

# Tactran

## Transport Carbon Assessment

Stage 1 Report  
November 2012

ATKINS

Plan Design Enable

# Notice

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# Table of contents

Chapter	pages
<b>1. Introduction</b>	<b>6</b>
1.1. Climate Change (Scotland) Act and related policies	6
1.2. Climate Change Delivery Plan	6
1.3. Report on Proposals and Policies (RPP)	7
1.4. Public bodies' duty on climate change	9
1.5. Mitigating Tactran's impact on climate change	10
1.6. This report	10
<b>2. Baseline carbon forecasts</b>	<b>11</b>
2.1. Scenarios	11
2.2. 'Do Minimum' scenario	11
2.3. 'CCC Carbon Budget Recommendations' scenario	17
<b>3. Mitigating transport sector emissions</b>	<b>22</b>
3.1. Developing mitigation targets for the transport sector	22
3.2. Current actions to reduce transport sector emissions	24
3.3. Potential interventions to further reduce transport sector emissions	26
<b>4. Next steps</b>	<b>31</b>

## Tables

Table 1.1 – RPP1 transport sector policies and proposals .....	7
Table 2.1 – “Do Minimum” assumptions.....	11
Table 2.2 – “Do Minimum” transport carbon emissions estimates – Tactran and Tayplan areas (MtCO <sub>2</sub> p.a.) .....	13
Table 2.3 – “CCC Carbon Budget Recommendations” scenario assumptions .....	17
Table 2.4 – EV and plug-in hybrid uptake in Scotland, % of vehicle fleet.....	17
Table 2.5 – “CCC Carbon Budget Recommendations” scenario transport carbon emissions estimates – Tactran and Tayplan areas (MtCO <sub>2</sub> p.a.) .....	18
Table 3.1 – Current Activities Addressing CO <sub>2</sub> emissions from Transport.....	25
Table A.1 – Comparison of 2007 road transport CO <sub>2</sub> forecasts, DECC and study model, MtCO <sub>2</sub> p.a. ....	33

## Figures

Figure 1.1 – Climate Change Act targets for Scotland .....	6
Figure 1.2 – Abatement potential in the non-traded sector in 2020, from policies and proposals by sector ....	8
Figure 1.3 – A step by step approach for public bodies to climate change action .....	9
Figure 2.1 – Estimated Traffic Growth from 2007 by Area (TMfS Scenario A) .....	12
Figure 2.2 - Indicative “Do Minimum” trajectory – Tactran area.....	15
Figure 2.3 - Indicative “Do Minimum” trajectory – Tayplan area .....	15
Figure 2.4 - Indicative breakdown of “Do Minimum” emissions by District/area – Tactran area.....	16
Figure 2.5 - Indicative breakdown of “Do Minimum” emissions by District/area – Tayplan area .....	16
Figure 2.6 - Indicative “CCC Carbon Budget Recommendations” scenario trajectory – Tactran area .....	19
Figure 2.7 - Indicative “CCC Carbon Budget Recommendations” scenario trajectory – Tayplan area .....	19
Figure 2.8 - Indicative breakdown of “CCC Carbon Budget Recommendations” scenario emissions by District/area – Tactran area .....	20
Figure 2.9 - Indicative breakdown of “CCC Carbon Budget Recommendations” scenario emissions by District/area – Tayplan area.....	20

Figure 2.10 – ‘CCC Carbon Budget Recommendations’ scenario private vehicle emissions under different carbon intensity of electricity scenarios .....	21
Figure 3.1 – ‘Do Minimum’ and ‘CCC Carbon Budget Recommendations’ scenarios in comparison with a ‘fair share’ target for transport emissions reductions in the Tactran area .....	23
Figure 3.2 – ‘Do Minimum’ and ‘CCC Carbon Budget Recommendations’ scenarios in comparison with a ‘fair share’ target for transport emissions reductions in the Tayplan area .....	23
Figure 3.3 – Transport sector mitigation framework .....	30

## Appendices

<b>A.</b>	<b>Appendix A: Further Modelling Detail</b>	<b>32</b>
A.1.	Introduction	32
A.2.	Traffic Growth Forecasts	32
A.3.	Emissions calculations	32
A.4.	Validation for base year	33

# Glossary

BAU	Business as Usual
CCC	Committee on Climate Change
CCS	Carbon capture and storage (energy sector)
CO	Carbon monoxide
CO <sub>2</sub>	Carbon dioxide
CO <sub>2</sub> e	Carbon dioxide equivalent
CVD	Clean Vehicle Directive (EU Directive)
DfT	Department for Transport
DECC	Department of Energy and Climate Change
EU	European Union
EU ETS	EU Emissions Trading System
Euro standard	European emission standards defining the acceptable limits for exhaust emissions of new vehicles sold in EU member states
EV	Electric vehicle
GHG	Greenhouse gases
GPP	Green Public Procurement (EU initiative)
HDV / HGV	Heavy Duty Vehicle / Heavy Goods Vehicle (truck)
IEA	International Energy Agency
IPCC	Intergovernmental Panel on Climate Change
ITS	Intelligent Transport System
IWW	Inland waterways
ktCO <sub>2</sub>	Kilotonnes of CO <sub>2</sub> (1,000 tonnes of CO <sub>2</sub> )
LDV - LGV	Light Duty Vehicle – Light Goods Vehicle (van)
MtCO <sub>2</sub>	Mega or million tonnes of CO <sub>2</sub> (1,000,000 tonnes of CO <sub>2</sub> – metric tonnes)
NAEI	National Atmospheric Emissions Inventory
NO <sub>x</sub>	Nitrogen oxides (NO and NO <sub>2</sub> )
NTM	National Transport Model
PHEV	Plug-in hybrid vehicle
PM	Particulate matter
PTP	Personalised travel planning
RPP	Report on Proposals and Policies
TMfS	Transport Model for Scotland
TRL	Transport Research Laboratory

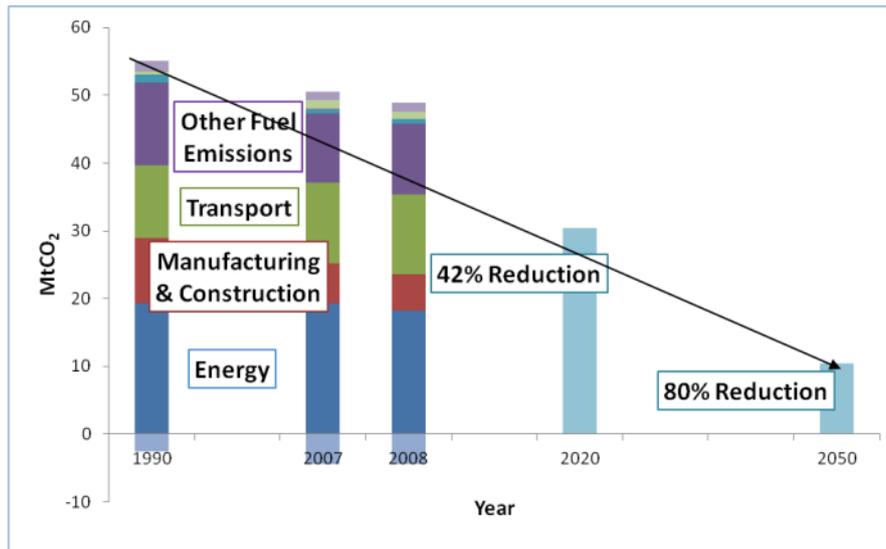
# 1. Introduction

## 1.1. Climate Change (Scotland) Act and related policies

The Climate Change (Scotland) Act 2009 commits the Scottish Government to significant reductions in greenhouse gas emissions and to achieve a transition to a low carbon economy for Scotland.

Part 1 of the Act, sets an interim 42% reduction target for 2020 and an 80% reduction target for 2050 (on 1990 levels) as shown in Figure 1.1. Annual targets have also been set through secondary legislation. All targets set apply to the whole of Scotland, across all sectors (including the transport sector). There are no sector specific targets at present.

Figure 1.1 – Climate Change Act targets for Scotland



## 1.2. Climate Change Delivery Plan

In 2009, the Scottish Government also published the Climate Change Delivery Plan, which sets out the broad measures required in each sector to meet Scotland's statutory climate change targets, to 2020 and in the long term. The Delivery Plan is built around four transformational outcomes that must be delivered to reduce emissions by 80% by 2050:

- a largely decarbonised electricity generation sector by 2030, using renewables complemented by fossil fuels with Carbon Capture and Storage;
- largely decarbonised heating for buildings by 2050, through reduced demand, energy efficiency, and renewable and low-carbon heating;
- almost complete decarbonisation of road transport by 2050, through wholesale adoption of electric cars and vans; and
- a comprehensive approach to carbon in rural land use, incorporating: protection for Scotland's carbon rich soils; minimised emissions from agriculture; use of natural resources to generate renewable energy; and increased sequestration of carbon, for example, through woodland planting.

The 2020 Routemap for Renewable Energy in Scotland goes further in relation to commitments in the energy sector by committing Scotland to generating an equivalent of 100% of electricity demand from renewable sources by 2020, along with at least 11% renewable heat.

### 1.3. Report on Proposals and Policies (RPP)

Low Carbon Scotland - Meeting the Emissions Reduction Targets 2010-2022 is the first RPP (RPP1), published in 2011. The Scottish Government will publish RPP2 (setting the strategy to 2027) in 2012.<sup>1</sup>

RPP1 includes:

- “policies”, considered to be a course of action which has been wholly or largely decided upon, often with committed funding and/or legislation and timescales; and
- “proposals”, considered to be a suggested course of action, either initiated by Scottish Ministers and set to become firm policies once development work is complete and/or financial resources allow, or suggested to Scottish Ministers as options to consider.

Policies and proposals presented in RPP1 cover all sectors of the Scottish economy. Transport sector policies and proposals are summarised in Table 1.1. Transport sector policies and proposals are assessed to contribute approximately a third of the emission reduction potential identified for RPP1 policies and proposals in the non-traded sector<sup>2</sup> in 2020, as shown in Figure 1.2.

**Table 1.1 – RPP1 transport sector policies and proposals**

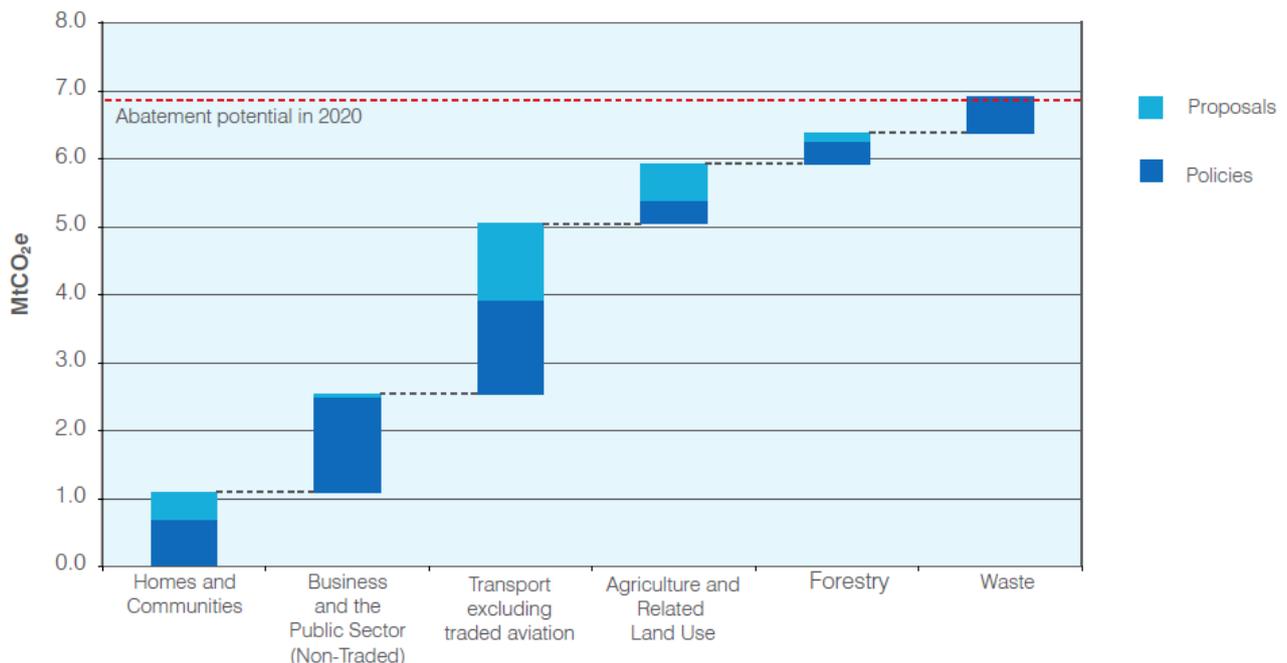
Category	Measures included in RPP1
<b>Policies</b>	EU policies <ul style="list-style-type: none"> <li>• Mandatory targets for the emissions intensity of new cars and vans</li> <li>• Clean Vehicle Directive (transposed into Scottish law)</li> <li>• Renewable Transport Fuel Obligation</li> </ul>
	Scottish (and UK) policies <ul style="list-style-type: none"> <li>• Provision of eco-driving advice and information, including for HGVs and freight van drivers, Freight Best Practice Programme</li> <li>• Financial support to low carbon vehicles and infrastructure</li> <li>• Plugged-in Places programme</li> <li>• Scottish Green Bus Fund and BSOG incentives</li> <li>• Intelligent Transport System Action Plan</li> <li>• Provision of travel planning advice, Smarter Choices, Smarter Places</li> <li>• Cycling Action Plan for Scotland</li> <li>• Support to car clubs</li> <li>• Freight grant schemes to transfer freight from road to rail or water</li> <li>• Edinburgh to Glasgow Rail Improvements programme (electrification), development of plans for improvements between Aberdeen and Inverness (included in BAU)</li> <li>• Scottish Planning Policy</li> </ul>
<b>Proposals</b>	Driving more efficiently <ul style="list-style-type: none"> <li>• Eco-driving for car drivers (extending the availability of eco-driving training, including within the public sector)</li> <li>• Speed limit enforcement (stricter enforcement of 70mph speed limit, “significant issues in relation to the practicality of enforcement and their implications for costs remain”)</li> <li>• Low carbon vehicles and infrastructure (Scottish biofuels, for example through Biofuels Business Programme, public sector procurement of LCVs, development of charging infrastructure, UK grants for private purchase, R&amp;D support)</li> <li>• Freight efficiencies (voluntary measures including reduction of empty/partial load running, increase road freight capacity to reduce overall number of journeys)</li> <li>• Van efficiencies (voluntary measures to encourage eco-driving)</li> <li>• Intelligent transport systems (ITS)</li> </ul>
	Widening travel choices <ul style="list-style-type: none"> <li>• Travel planning (personalised travel planning advice to all households in Scotland)</li> </ul>

<sup>1</sup> Expected to be laid in draft in Parliament towards the end of 2012

<sup>2</sup> Sectors outside the EU Emission Trading Scheme (EU ETS), including transport sector

Category	Measures included in RPP1
	<p>by 2022 and all workplaces with more than 30 employees to have an effective travel plan by 2022)</p> <ul style="list-style-type: none"> <li>• Cycling and walking infrastructure (provision of cycling infrastructure of a level and quality found in Sweden, Germany and Belgium, improvements to walking infrastructure)</li> <li>• Car clubs (range of options for support under consideration)</li> <li>• Buses and taxis (changes to BSOG to encourage low carbon buses, encouraging increases in bus use, improve efficiency of taxis and private hire cars)</li> <li>• Freight modal shift (financial incentives for mode shift to rail and water, load consolidation centres, investment in multi-modal hubs, use of planning system)</li> </ul> <p>Reducing the need to travel</p> <ul style="list-style-type: none"> <li>• Community hubs (further analysis of options)</li> </ul>
<b>Shipping</b>	<p>Policies</p> <ul style="list-style-type: none"> <li>• Ferries Review</li> </ul> <p>Proposals</p> <ul style="list-style-type: none"> <li>• Maritime transport (vessel design, hybrid engines, alternative fuels, fleet management and support for international agreement on shipping emissions)<sup>3</sup></li> </ul>
<b>Aviation</b>	<p>EU policy</p> <ul style="list-style-type: none"> <li>• EU Emission Trading System (EU ETS), including aviation from 2012<sup>4</sup></li> </ul>
<b>Supporting measures</b>	<ul style="list-style-type: none"> <li>• High speed rail (modal shift from air)</li> <li>• Supportive planning process (National Planning Framework and Scottish Planning Policy)</li> </ul>

Figure 1.2 – Abatement potential in the non-traded sector in 2020, from policies and proposals by sector



Source: Low carbon Scotland: meeting the emission reduction targets 2010-2022; The report on proposals and policies, Scottish Government, 2011

<sup>3</sup> Although not explicitly stated in RPP1, this will build upon existing EU Directives such as the EU Marine Low Sulphur Fuel Directive.

<sup>4</sup> From 2012 emissions from flights (excluding military aviation and some other specific types of flights) to, from and within the EU will be covered by the EU ETS. In 2012 emissions will be capped at 97% of average annual emissions from 2004 to 2006, and from 2013 to 2020 they will be capped at 95%. If air operators exceed these limits they will have to buy allowances from other participants (e.g. power stations), whose emissions are also capped, meaning that overall emissions will not rise.

## 1.4. Public bodies' duty on climate change

Part 4 of the Climate Change (Scotland) Act places duties on public bodies relating to climate change. The Act (section 44) requires that a public body must, in exercising its functions, act:

- in the way best calculated to contribute to delivery of the Act's **emissions reduction** targets;
- in the way best calculated to deliver any statutory **adaptation**<sup>5</sup> programme; and
- in a way that it considers most **sustainable**.

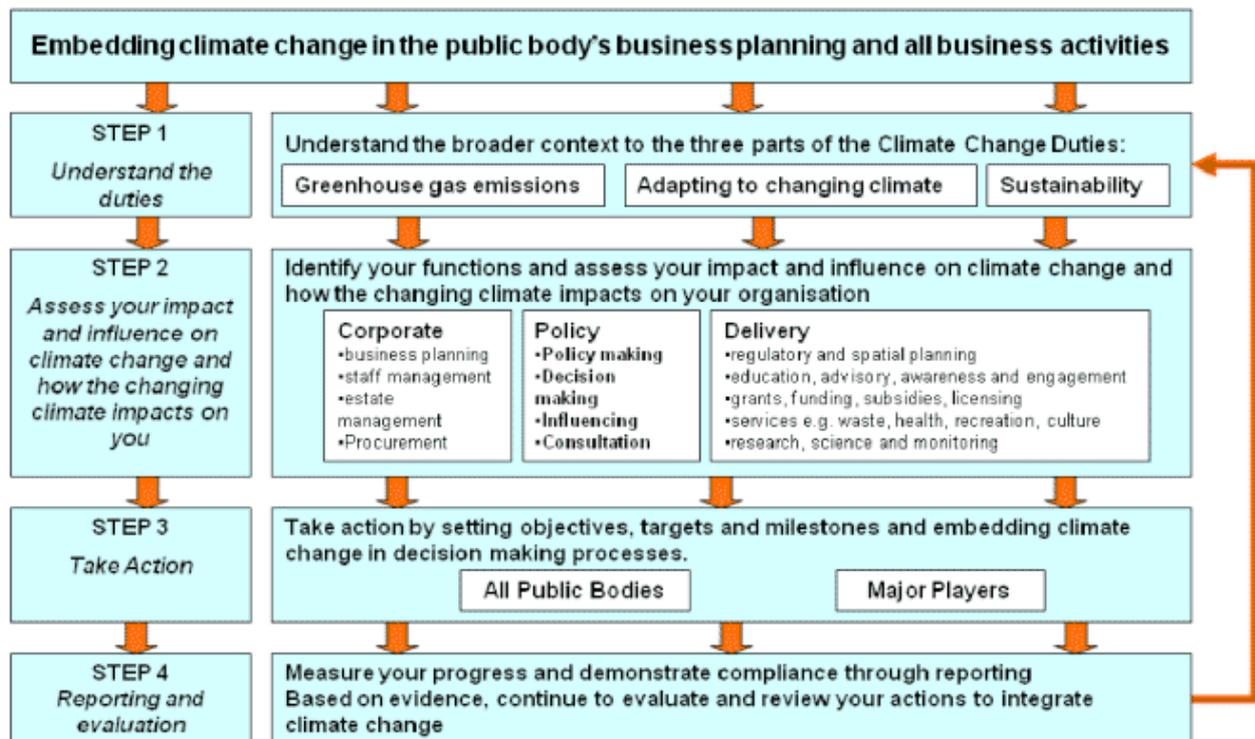
The duties came into force on 1 January 2011 and apply to all 'public bodies' including Tactran.

Guidance published in 2011 sets out a step by step guide to public bodies' duties with regard to climate change as summarised in Figure 1.3. Based on the guidance, Tactran will need to ensure that it monitors its climate change impacts, resulting from its own operations as well as its policy decisions.

Steps to monitor the impact of decisions taken in the public transport sector have already been taken at the national level with, for example:

- the development of the Carbon Account for Transport<sup>6</sup>, which presents the impact of all Scottish transport policies and projects that are expected to have a significant impact on carbon, whether positive or negative; and
- the carbon assessment of the Scottish Government budget, assessing emissions associated with the purchasing of goods and services, including the direct (such as fuel consumed), indirect (electricity use) and imported emissions that are generated in producing the goods and services that Government purchases<sup>7</sup>.

Figure 1.3 – A step by step approach for public bodies to climate change action



<sup>5</sup> "Changing behaviour so that it is more appropriate to the expected future climate". (Highways Agency, 2009)

<sup>6</sup> See [www.transportscotland.gov.uk/strategy-and-research/publications-and-consultations/j220616-00.htm](http://www.transportscotland.gov.uk/strategy-and-research/publications-and-consultations/j220616-00.htm) for the latest version

<sup>7</sup> See [www.scotland.gov.uk/Publications/2011/09/21111152/0](http://www.scotland.gov.uk/Publications/2011/09/21111152/0) for the carbon assessment of the 2012/13 draft budget

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*Source: Public bodies climate change duties: putting them into practice - Guidance required by Part 4 of the Climate Change (Scotland) Act 2009, Scottish Government, 2011*

## 1.5. Mitigating Tactran's impact on climate change

A workshop was held with the Tactran Board and its officers on 20th September 2011 to confirm the following:

- What action is Tactran currently taking to address transport CO<sub>2</sub> emissions?
- What should Tactran do to address transport CO<sub>2</sub> emissions moving forward?

The key outputs from the workshop are contained within Sections 3.2 and 3.3 of this report.

It was clear from the workshop that many of the policies and initiatives that Tactran has already implemented are contributing towards reducing CO<sub>2</sub> emissions, however, it was subsequently agreed that Atkins should fully utilise the model they developed for the Scottish Government to provide a base line projection of transport CO<sub>2</sub>.

## 1.6. This report

This report presents the results of the baseline surface transport CO<sub>2</sub> emissions analysis (baseline forecasts) undertaken by Atkins for Tactran; covering the Tactran area (Dundee, Angus, Perth and Kinross and Stirling) and the Tayplan area (Dundee, Angus, Perth and Kinross and North Fife).

The estimates build on those developed for Scotland as a whole during the Mitigating Transport's Climate Change Impact (MTCCI) study for the Scottish Government in 2009, taking account of subsequent developments in traffic and emissions forecasting.

**Chapter 2** sets out a summary of the forecasts and includes further details on the underlying assumptions.

**Chapter 3** presents initial considerations with regard to mitigation targets for the transport sector in the Tactran and Tayplan areas and potential policies to further reduce emissions in future years.

## 2. Baseline carbon forecasts

### 2.1. Scenarios

This section presents estimates of transport emission levels and trajectories for the Tactran and Tayplan areas under two scenarios:

- a “Do-Minimum” scenario, assuming no new measures to reduce CO<sub>2</sub> emissions beyond those that could be considered in progress, committed or very likely to 2020, with no further new measures assumed to be implemented beyond 2020; and
- a “CCC Carbon Budget Recommendations” scenario, assuming national action continues at the level suggested by the Committee on Climate Change to be necessary to meet carbon budgets, as described in the Extended Ambition Scenario to 2020 and Medium Abatement Scenario from 2020 to 2030 (as defined in the 2010 fourth carbon budget<sup>8</sup>).

### 2.2. ‘Do Minimum’ scenario

#### 2.2.1. Key assumptions and inputs

##### 2.2.1.1. Policies and interventions

The core assumptions on the ongoing interventions to reduce CO<sub>2</sub> emissions to 2020 included in the “Do Minimum” scenario are presented in Table 2.1 below. They are based broadly on those elements of the CCC’s Extended Ambition Scenario to 2020 (as defined in the 2010 fourth carbon budget<sup>9</sup>) that can be considered in progress, committed or very likely with no further interventions assumed beyond 2020.

Table 2.1 – “Do Minimum” assumptions

	Do Minimum Assumptions
New car emissions	Measures to meet EU Framework new car emissions’ targets, meeting the 130g CO <sub>2</sub> /km target in 2015 and making some further progress towards the proposed target 95 gCO <sub>2</sub> /km in 2020 but through power train and non power train improvements only, without the widespread uptake of electric vehicles (therefore achieving 50% of the additional progress required to meet the 95g target)
Biofuel uptake	% of road fuel used by cars, vans and HGVs which comes from biofuels rises to 10% in 2020 by volume, in line with Gallagher Review and remains consistent to 2030
Rail measures	Some cost saving efficiency measures (such as training and improved rolling stock) as estimated by DfT through the Rail Carbon Trajectories Working Group.

##### 2.2.1.2. Private vehicle emissions

The “Do Minimum” private vehicle emissions estimates are based on the following inputs and assumptions:

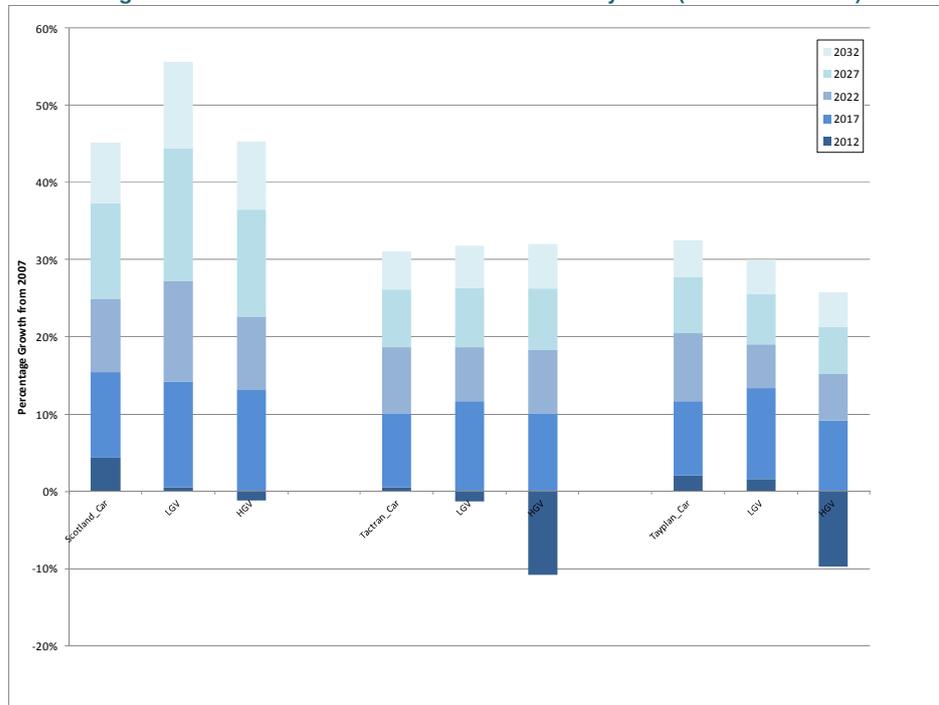
- Traffic levels by road and vehicle type (forecasts shown by vehicle type and area in Figure 2.1) -
  - for 2007, 2012, 2017, 2022, derived from Transport Model for Scotland model runs provided by Transport Scotland, provided as output which included information on traffic on links for the most up to date ‘Reference Case’, identified as Alternative Scenario A (run in 2011) which includes recent assumptions on economic, demographic and planning forecasts and likely future transport interventions, as detailed in Appendix A;
  - estimates of traffic levels for 2027 and 2032 made on the basis of the DfT’s TEMPRO estimates of future trip growth and the relationship between TEMPRO and TMfS forecast growth in the earlier modelled years;

<sup>8</sup> The Fourth Carbon Budget - Reducing emissions through the 2020s – CCC - 7 December 2010

<sup>9</sup> The Fourth Carbon Budget - Reducing emissions through the 2020s – CCC - 7 December 2010

- uplift to account for local traffic not represented in TMfS (which is designed to be a strategic model) based on comparison of modelled and observed traffic by area and road type for the base year;
- allocation of road link to local authority and Tayplan/Tactran area made on the basis of GIS analysis.

**Figure 2.1 – Estimated Traffic Growth from 2007 by Area (TMfS Scenario A)**



Note: the negative values for 2012 for LGV and particularly HGV traffic reflect the decrease in freight relative to 2007 caused by the economic recession.

- Fleet composition and emissions based on CCC forecasts of current conditions and Extended Ambition scenario measures to improve conventional car emissions rates to support progress towards the EU Framework target of 95g CO<sub>2</sub>/km emissions rates for new vehicles in 2020 but without the uptake of electric and plug in hybrid vehicles assumed in the main scenario and therefore achieving approximately half of the additional progress required from the 2015 target of new car emissions of 130g CO<sub>2</sub>/km, reaching 112g CO<sub>2</sub>/km by 2020 (with no further progress beyond 2020).
- Emissions associated with electricity generation – assuming that electricity is generated using the equivalent to current UK wide mix of generation methods (consistent with CCC's assumption).
- Rebound effect (assumed increase in driving distance in response to reduced driving costs) – estimates based on CCC assumptions on fuel and electricity costs along with elasticities of vehicle kilometres to fuel cost derived from the NTM (and also used in the CCC reports).

The spreadsheet calculations developed for the study were validated by cross referencing the 2007 district forecasts against DECC estimates for the same year (based on NAEI data). The results from the two sources are within 2% at the national and Tactran level<sup>10</sup> as shown in Appendix A.

### 2.2.1.3. Bus

The “Do Minimum” bus emission estimates were derived on the basis of the following assumptions:

- 2007 bus vehicle kilometres in Scotland based on Scottish Transport Statistics;
- National vehicle kilometres split between sub-regions in proportion to the TMfS forecasts of the levels of bus traffic in each area;

<sup>10</sup> It was not possible to directly compare the Tayplan area total as the DECC totals are provided for Local Authority areas only and only part of Fife falls within the Tayplan area.

- Average bus emissions - derived from emissions functions published by DfT (based on NAEI/TRL research and testing)<sup>11</sup>; and
- Assumption of static bus emissions throughout study timescales - consistent with Committee on Climate Change December 2008 report<sup>12</sup>.

#### 2.2.1.4. Rail

The “Do Minimum” rail emission estimates were derived on the basis of the following assumptions:

- Focus on diesel train emissions only - in line with the reporting structure adopted by the NAEI<sup>13</sup>. (By convention, the emissions associated with electric trains are reported under the electricity generation sector rather than the transport sector);
- 2007 emissions estimate - directly from the NAEI local authority estimates published by DECC;<sup>14</sup>
- Future year emissions:
  - 12% growth to 2022 (reflecting a balance between increased vehicle size and weight and efficiency measures);
  - beyond 2022 – no further growth or savings, in line with the approach adopted in the CCC fourth budget for the UK as a whole, reflecting uncertainties over potential for electrification and other issues;
  - patterns of change in emissions assumed to be identical in all authorities in Tactran and Tayplan areas.

### 2.2.2. Summary of results

Table 2.2 summarises the estimated ‘Do Minimum’ baseline surface transport related carbon emissions in the Tactran and Tayplan areas respectively in a base year of 2007 and forecast years of 2022 and 2032 by mode.

**Table 2.2 – “Do Minimum” transport carbon emissions estimates – Tactran and Tayplan areas (MtCO<sub>2</sub> p.a.)**

Mode	Tactran			Tayplan		
	2007	2022	2032	2007	2022	2032
Private vehicle tailpipe (incl. vans and HGVs)	1.36	1.41	1.54	1.20	1.25	1.36
Bus	0.04	0.04	0.04	0.05	0.05	0.05
Rail (excl. electric rail) <sup>1</sup>	0.03	0.03	0.03	0.03	0.03	0.03
<b>Total Point of Use Emissions</b>	1.44	1.48	1.62	1.28	1.33	1.44
<i>Private vehicle electric (current carbon intensity of energy mix)<sup>1</sup></i>	0.00	0.00	0.00	0.00	0.00	0.00
<b>Total Surface Transport</b>	1.44	1.49	1.62	1.28	1.33	1.44

*1 The convention followed in carbon emissions reporting (for instance in the NAEI) is to present emissions by sector. The transport sector considers emissions at point of use whilst emissions associated with electricity generation are presented under the power sector to avoid double counting. Rail electric emissions are excluded from this analysis in line with this convention as they vary little between scenarios. However, emissions associated with the electricity required to power electric road vehicles are presented separately to ensure that the full impacts of each scenario are considered on a comparable basis, as the focus is on the transport sector only.*

Figure 2.2 and Figure 2.3 show an indicative trajectory of change in baseline emissions levels between the forecast years for each area. Figure 2.4 and Figure 2.5 provide further detail of the composition of surface transport emissions in the constituent districts within the Tactran and Tayplan areas.

<sup>11</sup> [www.dft.gov.uk/pgr/roads/environment/emissions/?view=Standard](http://www.dft.gov.uk/pgr/roads/environment/emissions/?view=Standard)

<sup>12</sup> See Ref 2

<sup>13</sup> and required by the United Nations Framework Convention on Climate Change (UNFCCC)

<sup>14</sup> [www.decc.gov.uk/publications/basket.aspx?filepath=statistics%2fclimate\\_change%2f1\\_20100203143635\\_e\\_%40%40\\_lafulldataset.xls&filetype=4](http://www.decc.gov.uk/publications/basket.aspx?filepath=statistics%2fclimate_change%2f1_20100203143635_e_%40%40_lafulldataset.xls&filetype=4)

### 2.2.3. Commentary

The figures show that private vehicles dominate surface transport emissions, accounting for nearly 95% in both the Tactran and Tayplan areas. Of this total, emissions from cars account for approximately 65% of the total in each case, emissions from HGVs for approximately 20% and emissions from LGVs for approximately 15%.

Total emissions are forecast to grow slowly over the period between 2007 and 2022, by less than 5% in both areas. Growth is then forecast to accelerate between 2022 and 2032, leading to surface transport emissions levels in 2032 that are 9% greater than in 2022 in the Tactran area and 8% greater in the Tayplan area.

This changing pattern reflects the balance between the opposing effects of significant growth in forecast traffic levels and the assumed improvements in car efficiency resulting from manufacturers' actions to make progress towards the 2015 and 2020 EU Framework new car emissions targets.

The Do Minimum measures to 2020 to improve new car efficiency offset the effects of much of the traffic growth (for all vehicle types) over that period, leading to the limited net increase in emissions to 2022. However, as the scenario is limited to committed or currently very likely measures, improvements are assumed to stop in 2020. Consequently, increases in emissions to 2032 largely follow traffic growth, with reductions in emissions per kilometre being restricted to the effect of the most efficient (2020 standard) cars accounting for an increasing proportion of the fleet as fleet turnover continues and more new cars of this standard are purchased.

Table 2.2 also includes a line for emissions associated with the generation of electricity required to power plug in electric vehicles. However, the emissions in this category are negligible in this scenario as it is assumed that there is no expansion of the electric vehicle market beyond current very limited levels.

The table also shows slight increases in rail emissions over the time period. This is the result of increased size and weight of trains and increased distance of travel. However, on-going nationwide cost saving measures to improve efficiency are assumed to offset these impacts to a large extent, resulting in only a small net increase.

Bus emissions are assumed to remain broadly constant over the period to 2030. This is consistent with CCC analysis and reflects gains in vehicle efficiency which will be offset by additional bus mileage.

Figure 2.2 - Indicative “Do Minimum” trajectory – Tactran area

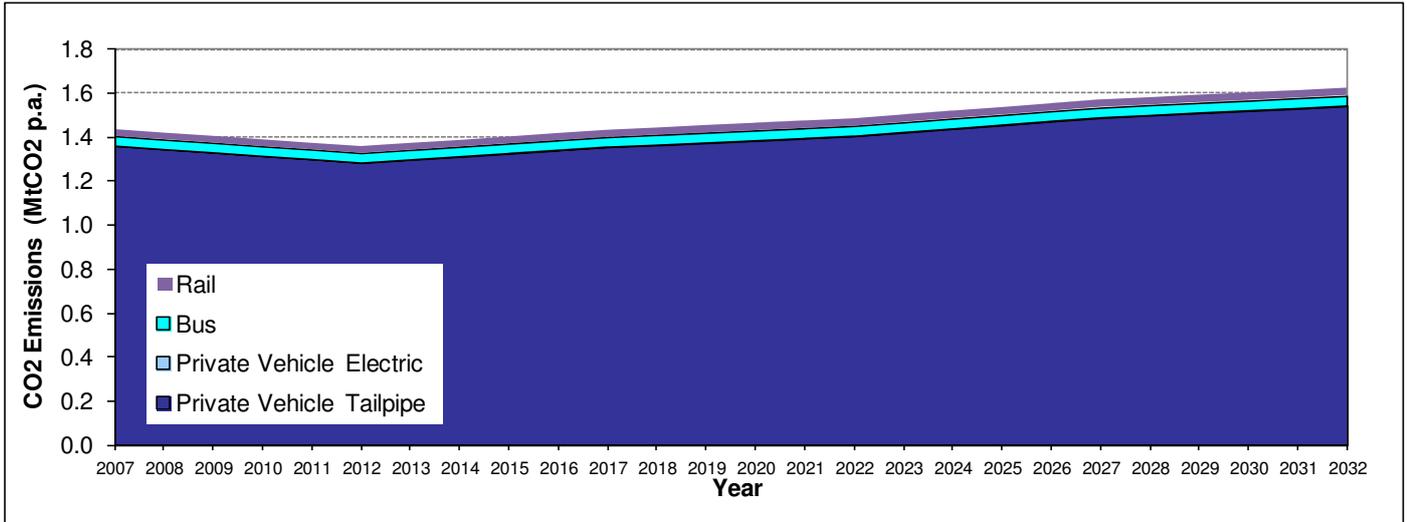


Figure 2.3 - Indicative “Do Minimum” trajectory – Tayplan area

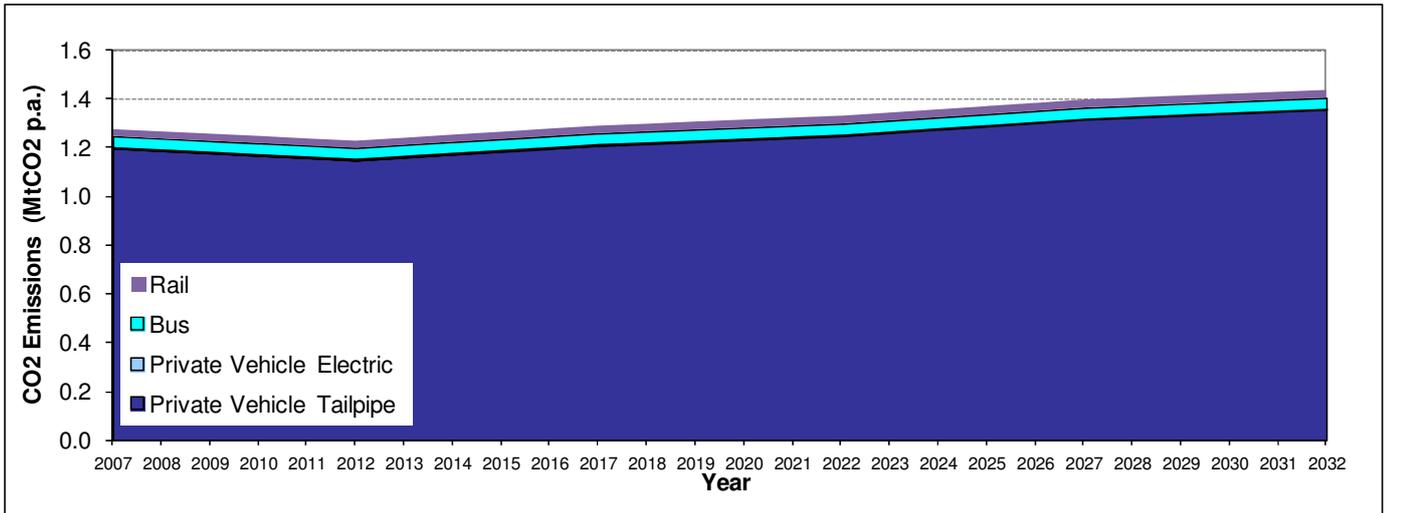


Figure 2.4 - Indicative breakdown of “Do Minimum” emissions by District/area – Tactran area

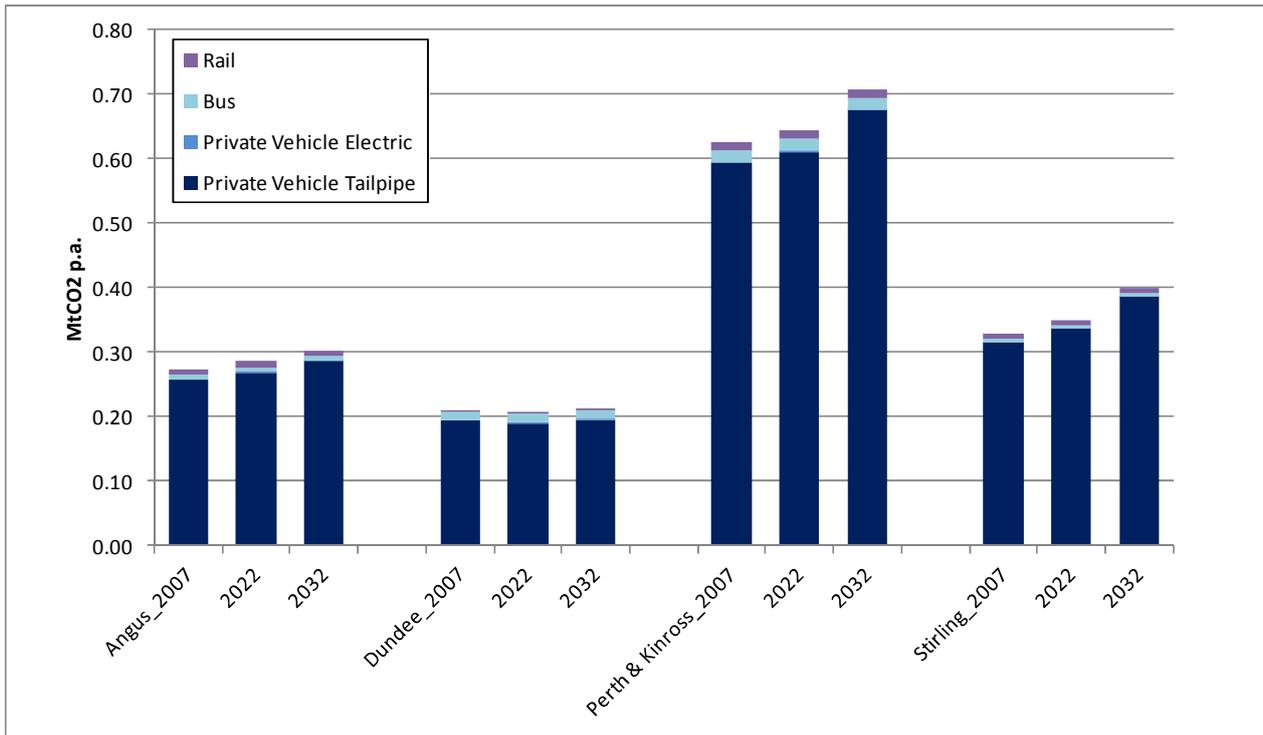
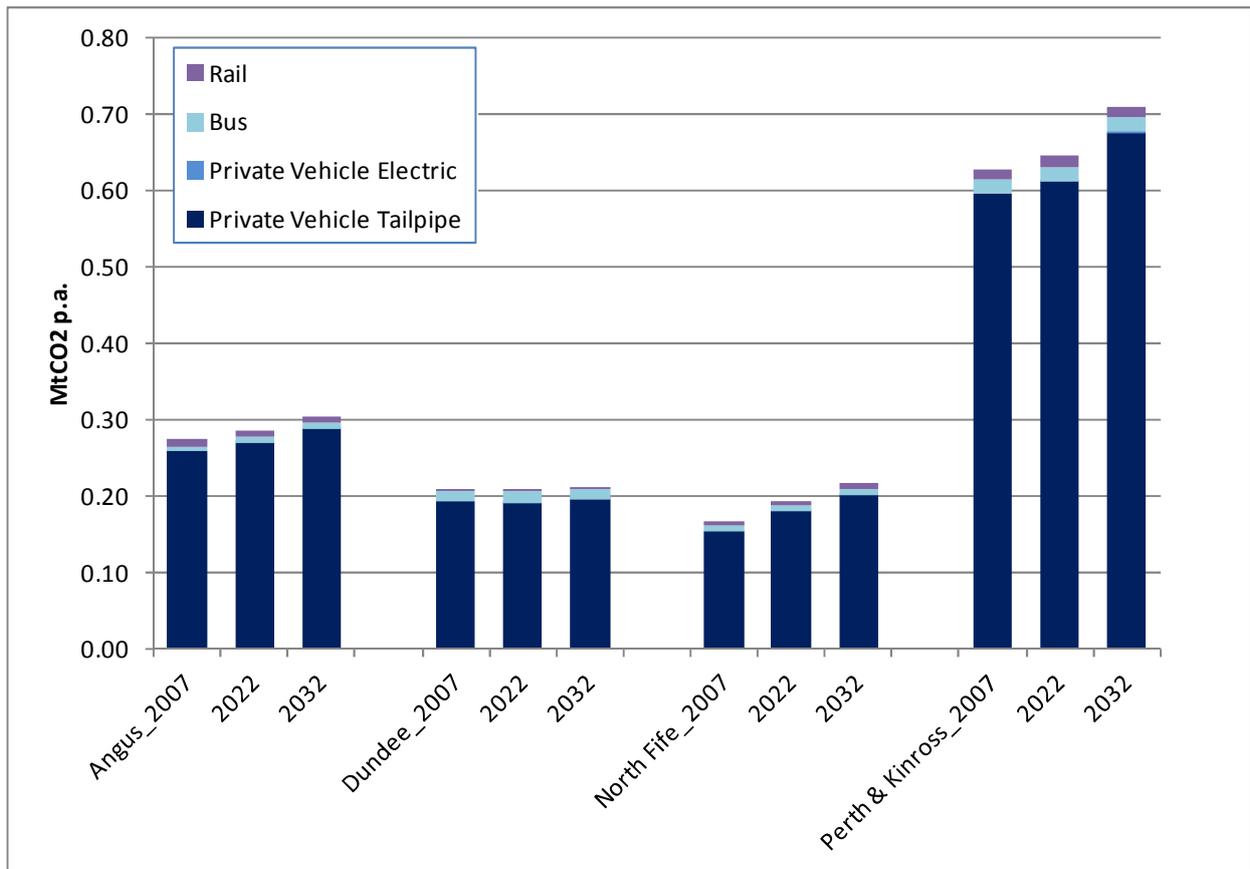


Figure 2.5 - Indicative breakdown of “Do Minimum” emissions by District/area – Tayplan area



## 2.3. ‘CCC Carbon Budget Recommendations’ scenario

The “CCC Carbon Budget Recommendations” scenario builds on the ‘Do Minimum’ scenario and incorporates current likely levels of national mitigation action required to meet carbon budgets as set out in the Committee on Climate Change reports (specifically using the Extended Ambition scenario to 2020 and Medium Abatement scenario to 2030 as identified in the fourth carbon budget published in 2010<sup>15</sup>). These CCC scenarios assume extensive improvements in vehicle efficiency and a strong shift towards electric vehicle use as described below.

### 2.3.1. Key assumptions and inputs

#### 2.3.1.1. Policies and interventions

The core assumptions on current and proposed interventions and policies in the CCC Carbon Budget Recommendations scenario are summarised in Table 2.3.

**Table 2.3 – “CCC Carbon Budget Recommendations” scenario assumptions**

	<b>Extended Ambition and Medium Abatement Scenario</b>
New car emissions	Measures to meet EU Framework on new car emissions achieving 95 gCO <sub>2</sub> /km in 2020 and 80gCO <sub>2</sub> /km in 2030 through power train improvements, increased uptake of hybrids, plug-in and electric cars and non-power train improvements.
New van emissions	Assumption of progress towards EU framework for van emission reduction and greater uptake of technology which brings financial savings achieving 150g/km in 2020 and 120g/km in 2030 - achieved through power train improvements - increased uptake of stop start vans, hybrids, plug-in and electric cars and non-power train improvements.
New HGV emissions	Limited change to 2020 but greater uptake of non-powertrain improvements after 2020 to achieve a 30% reduction in emissions across all HGV classes by 2030.
Biofuel uptake	% of road fuel used by cars, vans and HGVs which comes from biofuels rises to 10% in 2020 by volume, in line with Gallagher Review and remains consistent to 2030 - as Do Minimum
Rail measures	Efficiency measures (such as training and improved rolling stock) as estimated by DfT through the Rail Carbon Trajectories Working Group, including the assumed 0.03MtCO <sub>2</sub> saving identified by the CCC in ‘Scotland’s Path to a Low Carbon Economy’ in 2010
Smarter Choices and Eco driving	Savings to 2020 as identified in ‘Scotland’s Path to a Low Carbon Economy’ in 2010 (0.24MtCO <sub>2</sub> of savings attributable to Smarter Choices by 2020 and 0.11MtCO <sub>2</sub> savings attributable to eco-driving) with no additional savings beyond 2020. This in line with the UK wide assumption in the CCCs fourth carbon budget, assuming measures to lock in the savings achieved to 2020 but not assuming any further savings are achieved, despite the potential, due to the uncertainties

#### 2.3.1.2. Private vehicles

The “CCC Carbon Budget Recommendations” scenario private vehicle emissions estimates are based on the following inputs and assumptions:

- Traffic levels by road and vehicle type and allocation to geographical area– as Do Minimum scenario
- Fleet composition and emissions, as described above, resulting in the following assumed uptake of electric and plug in hybrid vehicles:

**Table 2.4 – EV and plug-in hybrid uptake in Scotland, % of vehicle fleet**

<b>Vehicle type</b>	<b>2008</b>	<b>2020</b>	<b>2030</b>
<b>Car</b>	0%	5%	31%
<b>Van</b>	0%	5%	29%
<b>HGV</b>	0%	0%	0%

- Emissions associated with electricity generation – assuming that electricity is generated using the equivalent to current nationwide mix of generation methods (consistent with CCC’s assumption).
- Rebound effect (assumed increase in driving distance in response to reduced driving costs) – estimates based on CCC assumptions on fuel and electricity costs along with elasticities of vehicle kilometres to fuel cost derived from the NTM (and also used in the CCC reports).

<sup>15</sup> The Fourth Carbon Budget - Reducing emissions through the 2020s – CCC - 7 December 2010

### 2.3.1.3. Bus

Assumptions as for the Do Minimum, consistent with Committee on Climate Change December 2008 report<sup>16</sup>.

### 2.3.1.4. Rail

Assumptions largely as for the Do Minimum but with the growth in emissions to 2022 limited to 9% reflecting greater activity to improve efficiency offsetting other influences to increase emissions, in line with the 0.03MtCO<sub>2</sub> saving identified by the CCC in 'Scotland's Path to a Low Carbon Economy' in 2010

## 2.3.2. Summary of results

Table 2.5 summarises the estimated 'CCC Carbon Budget Recommendations' scenario surface transport related carbon emissions in the Tactran and Tayplan areas respectively in a base year of 2007 and forecast years of 2022 and 2032 by mode, including an allowance for the fact that any reductions in travel costs are likely to cause a 'rebound effect' where people travel further as a result of the reduced costs they face.

**Table 2.5 – "CCC Carbon Budget Recommendations" scenario transport carbon emissions estimates – Tactran and Tayplan areas (MtCO<sub>2</sub> p.a.)**

Mode	Tactran			Tayplan		
	2007	2022	2032	2007	2022	2032
Private vehicle tailpipe (incl. vans and HGVs)	1.36	1.27	0.94	1.20	1.13	0.82
Bus	0.04	0.04	0.04	0.05	0.05	0.05
Rail (excl. electric rail) <sup>1</sup>	0.03	0.03	0.03	0.03	0.03	0.03
<b>Total Point of Use Emissions</b>	1.44	1.35	1.02	1.28	1.21	0.90
<i>Private vehicle electric (current carbon intensity of energy mix)<sup>1</sup></i>	0.00	0.06	0.30	0.00	0.05	0.27
<b>Total Surface Transport</b>	1.44	1.40	1.32	1.28	1.26	1.17

<sup>1</sup> The convention followed in carbon emissions reporting (for instance in the NAEI) is to present emissions by sector. The transport sector considers emissions at point of use whilst emissions associated with electricity generation are presented under the power sector to avoid double counting. Rail electric emissions are excluded from this analysis in line with this convention as they vary little between scenarios. However, emissions associated with the electricity required to power electric road vehicles are presented separately to ensure that the full impacts of each scenario are considered on a comparable basis, as the focus is on the transport sector only.

Figure 2.6 and Figure 2.7 show an indicative trajectory of change in emissions levels between the forecast years for each area under the 'CCC Carbon Budget Recommendations' scenario.

Figure 2.8 and Figure 2.9 provide further detail of the composition of surface transport emissions in the constituent districts within the Tactran and Tayplan areas.

### 2.3.3. Commentary

The figures show that under this scenario, although total emissions still change relatively little over the period between 2007 and 2032, there is a steady decrease, a reduction of about 3% between 2007 and 2022 and nearly 10% between 2007 and 2032.

This reflects the fact that significantly more activity to improve efficiency of private road vehicles is assumed in this scenario than in the Do Minimum scenario, both through wider uptake of electric vehicles in the car market and measures to improve efficiency of LGVs and HGVs. The actions are also assumed to continue beyond 2020, with further expansion of the plug in hybrid and electric vehicle market as well as further improvements in conventional vehicle efficiency. These changes are estimated to more than offset the forecast traffic growth over the time period to generate the net reduction in emissions seen.

<sup>16</sup> Building a low-carbon economy – the UK's contribution to tackling climate change – CCC - December 2008 <http://www.theccc.org.uk/reports>

Figure 2.6 - Indicative “CCC Carbon Budget Recommendations” scenario trajectory – Tactran area

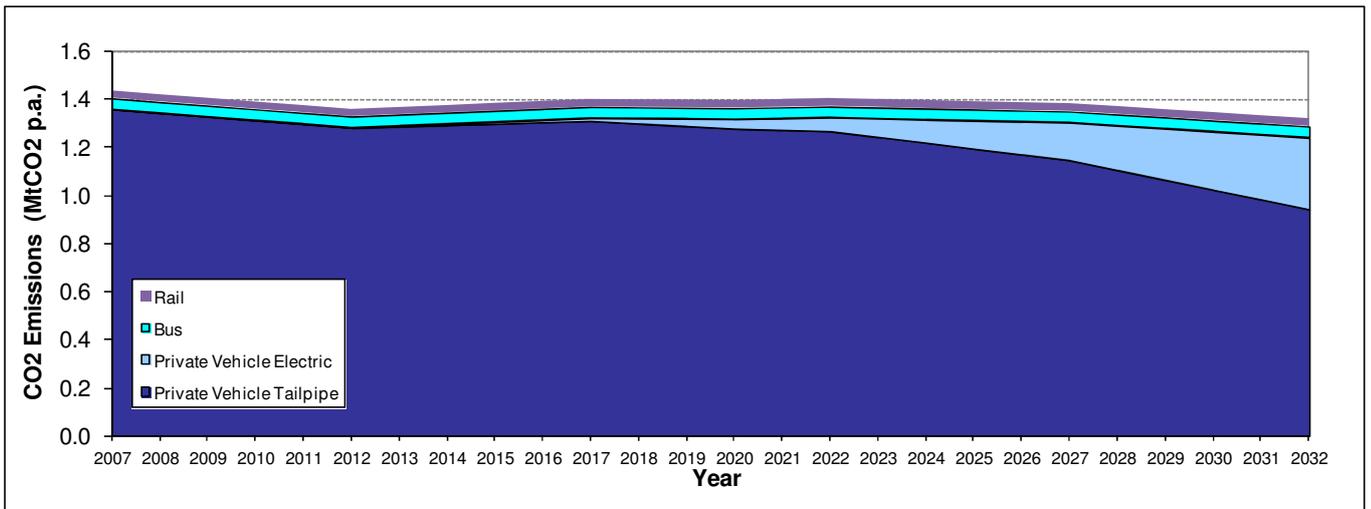


Figure 2.7 - Indicative “CCC Carbon Budget Recommendations” scenario trajectory – Tayplan area

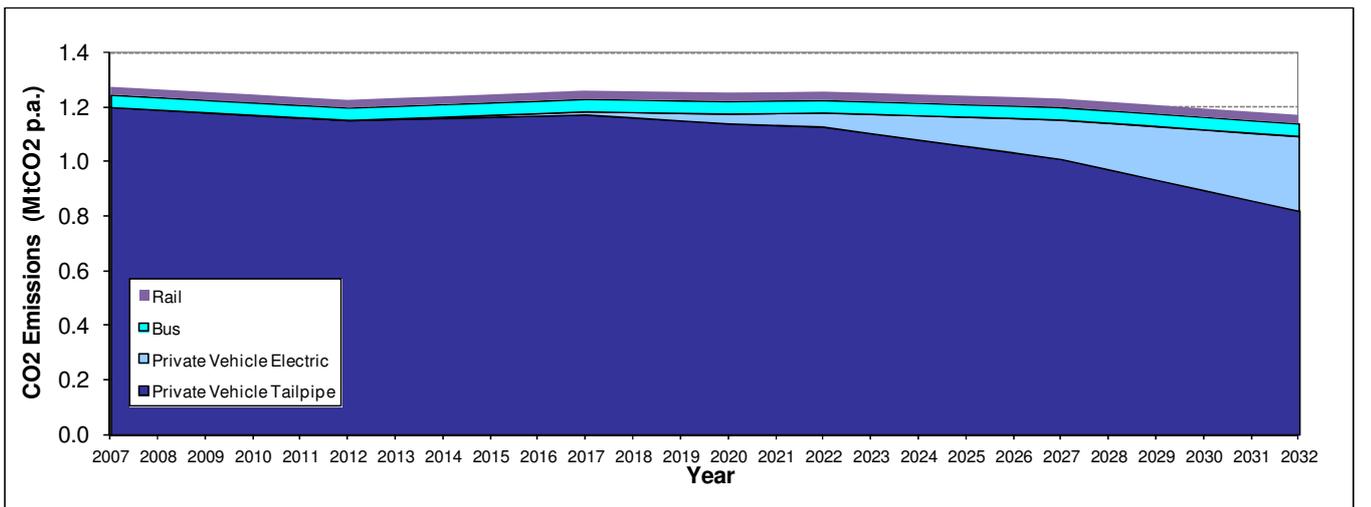


Figure 2.8 - Indicative breakdown of “CCC Carbon Budget Recommendations” scenario emissions by District/area – Tactran area

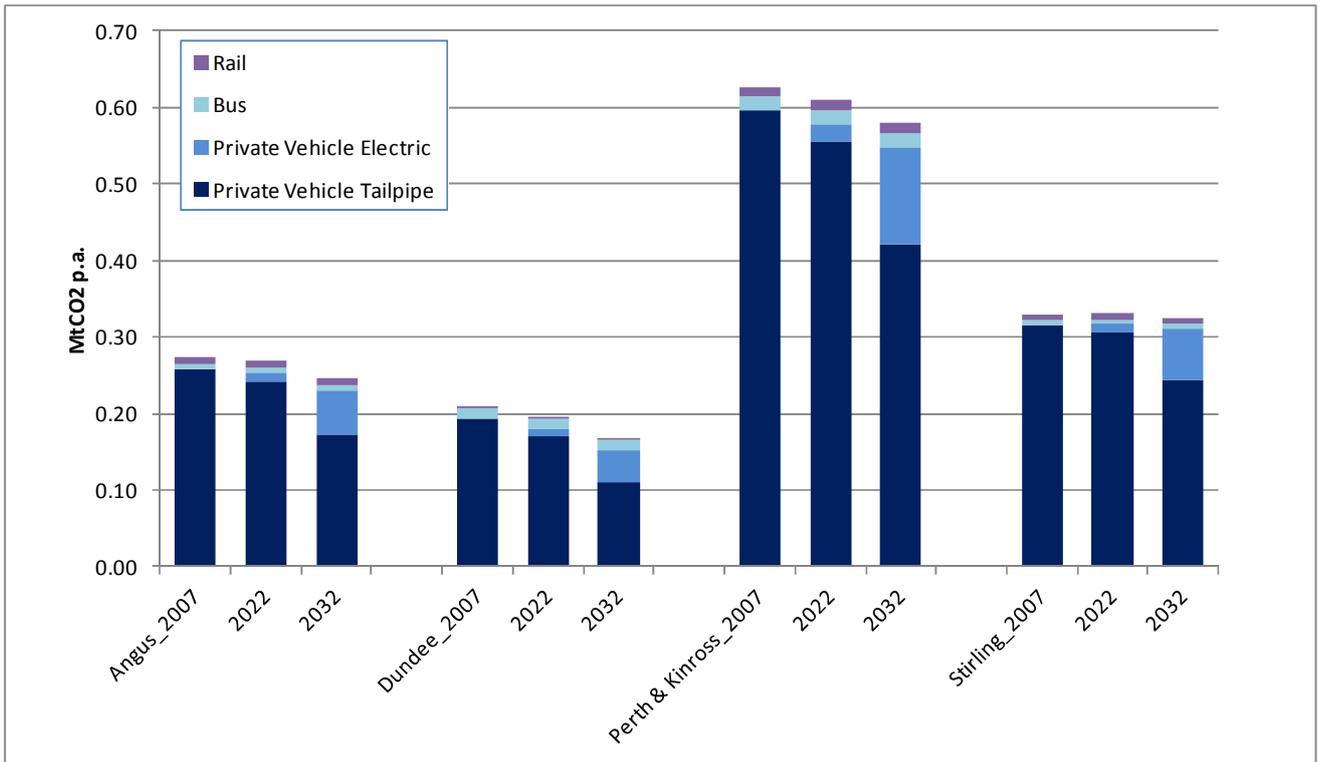
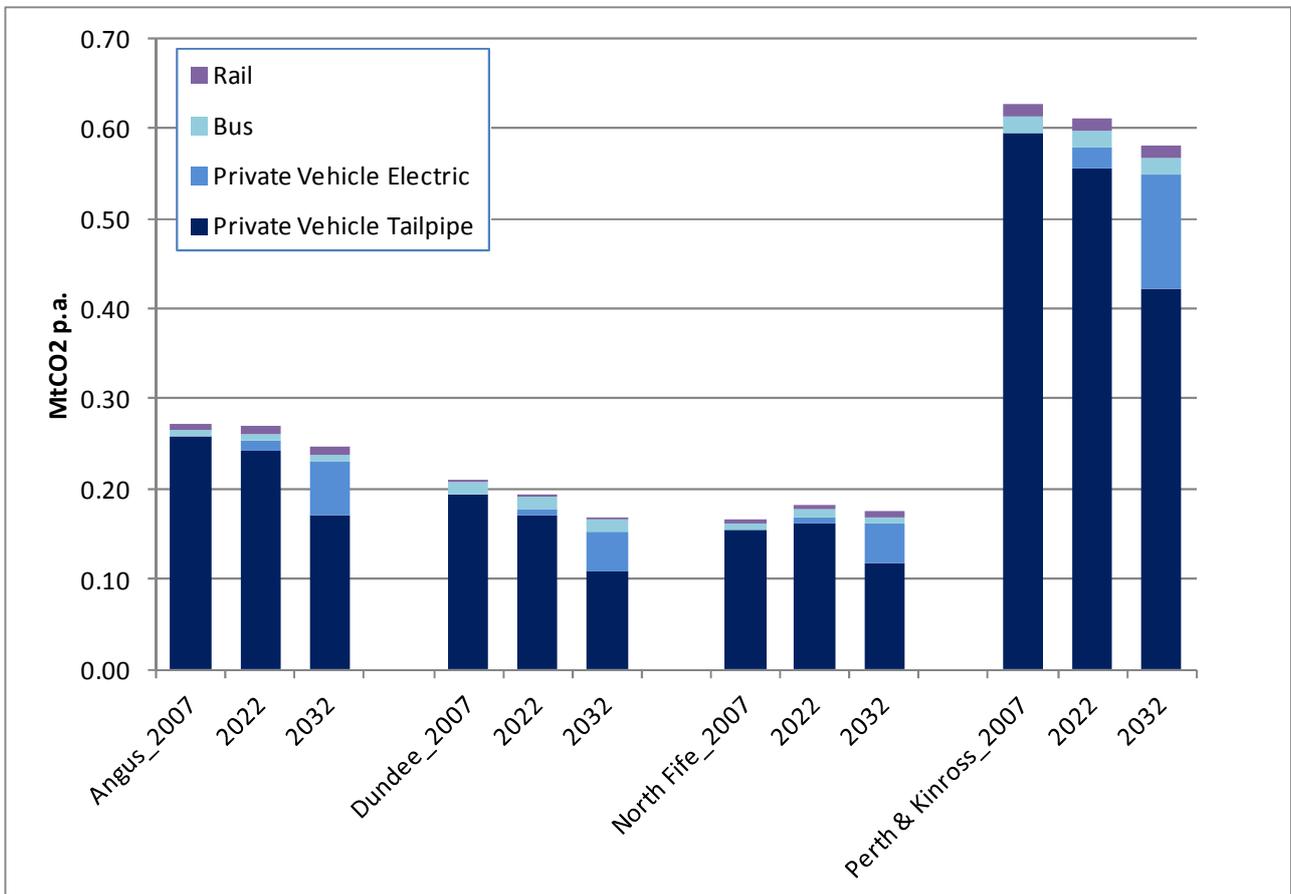
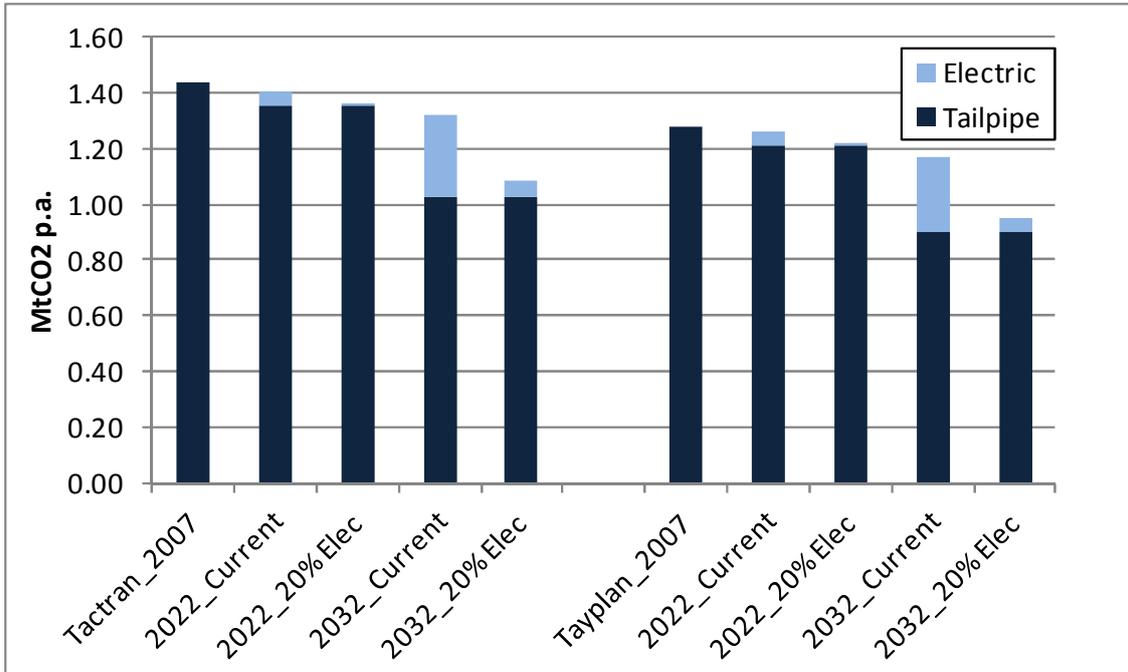


Figure 2.9 - Indicative breakdown of “CCC Carbon Budget Recommendations” scenario emissions by District/area – Tayplan area



As the table and graphs show, the reductions are considerably larger when only tailpipe emissions are considered (nearly 30% reduction between 2007 and 2032). Emissions linked to the electricity generation required to power electric and plug-in hybrid vehicles offset a significant proportion of the emissions saved through reduced tailpipe emissions, at least when the current energy mix (and associated carbon intensity) is assumed to continue to 2032. This forecast growth in emissions could be reduced through the development of low carbon energy sources, as illustrated in Figure 2.10 which shows the private vehicle emissions totals for the 'CCC Carbon Budget Recommendations' scenario assuming current carbon intensity of electricity generation and equivalent figures for a scenario where extensive uptake of renewable electricity has reduced the carbon intensity of generation to 20% of its current level.

Figure 2.10 – 'CCC Carbon Budget Recommendations' scenario private vehicle emissions under different carbon intensity of electricity scenarios



A further factor that offsets the reduction in emissions to 2032 (including those linked to electricity production), is the rebound effect. As electric vehicle penetration grows, under current assumptions on the price of fuel and electricity, it becomes cheaper to drive. Evidence from the NTM suggests that this would encourage drivers to travel more, leading to an increase in car vehicle kilometres of 2% by 2020 and about 5% by 2030<sup>17</sup>.

<sup>17</sup> Rebound effects were calculated on the basis of costs of fuel and electricity adopted in the CCC report and the National Transport Model forecasts of the extent to which reductions in fuel prices encourage increased travel through time. The same assumptions were used to underpin estimates of the rebound effect in the CCC reports

## 3. Mitigating transport sector emissions

### 3.1. Developing mitigation targets for the transport sector

Under the Climate Change Act Scotland, the country is to achieve an 80% reduction in overall greenhouse gas emissions by 2050, with an interim target of a 42% reduction by 2020 (on 1990 levels).

#### 3.1.1. International agreement's impact on transport sector targets

This overall reduction will be achieved by reduction in emissions across all sectors including:

- the “traded sector”: energy intensive industries, energy production and aviation which are subject to the European Emission Trading Scheme (EU ETS – a cap and trade scheme); and
- the “non-traded sector”: road transport, shipping, residential, agriculture, etc.

At EU level, member states have committed to a 20% cut in greenhouse gases emissions by 2020 (on 1990 levels) with the option to increase this target to 30% should an international agreement be reached through on-going UN negotiations to replace the Kyoto Protocol.

The impact of a potential stronger EU level commitment on required emission reductions for the transport sector can seem counter intuitive. If the EU adopts a stronger overall target for emissions reduction, it is likely that this would result in stricter targets for the “traded sector”, under EU ETS. This in turn would potentially result in reduced mitigation requirements for “non-traded sectors”, including transport.

The Committee on Climate Change (CCC)<sup>18</sup> estimates that:

- if the EU moves to a 30% target and tightens the EU ETS cap accordingly, a 39% reduction in emissions will be required from the “non-traded sector” and targets to 2020 could be met with Scotland’s current policies as listed in RPP1;
- under the current 20% EU target and EU ETS cap however, a 47% reduction in emissions is required from the “non-traded sector” by 2020 and the target is likely to be missed unless all RPP1 proposals are turned into policies rapidly.

#### 3.1.2. Setting a mitigation target for the transport sector

Two main approaches are generally used to set sector specific carbon mitigation targets:

- the top-down, “fair share” approach – where overall reductions required are passed on to each individual sector with each sector required to achieve similar reductions in emissions; and
- the bottom-up, “cost effectiveness” approach – where potential mitigation actions across sectors are assessed with regard to their potential to reduce emissions and their cost and the most cost effective actions are selected for implementation regardless of the sector they belong to.

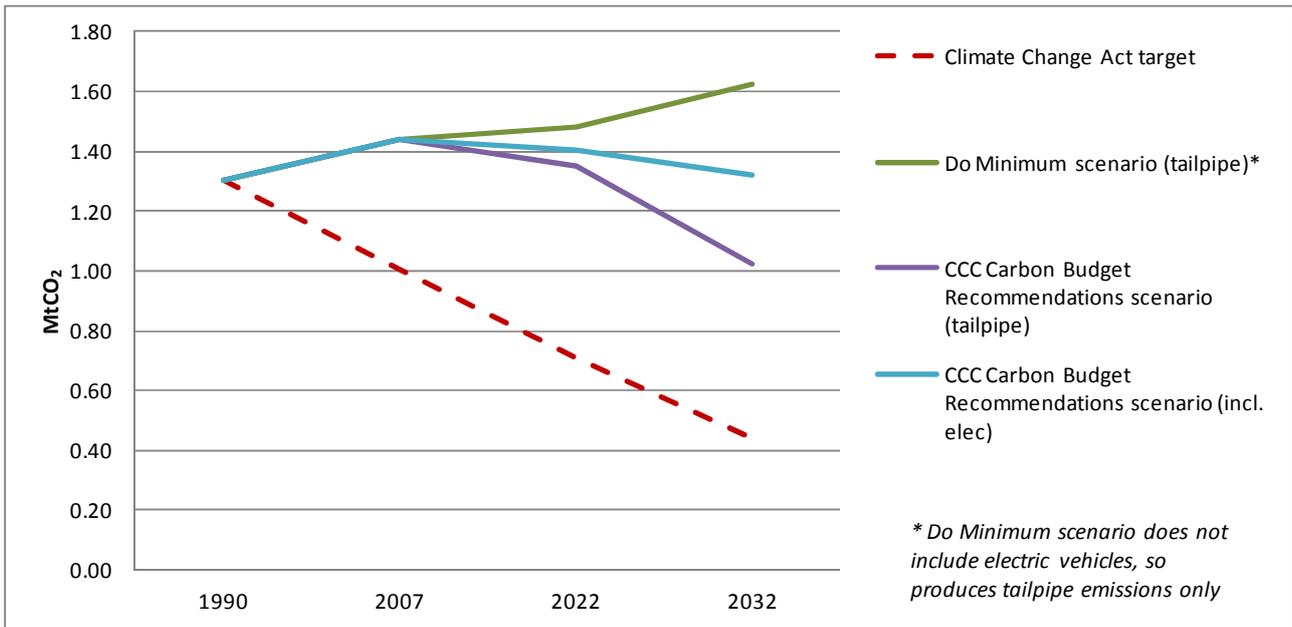
Although the cost-effectiveness approach might be seen as the most logical approach to developing targets and action plans for carbon mitigation, it is important to note that very significant action is required in all sectors for the challenging targets adopted at EU level and by Scotland to be met. This has led to several EU member states (France and Germany for example) adopting the “fair share” approach (sometimes with different trajectories for different sectors, recognising that some sectors might be able to deliver emission reductions at a faster pace). This also avoids individual sectors rejecting the responsibility for achieving emission reduction to other sectors where reductions are perceived as easier or cheaper to achieve and focuses professionals in all sectors on the challenging action plans required to achieve the significant level of emission reduction required.

<sup>18</sup> First progress report on reducing emissions in Scotland, CCC, January 2012

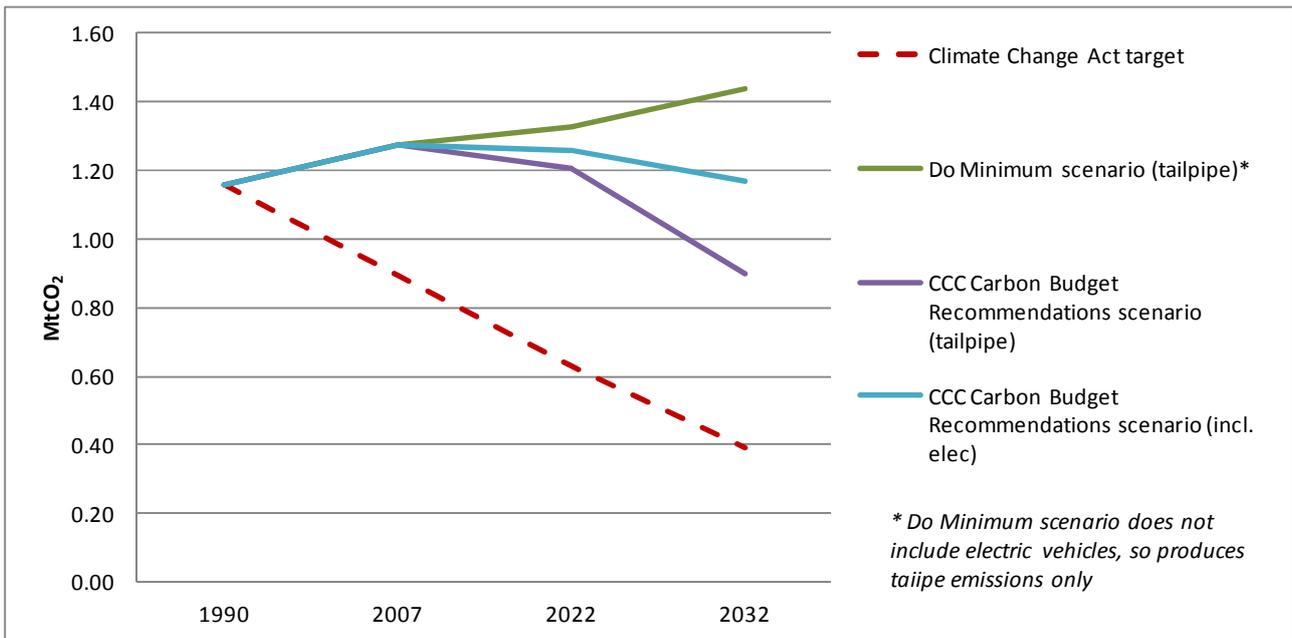
Adopting the fair share approach would in principle require the transport sector in Scotland to achieve a 42% reduction in emissions by 2020 (although with a potential for variation between 39 and 47% as explained above) and an 80% reduction in emissions by 2050 (on 1990 levels).

There are various ways to allocate requirements for emission reduction at a more regional basis (for example taking account of current emission levels per head, planned development, etc). To retain a simple approach which can be easily understood and accepted by all partners, we would however recommend the adoption of reduction targets similar to those adopted at the national level for transport sector emissions in the Tactran and Tayplan areas. Figure 3.2 show how forecast emissions under the Do Minimum and CCC Carbon Budget Recommendations scenarios compare with the ‘fare share’ targets for the transport emissions reductions required in the Tactran and Tayplan areas to contribute to the Climate Change Act target. The scale of the challenge is evident in the gap between the target line and the line for the CCC Carbon Budget Recommendations scenario, which already includes significant assumed improvements in vehicle efficiency.

**Figure 3.1 – ‘Do Minimum’ and ‘CCC Carbon Budget Recommendations’ scenarios in comparison with a ‘fair share’ target for transport emissions reductions in the Tactran area**



**Figure 3.2 – ‘Do Minimum’ and ‘CCC Carbon Budget Recommendations’ scenarios in comparison with a ‘fair share’ target for transport emissions reductions in the Tayplan area**



### 3.1.3. Key indicators

The Regional Transport Strategy (RTS) monitoring framework includes the following indicators which are relevant to monitor progress with regard to climate change mitigation:

- Labour market catchment population by public transport (Indicator 1);
- Number of employees covered by Travel Plans (Indicator 6, limited to Council and Health Boards employees);
- Percentage of the Tactran resident population who travel as a car driver, car passenger, on public transport, on foot or cycle (Indicator 14);
- Proportion of children taking active travel modes to school (walking/cycle – Indicator 16); and
- Proportion of active travel mode (walk or cycle) trips made by Tactran area residents (Indicator 17).

These indicators could be useful in monitoring progress. We would however recommend that a refreshed RTS monitoring framework include indicators which enable the monitoring of outcomes against the key changes required to reduce transport sector emissions, including:

- Low carbon vehicles – take-up of low carbon vehicles in the Tactran and Tayplan areas (including vans and HGVs);
- More efficient use of vehicles – fuel consumption per vehicle kilometre in the area (if available);
- Shift towards more efficient modes – mode share (across a range of journey purposes);
- Reduction of travel need and destination shift – vehicle kilometres travelled in the Tactran and Tayplan areas.

These indicators should be developed in discussion with the Scottish Government (taking into account the work carried out to develop the Carbon Account for Transport) to ensure that data collated at the national level can be used to monitor progress in the Tactran and Tayplan areas.

As per the Carbon Account for Transport developed by the Scottish Government for Scotland as a whole, Tactran and Tayplan could also adopt a carbon balance sheet approach to record the carbon impact (negative or positive) of all decisions and investments.

#### Scotland Carbon Account for Transport - Key indicators

- Road vehicle kilometres travelled
- Road transport fuel consumption per vehicle kilometre
- Proportion of new road vehicles that are alternatively fuelled
- Modal share of public transport and active travel
- Aviation passengers (terminal and transit)
- Waterborne freight lifted in Scotland and moved

## 3.2. Current actions to reduce transport sector emissions

### 3.2.1. Tactran Board Workshop

The workshop held with the Tactran Board and its officers on 20th September 2011 confirmed that many of the policies contained with the Tactran RTS are already making a substantial contribution to reducing transport's impact on Climate Change.

The table on the next page presents the existing Tactran actions that were identified as contributing towards Climate Change mitigation.

Table 3.1 – Current Activities Addressing CO<sub>2</sub> emissions from Transport

Measures designed to change attitudes and behaviour	Tactran connect Travel Planning Smarter Choices/Smarter Places Community Planning – input to Action Plans Charging points for electric cars Health & Transport Agenda Cross boundary working with SEStran
Information based measures	Tactran connect Travelknowhow Liftshare Facebook Twitter Bus Information Strategy Smarter Choices/Smarter Places
Walking & Cycling measures	Cycling infrastructure Cycle lanes/links Tactran connect CWSS Dundee Cycle Way/Green Circular Dundee Travel Active Maps detailing walking routes Walking & Cycling Strategy Gap filling in NCN Path widening at Ninewells hospital Health & Transport Agenda Raploch footpath
Bus Based measures	Park & Ride Buses Strategy & Action Plan 333 Service Quality Bus Partnerships/Corridors Bus Information strategies (including real time information) Arbroath Bus Station Dundee Bus Station Upgrading Perth bus station Bus stops
Rail based measures	TERS Broughty Ferry and Invergowrie service improvements Station access improvements
Measures associated with improving multi modal interchange	Park & Ride Car parks with electric charging points
Community & DRT	Dundee DRT (once established) Interaction with LCPP's Partnership working Stirling DRT pilot
Freight specific measures	Freight Quality Partnership LaMiLo FCC project funding bid Road Access to Dundee port improvements Freight/rail inter-modal at Dundee port Off road schemes Lorry routing & Mapping Montrose Port enhancements Freight Facilities Grant possibilities Freight Consolidation Centre proposals Highland Spring /rail freight proposals
Land Use and Planning related measures	TAYplan LDP's Park & Ride

	Freight Consolidation Centre
Air Transport measures	Support for maintenance of Dundee to London City service
Road Infrastructure	Access to Dundee port Investigate A90 through and around Dundee Funding for A9/A94 Cross Tay Link Road and Perth Western Edge roads infrastructure feasibility and design

### 3.3. Potential interventions to further reduce transport sector emissions

When considering potential future activities the Tactran Board Workshop participants identified the following:

- Encourage more home working / flexible working;
- Need for Bike facilities at Broxden;
- Investigate potential for virtual meetings using video-conference and Skype;
- Tactranconnect - investigate facility for optimum meeting scheduling to encourage public transport use;
- Promote car sharing for meetings; and
- Promote use of public transport and remove the “stigma”.

In general discussion the following issues were identified by the workshop participants:

- Scottish Government promoting Travel Planning but removing dedicated RTP funding for Travel Plan implementation;
- Need to review/increase public parking charges;
- Need to reduce bus fares to make more attractive;
- Car industry incentives making it too easy/attractive to purchase cars;
- Sustainability of National Concessionary Travel scheme – studies available on usage and possible restrictions on peak travel;
- Cycling Scotland training school children to cycle safely on roads and encourage cycling – Safe Routes to Schools;
- Electric Vehicles and charging infrastructure – need for more publicly available infrastructure through LCV funding; need for Scottish Government to extend Plugged In Places across Scotland;
- Car Clubs – Glasgow Peugeot launched; and
- M4 Hydrogen Corridor.

In addition to the above Atkins and the Tactran Board<sup>19</sup> have identified a number of policies and proposals that could be considered by Tactran, and these are set out below.

#### 3.3.1. Low carbon vehicles

##### Existing policies

- EU targets for new cars and vans efficiency;

<sup>19</sup> Those in bold below.

- **Financial support to low carbon vehicles and infrastructure (RPP1);**
- Clean Vehicle Directive;
- Scottish Green Bus Fund;
- *Improve efficiency of taxis and private hire cars (RPP1 proposal);*
- *Changes to BSOG to encourage low carbon buses (RPP1 proposal);*

#### Additional options

- **Stronger financial support to accelerate take-up of electric and plug-in hybrid vehicles (incl. to R&D);**
- Public sector vehicle procurement applying strict efficiency criteria.

### 3.3.2. Low carbon fuels

#### Existing policies

- Renewable Transport Fuel Obligation;
- Scottish Biofuels, Biofuels Business Programme.

#### Additional options

- Further support to development of sustainable biofuels;
- Support production of low carbon electricity (EVs).

### 3.3.3. More efficient use of vehicles

#### Existing policies

- Eco-driving advice (RPP1);
- **Intelligent Transport System Action Plan (RPP1);**
- *Speed limit enforcement (RPP1 proposal);*
- **Liftshare schemes.**

#### Additional options

- Ensure that upper speed limit is not increased;
- Lower speed limits on trunk roads and strict enforcement of speed limits;
- Stronger incentives/support for eco-driving (including for vans and HGVs);
- National motoring package (MTCCI);
- Faster/wider roll-out of active traffic management;
- Further support for car sharing and increase freight loading (consolidation centres).

### 3.3.4. Shifting to more efficient modes

#### Existing policies

- **Travel planning advice, Smarter Choices Smarter Places (RPP1);**
- *Personalised travel planning, all households by 2022 (RPP1 proposal);*
- *All workplaces with effective travel plan by 2022 (RPP1 proposal);*
- **Cycling Action Plan (RPP1);**
- ***Cycling and walking infrastructure (as in Sweden - RPP1 proposal);***
- **Support to car clubs;**
- Freight grant scheme (road to rail or water);
- **Rail improvements.**

#### Additional options

- **Stronger investment in public transport, walking and cycling infrastructure;**
- **Improvements to delivery of PT services (bus quality partnerships, quality contracts);**
- **Stronger investment in travel planning and Smarter Choices programme (early delivery and further roll-out/repeat interventions);**
- **Use of pricing mechanisms: road user charging, car parking charges, workplace parking levy, etc / PT fare reduction, reward schemes.**

### 3.3.5. Reducing the need to travel and changing destinations

#### Existing policies

- Scottish Planning Policy;
- *Community hubs (RPP1 recommends further analysis of options);*
- **Home/flexible working.**

#### Additional options

- **Review of service delivery to reduce need to travel (education, health, public services, shopping, leisure);**
- Faster roll-out of community hub programme;
- **Scottish Planning Policy to support urban density increases;**
- **Further support to encourage home/flexible working.**

### 3.3.6. Avoiding counterproductive investment

Potential issues include:

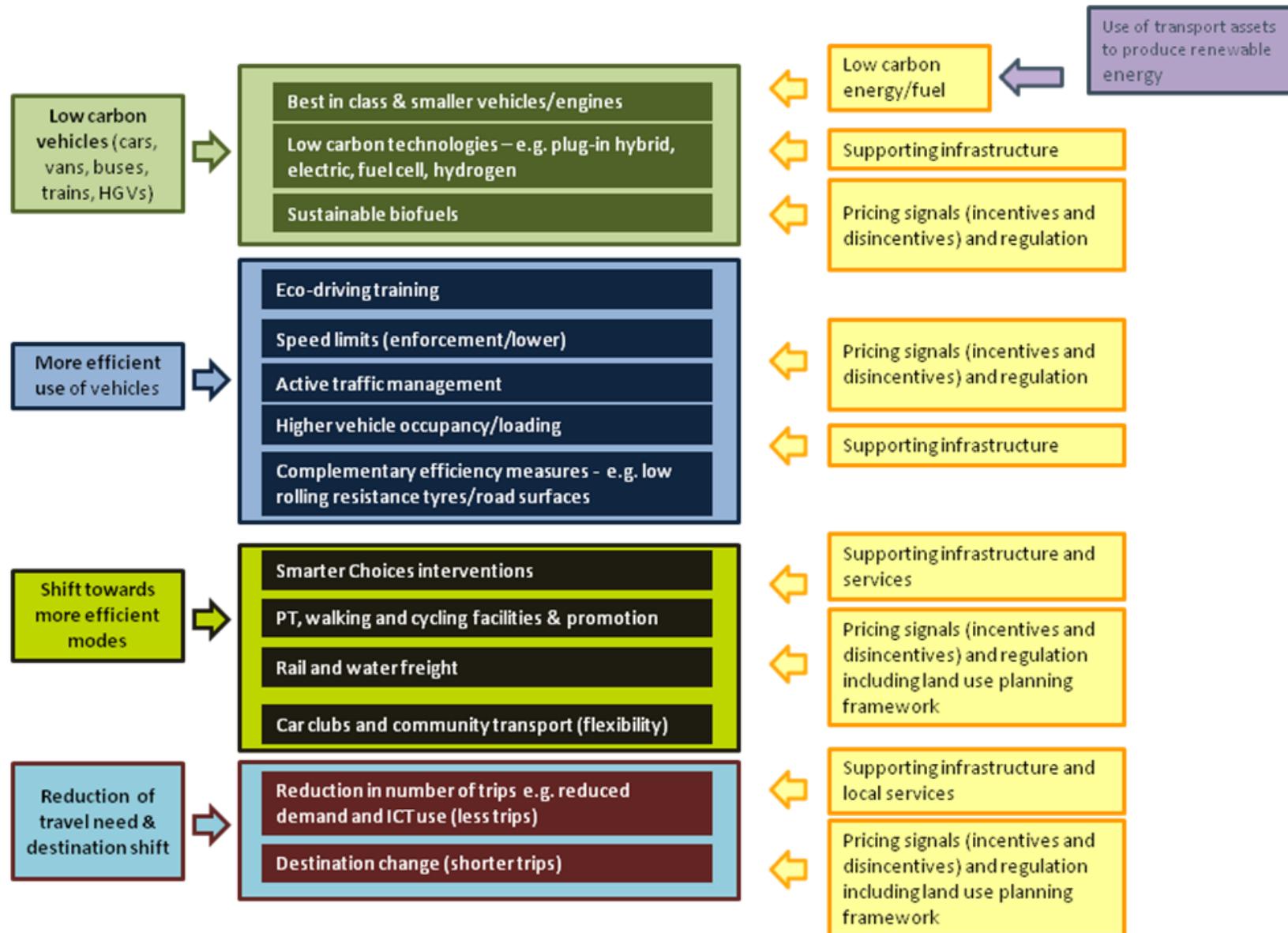
- Proposal to increase speed limits in the UK to 80mph on motorways (decision to be devolved in Scotland);

- 
- Transport investment and scheme design; and
  - Changes to financial incentives and disincentives (for example fuel tax, vehicle tax, etc).

### **3.3.7. Transport sector mitigation framework**

Options to further reduce transport sector emissions are summarised in the transport sector mitigation framework presented in Figure 3.3 overleaf.

Figure 3.3 – Transport sector mitigation framework



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## 4. Next steps

This chapter identifies the next steps for Tactran and Tayplan to develop their climate change strategies to address the public bodies' duties:

- Monitor current Regional Transport Strategy (RTS) and delivery of transport schemes and investment in the Tactran / Tayplan area to assess potential impact/evaluate actual impact on emissions;
- Gather information on current best practice and outcomes of investment and behaviour change work in the area (for example, on the outcomes of the Smarter Choices, Smarter Places programme and on progress made by local employers);
- Identify and test required changes in policy/strategy to achieve further emission reduction through the development of RTS2 (linked to the development of SDP2 by Tayplan) and Community Planning approach;
- Review current RTS monitoring framework and update indicators to take account of requirements for mitigation and adaptation monitoring as well as data availability (liaising with Scottish Government to identify the best data sources to be used, for example based on data used for the Scotland Carbon Account for Transport and RPP1/2 monitoring, and considering monitoring frameworks set out through SOAs); and
- Review climate change risks with regard to the area's transport system and service and develop a climate change adaptation strategy for the transport sector.

## A. Appendix A: Further Modelling Detail

### A.1. Introduction

This appendix provides further detail on the spreadsheet modelling undertaken to produce the emissions forecasts presented in the main report.

### A.2. Traffic Growth Forecasts

Estimates of traffic levels in 2007, 2012, 2017 and 2022 for both scenarios were derived from Transport Model for Scotland model runs provided by Transport Scotland. The output provided comprised information on traffic on links for the most up to date 'Reference Case'. This was identified by Transport Scotland to be Alternative Scenario A (run in 2011) which includes the following key inputs and assumptions:

- Economic Scenario based on;
  - published statistics for the period up to 2009;
  - Ernst and Young Scottish ITEM Club December 2010 Forecasts for the period to 2020; and
  - Transport Scotland's trend forecasts for post 2020.
- National Demographic Scenario - 2008 mid year GROS National Population projections;
- Model updates with respect to most recent webTAG guidance;
- Rail fares assumed to increase over time at 1% above RPI;
- Planning Data - 2007 and 2008 based approved planning policy information;
- Transport Interventions - 2011 list of 'most likely' transport interventions.

Estimates of traffic levels for 2027 and 2032 (which exceed the current TMfS forecasting horizon) were made on the basis of the DfT's TEMPRO estimates of future trip growth and a relationship between TEMPRO and TMfS forecast growth derived from comparison of the growth forecast by the two sources in the earlier modelled years.

Traffic data from TMfS was provided for each link in the model for each time period and modelled year. The links were then allocated to the relevant local authority districts and to the Tactran and Tayplan areas using GIS analysis.

Uplifts to account for the local traffic not captured in the model (as TMfS is intended to be a strategic model) were made on the basis of a comparison of modelled and observed traffic by area and road type in the base year.

### A.3. Emissions calculations

To facilitate the emissions calculations, the link based TMfS traffic information was summarised in the spreadsheet model, disaggregated into categories identified by:

- Average speed on link;
- Road type (Motorway, Trunk Urban/Rural, A Urban/Rural, Minor Urban/Rural);
- Vehicle type (broad categories Car, LGV, HGV – then split into technology categories using CCC assumptions - see below); and

- Level of congestion on link (determined in terms of ratio between traffic volume and road capacity).

Estimates of the emissions generated by each category of traffic were then made on the basis of emissions factors derived from:

- Speed profiles: applied to estimate variation in speed around the average for each link (currently based on GB profiles);
- Assumed detailed fleet composition: based on CCC Extended Ambition Scenario<sup>20</sup> (8 main vehicle types, small, medium and large cars, vans, rigid goods vehicles (< and > 7.5tonnes) and articulated goods vehicles (< and > 33tonnes) subdivided into over 80 technology categories); and
- Emissions factors based on CCC assumptions but with additional information on variation in emissions with speed built in (based on NAEI functions).

#### A.4. Validation for base year

The spreadsheet calculations of emissions totals developed for the study were validated by cross referencing the 2007 district forecasts against DECC estimates for the same year (based on NAEI data). The results from the two sources are within 2% at the national and Tactran level<sup>21</sup> as shown in Table A1 below.

**Table A.1 – Comparison of 2007 road transport CO<sub>2</sub> forecasts, DECC and study model, MtCO<sub>2</sub> p.a.**

Area	DECC 2007 (NAEI)	Model Forecast	Difference
Tactran	1.44	1.41	-2%
Scotland Total	11.29	11.13	-1%

<sup>20</sup> Derived from the spreadsheet model used by the CCC to support forecasting of transport emissions in the budget periods to 2022

<sup>21</sup> It was not possible to directly compare the Tayplan area total as the DECC totals are provided for Local Authority areas only and only part of Fife falls within the Tayplan area.

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