Strategic Transport Plan Evidence Base

Initial Carbon Analysis

Executive Summary

Transport for the North (TfN) is seeking to enable transformational economic growth in the North of England. We are committed to doing this in a sustainable manner in line with relevant UK obligations and legislation.

A number of scenarios have previously been produced to forecast travel demand for this transformational growth. Some of these scenarios show slightly higher demand and some a slightly lower demand in the North of England, in comparison to a Department for Transport (DfT) reference case.

As part of TfN's commitment to best practice, a preliminary analysis of the impact of this additional demand on carbon emissions has been undertaken, using a number of scenarios representing different levels of emissions mitigation.

Due to relatively small differences in demand under DfT and TfN scenarios, it is changes in vehicle technology and ongoing decarbonisation of the energy supply that has the most significant impact on carbon emissions. Under all DfT and TfN demand scenarios, annual carbon emissions are reduced by around 90% by 2050 in a 'high mitigation' scenario, or around 75% in a 'low mitigation' scenario. The impact of the different TfN demand scenarios on cumulative total emissions over the time period is smaller, ranging between a no change to a 4% increase in emissions compared to the refence case.

TfN is supportive of realising levels of emission reduction in line with the central and high mitigation scenarios set out here and minimising any environmental impacts of any increases in transport demand brought about by transforming the north's economy.

Further analysis will be undertaken to refine our understanding of the impact of TfN's proposals on carbon emissions in more detail and with more accuracy.

Introduction

Transport for the North (TfN) published its Final Strategic Transport Plan in February 2019. The STP establishes a framework for how it plans to develop its programmes, and those undertaken by Delivery Partners, including a number of principles for embedding social, economic and environmental elements within business case and intervention delivery. The framework in the STP and these principles were subject to an independent Integrated Sustainability Appraisal (ISA), developed in parallel, to ensure the STP is complying with all its statutory requirements.

This initial analysis sets out to understand the impact of the STP travel demand scenarios on carbon emissions, under different scenarios. It seeks, on a preliminary, high level basis, to go beyond the requirements of the ISA as part of TfN's commitment to best practice, and is intended to start the work towards developing a Pathway to 2050, as set out in the STP.

Objectives

This analysis aims to answer the following questions.

- By how much will TfN's travel demand scenarios increase in-year and cumulative emissions of CO2 relative to a reference case scenario?
- How will three emissions mitigation policy scenarios affect these emissions?
- What are the areas for further work?

Background

The STP is the North's first multi-modal transport strategy, covering a range of strategic interventions across the road and rail networks out to 2050. Given that around 98% of surface transport CO2 emissions are currently from road transport[1], the analysis presented here is largely focussed on road. Based on current Government targets, we have used the assumption that emissions from rail are reduced to zero by 2040 in all scenarios. The STP makes a commitment to support this target.

The STP is underpinned by scenarios of future travel demand in the North of England. These scenarios were produced by Steer (formerly SDG) for TfN using the Northern Transport Demand Model (NTDM). Some modelling assumptions are common to all of the scenarios:

- The level and distribution of population and employment growth envisaged in the Northern Powerhouse Independent Economic Review
- The implementation of TfN-sponsored interventions in road, rail and integrated travel.

Other modelling assumptions differ across the scenarios:

- Enabling Policy & Plans: The level of synergy of local transport plans and policies with wider connectivity across the North; and
- Technological & Socio-Cultural Change: The effect of the evolution of technology on socio-cultural attitudes towards travel and digital connectivity.

By considering opposite ends of these two dimensions, four travel demand scenarios have been considered:

- Compact & Digital
- Compact & Travel Friendly
- Dispersed & Digital
- Dispersed & Travel Friendly

[1] UK local authority and regional carbon dioxide emissions national statistics: 2005-2013, available at https://www.gov.uk/government/statistics/uk-local-authority-and-regional-carbon-dioxide-emissions-national-statistics-2005-2013

Table 1 compares the four TfN scenarios to DfT National Road Traffic Forecasts (NRTF)[2], indicating that they are within the range of the lower and upper projection. Note that for TfN scenarios, growth in van traffic is taken from NRTF and growth in heavy goods vehicle (HGV) traffic is taken from analysis carried out for TfN by MDS Transmodal, derived from the Great Britain Freight Model.

Table 1: Benchmarking against NRTF (DfT, 2018). Extrapolates DfT forecasts from 2040 to 2050 assuming growth continues at the same rate.

Scenario	**Growth in total road transport demand in vehicle-km (2015 – 2050)**
DfT NRTF 1 (Central growth, central travel propensity)	35%
DfT NRTF 3 (Central growth, low travel propensity)	17%
DfT NRTF 5 (High growth, high travel propensity)	43%
TfN 1: Compact & Digital	23%
TfN 2: Compact & Travel Friendly	46%
TfN 3: Dispersed & Digital	24%
TfN 4: Dispersed & Travel Friendly	49%

The update to NRTF published in 2018 show lower levels of forecast demand than the NRTF published in 2015, in part because the macroeconomic forecasts on which demand projections are based were revised down significantly in March 2018. The impact of these revised macroeconomic projections on TfN demand scenarios will be considered as part of the forthcoming refresh of the Independent Economic Review.

NRTF Scenario 1 is used for the purposes of Government emissions projections, both by the Department for Business Energy and Industrial Strategy (BEIS) and the Committee on Climate Change (CCC), the Government's independent advisors on climate change targets. For this reason, we have chosen to use NRTF Scenario 1 as the transport demand projection underpinning our 'reference case' emissions projection.

In 2017, the Government published its Clean Growth Strategy[3], which sets out a series of policies and proposals to meet the UK's legislated emission reduction targets. This was followed by the 'Road To Zero' Strategy[4] in 2018, which provided further detail on how the Government plans to reduce emissions from vehicles. In particular, these strategies make a significant commitment to increase the use of Electric Vehicles (EVs), including a proposed phase-out of the sale of fossil fuelled cars and vans by 2040.

National Road Traffic Forecasts, DfT (2018), available at: https://www.gov.uk/government/publications/road-traffic-forecasts-2018

Clean Growth Strategy, BEIS (2017), available at: https://www.gov.uk/government/publications/clean-growth-strategy

Road To Zero, DfT (2018), available at: https://www.gov.uk/government/publications/reducing-emissions-from-road-transport-road-to-zero-strategy

Where possible, we have drawn our assumptions on the future makeup of the vehicle fleet from scenarios in these strategies to align with the latest national position on tackling climate change.

We have also aligned our assumptions and scenarios to the scenarios of the transport sector set out in the CCC's most recent report[5] on meeting the fifth carbon budget (a legislated national emissions cap for the period 2028-2032). These scenarios are designed such that they are on an achievable and cost-effective path to the UK's overall 2050 emission reduction target.

The next section sets out the methodology and assumptions used to estimate future carbon emissions.

Methodology

TfN has developed a simple spreadsheet model to estimate emissions from road and rail transport in the North of England. This section describes each of the underlying assumptions and calculation elements underlying this model.

- Vehicle fleet: The model represents the vehicle fleet in the North using the following vehicle characteristics:
- Vehicle types: The model splits vehicles into three broad categories, cars, vans and HGVs.
- Powertrain types: Cars and vans can either be Internal Combustion Engine (ICE) or Battery Electric Vehicle (BEV). For the purposes of this calculation we assume HGVs can only be ICE. For simplicity, neither Plug-in Hybrid Electric Vehicles (PHEVs) nor Fuel Cell Electric Vehicles (FCEVs) are considered here, but this could be included as part of further work.
- Fleet age profile: Based on UK vehicle licensing statistics for cars, vans and HGVs.
- Baseline vehicle efficiency projections: Baseline assumptions are drawn from DfT's WebTAG data book, split by vehicle type and powertrain.
- Powertrain and efficiency assumptions: Our vehicle powertrain and efficiency assumptions are summarised in the table below, for three mitigation scenarios (sources provided in the text below):

Fifth Carbon Budget, CCC (2015), available at: https://www.theccc.org.uk/publication/the-fifth-carbon-budget-the-next-step-towards-a-low-carbon-economy/

Scenario	EV cars and vans (% of new sales)		EV HGVs (% of new sales)		EV Buses	ICE efficiency gain by 2050			
	2030	2040	2030	2040	2030	Car	Van	HGV	Bus
Low mitigation	40%	100%	0%	0%	100%	24%	13%	15%	15%
Central mitigation	60%	100%	10%	25%	100%	37%	33%	24%	24%
High mitigation	65%	100%	15%	50%	100%	44%	40%	24%	24%

These assumptions have been sourced from:

- Car van and HGV efficiency scenarios are based on the following:
  - Low mitigation scenario assumptions are based on the DfT's central scenarios for vehicle efficiency taken from the WebTAG data book6. These scenarios are based on the likely trend under existing vehicle taxation and regulation regimes.
  - The central and high mitigation scenarios are based on central and high scenarios from the CCC's fifth carbon budget transport analysis6.
- EV car and van scenarios are based directly on scenarios from the CCC's fifth carbon budget transport analysis6. The main inconsistency is that the CCC's scenario includes a mixture of PHEVs and BEVS, whereas this analysis assumes all EVs are BEVs, meaning higher levels of emission reduction that in the CCC scenarios.
- EV HGV scenarios are loosely based on scenarios from the CCC's fifth carbon budget transport analysis6. The CCC specifies uptake of EVs by different sized HGVs, with uptake mostly for smaller HGVs. As our analysis only includes a single category of HGVs, we have scaled down these uptake percentages accordingly. We will consider disaggregating HGVs into size categories in future analysis.
- EV bus scenarios have a consistent level of ambition, to allow the realisation of a zero emission public transport network by 2050, consistent with the aims of TfN and those of many of its partners.
- Transport demand: The total vehicle-km travelled in each year is taken from the SDG NTDM scenarios outlined above. As this is only available for 2050, interpolation has been undertaken for intermediate years assuming constant Compound Annual Growth Rate (CAGR). As noted above, we also consider DfT's NRTF Scenario 1 as a reference case.
- Electricity grid CO2 intensity: As a sensitivity, we have estimated the indirect emissions from EVs. We assume the CO2 intensity falls from the outturn value of 286 gCO2/kWh in 2016 to 100 gCO2/kWh in 2030

[6] WebTAG databook (2018), available at https://www.gov.uk/government/publications/tag-data-book

and to 50 gCO2/kWh by 2050 (broadly in line with the most conservative scenarios publish by the CCC[7]).

- CO2 emissions: The total CO2 emissions (direct and indirect) in each year are then calculated by multiplying the fleet-average gCO2/km by the total vehicle-km.

Assumptions

It is our assessment that the central and high mitigation scenarios are plausible the following reasons:

- The Government's 2040 ICE ban is significantly later than similar bans announced by some other counties, such as Norway (2025), the Netherlands (2025) and India (2030), which suggests that there is potential for a global transition to EVs to happen sooner than 2040.
- Despite not featuring significantly in Government scenarios, electric HGVs are already available for purchase in operation in a range of freight applications[8,9]; and
- Under most CCC scenarios, power sector emissions will need to be close to zero to meet the UK's 2050 target. It is also worth noting that the STP seeks to directly support low carbon energy production, and this is something that might be further quantified.

These emissions reduction projections could also be considered to be on the conservative side, as there are a number of other factors not yet considered:

- There is potential for some of the economic activity driving these additional emissions to be displaced from the rest of the UK, for example in the movement of passengers and freight to international gateways, such that the net national impact on UK domestic emissions could be smaller than the figures presented above; and
- The STP and other TfN policies programmes may in and of themselves contribute to reduced carbon emissions. For example, the STP includes an objective relating to more efficient use of the network such as through higher vehicle occupancy.

It should be noted that the 'low mitigation' scenario is simply an analytical device to illustrate the potential 'high end' impact of TfN scenarios on carbon emissions. These conservative assumptions do not reflect TfN's position on the overall level of decarbonisation the transport sector will need to achieve by 2050. It is TfN's position that the transport sector will need to make an appropriate contribution to meeting the UK's 2050 target, based on the

[7] Fifth Carbon Budget, CCC (2015), available at: https://www.theccc.org.uk/publication/the-fifth-carbon-budget-the-next-step-towards-a-low-carbon-economy/

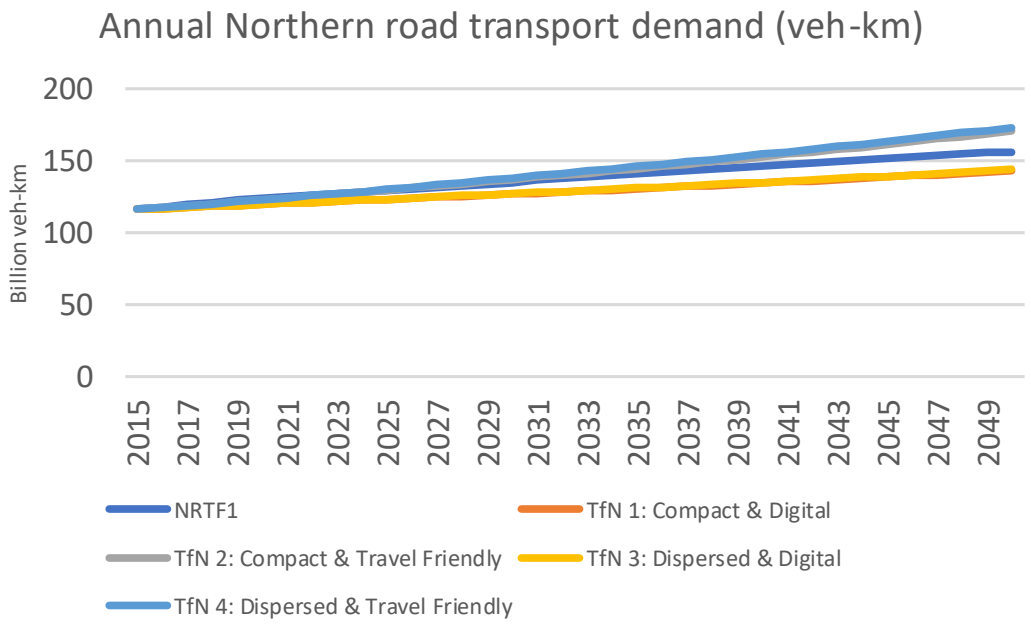
[8] https://www.smmt.co.uk/2018/09/royal-mail-electric-fleet-debuts/

[9] https://www.bloomberg.com/news/articles/2018-09-05/electric-trucks-could-save-europe-11-billion-barrels-of-oil

relative costs and feasibility of reducing emissions across all sectors of the economy.

Results

This section summarises the results from the modelling methodology outlined above. Figure 1 shows the total transport demand in the North from 2015 to 2050 across the DfT reference case and four TfN scenarios considered.



As set out in Table 1, the two TfN 'Travel Friendly' scenarios have slightly higher travel demand than NRTF1, whereas the two 'Digital' scenarios have lower travel demand.

In the three mitigation scenarios and across the four TfN demand scenarios, total direct emissions fall by around:

- 73-74% between 1990 and 2050 in the low mitigation scenario;
- 82-83% between 1990 and 2050 in the central mitigation scenario; and
- 87% between 1990 and 2050 in the high mitigation scenario.

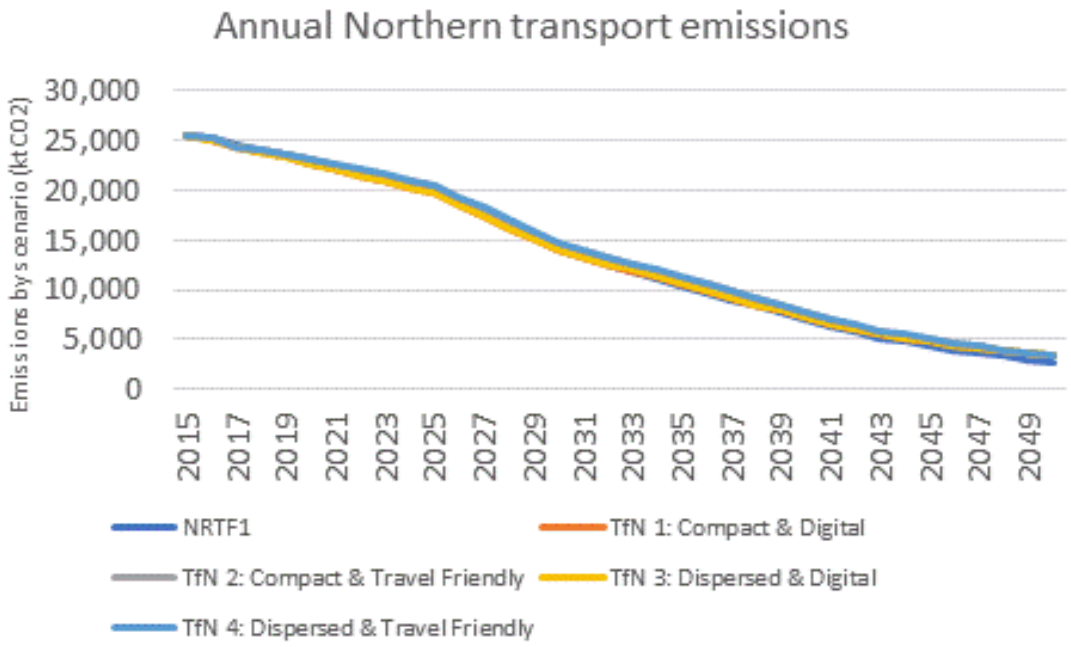
In the three mitigation scenarios for the NRTF 1 scenario, total emissions (direct and indirect) fall by:

- 78% between 1990 and 2050 in the low mitigation scenario;
- 86% between 1990 and 2050 in the central mitigation scenario; and
- 89% between 1990 and 2050 in the high mitigation scenario.

This illustrates that TfN demand scenarios do not substantially increase emissions over and above a Government 'business as usual' demand scenario and are consistent with meeting the UK's 2050 emission reduction target if a central or high mitigation scenario can be achieved.

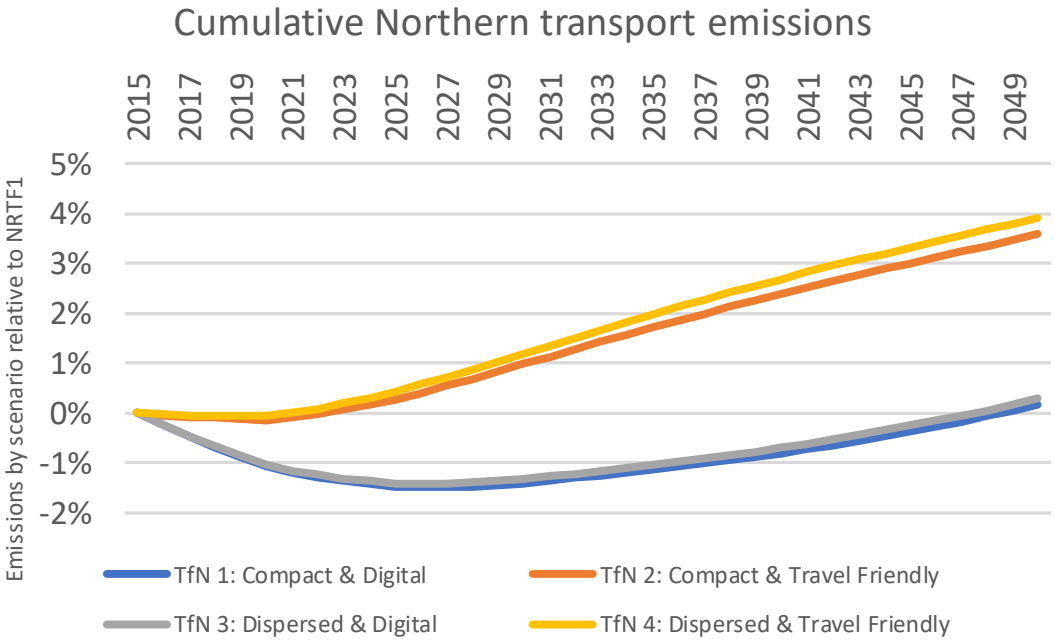
Although the CCC counts indirect emissions from electric vehicles in the power sector, as a sensitivity, we have tested the impact of counting these emissions in the transport sector. For the TfN scenarios, total emissions fall by 78-79% in the central mitigation scenario, compared to 82-83% for direct emissions.

Figure 2 shows the annual total road and rail transport CO2 emissions in the North from 2015 to 2050 under the high mitigation scenario and across the five demand scenarios considered, relative to 2015.



In the "Travel Friendly" scenarios the impact of cumulative emissions over the period is around a 4% increase relative to the NRTF scenario, while the "Digital" scenarios show a negligible impact.

Figure 3 shows the cumulative total road and rail transport CO2 emissions from 2015 to 2050 across the four TfN scenarios, relative to the NRTF reference case. This figure shows the high mitigation scenario, but the result holds across all mitigation scenarios.



As well as comparing to the 2050 target, we have also compared to the levels of emission reduction set out in the CCC's fifth carbon budget. The CCC scenarios suggest that transport sector emissions need to fall by 33-52%, with a central estimate of 45%, between 1990 and 203010. Under TfN demand scenarios we estimate an equivalent reduction of 20-46%, with a central estimate of 40%. Although this range is generally lower than the CCC's, there is sufficient overlap to suggest that the path to meeting the 2050 target is achievable under TfN demand scenarios.

Conclusions

The report has set out a high-level analysis of the impact of TfN travel demand on carbon emissions between 2015 and 2050 (and 1990 to 2050, for the purposes of comparing to the UK's 2050 target). The main conclusions are:

- only the TfN 'Travel Friendly' scenarios have higher levels of demand in 2050 than the reference case scenario taken from DfT's National Road Traffic Forecasts;
- even under these higher demand scenarios, a significant emission reduction of around 87% is achievable by 2050, compared to an equivalent of 89% under the slightly lower DfT demand projection;
- given that the higher levels of demand in the TfN scenarios occur closer to 2050, when the vehicle fleet has a very low emissions intensity, the impact on cumulative emissions between 2015 and 2050 is relatively low, between 0% and 4% increase; and

Exhibits from the fifth carbon budget (2015), available at https://www.theccc.org.uk/publication/sectoral-scenarios-for-the-fifth-carbon-budget-technical-report/chapter-5-transport-exhibits/

- TfN is supportive of realising levels of emission reduction in line with the central and high mitigation scenarios set out here and minimising any environmental impacts of any increases in transport demand brought about by transforming the north's economy.

Further work

Further carbon analysis work to define the 'Pathway to 2050' will consider:

- Development of an estimate of 1990 baseline emissions for the North to enable comparison with appropriate national carbon budget reductions.
- Definition of scenarios to explore linkages between potential policies and interventions, scenario parameters and strategic outcomes. Direct consideration of modal split will form a strong focus of this approach, in particular active and public transport versus other road transport and consideration of rail and other non-road modes.
- Further detailed modelling of travel demand over time and across different parts of the North.
- Development of an enhanced approach to modelling scenarios/options, which is strategic outcomes-led and focused on definition, evaluation and programming of policy/intervention/package options designed to deliver strategic outcomes over the STP programme to 2050.
- Refinement of the model to include consideration of the range of low and zero emission road vehicles other than electric vehicles, covering all vehicle types.
- Refinement of the model to consider a wider range of technologies and emission reduction measures, such as plug-in hybrid electric vehicles, biofuels and technologies that promote smoother driving.
- Modelling of emissions of local air pollutants.
- The impact of a number of policy assumptions, such as more efficient use of the network, displacement of emissions from elsewhere in the UK and low carbon energy production, directly enabled by the Strategic Transport Plan.