to measures that reduce greenhouse gas emissions, climate change adaptation measures are those that reduce or avoid the potential for harm caused by a changing climate, as well as those measures that seek to exploit the potential opportunities presented. There are a wide range of adaptation measures related to transport infrastructure, from flood risk management and heatwave planning, through to increasing the resilience of active modes and the adoption of green and blue infrastructure.

[13] PAS2080:2016 – Carbon Management in Infrastructure

Figure 30: Key risks to infrastructure from climate change[14]

[14] Source: UK Climate Change Risk Assessment https://www.theccc.org.uk/uk-climate-change-risk-assessment-2017/

Co-benefits of climate change adaptation

The benefits of developing climate change adaptation measures, particularly nature-based solutions, often have wider impacts than just increased resilience to climate change effects. If planned and delivered in the right way, potential co-benefits include:

- ⇒ Ecological enhancements
- ⇒ Flood and coastal resilience
- ⇒ Improved water quality
- ⇒ Improved air quality
- ⇒ Improved physical and mental human health
- ⇒ Reduced need for mechanical cooling
- ⇒ Increased uptake of active travel
- ⇒ Creation of green jobs

How we are increasing the resilience of our projects

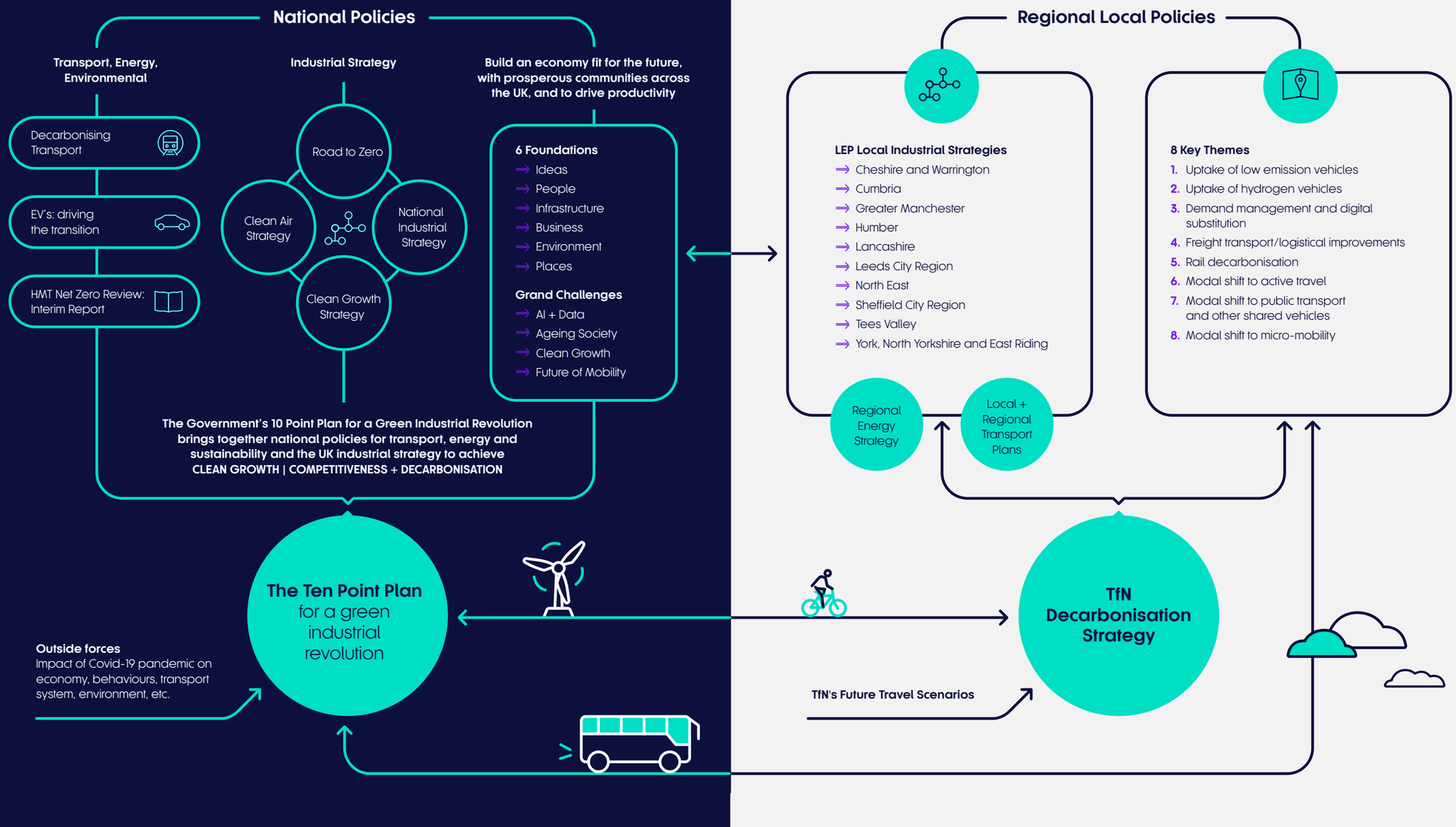
By undertaking a Climate Risk Assessment, we are able to identify and assess the climate change risks for our major transport infrastructure programmes and for any other projects with elements that could be affected by the weather and effects of climate change.

We will undertake a Climate Risk Assessment for all TfN-led major infrastructure projects. By doing this we will be able to:

- ⇒ Refine early designs to improve resilience to future climate change
- ⇒ Incorporate climate scenarios within our appraisal of costs and benefits
- ⇒ Identify no or low-regret adaption actions
- ⇒ Develop adaptive management processes that allow a project to adapt to changing risk over time, given the high uncertainty over the future impacts of climate change
- ⇒ Prioritise green infrastructure solutions which can deliver a wide range of co-benefits

Stimulating clean growth in the North

Figure 32: Clean Growth Policy Framework



While the ultimate aim of transport decarbonisation is to limit and eventually eliminate greenhouse gas emissions as a result of our travel, the potential opportunities in terms of driving economic growth and social value are significant.

It is important to understand the opportunities for transformational economic growth that can be driven by the decarbonisation of transport itself. Economic growth that is achieved at the same time as cutting greenhouse gas emissions is often referred to as 'clean growth'.

We have explored the existing clean growth opportunities and initiatives already identified by our Local Enterprise Partnership (LEP) partners and other business/industrial groupings to understand how TfN could support these opportunities and initiatives, as well as any opportunities that remain relatively unexplored, and which of these exhibit the greatest potential for the North.

Our Clean Growth Opportunity Summary Matrix explains the eight priority Clean Growth Actions identified during the preparation of our strategy.

All identified potential Clean Growth Actions have moderate to strong potential to stimulate growth in either jobs or skills within our region. The strongest actions are likely to be those in relation to expediting the effective development of ZEV charging infrastructure and increased uptake of ZEVs in the region, and in doing so, demonstrating significant regional demand to the supply chain.

Figure 34: Clean Growth Opportunity Summary Matrix

Definition: Socio-Economic Factors

Jobs	Potential to support job growth directly through design, manufacturing and construction opportunities, and also in the wider job market by improving connectivity and resilience.
Skills	Potential to increase the skills base within our communities and the demand for skilled labour to support business growth and new mobility infrastructure.
Health	Potential to improve the health and wellbeing of our communities.

Definition: Impact

Strong	Strong potential to deliver socio-economic benefits of jobs, skills and health. Policy is very likely to induce private sector investment and support a high level of job creation in innovative and future industries, requiring an increased level of skilled workers. Strong potential to support the health agenda, encouraging an active lifestyle, and reducing pollution.
Medium	Those opportunities where there is a more modest potential to deliver socio-economic targets of jobs, skills and health, or where the potential is strong but uncertainty is high. Some potential to support the health agenda, encouraging an active lifestyle, and reducing pollution.
Low	Weaker potential to deliver socio-economic targets of jobs, skills or health. Policy may not have strong outcomes in all three socio-economic areas, or, only over the long-term horizon.

Clean Growth Actions	Potential for Beneficial Socio-Economic Impact			Justification
	Jobs	Skills	Health	
Action 1: Develop a regional EV charging framework	Strong	Strong	Low	Effective ZEV infrastructure resulting in higher ZEV uptake leading to a stronger supply chain. Jobs and skills benefits from the manufacture and installation of infrastructure and investment in the region from OEMs. Health benefits less clear due to risks associated with increased uptake of private vehicles and persistent local air quality emissions along with potential to exacerbate TRSE.
Action 2: Supporting local partners in the development of local EV charging infrastructure	Strong	Strong	Medium	Effective ZEV infrastructure resulting in higher ZEV uptake leading to a stronger supply chain. Jobs and skills benefits from the manufacture and installation of infrastructure and investment in the region from OEMs. Provision of data in relation to distributional impacts and transport related social exclusion may help obviate potential health impacts.

There is also significant economic growth potential in proving a market for hydrogen fuels for first-mile freight journeys, however, there is also a greater level of uncertainty around these outcomes which is related to the relative immaturity of technology in this area.

Stronger, 'all-round' performers include actions around supporting demand management and modal shift, which may see increased health benefits and more potential to simulate growth in a more equitable way. All eight of the identified potential Clean Growth Actions are incorporated within TfN's priority activities to 2025.

Clean Growth Actions	Potential for Beneficial Socio-Economic Impact			Justification
	Jobs	Skills	Health	
Action 3: Undertake or support a pan-northern hydrogen transport refuelling study	Medium	Medium	Medium	The hydrogen economy presents significant opportunities for jobs and growth in the North and developing a market in hydrogen for transport would further stimulate this. Medium ratings reflect a significant uncertainty that persists around the viability of hydrogen as a fuel relative to other technologies.
Action 4: Supply chain support for future hydrogen infrastructure solutions	Medium	Medium	Medium	The hydrogen economy presents significant opportunities for jobs and growth in the North and developing a market in hydrogen for transport would further stimulate this. Medium ratings reflect a significant uncertainty that persists around the viability of hydrogen as a fuel relative to other technologies.
Action 5: Developing Clean Mobility Visions for the North	Medium	Low	Strong	This activity in itself is unlikely to lead to direct significant growth in jobs and skills, however, a shift away from private vehicle use and any uptake in active travel is likely to lead to health and wellbeing benefits. A more effective, integrated and comprehensive public/ shared/ active transport system is ultimately likely to be a more equitable transport system, allowing a broader spectrum of our communities to access more jobs.
Action 6: Supporting local partners in the development of mobility hubs	Medium	Medium	Medium	Mobility hubs may principally encourage healthier and greener mobility choices, improving air quality and tackling TRSE. Dependent on location and integration into spatial planning, they also provide an opportunity to accelerate commercial regeneration and localisation concepts.
Action 7: Developing and supporting partnerships to consider zero carbon, port-to-port freight corridors	Strong	Medium	Medium	Using the strong connection between out ports, airports and intermodal terminals to both stimulate the transition to clean fuels and create substantial economic investment opportunities in our ports and their hinterlands. The use of hydrogen as a fuel for first mile journeys, would stimulate the maximum opportunity for our region, however, significant uncertainties persist around the viability of hydrogen as a fuel relative to other technologies.
Action 8: Supporting our partners to attract testing and pilots of new low emission train technologies	Strong	Medium	Low	Given the existing strong rail manufacturing base in the North, it is well placed to deliver the materials needed to decarbonise railways/locomotives. Health benefits are relatively low next to other actions given the limited portion of air quality / carbon emissions generated from existing railways.

TfN's Priority Decarbonisation Actions

Our policy analysis work has revealed those areas of policy through which the most challenging emissions reductions must be achieved. These provide a focus for our proposed research, data and evidence-building activities in the short-term to 2025. Specific activities generated by this analysis are signposted as 'Policy Gap Actions' (PGAs).

Alongside the policy analysis, our exploration of activities which can provide the greatest potential for clean, green growth in the North has identified eight 'Clean Growth Actions' (CGAs).

Finally, a number of additional activities have been identified as priorities and refined through engagement with our partners, industry, research networks such as DecarboN8, and other Sub-national Transport Bodies, and these are highlighted as 'Stakeholder Driven Actions' (SDAs).

Taken together, these represent TfN's proposed Priority Decarbonisation Actions.

Given the enormity of the decarbonisation challenge and the risks associated with failing to achieve what is needed, the majority of activities around decarbonisation would justifiably be classed as 'high priority'. TfN's proposed Priority Actions are those activities which we believe need to happen in the short-term (up to 2025) and that are most effectively delivered at a pan-Northern level.

This table defines TfN's proposed Priority Decarbonisation Actions by policy area.

The public consultation provided insights on the priorities from different groups of stakeholders on different activities, and their views on the most appropriate role for TfN in relation to those activities. Further details can be found in TfN's Decarbonisation Strategy: Consultation Analysis Report, available at transportforthenorth.com/decarbonisation. These stakeholder priorities are noted in the table.

Table 8: TfN's proposed Priority Decarbonisation Actions by policy area

Policy Area	TfN Role	TfN Decarbonisation Action	Scope	Timeframe
Decarbonisation Strategy	Leading	**Stakeholder Priority - SD1:** Regional route-map for transport decarbonisation.	Disaggregating baseline emissions for a number of place typologies that typify the North. Assessing against a regional trajectory to develop place-specific policy baskets and to understand the optimum timing and resource use profiles for each typology, in order to achieve regional decarbonisation.	Pre-2025
	Supporting	**Stakeholder Priority - SD2:** Developing place-based decarbonisation pathways for rural typologies.	Similar to the work proposed under the 'regional route-map' action, although focused predominantly on the challenges and opportunities of decarbonising rural transport systems. Includes development of appropriate policy baskets.	Pre-2025
	Leading	**SD3:** Formation of decarbonisation working group/s with TfN partners.	Working groups to help scope and guide the implementation of the Decarbonisation Strategy. This may take the form of one dedicated working group or a number of project specific steering panels.	Pre-2025
	Leading and Supporting	**Stakeholder Priority - SD4:** Exploring the relationship between transport decarbonisation and transport-related social exclusion (TRSE) (inclusive of PGA11).	Understanding the geography of TRSE in the North and the potential effects on TRSE, by place, of different transport decarbonisation policy measures.	Pre-2025
	Supporting	**SD5:** Research into embodied carbon analysis for strategic transport infrastructure programmes.	Partnering with research bodies to investigate the requirements and feasibility of carrying out embodied carbon assessments of strategic multimodal transport infrastructure corridor proposals. We shall use a selection of schemes from TfN's existing Strategic Development Corridors for this task.	Pre-2025
	Leading	**SD6:** Programmatic assessment of Investment Programme (IP) against TfN's Decarbonisation Trajectory.	Assessment of modelled emissions as a result of TfN's IP Intervention Sequencing Strategy, against TfN's Decarbonisation Trajectory to identify any additional decarbonisation policy required and potential adjustments to the IP.	Pre-2025
	Leading and Supporting	**SD7:** Consideration of emissions from aviation and shipping generated by the North.	Calculating the North's contribution to UK aviation and shipping emissions, and inclusion of this within our future emissions baselines. Analysis of national policy measures to reduce aviation and shipping emissions to consider how TfN and its partners can support these policies, as well consideration of additional local measures and further focused TfN activities.	Pre-2025

Table 8: TfN's proposed Priority Decarbonisation Actions by policy area

Policy Area	TfN Role	TfN Decarbonisation Action	Scope	Timeframe
Electric Vehicles and Fuel Efficiency	Leading	**Stakeholder Priority – CGA1:** Develop a regional ZEV charging framework (inclusive of PGA1).	Identifying those facets of a low carbon charging system that are best approached at a pan-Northern level, including coverage of the Major Road Network (MRN), consistency and interoperability of technology and payment systems, procurement principles, future proofing and consideration of future grid requirements.	Pre-2025
	Supporting	**CGA2:** Supporting local partners in the development of local ZEV charging infrastructure.	Supporting local partners in the development of local ZEV infrastructure charging plans and the pursual of funding opportunities, through the provision of data and evidence.	Pre-2025
	Supporting	**Stakeholder Priority - PGA14:** Increase awareness of fuel-efficient driving styles.	Through the policy positions we adopt and our communication and engagement activities, work with partners to increase public awareness of fuel-efficient driving styles and the associated environmental and financial benefits.	Continuous
Hydrogen	Supporting	**Stakeholder Priority - SCGA3:** Support a pan-northern hydrogen transport refuelling study.	Using modelled HGV demand across the MRN, as well as potential interfaces with the rail, aviation and shipping networks, to identify strategic locations for investment in hydrogen refuelling depots/stations and storage facilities.	Pre-2025
	Supporting	**CGA4:** Supply chain support for future hydrogen infrastructure solutions.	Engaging with emerging hydrogen partnerships in the North to support the development of a viable business case for hydrogen for first mile freight applications and provide confidence to the supply chain.	Continuous

Policy Area	TfN Role	TfN Decarbonisation Action	Scope	Timeframe
Demand Management	Supporting	**SD8:** Supporting the development of scalable digital solutions for incentivising greener, shared and active mobility in rural areas.	Supporting partners, through provision of evidence and data, in understanding the key requirements of an effective rural MaaS system.	Continuous
	Leading and Supporting	**Stakeholder Priority - CGA5:** Developing Clean Mobility Visions for the North	Developing compelling visions highlighting the advantages of reduced car usage, active travel, micro-mobility and public transport in creating 'Liveable Places' across the various geographies of the North. Underpinning this work with a robust evidence base and baskets of relevant policy measures.	Pre-2025
	Supporting	**CGA6:** Supporting local partners in the development of Mobility Hubs.	Provision of data and evidence to facilitate analysis into potential locations for mobility hubs, in both rural and urban areas, and to access funding sources.	Pre-2025
	Supporting	**PGA10:** Consider the role of micro-mobility/shared mobility in the first and last mile journeys at train stations.	Use our role within the Rail North Partnership to facilitate a consideration of how shared mobility, including cycle hire and e-scooter schemes, can be encouraged for first and last mile journeys at train stations.	Pre-2025
	Leading	**Stakeholder Priority - PGA8:** Develop schemes and infrastructure to improve the regional public transport network, e.g. Northern Powerhouse Rail.	Develop and implement comprehensive plans for the regional public transport network, such as Northern Powerhouse Rail and wider improvements to the rail network.	Continuous (and beyond 2025)
	Supporting	**PGA9:** Research on the effects of home-working upon productivity and agglomeration.	Continue to an evidence base on the extent to which less work-related travel has a detrimental effect on productivity and agglomeration to understand whether home-working can be consistent with TfN's vision for a transformed Northern economy.	Pre-2025

Table 8: TfN's proposed Priority Decarbonisation Actions by policy area

Policy Area	TfN Role	TfN Decarbonisation Action	Scope	Timeframe
Freight	Supporting	**Stakeholder Priority - SD9:** Low carbon urban freight scenarios.	Research on appropriate place-based, low carbon, urban freight (last-mile) solutions in the North.	Pre-2025
	Leading and Supporting	**Stakeholder Priority - CGA7:** Developing and supporting partnerships to consider zero carbon, port to port freight corridors.	Exploring the potential for our partners (ports, local authorities and delivery authorities) to work together to deliver effective 'port to port', multi-modal, hydrogen and/or electric refuelling corridors across our region. Many of these corridors are identified within the Strategic Development Corridors defined within TfN's Strategic Transport Plan.	Pre-2025
	Supporting	**PGA2:** Facilitating large ZEV truck trials in the North.	Work with local authority partners and Highways England to facilitate large ZEV truck trials in high traffic corridors in the North.	Continuous
	Supporting	**PGA3:** Support partners to aggregate large orders of ZEV vans, truck and buses across the North.	Current ZEV production will not meet the demand required to hit our targets. By helping to aggregate demand from stakeholders across the North, significant numbers of vehicles would be drawn to the region and would signal to manufacturers that the regional demand is present.	Continuous
	Supporting	**PGA12:** Supporting freight information democratisation schemes.	Working with and influencing government to support information democratisation schemes that make the latest information on the best efficiency schemes and technology available to everyone.	Continuous
Rail	Supporting	**Stakeholder Priority - CGA8:** Supporting our partners to attract testing and pilots of new low emission train technologies (inclusive of PGA6).	Work with partners, Network Rail and Train Operating Companies (TOCs) to bid for the testing and trialling of new low emission train technologies in the region.	Continuous
	Leading and Supporting	**Stakeholder Priority - PGA4:** Identify appropriate routes for electrification.	Support the Government and Network Rail, utilising the NPR project, in identifying appropriate routes for electrification and associated implementation.	Pre-2025
	Supporting	**Stakeholder Priority - PGA5:** Work with Train Operating Companies (TOCs) and Freight Operating Companies (FOCs) to exploit operational efficiency opportunities (inclusive of PGA7).	Work with train operating companies to: a. Revise service patterns based around the progression of electrification to minimise the use of diesel-only trains before they are phased out; b. Optimise timetables to maximise benefits of frequency and reduce flighting of services; c. Work with freight and train operating companies and Network Rail to ensure there is sufficient capacity to allow freight traffic to run directly and with minimal dwell times, reducing emissions from existing diesels.	Continuous
Project-level Carbon	Supporting	**SD10:** Support the development of an embodied carbon database for major infrastructure developments.	Supporting the development of an embodied carbon database to assist partners in baselining embodied carbon for major infrastructure development projects in a consistent and robust way. This will include consideration of recent work by Network Rail and RSSB in this area.	Pre-2025
	Supporting	**PGA13:** Influence government to seek augmented DFT appraisal guidance.	Influence government to seek augmented DfT appraisal guidance on how to better include for the impacts of transport projects on carbon, air quality and urban realm, and the full environmental impacts of cars.	Continuous
	Leading	**Stakeholder Priority - SD13:** Undertake a strategic embodied carbon footprint study of those schemes included within our Investment Programme (IP) scheduled for delivery up to 2033.	Leading a carbon footprint exercise to understand the potential minimum and maximum range of embodied carbon from schemes where sufficient data exists and uncertainty is manageable. Understanding the implications for achieving TfN's Decarbonisation Trajectory.	Pre-2025
Awareness Raising and Behaviour Change	Leading and Supporting	**Stakeholder Priority – SD11:** Engagement and awareness-raising activities.	To be defined alongside partners, to understand what activities might be best undertaken at a pan-Northern level. Building on, and learning from, existing initiatives like the Leeds Climate Citizens Jury and the Lancaster district People's Jury, e.g. Leeds Act Together.	Continuous
	Supporting	**SD12:** Behaviour change research.	Development of a research depository and gap analysis to understand areas for further research effort.	Pre-2025
	Supporting	**Stakeholder Priority - SD14:** Work with LEPs to directly support SMEs in their green transitions.	To work with LEPs and local authorities to consider how we can more directly support SMEs to both adopt and take advantage of the opportunities from, the transition to clean green transport.	Pre-2025

The role of Sub-National Transport Bodies (STBs)

The government's Transport Decarbonisation Plan proposes a clear role for Sub-national Transport Bodies (STBs) to turn national priorities into actionable plans for their region and support the Government's decarbonisation objectives by ensuring a coherent approach across local authority borders[15]. A key component of this work will be supporting our partners in the preparation of their Local Transport Plans.

TfN has been building a useful repository of data and evidence in recent years, including research studies into the North's visitor economy, transport-related social exclusion, and user insight surveys. In addition, our Analytical Framework and carbon modelling tool have the potential to provide the data needed for our partners to derive, measure and monitor both the targets and quantifiable reductions required of them. It is our intention to build on this existing evidence base, for use by our partners, through many of the activities proposed within the strategy.

[15]Decarbonising transport: a better, greener Britain (July 2021), pg. 152

Internal assurance, monitoring and evaluation

Through our internal policy framework, we will consider the carbon implications of all our projects and programmes at their inception, to ensure we understand the implications and, where appropriate, take actions to mitigate the impacts.

Where proposals are in relation to infrastructure development, or the procurement of supply chain services, they will also need to align with TfN's targets in relation to reducing supply chain and construction carbon.

Rigorous monitoring and evaluation processes will ensure that progress towards TfN's decarbonisation commitments is clearly measured, that reductions in carbon can be attributed to specific causes, and that any unforeseen consequences of this are properly analysed.

TfN is currently developing a Monitoring and Evaluation (M&E) Strategy and Framework, which is scheduled for completion in early 2022. This will include a set of indicators that will allow us to understand the North's progress in terms of the decarbonisation of our surface transport and allow us to benchmark this progress against our Decarbonisation Trajectory.

Additionally, the strategy commits to the measurement of a number of additional indicators designed to understand the success of the specific measures and actions committed to within the strategy.

It will be important to take stock before each milestone along our Decarbonisation Trajectory, the next being in 2025, to allow us to adjust our focus and strengthen our approach where needed.

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