TRANSPORT SCOTLAND
CÒMHDHAIL ALBA

Carbon Account for Transport

No. 7: 2015 Edition

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This document provides an annual update of the Carbon Account for Transport, first published in August 2009. Future updates will be released as new data become available.

Contents

Executive Summary

The CAT provides a carbon balance sheet for Scotland, and presents the impact of all Scottish transport policies and projects: .... *expected to have a significant impact on carbon, whether positive or negative* (National Transport Strategy page 46). Based on greenhouse gas emissions estimates up to and including 2013, the main findings in this latest report are:

- In 2013 Scottish emissions from all sectors amounted to 53.0 mega-tonnes of carbon dioxide equivalent ($MtCO_2e$). Transport's share, including emissions from international aviation and shipping (IAS) was 12.9 $MtCO_2e$. Transport thus accounts for just under one quarter of Scotland's total emissions.

- Transport emissions, including IAS have fallen for six consecutive years and by 1.9 $MtCO_2e$ since peak figure of 14.8 $MtCO_2e$ recorded in 2007.

- Road transport emissions account for 72.0% of all transport emissions and cars account for over half road emissions. Emissions from cars account for just under 40% of all transport emissions while emissions from goods vehicles (combined light and heavy) account for 28% of total transport emissions.

- Looking at the entire period 1990-2013:

  Total transport emissions (12.9 $MtCO_2e$) remain below their 1990 level of 13.2 $MtCO_2e$.

  At 5.1 $MtCO_2e$, emissions from cars are below their 1990 level of 5.8 $MtCO_2e$

  Emissions from aviation have risen by a third since 1990 to stand at 1.9 $MtCO_2e$ with goods vehicle emissions up 27% at 3.7 $MtCO_2e$.

  The significant rise in emissions from good vehicles (from 2.9 $MtCO_2e$ to 3.7 MtCO2e in 2013) is largely a result of the increase in emissions from Light Good Vehicles prior to 2007 with HGV emissions accounting for the bulk of the increase from 2009.

- The specific infrastructure projects outlined in the CAT add an estimated net 0.05 MtCO2e to total transport emissions in 2027 – equivalent to 0.4% of current transport emissions.

Chapter 1: Introduction

This is the seventh edition of the Carbon Account for Transport. This seventh report follows the same structure as previous reports and for the second year is accompanied by an infographic to highlight some of the key headlines from the report. Due to delays in the publication of other data used in this report there is no comparison with EU countries in this edition. Similarly, a slight delay in other key disaggregated UK transport data means that the sources and data used to consider the picture in 2014 have changed. These new data sources do though still provide a useful insight into the likely position of Scotland's 2014 emissions.

This year's edition contains one new section, a more in depth look as the light goods sector of the vehicle fleet. This analysis lies between sections 2.5 and 2.6

1.1 Policy Context

The Government Economic Strategy[1] states that the Purpose of the Scottish Government is to:

"… create a more successful country, with opportunities for all of Scotland to flourish, through increasing sustainable economic growth." (The Government Economic Strategy 2015, p4).

In support of the Strategy, the Climate Change (Scotland) Act[2] creates the statutory framework for greenhouse gas emissions reductions in Scotland by setting an interim 42% reduction target for 2020, and an 80% reduction target for 2050. To help ensure the delivery of these targets, the Act also requires Scottish Ministers to set batches of annual targets for Scottish emissions in the period 2010 to 2050. In October 2010, the Scottish Parliament passed legislation setting the first batch of annual targets for the years 2010 to 2022[3].

[1] http://www.gov.scot/Resource/0047/00472389.pdf
[2] http://www.gov.scot/Topics/Environment/climatechange/scotlands-action/climatechangeact
[3] The Climate Change (Annual Targets) (Scotland) Order 2010, SSI 2010 no.359

Finalised in March 2011, Low Carbon Scotland: Meeting the Emissions Reduction Targets 2010-2022: The Report on Proposals and Policies[4], and the Low Carbon Economic Strategy (LCES)[5] together set out how we can meet these climate change targets and secure the transition to a low-carbon economy.

In line with the requirements of the Climate Change (Scotland) Act, the latest batch of annual targets covering the period 2023-27 were agreed in October 2011[6] and in June 2013 the Government published Low Carbon Scotland: Meeting the Emissions Reduction Targets 2013-2027: The Second Report on Proposals and Policies[7] (RPP2). This document set out a possible pathway and options for delivering the necessary reductions out to 2027.

Delivering both the interim and final emissions reduction target will be challenging. Tackling emissions from transport will require the combination of both reserved and devolved policies set out in RPP2 to ensure the sector plays its full and fair part in achieving each target.

1.2 Purpose of the Carbon Account for Transport

The National Transport Strategy (NTS)[8] outlines three key strategic outcomes for transport in Scotland:

- Improve journey times and connections
- Reduce emissions
- Improve quality, accessibility and affordability

The 'reduce emissions' outcome includes a commitment to develop a carbon balance sheet for transport with the expectation that:

[4] http://www.gov.scot/Topics/Environment/climatechange/scotlands-action/lowcarbon/rpp
[5] http://www.gov.scot/Publications/2010/11/15085756/0
[6] http://www.legislation.gov.uk/ssi/2011/353/made
[7] The Second Report on Proposals and Policies
[8] Scotland's National Transport Strategy (2006), The Scottish Executive.

"This will present the impact of all Scottish transport policies and projects that are expected to have a significant impact on carbon, whether positive or negative."(National Transport Strategy, p46)

This commitment is met by the regular publication of the Carbon Account for Transport (CAT). The CAT provides updates on the following information:

- Official Scottish transport emissions data from 1990 up to 2013
- Emissions efficiency estimates for passenger vehicles
- Key forward looking transport indicators
- Scottish transport infrastructure projects likely to have a significant impact upon emissions
- [Assessments of likely impact of Scottish, UK and EU wide regulatory and fiscal measures]

Each of these components can be used to monitor and review progress towards achievement of the 'reduced emissions' strategic outcome for transport and further support the development and implementation of actions to reduce emissions in accordance with the targets in the Climate Change (Scotland) Act.

It is important to be clear from the outset that the CAT is not a decision making tool at either the individual project or policy level. Nor is its function to reject those projects or policies that have a negative impact on emissions (i.e. lead to increased emissions). Instead, its purpose is to present in a clear and consistent manner relevant data and analysis to inform the Scottish Government and Transport Scotland's consideration of future transport options. The tool for appraising new transport policies and projects, where the impact on the environment is one of the five criteria considered alongside economy, safety, integration and accessibility and social inclusion remains the Scottish Transport Appraisal Guidance (STAG)[9].

The CAT continues to provide an estimate of the net impact of all devolved transport infrastructure interventions that fall within the competence of the Scottish

[9] http://www.transport.gov.scot/stag

Government or other Scottish public bodies and are likely to have a material impact on emissions. Details of the methodology and the results from the current assessment are set out in section 3.4.

In achieving its objectives, the CAT constitutes an important element of a wider framework adopted across the Scottish Government to monitor the rate of emissions reduction.

Chapter 2: Historical emissions analysis

2.1 Background and data sources

The emissions data presented in this chapter are from the 'Greenhouse Gas Inventory for England, Scotland, Wales and Northern Ireland: 1990-2013'[10] (GHGI) unless otherwise stated. The GHGI is compiled on an annual basis and the complete time series of all greenhouse gases is updated in each publication to take account of improved data and any advances in calculation methodology. This updating has led to a significant increase in the base year Scottish emissions figure for 1990 which in turn has impacted on the absolute emissions reduction required to meet the key climate change targets. The greenhouse gases associated with transport and recorded by GHGI are Carbon Dioxide (CO_2), Nitrous Oxide (N_2O) and Methane (CH_4)[11].

The transport category within the GHGI covers emissions from road, aviation, rail and maritime transport. While domestic aviation and shipping emissions are recorded in the GHGI, emissions associated with international aviation and shipping (IAS) were not originally reported. However, using existing data sources, an indicative assessment of the emissions from international aviation and shipping from each country in the United Kingdom was first published in 2009 and continues to be published within the dataset that accompanies the GHGI publication. Consequently,

[10] Greenhouse Gas Inventory for England, Scotland, Wales and Northern Ireland: 1990-2012, AEA Technology; http://naei.defra.gov.uk/reports/

[11] While not relevant to the transport sector, the full inventory includes the three other greenhouse gases - Hydrofluorocarbons (HFCs) Perfluorocarbons (PFCs) and Sulphur hexafluoride (SF_6).

in line with the Scottish Government commitment to include emissions from IAS within the targets set by the Climate Change (Scotland) Act, references to aviation and maritime emissions in this document refer to both domestic and international, unless otherwise stated.

In line with the methodology used to report against the Climate Change (Scotland) Act, the transport emissions reported in this section only cover emissions at the point of use (tailpipe emissions). Consequently, no lifecycle impacts within the transport infrastructure and no displaced impacts, such as the emissions generated by the electricity used on electrified railways, are included.

2.2. Total emissions trends for Scotland and the Scottish transport sector

In 2013 total Scottish emissions from all sectors amounted to 53.0 mega-tonnes of carbon dioxide equivalent ($MtCO_2e$)[12]. This total represents a 2.0 $MtCO_2e$ or 3.6% reduction from the equivalent 2012 figure. Compared to the 1990 base year Scotland has reduced its total emissions by 34.4%.

Transport's share of this Scottish total is 12.9 $MtCO_2e$. After a sequence of almost continual increases in transport emissions from 2000, the run peaked in 2007. Since reaching this peak of 14.8 $MtCO_2e$ transport emissions have fallen year on year and are now below their 1990 base year level of 13.2 $MtCO_2e$ and 13%, or 1.9 $MtCO2_e$, below the 2007 peak.

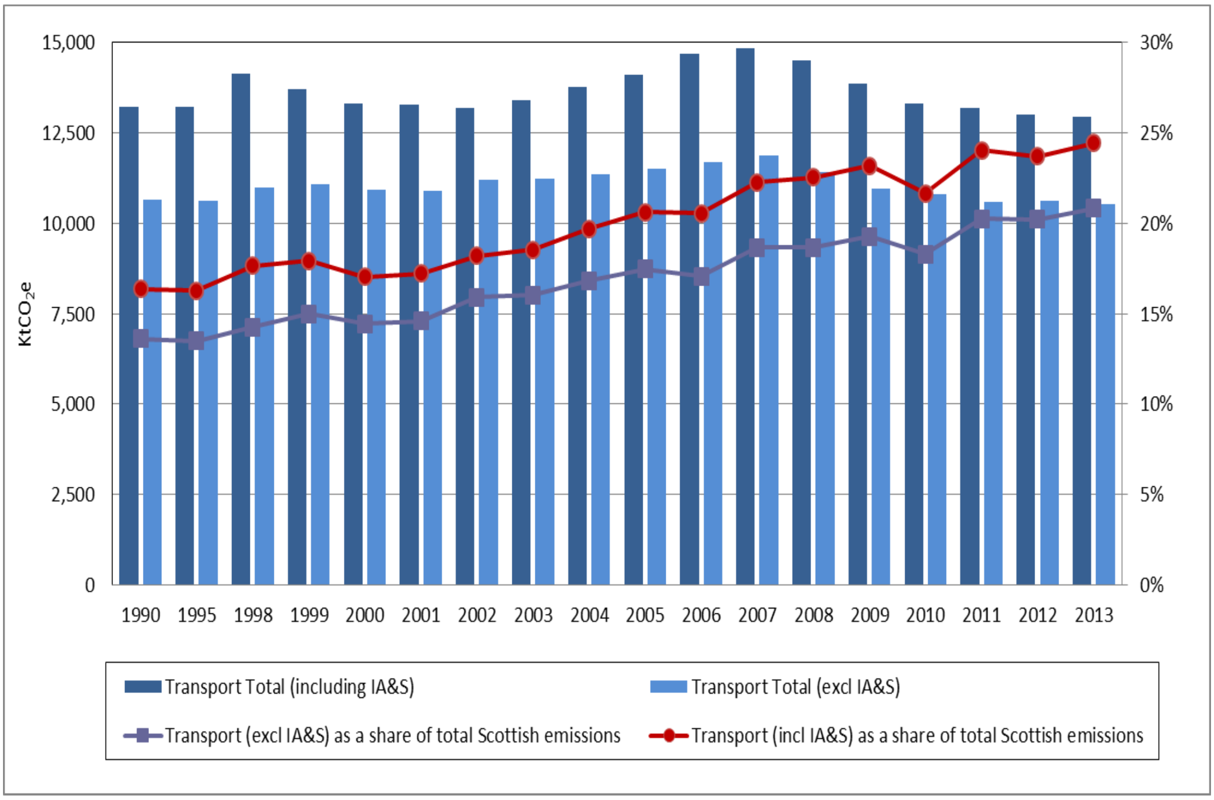
The run in emissions reductions has been as a result of a number of factors. Principal among them initially was the continuing uneven nature of the recovery in real household incomes, a growing investment in public transport infrastructure, improvements in fuel efficiency, government emissions policies, land-use planning and high global oil prices. More recently, as road emissions have stabilised it is lower maritime emissions that are behind the continuing downward trend.

[12] This calculation uses the unadjusted Scottish emissions total for 2013- i.e. excluding the impact of the EU Emissions Trading System (ETS). Including the ETS would lower Scotland's net emissions total and it is this adjusted total that is used in assessing Scotland's performance under the Climate Change (Scotland) Act.

The latest data on economic performance in Scotland shows 11 quarters of positive GDP growth. The close correlation between GDP and transport emissions will continue to put pressure on the downward sequence of emissions.

With IAS emissions excluded, the transport sector accounts for 20.8% of total Scottish emissions: with them included the proportion rises to 24.4%. The respective shares in 2007 and 1990 were 18.7% and 22.3%, and 13.6% and 16.3%. Figure 1 shows the growing relative importance of transport emissions in Scotland's emissions total.

Figure 1: Total emissions from transport and transport emissions as a percentage of total Scottish emissions, 1990-2013



Source: Greenhouse Gas Inventory, NAEI, 2015, Transport Scotland. Total emissions calculation excludes the impact of the EU Emissions Trading System.

2.3 Emissions analysis by transport sector

2.3.1 Road Transport

Road transport emissions include all private, public and commercial road vehicles. In total, this category accounts for 9.3 $MtCO_2e$ or 72.0% of total transport emissions. The 2013 figure is marginally (less than 0.1$MtCO_2e$) lower than the 2012 figure because the fall in car emissions just exceeded the rise in LGV and bus emissions.

Figure 2 shows that road emission rose almost continuously from 1990 to a peak in 2007 of 10.2 $MtCO_2e$. Since this 2007 peak, road emissions have fallen for five out of the last six years and in 2013 stand 9% below this peak. Total road kilometres since 2007 are only down 2%. Road emissions are though still 2.5% above the 1990 equivalent figure.

Figure 2: Road transport emissions and road transport emissions as a share of total transport emissions, 1990-2013

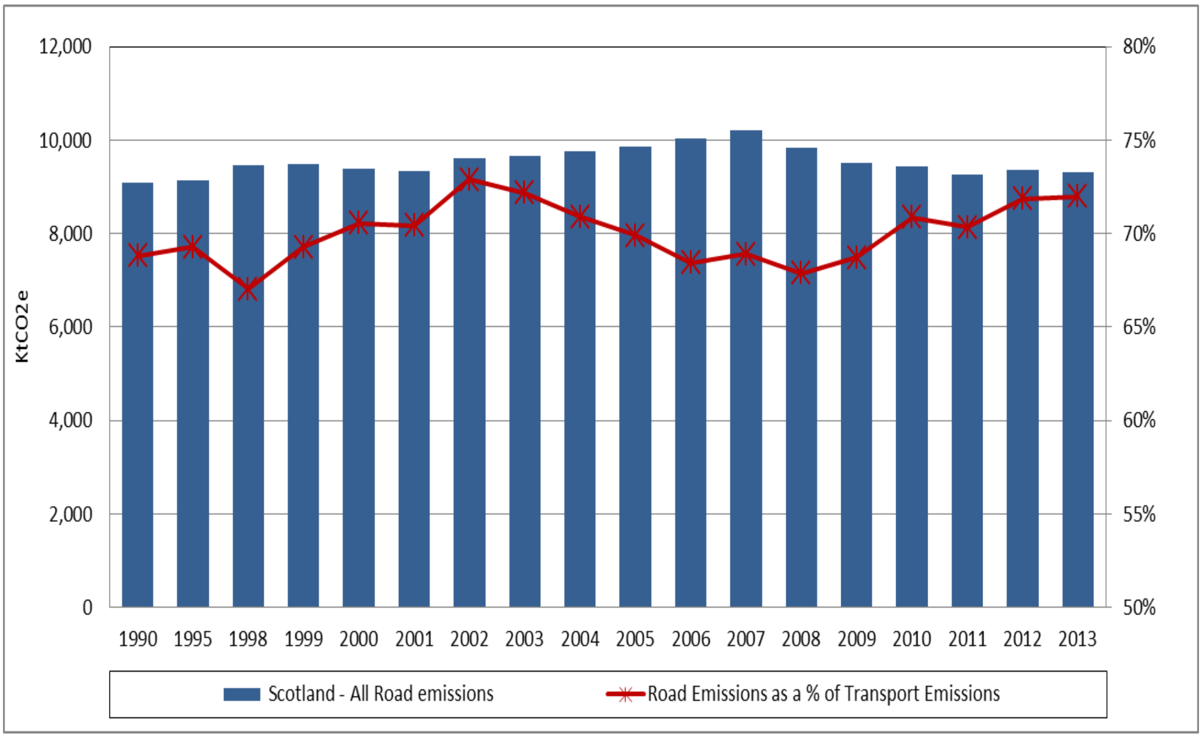
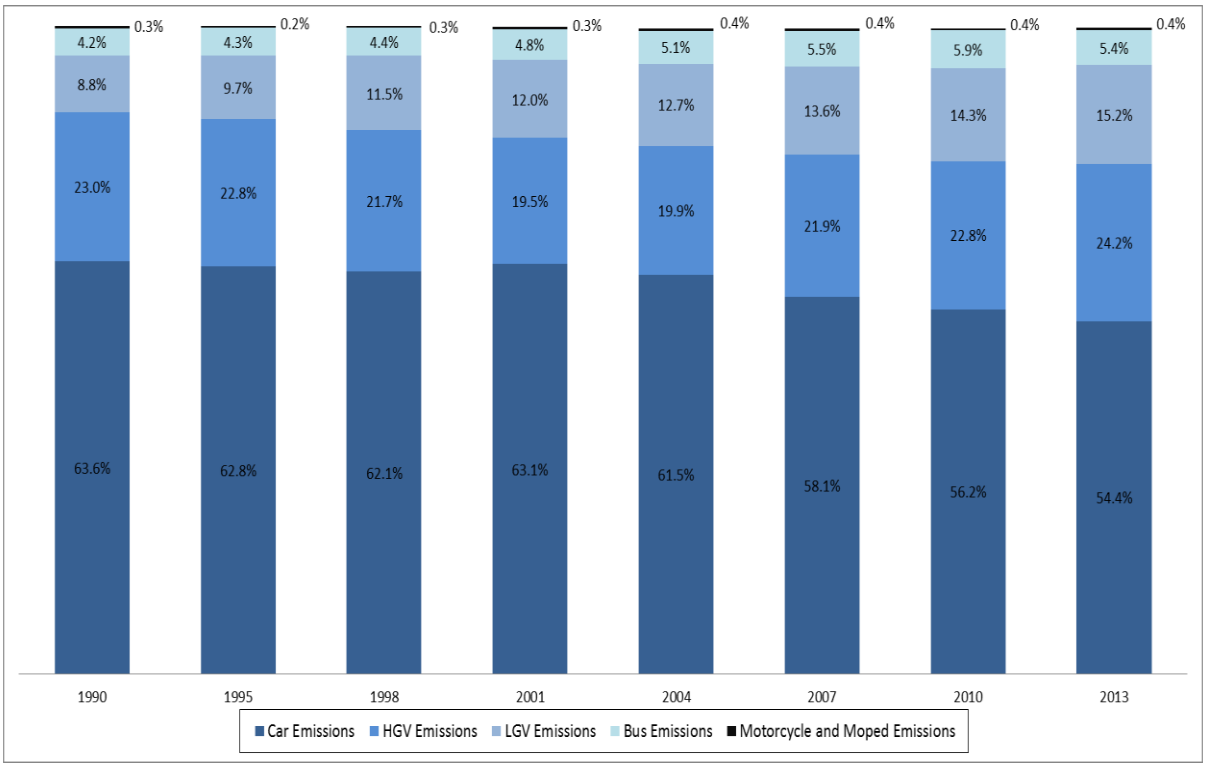


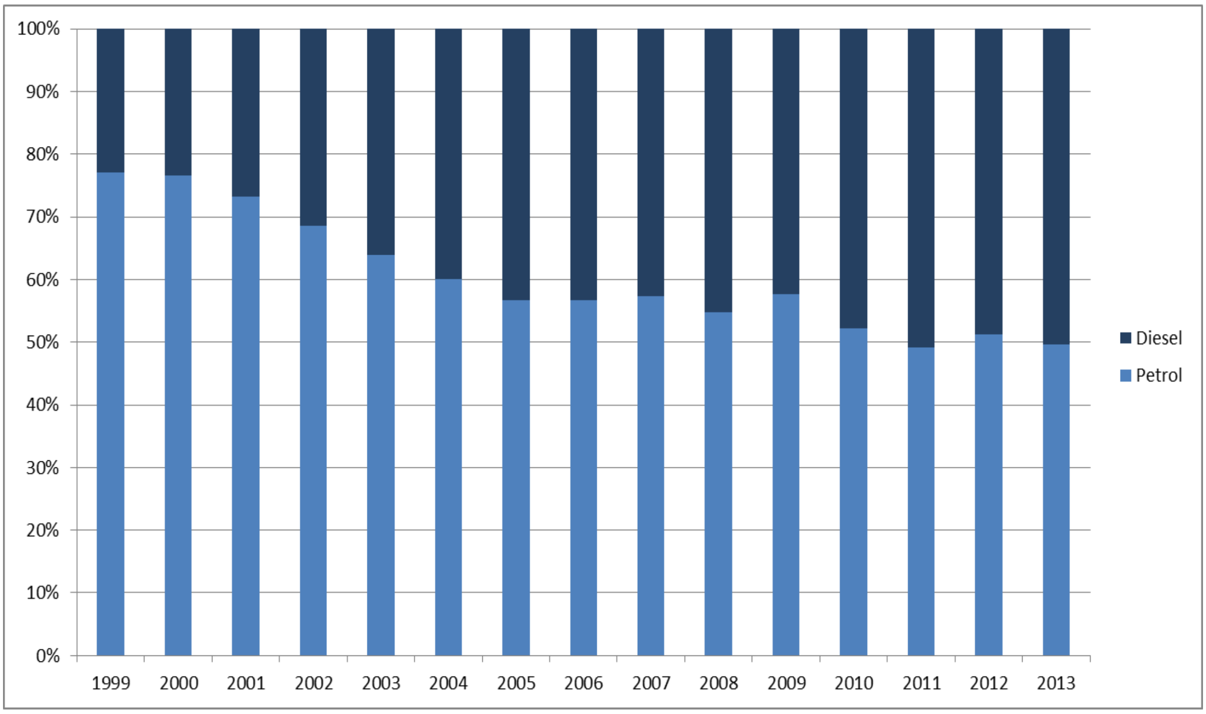
Figure 3 shows the growing relative importance of goods vehicle emissions over cars. While the share of road emissions from cars has fallen from 63.6% to 54.4%, total goods vehicle emissions have risen from 31.8% to 39.4%. Bus and coach emissions have also seen a very small increase over the period but emissions from buses still amount to less than 6% of road transport emissions.

Figure 3: Distribution of road transport emissions by mode – selected years



As well as reflecting improvements in car energy efficiency, car emissions have been affected by changes in the make-up of the passenger car fleet by fuel type. With diesel engines being more fuel efficient than their petrol equivalent (all other things being equal) the balance of the fleet moving in favour of diesel (see Figure 4) has improved the GHG emissions situation. Should the split in new registrations between diesel and petrol settle (around a 50:50 split) this year on year reduction in fleet emissions as a whole from the switching to diesel will end. Further detailed analysis of road transport emissions by vehicle type and road type is undertaken in sections 2.4 and 2.5.

Figure 4: Distribution of new Scottish registrations between petrol and diesel, 1999-2013 – all vehicle body types



2.3.2 Maritime Transport

Emissions from maritime transport[13] in 2013 are estimated to be 1.6 $MtCO_2e$ or 12% of total transport emissions. Figure 5 shows that emissions from this sector have been volatile, due in part to methodological and GHG reporting changes.

Maritime emissions fell by over one million tonnes from their 1998 peak of 2.8 $MtCO_2e$ to 1.7 $MtCO_2e$ in 2002. Thereafter they rose by 0.6 $MtCO_2e$ to reach 2.4 $MtCO_2e$ in 2008 before falling to a new series low in 2013. The 2013 estimate is 39% or 1.0 $MtCO_2e$ below the equivalent 1990 figure. The volatility in the series can be attributed to the performance of international shipping sector (IS) as historically IS emissions account for more than 70% of all maritime emissions. Figure 6 also shows domestic maritime emissions are on a gentle downward pathway.

[13] Includes national navigation and international shipping

Figure 5: Maritime transport emissions and maritime transport emissions as a share of total transport emissions, 1990-2013

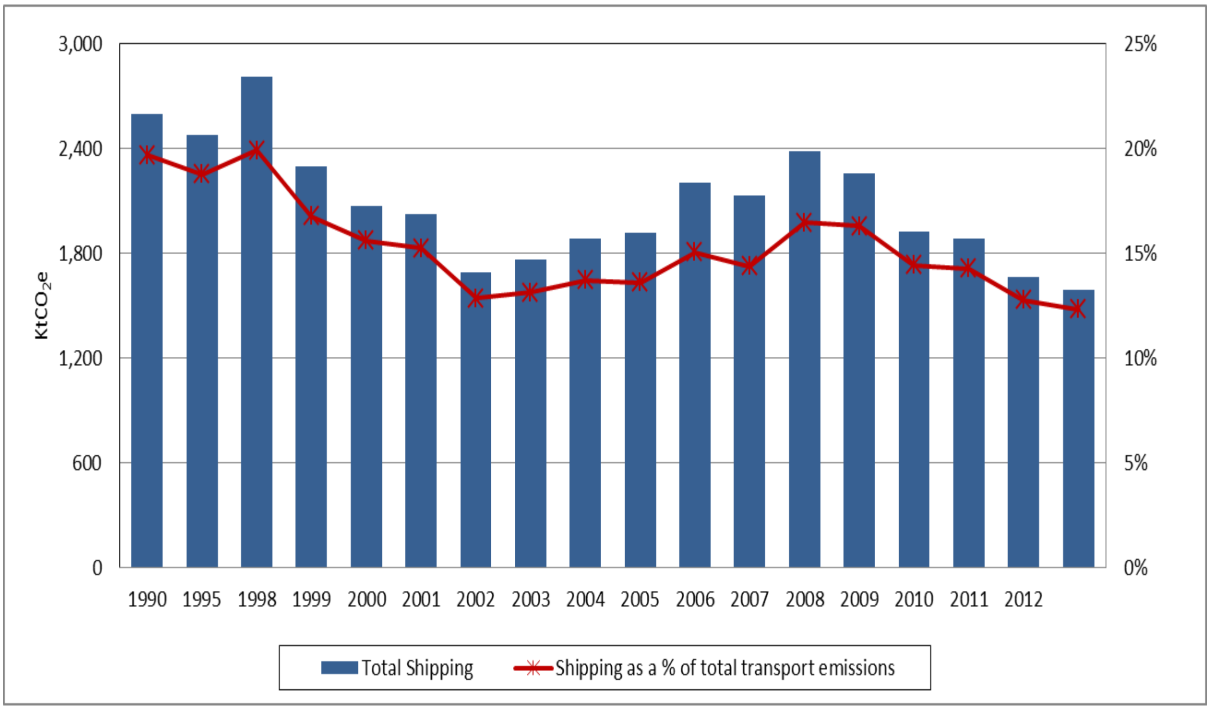
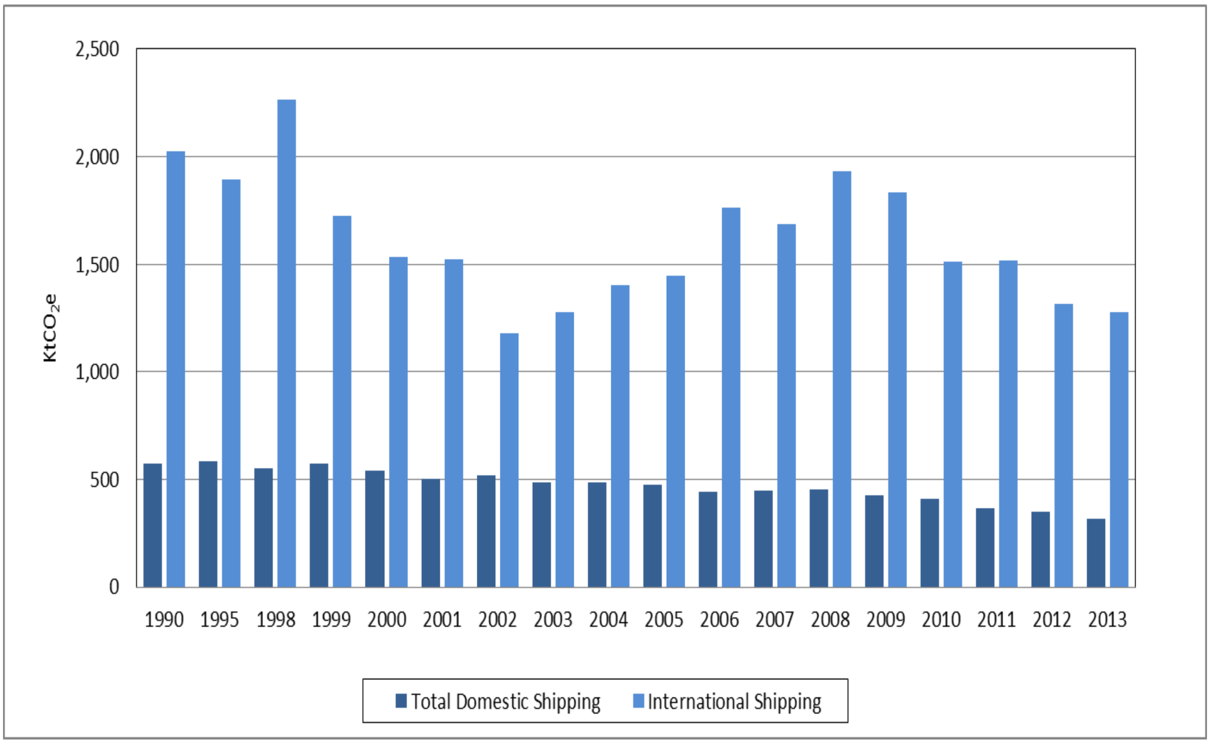


Figure 6: Comparison between domestic and international shipping emissions



2.3.3 Aviation

In 2013 aviation emissions rose back to their 2011 level of 1.9 $MtCO_2e$. This represents an increase of less than 0.1 $MtCO_2e$ over 2012 but aviation emissions are some 0.5 $MtCO_2e$ or a third above their 1990 base year. Aviation emissions now represent 14% of total transport emissions. Figure 7 shows the increasing trend in emissions from 1990 out to 2007 (2.3 $MtCO_2e$) before the recent recession lead to lower year on year emissions until 2010.

Figure 7: Aviation transport emissions and aviation transport emissions as a share of total transport emissions, 1990-2013

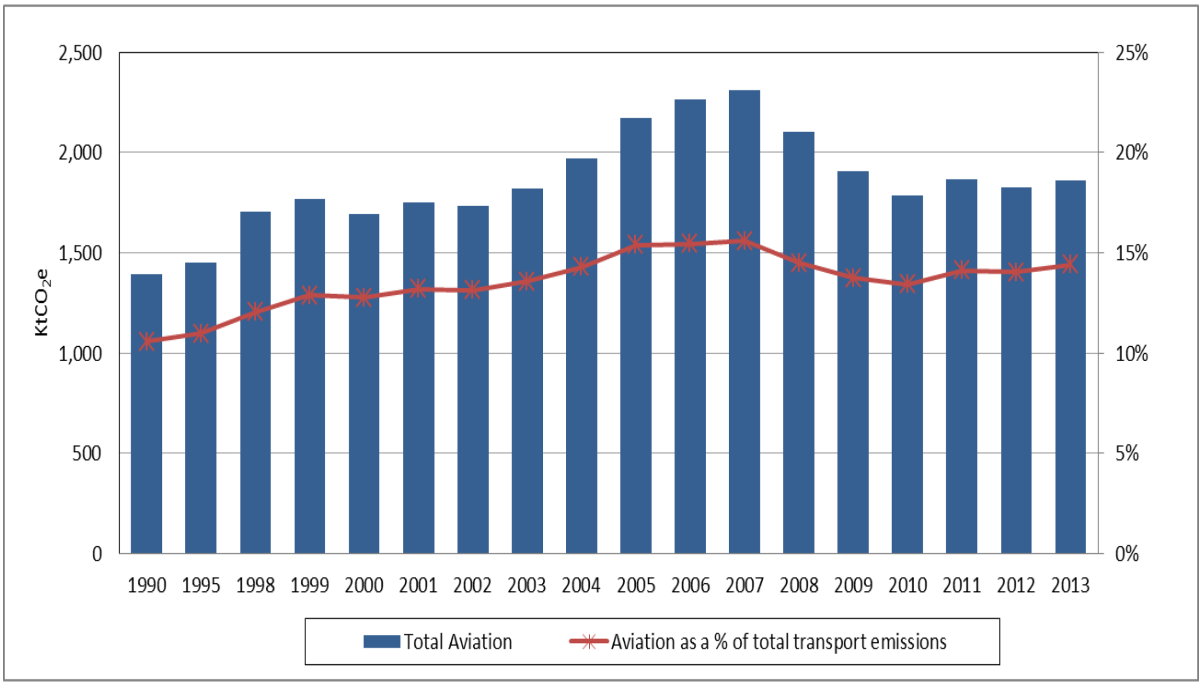
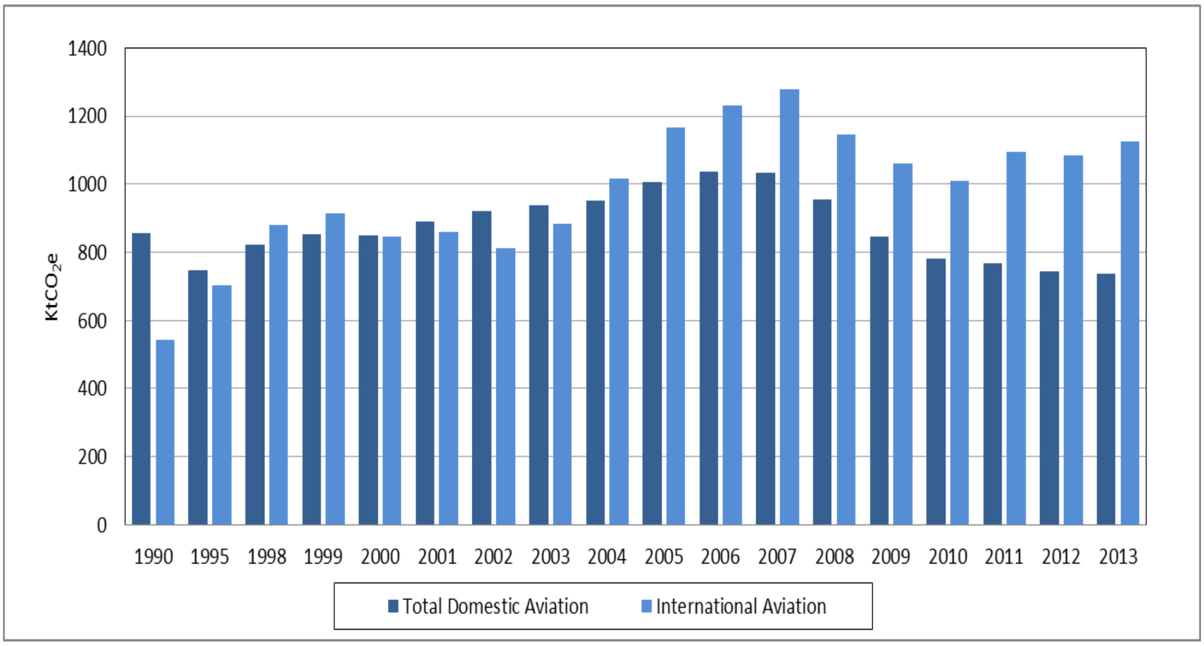


Figure 8 shows that from 1998 to 2004 emissions from domestic and international aviation were very similar and moved together. Since then the series have diverged. In 2013 international aviation emissions are estimated to account for 60% of total Scottish aviation emissions, almost the opposite of the situation in 1990 when domestic aviation emissions accounted for 61% of aviation's total. Between 2012 and 2013 domestic aviation emissions are estimated to have continued to decline (by 1.0%) with emissions from international aviation rising by 4.0%.

Figure 8: Comparison between domestic and international aviation emissions



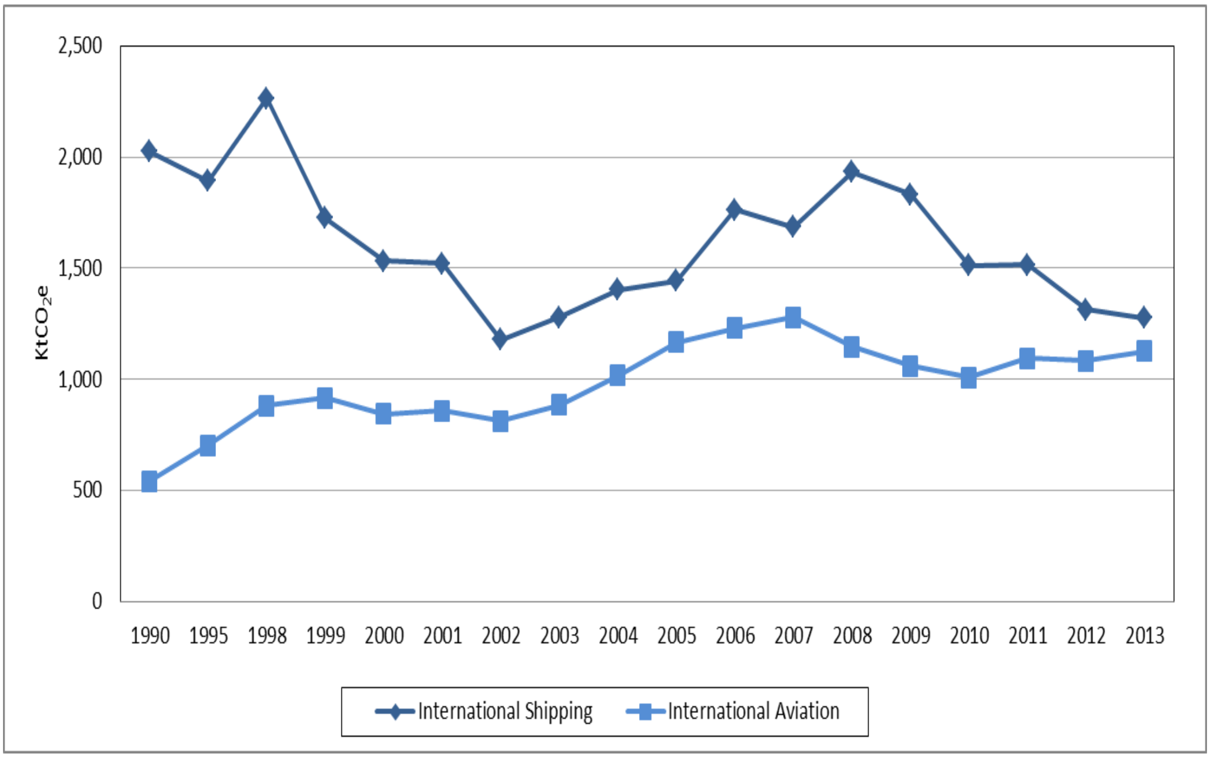
2.3.4 International Aviation and Shipping

After peaking in 2008 at 3.1 $MtCO_2e$, emissions from IAS were almost 0.7 $MtCO_2e$ lower in 2013 at 2.4 $MtCO_2e$. The 2013 figure is marginally higher than the 2012 figure (<0.05 $MtCO_2e$) but 6.4% below the 1990 figure. Between 2007 and 2010 the number of international flights from Scotland fell by 13.9% and emissions form international aviation fell by 21.1%. In the three years since 2010, international flight departures have risen by 17% and international aviation emissions are up by almost 12% or 0.11 $MtCO_2e$.

The estimates for IS emissions fell by 3% in 2013 to just below 1.3 $MtCO_2e$. This 2013 figure is the lowest figure since 2002 and 0.7 $MtCO_2e$ below the 1990 base year estimate.

The split in emissions between the two modes has changed over time with the share of the total coming from aviation rising from 20% in 1990 to almost 48% in 2013.

Figure 9: International maritime and aviation emissions, 1990-2013

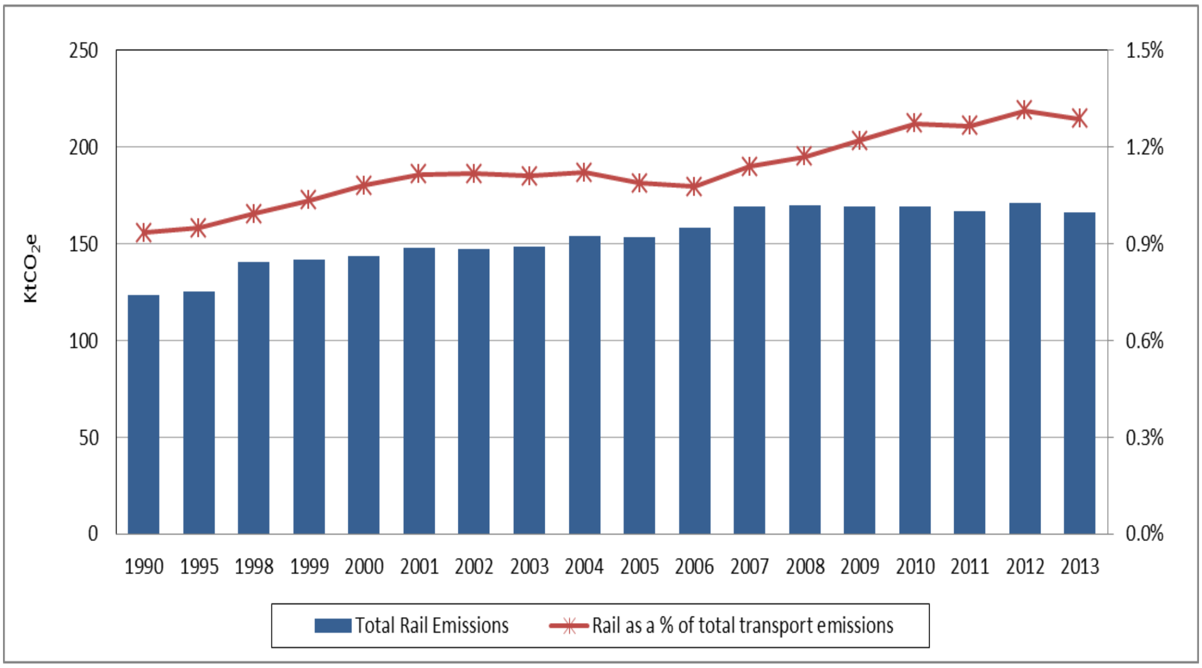


2.3.5 Rail

Rail emissions in 2013 remain under 0.2 $MtCO_2e$, virtually unchanged from 2012. Although rail emissions are 55% above their equivalent 1990 figure rail emissions only account for 1.4% of all transport emissions in Scotland. Total passenger kilometres travelled by rail have increased by almost 40% for the period 2003-04 to 2013-14[14] and scheduled train kilometres have increased by almost 20% over the same period.

[14] Source: Scottish Transport Statistics, No 33, 2014 Edition, Table 7.1

Figure 10: Rail transport emissions and rail transport emissions as a share of total transport emissions, 1990, 2013



2.4 Road emissions by vehicle type[15]

2.4.1 Cars

Emissions from cars have fallen from a peak of 6.1 $MtCO_2e$ in 2002 to an estimated 5.1 $MtCO_2e$ in 2013, a fall of 17%. Over the same period (2002-2013) car kilometres have risen from 33.1 billion kms to 33.8 billion kms. Compared to the 1990 base year car emissions have fallen by around 0.7 $MtCO_2e$ or 12%. Despite this fall, car emissions continue to account for the greatest proportion of road transport emissions at 54%. They also account for 39% of all transport emissions.

2.4.2 Heavy Goods Vehicles

HGV emissions make up the second largest proportion of road emissions and are estimated at 2.3 $MtCO_2e$ in 2013, the same as the 2012 estimate. HGV emissions fell slowly between 1990 and 2001 before growing rapidly. By 2006 HGV emissions surpassed their 1990 baseline figure of 2.1 $MtCO_2e$ reaching 2.2 $MtCO_2e$ in 2007. Emissions then fell in 2008 and 2009. Rises in the 2012 and 2013 have set new emissions peak for HGVs in each year.

[15] For a full definition of exact vehicle types see: DfT vehicle definitions

2.4.3 Light Goods Vehicles

There has been a 78% increase in LGV emissions since 1990. At 1.4 $MtCO_2e$ in 2013 LGV emissions account for 15% of road emissions and 11% of total transport emissions. Emissions increased by almost 3% between 2012 and 2013 in line with the recent steady year on year increase in vehicle kilometres within this vehicle group.

2.4.4 Buses

Emissions from buses rose marginally between 2012 and 2013 and now account for just over 0.5 $MtCO_2e$. Current bus emissions are though still 0.1 $MtCO_2e$ or 32% above the 1990 base year emissions estimate of just under 0.4 $MtCO_2e$. Both vehicle kilometres and passenger journeys were stable between 2012/13 and 2013/14 but both are below their equivalent figure a decade ago.

2.4.5 Motorcycles

Motorcycle emissions fell by 1% in 2013 compared to 2012 but remain at 0.03 $MtCO_2e$ and account for just 0.4% of road emissions and 0.3% of total transport emissions. There has been little change in either kilometres travelled or emissions since the base year.

Figures 11, 12 and 13 illustrate the changes in road emissions by vehicle type, the share of each vehicle type in total road emissions and the year in year change in car, HGV and LGV emissions respectively.

Figure 11 shows that goods vehicles were largely responsible for the increase in road emissions to 2007. Since then the decline in emissions from car has been behind the overall reduction in road emissions. The change in shares between vehicle types between 1990 and 2013 can be seen in Figure 12.

Figure 13 shows seven consecutive year-on-year falls in car emissions from 2007. The pattern with goods vehicles is more mixed with 2008 and 2009 being the only years in which there was a reduction in emissions for both goods vehicle types. Emissions from both rose in both 2012 and 2013.

Figure 11: Breakdown of road emissions by vehicle type, selected years

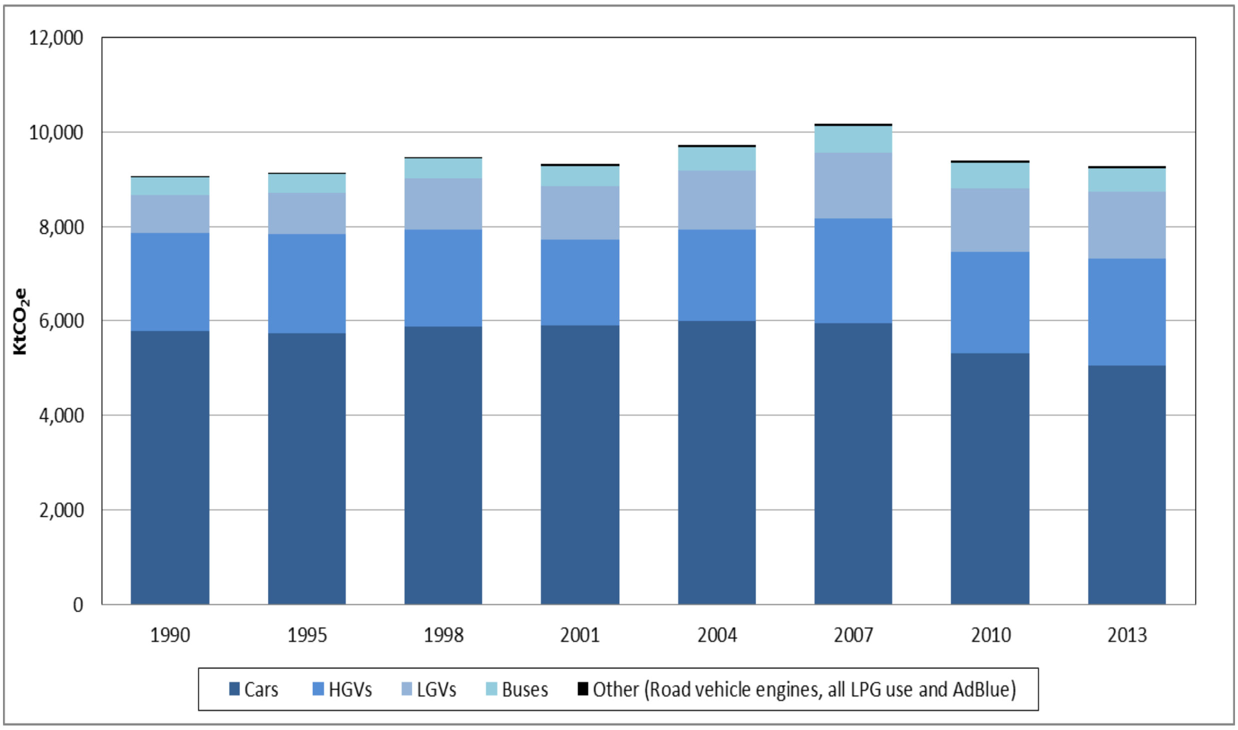
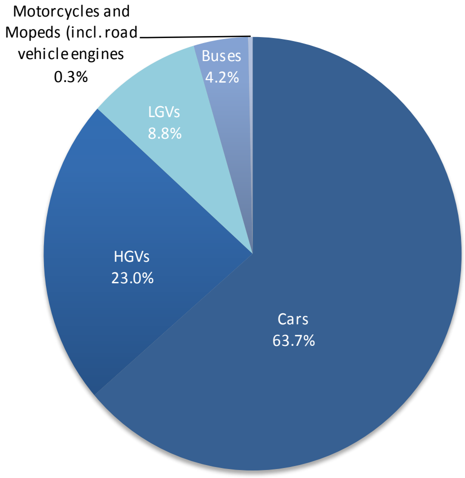


Figure 12: Share of road emissions by vehicle type in 1990 and 2013

1990–total emissions 9.1 $MtCO_2e$



2013–total emissions 9.3 $MtCO_2e$

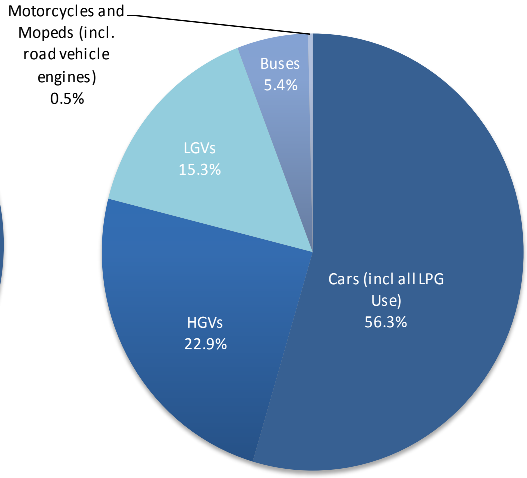
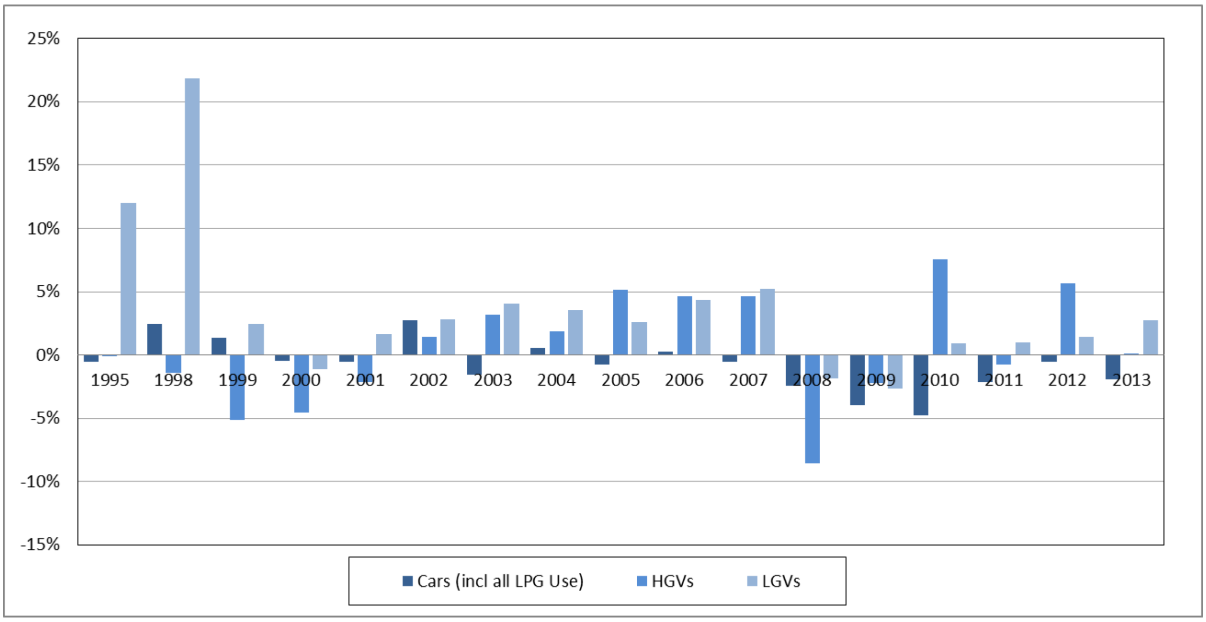


Figure 13: Year in year change in car, HGV and LGV emissions 1995-2013



2.5 Road emissions by road type[16]

2.5.1 Rural

Emissions on rural roads have fallen for six consecutive years since 2007 although only very marginally in 2013. In 2013 rural road emissions are estimated at 4.6 $MtCO_2e$. The latest year's estimate is almost 0.2 $MtCO_2e$ the base year figure of 4.8 $MtCO_2e$. Rural emissions account for half of total road emissions.

2.5.2 Urban

At an estimated 2.7 $MtCO_2e$ in 2013, urban emissions are 10% below their 1990 level and down from a peak of 3.2 $MtCO_2e$ in 2007. Emissions from urban traffic currently account for just under 30% of road emissions.

2.5.3 Motorway

At just over 20%, emissions from motorway traffic account for the smallest proportion of road emissions. At 1.9 $MtCO_2e$ they are though at their highest annual figure. The share in emissions from motorway traffic has been growing and shows a 51% increase over the share in 1990 (Figure 14).

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[16] Rural areas are defined as major and minor roads outside urban areas. Urban areas are defined as having a population of more than 10,000 people. Motorways are a separate classification.

Figure 14: Emissions by road type (Index=1990 for each road type)

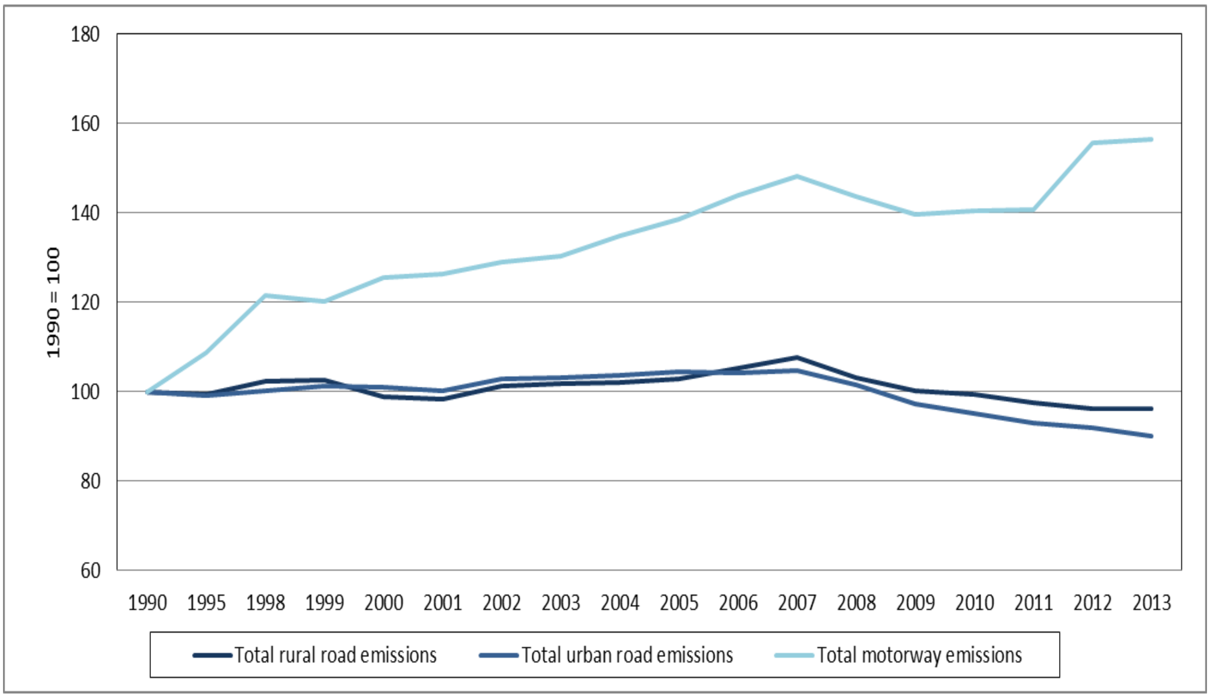
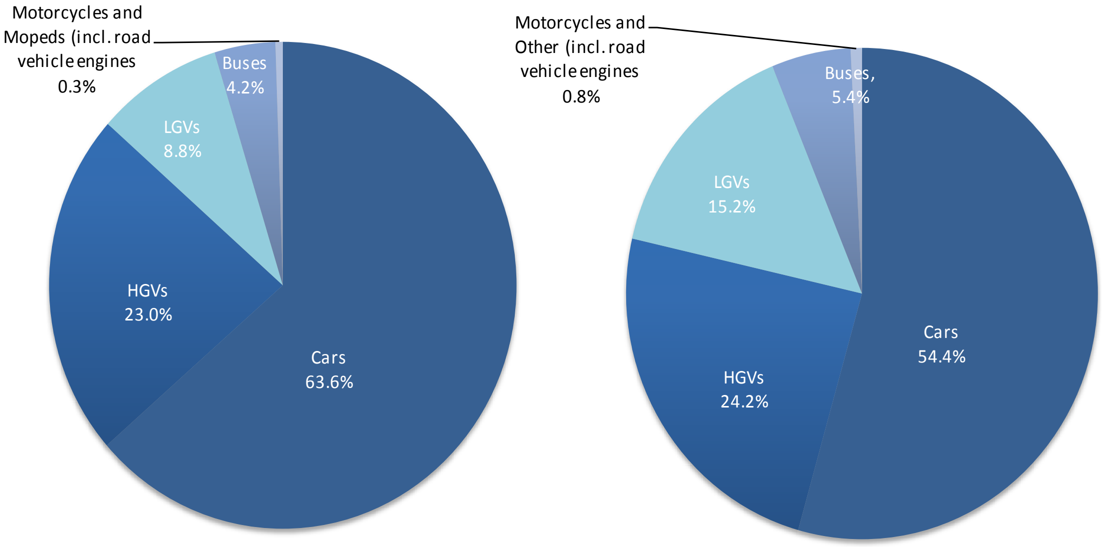


Figure 15: Share of road emissions by road type



1990 Share by road type

2013 Share by road type

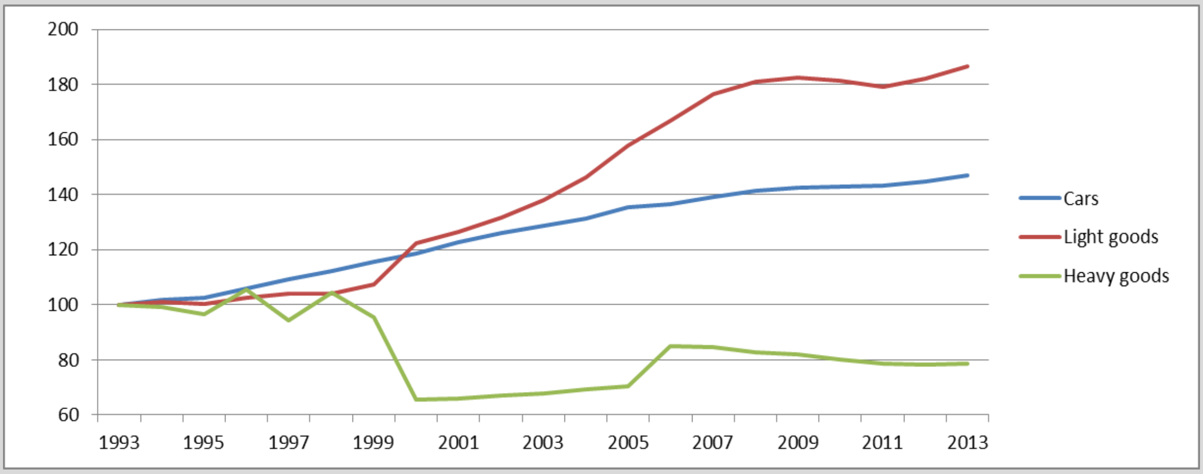
The Light Goods Vehicle sector in Scotland

Light Goods Vehicles (LGVs) cover vans up to a laden weight of 3.5 tonnes and includes small car-like vans made by most vehicle manufacturers, transit vans, long wheelbase vans used by many of the parcel delivery companies, and Luton vans, often used for small house moves or clearances.

Number of vans in Scotland

At the end of 2003 there were 132,000 light goods vehicles registered in Scotland. By 2013 this figure had risen to 247,000, an increase of 115,000 or almost 90%. Over the same period the number of HGVs (>3.5 tonnes) fell from 45,000 to 36,000, a fall of just over one-fifth. As a share of all vehicles, vans have risen from 7.0% to 9.0%.

Figure B1: Change in total registered vehicles by vehicle type 1993-2013 (1993=100)



Numbers of kilometres travelled by vans in Scotland

LGV kilometres driven in Scotland are estimated to have risen steadily since 1995. Back in 1995 they stood at 3.8 billion kilometres. By 2003 they had topped 5 billion and it only took a further 4 years for the total distance to exceed 6 billion kilometres. The global recession then briefly reduced the total distance travelled but LGV kilometres are now on the rise again and reached a new peak distance of 6.3 billion kilometres in 2013. Since 1995 total kilometres have increased 2.4 billion or just under 65% (Figure B2). Over the same period, 1995-2013, total traffic kilometres rose by 7.1 billion kilometres so LGVs are responsible for 35% of the increase in total kilometres (Figure B3). In 1995 vans accounted for just over 10% of total vehicle kilometres. In 2013 this percentage has risen to 14.4%.

Just over 4 billion or 64% of current van kilometres are travelled on major (Motorway & Trunk) roads. A slightly smaller total and percentage of their total kilometres (3.6 billion and 57%) takes place on rural roads (rural roads includes motorway, trunk and minor roads) with 1.7 billion kilometres or 27% accounted for by driving on, mainly minor, urban roads.

Figure B2: Growth in kilometres travelled (1995=100)

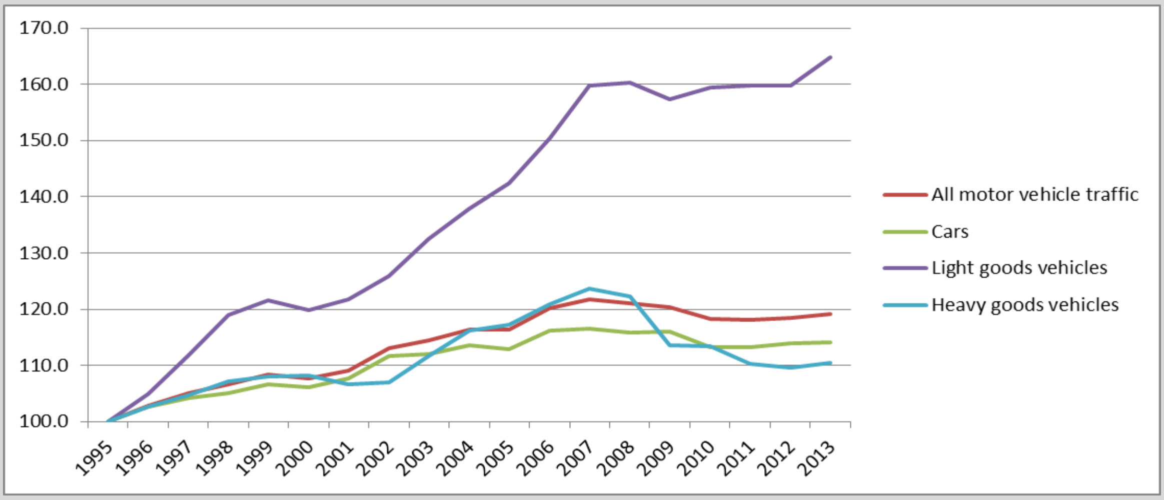
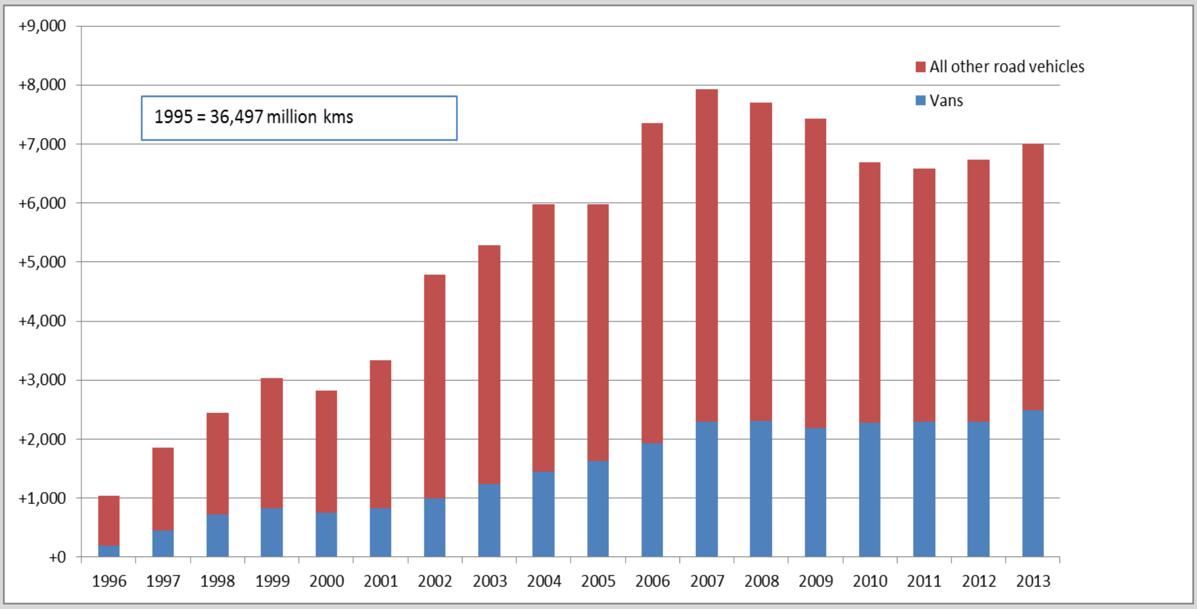


Figure B3: Annual additional million kilometres, light goods vehicles and all other vehicles, compared against 1995 baseline

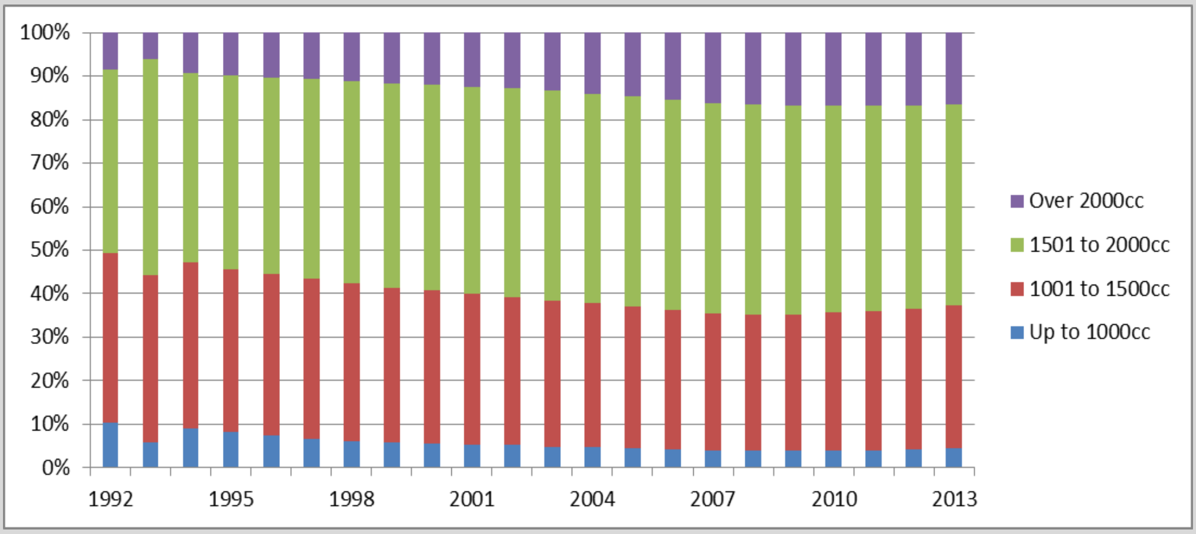


Licenced LGVs: by engine cylinder size

Information is available on the engine size of the LGV, and while this does not also include load capacity there will be a strong correlation between load carrying capacity and engine size. Of course the load factor on an individual journey may be well below the load capacity of the vehicle.

The data on engine size shows that the proportion of vans with a cylinder size of 1500cc or below has fallen from 49% of the fleet in 1992 to 37% in 2015. Some of this may be due to the increasing efficiency of the engines, but the growth in the proportion of engines above 2000cc from around 8% of the fleet in 1992 to 17% in 2013 suggests that the payload capacity of the LGV fleet is increasing (Figure B4).

Figure B4: Change in share of licenced vans at year end, by cylinder size, 1992-2013



The most recent sales data from the Society of Motor Manufacturers and Traders (up to September 2015) covering the UK as a whole shows that there has been a strong growth in LGV sales across the board and but that there has been a particularly strong growth in the 2.5t – 3.5t van category.

Table B1: Breakdown of van sales to September 2015 by type and weight

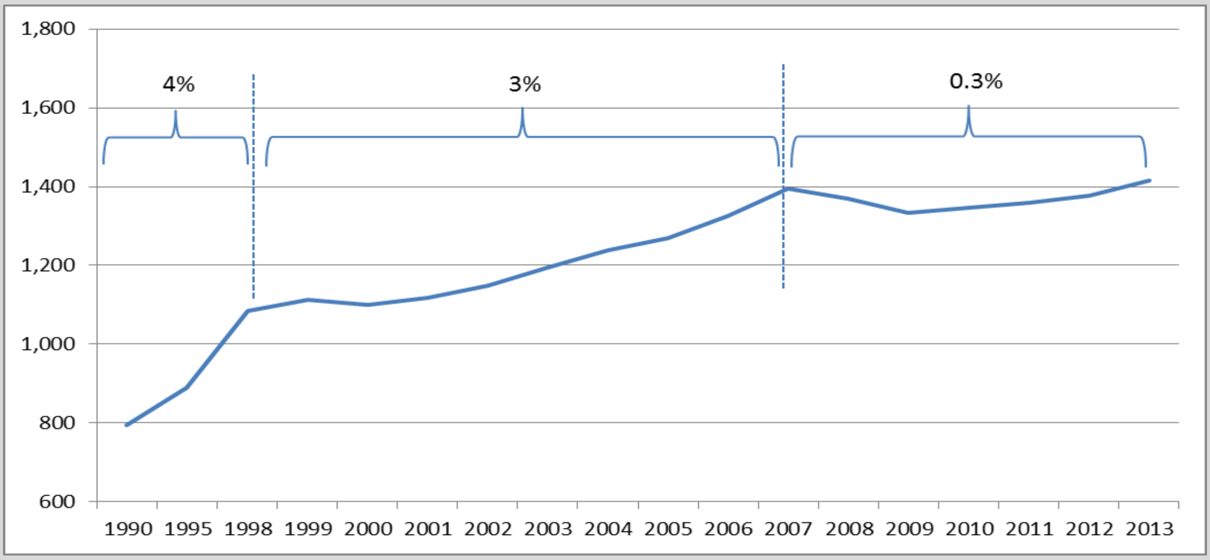
	Year to date	% share
Pickups	32,192	11.3%
4x4s	8,370	2.9%
Vans <= 2.0t	34,009	12.0%
Vans > 2.0 - 2.5t	44,602	15.7%
Vans > 2.5 - 3.5t	164,988	58.1%
All Vans to 3.5T	**284,161**	

Source SMMT: vans sales and own calculation

Emissions from LGVs

With the rise in kilometres driven there has been a consequential rise in emissions from this vehicle category, particularly over the period 1990 to 1998. The introduction of the vehicle emissions directive restricting the emissions per kilometre along with the global recession has slowed the subsequent rate of emissions increase, particularly over the period since 2007 (Figure B5).

Figure B5: Rate of growth in and aggregate emissions from LGVs ('000 $tCO2_e$) 1990-2013



In 1995 emissions per kilometre were estimated to be around 230g CO_2e/km. By 2000 this figure had hardly changed and even in 2013 the figure has only fallen to 225g CO_2e/km. The 65% increase in kilometres marginally exceeds the 59% increase in LGV emissions. Obviously these high level averages cannot take account of payload weight in each period or the engine size changes over the years.

Future LGV use

The Department for Transport projections see kilometres travelled by heavy goods vehicles and cars increase by 44% and 37% respectively between 2010 and 2035; for light goods vehicles, which can weigh up to 3.5 tonnes fully laden, the expected rise is 87% - an annual average growth rate in kilometres travelled of 2.5%.

2.6 Comparison of key Scottish and UK transport emission statistics

Table 1 sets out a number of comparisons between UK and Scottish emissions by broad sector or category, over both the short and longer term.

Table 1: Comparison of Scottish and UK GHG emissions

	Scottish emissions 2013 (ktCO2e)	Scottish emissions as a % of UK emissions 2013	Change in Scottish emissions (2012-13)	Change in UK emissions (2012-13)	Change in Scottish emissions (1990-2013)	Change in UK emissions (1990-2013)
All Transport	12,932	8.2%	-0.6%	-1.0%	-2.1%	7.8%
All Transport (excl. IAS)	10,529	9.1%	-0.8%	-1.0%	-1.0%	-4.1%
Road Transport	9,311	8.7%	-0.5%	-0.8%	2.5%	-2.1%
of which :						
Cars	5,062	8.1%	-1.9%	-2.1%	-12.4%	-13.5%
HGVs	2,256	9.3%	0.1%	0.2%	8.2%	1.3%
LGVs	1,416	9.0%	2.8%	2.7%	78.1%	66.8%
Bus and coach	505	12.5%	3.5%	2.5%	31.9%	19.5%
Motorcycles	33	6.4%	-0.9%	-4.5%	-12.4%	-18.0%
Rural	4,627	10.9%	0.0%	-0.4%	-3.8%	-3.5%
Urban	2,732	7.3%	-1.9%	-2.1%	-9.9%	-15.1%
Motorway	1,897	7.1%	0.6%	0.6%	56.5%	26.6%
Rail Transport	166	7.8%	-2.6%	-2.9%	34.8%	0.8%
Aviation Transport	648	19.8%	-1.5%	-4.8%	-19.5%	-39.6%
Aviation Transport (incl. IA)	1,862	5.2%	2.0%	-1.0%	33.4%	69.9%
Maritime Transport	315	10.8%	-10.0%	-5.4%	-45.2%	-20.4%
Maritime Transport (incl. IS)	1,592	14.1%	-4.3%	-3.4%	-38.7%	-8.8%

- In 2013 Scottish transport emissions, including IAS, accounted for an estimated 8.2% of total UK transport emissions and 9.1% of emissions if IAS is excluded.
- The share of emissions from buses, traffic on rural roads, domestic and international maritime combined and from domestic aviation are disproportionately greater in Scotland than in the UK as a whole, with the opposite holding true for motorway emissions and international aviation. The shares in other categories are broadly similar to the overall picture.
- Between the 1990 base year and 2013, transport emissions in Scotland have fallen by 2.1% whereas for the UK as a whole they have risen by 7.8%.

Without the inclusion of IAS the improvement for the UK as a whole (-4.1%) is greater than for Scotland alone (-1.0%)

- Over time, all sub-categories of Scottish transport emissions have tended to change broadly in line with the equivalent UK series.
- A number of sub categories (vans, motorway emissions, rail, bus and coach and international aviation) have seen sharp rises in emissions over the period 1990-2013 but in absolute terms it is only for vans and international aviation where the increase has been particularly significant.
- Scottish aviation emissions (with IA included) account for only 5.2% of the total UK aviation emissions but this percentage rises to 19.8% if only domestic aviation emissions are considered. This is to be expected given the relative importance of international aviation traffic (and emissions) in England relative to Scotland.
- Emissions from maritime transport in Scotland fell by 4.3% between 2012 and 2013, similar to but slightly greater than the UK reduction over the same period (3.4%). With IS included, maritime emissions in Scotland and in the UK are well below their respective 1990 figures (by 38.7% and 8.8% respectively).

Breaking down the UK estimates to the four home countries sheds a little more light on Scotland's performance relative to England, Wales and Northern Ireland.

- Compared with the 1990 base year, the Scottish aggregate emissions total (incl. IAS) shows a decrease of 2.1%. This is less of a reduction than in Wales but better than the outcome in both England and in N. Ireland where emissions have actually increased.
- Between 2012 and 2013 all four countries saw a reduction in their respective total emissions (incl. IAS).

Table 2: Comparison of Scottish, English Welsh and Northern Irish GHG emissions 1990 – 2013 and 2012 – 2013

			Road	Rail	Aviation	Aviation (incl.IA)	Maritime	Maritime (incl. IS)	All Transport	All Transport (incl. IAS)
SCOTLAND	Emissions	2013	9,311	166	737	1,862	315	1,592	10,529	12,932
	Change in emissions	2012-13	-0.5%	-2.6%	-0.8%	2.0%	-10.0%	-4.3%	-0.8%	-0.6%
		1990-2013	2.5%	34.8%	-13.8%	33.4%	-45.2%	-38.7%	-1.0%	-2.1%
ENGLAND	Emissions	2013	89,278	1,671	2,720	33,626	2,271	8,086	95,939	132,660
	Change in emissions	2012-13	-0.8%	-3.0%	-4.5%	-1.1%	-5.2%	-3.4%	-1.0%	-1.1%
		1990-2013	-3.3%	-3.7%	-38.2%	74.5%	-16.2%	-1.4%	-5.2%	9.2%
WALES	Emissions	2013	5,334	94	71	139	220	1,137	5,719	6,704
	Change in emissions	2012-13	-0.5%	-2.1%	-9.6%	-5.8%	-2.0%	-2.6%	-0.7%	-1.0%
		1990-2013	-3.8%	36.3%	-59.4%	-45.0%	-17.8%	-3.7%	-5.6%	-4.8%
N.IRELAND	Emissions	2013	3,687	37	259	394	107	502	4,089	4,619
	Change in emissions	2012-13	-1.1%	-1.3%	-2.5%	-6.3%	-2.6%	-2.7%	-1.2%	-1.7%
		1990-2013	23.3%	48.0%	10.9%	36.9%	-1.8%	15.8%	21.8%	23.6%

2.7 Efficiency of passenger vehicles

Measuring the efficiency of passenger vehicles in terms of the CO_2e per passenger kilometre (ppkm)[17] provides another useful dimension for transport emissions - it helps consider relative efficiencies at mode level within the aggregate emissions story.

According to UK Company Reporting Guidelines[18], at just under 30g CO_2e/ppkm a coach generates the least emissions per passenger kilometre, followed by rail at just under 45g CO_2e/ppkm. The average diesel and petrol car produces emissions of 121g CO_2e/ppkm and 127g CO_2e/ppkm respectively, figures only exceeded by domestic flights with emissions of 158g CO_2e/ppkm.

[17] Emissions per passenger kilometre are calculated as the distance a vehicle travels and its fuel efficiency divided by the number of occupants travelling that distance.

[18] 2014 Government GHG Conversion Factors for Company Reporting
Company reporting guidelines

Table 5 also shows that, over time, almost all modes are seeing improvements in emissions per passenger kilometre, with rail and aviation seeing double digit improvements in performance. Since 1999 average car occupancy has fallen by 9.5% acting as a drag on the improved efficiency of the internal engine in terms of emissions per passenger kilometre.

Table 3: CO_2e emissions per passenger kilometre by mode[19]

Sector	Mode and fuel	gCO₂e/ppkm 2012	2013	2014	2015	% Change 2012-2015
Road	Average petrol car	134	131	128	127	-5.3%
	Average diesel car	124	121	123	121	-2.5%
	Average petrol hybrid car	89	87	89	85	-3.9%
	Average petrol motorbike	119	119	120	120	0.6%
	Average bus	112	112	109	109	-2.8%
	Average coach	29	29	29	29	2.0%
Rail	National rail	58	49	47	45	-22.6%
	Light rail and tram	68	60	62	55	-19.1%
Ferry (Large RoPax)	Average foot and car passengers	116	116	116	116	0.0%
Aviation	Average domestic flights	180	173	155	158	-12.5%
	Average short haul international	104	102	88	90	-13.5%
	Average long haul international	119	120	111	105	-11.8%

Source: Government Conversion factors for company reporting
http://www.ukconversionfactorscarbonsmart.co.uk/

2.8 Leading indicators

Data on Scottish greenhouse gas emissions emerges around 18 months after the end of the year in question. Unfortunately, there are not a large number of Scottish lead indicators that throw much light on performance in the period beyond the latest emissions data, but those that are available, including UK series, are discussed below and reported in Table 4.

- *Road vehicle kilometres travelled*: Road emissions are directly related to the kilometres travelled. This indicator tracks vehicle kilometres travelled by all vehicle types on all roads. From 2007 to 2011 the trend in total kilometres travelled in Scotland has been a slow decline. Since then total road

[19] All car figures assume an average car occupancy rate of 1.51 passengers based on the latest Household Survey Travel Diary. Bus and coach figures assume an average vehicle occupancy rate based on Guidelines to Defra/DECC's GHG Conversion Factors for Company Reporting.

kilometres have increased marginally year on year and in 2014 are back to 2007 levels.

- *Proportion of new road vehicles that are alternatively fuelled*: Alternatively fuelled vehicles, including electric and hybrid vehicles, produce fewer GHG emissions per kilometre travelled. An increase in the proportion of those vehicles on the road will reduce emissions from the transport sector. This indicator tracks the number of newly registered cars that received the Plug in Grant. 2014 saw a sharp increase in sales over 2013 and this trend has continued into 2015. This vehicle group does though still represent a very small proportion of total vehicles in Scotland and proportion of total vehicle kilometres travelled.

- *Aviation movements*: Emissions from international aviation in particular have grown rapidly over the past 20 years. This indicator tracks the total number of aviation movements at Scottish airports (take-off and landing) and shows another small increase between 2013 and 2014.

- *2014 UK provisional emissions estimates*: Provisional UK emissions data for 2014 was published in March 2015 while final Scottish data for 2014 will not be published until June 2016. The latest UK transport emissions estimate shows a small increase in transport emissions taking them back to 2012 levels. This is the first reversal on a downward trend in emissions that begun after 2007. As yet there is no estimate available for 2014 emissions from International Aviation and Shipping. Even though there tends to be a strong correlation between emissions movements at the UK and Scottish levels there is no guarantee that this UK picture will be replicated in Scotland, particularly when international emissions estimates are unavailable and form a significant part of total Scottish transport emissions.

- *Total transport fuel consumption*: Improved fuel efficiency will reduce emissions per kilometre travelled. This indicator tracks total transport fuel sales and shows that total sales in 2014 decreased again, despite a small increase in both road and air activity.

- *Average CO2/km of cars registered for first time:* As the fleet becomes more fuel efficient and an increasing proportion of the fleet uses fuels other than mineral fuels so the average emissions of a newly registered car will fall. Table 4 shows there has been a fall in emissions per kilometre for both petrol and diesel engines between 2013 and 2014.

- *Scottish GVA: Q1 2013 to Q1 2014:* over the year to the end of the second quarter of 2014 Scottish GVA grew by 3.1%. While economic performance and emissions remain so strongly linked, an improving economic performance is likely to put upward pressure on Scottish emissions. This pressure will be felt not just in the transport sector where goods vehicle kilometres and private mileage have tended to increase during periods of economic growth but across other sectors of the economy too.

- *Scottish forecourt pump prices Q1 2013 to Q1 2014:* after a number of years of significant fuel price rises the trend was reversed in the last quarter of 2013 and pump prices have fallen sharply since and this has continued into 2015. 2015 prices are back to levels not seen since the beginning of 2010. While demand for fuel is generally inelastic (price changes have little impact on demand for fuel) the reduction in fuel prices is likely to see a small increase in demand for fuel at the forecourts.

Together, the available indicators suggest that pressure is building on Scottish transport emissions with a number of key indicators moving in a direction that, if continued will lead to an increase in emissions in the near future. As cars become a smaller share of total transport emissions so the aggregate impact of the measures to reduce car emissions declines.

Table 4: Trends in leading transport indicators

Indicator	2013	2014	Average growth p.a. (2003-2014)	Growth (2013-2014)
Scottish vehicle kilometres travelled (million km)[20]	43.5	44.4	0.6%	2.1%
Sales of Plug in Grant eligible cars (Scotland)[21]	194	832	-	329%
Aircraft movements at Scottish Airports ('400s) [22]	482	485	3.2%	0.6%
UK transport emissions (excl. IAS) ($MtCO_2e$)[23]	115.7	116.9(p)	-0.8%	1.0%
UK domestic petroleum consumption by transport (million tonnes)[24]	24.1	23.7	-2.4%	-1.7%
Average CO_2/km of petrol cars registered for first time	131.2	128.4		-2.1%
Average CO_2/km of diesel cars registered for first time	123.8	121.7		-1.7%
				Q1 2013 – Q1 2014
Scottish year-on-year GVA growth (to Q1 2014)	-		-	3.1%
Scottish year-on-year change in a) petrol and b) diesel prices[25]				a) -7.1% b) -9.1%

20 https://www.gov.uk/government/collections/road-traffic-statistics#publications-released-during-2015
21 Transport Scotland
22 CAA aircraft movement data
23 UK 2014 provisional GHG emissions estimate
24 DUKES Table 3.2
25 Source: AA forecourt pump prices in Scotland

Chapter 3: Future emissions impact of transport interventions

3.1 Background

This chapter lists those transport interventions, whether devolved or reserved to the UK/EU, which are firm commitments and are expected to have a direct and significant impact on Scottish transport emissions into the future. The interventions are separated between infrastructure projects and those that involve fiscal policy or regulation. Emissions impacts used here are taken from the available project or policy documents, and have been rounded to the nearest 1 kilo-tonne of carbon-dioxide equivalent ($ktCO_2e$) where appropriate.

As well as reporting the emissions impacts, where possible the chapter outlines the general methodological approach for estimating the impact of both infrastructure projects and fiscal/regulatory policies. As independently commissioned projects, the precise estimation methodology may differ significantly depending upon the type of intervention and the modelling approach adopted. Emissions estimates are frequently assessed in isolation, and so will not necessarily include the full interactions between measures or take account of the impact of any future measures on the project. Furthermore, for many interventions there are likely to be a number of localised impacts which may not be captured or presented consistently between appraisals. Where possible, the impacts presented here are the net emissions impact at a national level.

As a result of such methodological variation, the emissions estimates and related timescales are to be used as an informative guide to the direction of change and the order of magnitude only. <u>The comparison, addition or netting off of emissions estimates between interventions or against the GHGI data is not statistically valid and may lead to incorrect conclusions being drawn</u>**.**

3.2 Infrastructure projects

Undertaken by Transport Scotland and announced by The Minister for Transport, Infrastructure and Climate Change in December 2008, the Strategic Transport Projects Review (STPR) sets out the strategic transport investment priorities for the next twenty years and provides the basis on which Ministers can make informed decisions about future transport spending beyond the current programme. The nature of this publication means that many of the projects will be undertaken at a future date and thus lack a designated timetable and a formal appraisal process. Individual projects from within STPR likely to have a significant emission impact will be included in the CAT commentary as and when they become committed schemes.

Methodology for measuring environmental impacts

Environmental impacts of infrastructure projects are taken from the latest available project documents. In most cases this will be the emissions estimate contained in the project specific Environmental Statement. Some recently announced projects will though not yet have begun a formal appraisal process so have no estimate. For reference, links to the project home page are also provided where an online assessment is available.

STAG recommends that greenhouse gas emissions from road traffic are calculated according to the methodology in the Design Manual for Roads and Bridges[26] (DMRB). DMRB was first introduced in 1992 in England and Wales, and subsequently in Scotland and Northern Ireland. It provides a comprehensive manual system which accommodates current Standards, Advice Notes and other published documents relating to Trunk Road Works.

For emissions associated with the running of diesel and electric trains, STAG recommends the use of the Rail Emission Model Final Report[27] that was produced for the Strategic Rail Authority. This is published on the Department for Transport

[26] Design Manual for Roads and Bridges (2009): Highways Agency Design Manual for Roads and Bridges (DMRB)
[27] Rail Emission Model (2001), AEA Technology Environment

website, and provides estimated emission factors and detailed data for individual diesel and electric train types.

There are no such established guidelines for estimating carbon estimates for other travel modes. Should such a project arise, the methodology used to estimate the carbon impact is tailored specifically to that individual project. Similarly, it is important to note that when considering the predicted emissions impacts of these infrastructure projects, the modelling procedures used to derive these predictions can differ significantly, particularly in the way in which they account for secondary impacts such as land-use changes resulting from the transport project.

Road

A75 Dunragit Bypass
http://www.transport.gov.scot/projects/trunk-road-projects/a75-dunragit-bypass-project

- Document: Environmental Statement, Young Associates / Mouchel Parkman
- Construction completion: March 2014
- Estimated emissions impact: +4ktCO_2e p.a. from 2022

Previously, drivers experienced limited overtaking opportunities along much of the A75, which led to traffic congestion, driving conditions with lower average speeds, increase driver frustration and the potential for accidents. The new scheme comprises an off-line road alignment and, in accordance with its stated objective, provides guaranteed overtaking in both eastbound and westbound directions. The additional CO_2e emissions are expected as a result of the increase in distance that vehicles will travel due to the addition of the bypass.

M8, M74 and M73 Motorway Improvements Project

http://www.transport.gov.scot/road/projects/m8m73m74

Following award of the contract to Scottish Roads Partnership (SRP) in February 2014, the M8 M73 M74 Motorway Improvements Project is currently well underway and scheduled for completion in Spring 2017. This project bundles together three individual projects: M8 Baillieston to Newhouse, M74 Raith Interchange, and M8 M73 M74 Network Improvements.

SRP anticipate that the project will create in excess of 1,000 jobs in Scotland – the large majority of these jobs are expected to be filled by workers from the local area, similar to the M74 Completion project where 70% of site-based staff came from the local area. The motorway improvements project is expected to reduce the journey time for the 115,000 vehicles that use the busiest sections of the M8 each day.

It is predicted that the scheme will lead to a reduction of more than 100 accidents per year and more freely flowing traffic on these strategic routes will reduce the emissions associated with queuing traffic and improving both air quality and health.

M74 Raith Interchange

- Document: Environmental Statement (2007), Mouchel Fairhurst JV
- Anticipated construction completion: 2017
- Estimated emissions impact: +10ktCO_2e p.a. from 2017; +10ktCO_2e p.a. from 2020

The scheme is aligned with the M8 Baillieston to Newhouse works and the Associated Network Improvements**.** These are vital links in the trunk road network of Central Scotland and serve substantial existing developments as well as some of the most significant future development sites in Scotland.

Severe traffic problems exist at Raith Junction due to the interaction of heavy turning volumes from the A725 and the M74 at the signalised roundabout. This scheme aims to relieve traffic congestion at the junction creating free-flow conditions on the A725.

M8 Associated Network Improvements

- Document: Environmental Statement, 2008 (Mouchel Fairhurst JV)
- Anticipated construction completion: 2017
- Estimated emissions impact: +2ktCO_2e p.a. by 2020

This scheme comprises capacity improvements on sections of the M73, M74 and M8 adjacent to Baillieston and Maryville interchanges as a result of changes to east-west traffic patterns following completion of the M74 and once improvements to the M8 are in place. The scheme will be procured as a package with the M8 Baillieston to Newhouse Scheme and M74 Raith Junction.

M8 Baillieston-Newhouse

- Document: Environmental Statement (2007), Mouchel Fairhurst JV
- Anticipated construction completion: 2017
- Estimated emissions impact: +30ktCO_2e p.a. from 2017; +30ktCO_2e p.a. from 2020

This project is a proposal to upgrade the existing A8 between Baillieston and Newhouse to dual three-lane motorway standard equivalent.

The DMRB was used to calculate the change in greenhouse gas emissions, therefore the assessment has included all traffic on the entire modelled network, in addition to links that were explicitly included in the local assessment. The increase in emissions is due to an increase in predicted traffic levels.

A90 Aberdeen Western Peripheral Route (AWPR) and A90 Balmedie-Tipperty

http://www.awpr.co.uk/

http://www.transport.gov.scot/projects/trunk-road-projects/a90-balmedie-to-tipperty-dualling-project

- AWPR Document: Assessment of Effects of Updated Traffic Model submitted for PLI (2008), which updates previous source of 2007 Environmental Statement, Jacobs
- Balmedie - Tipperty Document: Environmental Statement (2007), Grontmij / Natural Capital
- Anticipated construction completion: It had been hoped to start construction of the AWPR in 2011 however, legal challenges submitted to the Court of Session challenging the decision to proceed with the project will delay construction until resolution of the challenges. AWPR has now been combined with B-T to form one project.
- Estimated emissions impact for AWPR: +8ktCO_2e p.a. from 2012; +10ktCO_2e p.a. from 2027. For Balmedie- Tipperty : +2ktCO_2e p.a. from 2010 (assumed opening year in environmental statement)

A peripheral route around Aberdeen is proposed to reduce the high volumes of traffic using the A90 in the centre of Aberdeen, and to reduce the traffic congestion that the city experiences as a result of the volume of traffic using the A90 and its associated radial roads. The overall increase in the number of road vehicles, however, is expected to lead to an increase in carbon dioxide emissions.

The AWPR will provide substantial benefits across the whole of the North East of Scotland and will provide a boost to the economy; increase business and tourism opportunities; improve safety; cut congestion as well as increasing opportunities for improvements in public transport facilities.

This proposed dualling of the A90 between Balmedie and Tipperty will provide continuous dual carriageway between Aberdeen and Ellon, which will remove the bottleneck caused by the existing single carriageway. The local community has been pressing for this upgrade for a number of years. The increase in emissions through Balmedie -Tipperty is mainly due to the increase in the road sections that make up the total road network assessed.

Forth Replacement Crossing

- http://www.transport.gov.scot/project/forth-replacement-crossing Document: Forth Replacement Crossing Environmental Statement (2009), Jacobs Arup
- Anticipated construction completion: 2016
- Estimated emissions impact: +20ktCO_2e p.a. in 2032

The Forth Replacement Crossing (FRC) is a major road infrastructure project being delivered by Transport Scotland. The project was driven by uncertainty over the future viability of the existing Forth Road Bridge, and is designed to safeguard this vital connection in Scotland's transport network. It comprises a new cable-stayed bridge across the Firth of Forth (the Queensferry Crossing), to the west of the existing Forth Road Bridge, and associated new and improved road infrastructure to the north and south of the bridge. The scheme will retain the existing Forth Road Bridge as a public transport corridor for use by buses, taxis and other specified users and for continued use by pedestrians and cyclists. The Queensferry Crossing will be used by all other traffic including private cars and heavy goods vehicles. Emergency vehicles will be able to use either bridge.

The FRC was identified as a key strategic investment project in Scotland's national transport network in the Strategic Transport Projects Review (STPR) undertaken by Transport Scotland in December 2008, and the National Planning Framework (NPF2) published by the Scottish Government in June 2009. There are eight specific transport planning objectives for the FRC which have underpinned the work on the project. These are to:

- maintain cross-Forth transport links for all modes to at least the level of service offered in 2006
- connect to the strategic transport network to aid optimisation of the network as a whole
- improve the reliability of journey times for all modes

- increase travel choices and improve integration across modes to encourage modal shift of people and goods
- improve accessibility and social inclusion
- minimise the impacts of maintenance on the effective operation of the transport network
- support sustainable development and economic growth
- minimise the impact on people, and the natural and cultural heritage of the Forth area.

Construction commenced in 2011 and the FRC remains on target to open late 2016.

Dualling of A9

- Document: Environmental Statement: not yet available
- Anticipated construction completion: 2025
- Estimated emissions impact: not yet available

This programme will address issues of driver frustration on the A9 caused by the limited guaranteed overtaking opportunities that current exist, resulting in improved connections between Perth and Inverness. Options for the proposed dual carriageway are currently being developed but it is likely that it will largely comprise on-line widening due to the environmental and physical constraints in the corridor.

It is too early to say how CO_2e emissions may change as a result of the scheme. Design development work is now underway and the emerging findings are that the dualling will increase emissions as a consequence of changes to vehicle speeds. Quantification of that impact across the programme is not yet available and a number of route options are still being assessed. Quantification will take place as part of the preparation of the Environmental Statements for the component projects.

Dualling of A96

Document: Environmental Statement: not yet available

- Anticipated construction completion: 2030
- Estimated emissions impact: not yet available

This programme will address issues of driver frustration on the A96 caused by the limited availability of overtaking opportunities. It will also address issues of community severance by introducing bypasses to communities along the route. Both objectives will serve to improve connectivity between Inverness and Aberdeen. Baseline information and constraints mapping is currently being collated to support future option development for the proposed dual carriageway.

Given the likelihood of extended lengths of dual carriageway to provide bypasses it is likely that CO_2e emissions will increase as a result of the scheme. However further work will be undertaken during the design development to understand changes to vehicle speeds and their consequences for emissions before and after the scheme is in place.

Rail

Borders Railway

http://www.bordersrailway.com

- Document: Borders Railway Design Development Appraisal (2008), Transport Scotland
- Construction complete – Borders Railway operational as of 6/9/2015
- Estimated emissions impact: Cumulative impact of 32ktCO_2e by 2030, 2ktCO_2e by 2050 and -29ktCO_2e by 2070[28].

This project has reinstated part of the former Waverley rail route from the Scottish Borders to Edinburgh.

The change in CO_2e emissions has been calculated in line with STAG guidelines. For road traffic, the calculations are based on changes to the number of car journeys between the different stations, with each journey modelled separately. The emissions from the railway have been calculated in line with the Rail Emissions Model produced by the Strategic Rail Authority.

[28] Emissions figures have been updated since 2010 publication from Carbon emissions to CO_2 emissions.

Overall, the Borders Railway Project will have a beneficial impact on CO_2e levels but most recent assessments suggests that it will see a small net increase in emissions in the early years before removing approximately 29ktCO_2e over the appraisal period to 2070.

Edinburgh-Glasgow (Rail) Improvements Programme

http://www.transport.gov.scot/project/egip

- Document: Edinburgh Glasgow Improvement Programme (EGIP) Appraisal and Analysis Model (2013), Transport Scotland
- Anticipated construction completion: Phased to 2016
- Embodied carbon emissions: +112ktCO_2 (Phase 1 only) or +157ktCO_2 (Phase 1&2) from construction and rolling stock provision
- Operational emissions [29]:
- Average annual savings of -28ktCO_2 (Phase 1 only) or -30ktCO_2 (Phase 1&2) p.a. from 2017
- Cumulative savings of:
  - -234ktCO_2 (Phase 1 only) or -236ktCO_2 (Phase 1&2) by 2025.
  - -946ktCO_2 (Phase 1 only) or -995ktCO_2 (Phase 1&2) by 2050.
  - -1,743ktCO_2 (Phase 1 only) or -1,843ktCO_2 (Phase 1&2) by 2075.

This intervention was identified early in the STPR and brought forward in a study which considered improvements to the capacity, frequency and journey time of rail services between Edinburgh and Glasgow.

The change in CO_2e emissions has been calculated in line with guidance from the Department for Energy and Climate Change. Previous estimates derived from the Network Modelling Framework (NMF) have been significantly revised to reflect the latest operational assumptions for the programme. There is estimated to be a

[29] To be consistent with the scope of this document, these figures (both the average annual savings and the cumulative savings) relate to emissions in the transport sector only and *exclude* increased emissions in the electricity production and distribution sector associated with electrification. However, the estimated net impact at the overall Scottish level, even including these emissions, is to lower emissions over the longer term

reduction in road emissions of around -3ktCO_2e p.a. which is included in the overall figures presented.

The Edinburgh Glasgow Improvement Programme is expected to result in a significant reduction in emissions, through the electrification of approximately 350 km of single track and the resulting move from diesel to electric trains. The programme therefore achieves its emissions reductions reported here through transferring emissions from the non-traded sector to the traded sector, as demonstrated in the table below. If electricity emissions and those from embodied carbon are included, the total net impact of EGIP is -1,116 (-1,114 for Phase 1 only) ktCO_2e by 2075. Of this total, -1,669 ktCO_2e arises from diesel savings from trains removed from the network (same value for Phase 1 only), -174 (-74 for Phase 1 only) ktCO_2e from cars removed from the road network, and +570 (518 for Phase 1 only) ktCO_2e from the new electric trains added to the network. Table 4 demonstrates the precise breakdown of the emissions impact across the different sectors.

Aberdeen to Inverness

- Document: Not yet available
- Environmental Statement: not yet available
- Anticipated construction completion: In phases through to 2030
- Estimated emissions impact: not yet available

This project will deliver significant journey time improvements and greater connectivity for both passenger and freight services operating on the Aberdeen to Inverness rail corridor. It is too early to say how CO_2e emissions may change as a result of the improvement project. Further work will be undertaken during the design development to understand the impact the increased frequency and additional services will have on emissions following their introduction.

Highland Mainline

- Document: Not yet available
- Environmental Statement: not yet available

- Anticipated construction completion: In phases through to 2025
- Estimated emissions impact: not yet available

This project will deliver significant journey time improvements and greater connectivity for both passenger and freight services operating between Inverness and the Central belt. It is too early to say how CO_2e emissions may change as a result of the improvement project. Further work will be undertaken during the design development to understand the impact the increased frequency and additional services will have on emissions following their introduction.

Table 5: Change in emissions from EGIP (Phase 1&2, 'Phase 1 only' impact in brackets) by sector ($ktCO_2e$)

Budget Period	Operational		Embodied**
	Transport sector	Non-transport sector*	
2013 - 2017	-17 (-17)	+16 (+16)	+105 (+105)
2018 - 2022	-132 (-132)	+129 (+129)	+7 (+7)
2023 onwards	-1,694 (-1,595)	+425 (+373)	+46 (+0)
UK Net	-1,843 (-1,743)	+570 (+518)	+157 (+112)

* Electricity production and distribution sector
** Primarily manufacturing and construction

Table 6: Estimated net emissions impact of individual transport infrastructure projects

Project title	Published emissions estimate
A75 Dunragit Bypass	+4 $ktCO_2e$ p.a. from 2022
M74 Raith Interchange	+10 $ktCO_2e$ p.a. from 2020
M8 Associated Network Improvements	+2 $ktCO_2e$ p.a. by 2020
M8 Baillieston-Newhouse	+30 $ktCO_2e$ p.a. from 2020
A90 Balmedie-Tipperty	+2 $ktCO_2e$ p.a. from 2013
A90 Aberdeen Western Peripheral Road	+10 $ktCO_2e$ p.a. from 2027
Forth Replacement Crossing	+20 $ktCO_2e$ p.a. in 2032

Stirling-Alloa-Kincardine Railway Line	+2 ktCO_2e p.a. from 2009
Borders Railway	+32 ktCO_2e total by 2030
	+2 ktCO_2e total by 2050
	-29 ktCO_2e total by 2070
Edinburgh-Glasgow (Rail) Improvements Programme	-28 ktCO_2e average p.a. from 2017
	-1843 ktCO_2e total by 2075
	+167 ktCO_2e p.a. from 2031

The emission estimates within this table are forecast changes in carbon dioxide emissions with the project compared to without the project in a given future assessment year. These estimates have been calculated using a variety of methodologies and, consequently, it is not statistically valid to aggregate the individual figures or directly compare them with one another.

3.3 Fiscal / regulatory measures

The current split between devolved and reserved powers means that the majority of fiscal and regulatory decisions that impact on Scottish transport emissions are taken at either the UK or EU level.

Those areas over which Scottish Ministers have direct control are though still extremely important for Scottish emissions, particularly in respect of behaviour change, a vital component of long term emissions reductions, and the removal of certain key barriers that could affect the significant uptake of ultra-low or zero carbon vehicles by households.

Published in June 2013, the Second Report on Proposals and Policies provides the most up to date and comprehensive analysis and assessment of these Scottish policies and the potential impact these measures can have on emissions out until 2027[30]. The impact of tightening EU car and van emissions standards and the Renewable Fuels Transport Obligation are also covered within the RPP's analysis.

With a narrower focus on road transport emissions, and particularly on the transition from reliance on fossil-fuelled vehicles towards plug-in cars and vans, *Switched on Scotland* [31] sets out the necessary steps and barriers to be overcome on the pathway to the almost complete decarbonisation of road transport.

It is more difficult to ascertain the potential emissions impact in Scotland from UK and (other) EU fiscal or regulatory measures, not least because the impacts are analysed and estimated at a more aggregate level. That said, some Scottish estimates have been generated and where available these are recorded below alongside the description of the policy intervention.

The best and most readily available sources of information for the remaining aggregate UK emissions impacts include published Impact Assessments, associated documents accompanying the annual HM Treasury (HMT) Budget and Autumn

[30] http://www.gov.scot/Publications/2013/06/6387/9
[31] http://www.transport.gov.scot/sites/default/files/documents/rrd_reports/uploaded_reports/j272736/j272736.pdf

Statement/Pre-Budget reports, HMRC notes and the House of Commons Library for more general topic background and briefing.

Air Passenger Duty (APD)

Key documents and analysis:

- House of Commons Library Note SN5094 Air Passenger Duty: recent debates and reform http://www.parliament.uk/briefing-papers/SN05094/air-passenger-duty-recent-debates-reform
- HMRC Tax Information and Impact Note March 2014: Air Passenger Duty: banding reform - Publications
- Estimated emissions impact UK 0.3 $MtCO_2e$
- Transport Scotland assessment on impact on emissions of reducing APD by 50% (2014) http://www.transport.gov.scot/report/j340458-01.htm
- Estimated emissions impact: 0.05 $MtCO_2e$ to 0.06 $MtCO_2e$ in Scotland

Air passenger duty (APD) is charged on all passenger flights from almost all UK airports[32]. The rate of tax varies according to passenger destination and the class of passenger travel. Between 1 2009 and 2014 APD was been structured around four distance bands, set at intervals of 2,000 miles from London. Since 2013 APD rates have been increased in line with inflation.

The 2014 Budget announced the merging of highest APD bands (B, C and D) so that any flight to a country with a capital city more than 2000 miles from London would now be charged at the current Band B rate. Very few current direct flights from Scotland are affected by this simplification of the banding structure. This change is estimated in increase annual UK emissions by 0.3 MtCO2e but is unlikely to have a material impact on Scottish emissions.

More recently, Transport Scotland has published its assessment of the likely impact on emissions following a reduction in APD in Scotland. This work used Scottish information and data wherever possible and also checked the result against the earlier UK analysis. This analysis suggests that cutting APD by 50% in Scotland

[32] Flights from Highland and Island airports are excluded

would lead to an annual increase in Scottish emissions of 0.05 MtCO2e to 0.06 MtCO2e[33].

In May 2015 children under 12 travelling in the lowest class of travel became exempt from APD, and from March 2016 an extension is planned to include children up to the age of 16 in this exemption. The impact at the UK and Scottish level on demand and the economy more generally is expected to be negligible.

Inclusion of aviation in EU ETS

Key documents and analysis:
http://ec.europa.eu/clima/policies/transport/aviation/index_en.htm
http://www.parliament.uk/briefing-papers/SN05533

- Implementation date: 2010
- Estimated emissions impact: up to - 183 $MtCO_2e$ p.a. in 2020 across Europe relative to no cap

Following a Commission proposal in December 2006, a directive was adopted that required all operators flying into or out of aerodromes in the European Economic Area (EEA) to monitor annual carbon emissions, to report them and to surrender the corresponding number of carbon allowances.

The Aviation Greenhouse Gas Emissions Trading Scheme Regulations 2010 came into force in the UK on 31 August 2010. The inclusion of aviation within the emissions trading system allowed the sector to take responsibility for its carbon emissions in the most cost effective way. While it is difficult to predict the exact impact of the scheme, particularly with the ongoing economic uncertainties, earlier estimates made by the Commission suggest that the aviation cap could reduce emissions in 2020 by up to 183 million tonnes CO_2e.

In the face of international opposition to the Directive the European Commission announced in November 2012 that it would “Stop the Clock” on the implementation

[33] Estimate of the Impact on Emissions of a Reduction in Air Passenger Duty in Scotland | Transport Scotland

of the “international” aspects of the Aviation Emissions Trading System in an effort to facilitate a global based trading system through the International Civil Aviation Organisation (ICAO). The effect of the Commission’s action is that only flights between EAA aerodromes need comply with the Aviation ETS at this time. The impact of this revision on the Commission’s original assessment of emissions reductions is unclear but the revision is unlikely to have any material effect on the impact of the regulation on Scottish aviation emissions as the majority of flights from Scotland are within the EEA.

Fuel duty

Latest documents and analysis: Budget March 2015:
https://www.gov.uk/government/publications/budget-2015-documents
https://www.gov.uk/government/news/rural-fuel-price-cut-begins

- Estimated emissions impact: +0.2 $MtCO_2e$ per year, +0.3 $MtCO_2e$ (UK).

Due to high oil prices, Budget 2011 cut the fuel duty by one penny per litre and since then all increases in fuel duty have been cancelled. Up until 2014, the cancellation of these fuel duty rises has been estimated to add 0.5 $MtCO_2e$ per annum to the UK emissions total compared to where it would otherwise have been. It should be noted that this assessment does not take account of the dampening effect of the rise in wholesale fuel prices and therefore pump prices on demand, or the continued freeze in duty announced in the March 2015 budget.

From 31 May 2015 the Rural Fuel Rebate allowed customers in certain rural post codes to benefit from a cut of 5 pence per litre in the fuel price. Thirteen of the seventeen named post codes eligible for this cut are in Scotland, eleven in Highland and two in Argyll and Bute. These cuts would be expected to lead to a negligible increase in emissions.

Reform to vehicle excise duty

Latest documents and analysis:
https://www.gov.uk/government/publications/vehicle-excise-duty/vehicle-excise-duty
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/443822/OOTLAR_2015.pdf

- Budget 2015 HMRC documentation
- Estimated emissions impact of 2010 change: -0.9 $MtCO_2e$ by 2020
- Estimated impact of 2017 proposal:- not quantified

In April 2010, the Government introduced a new first-year rate of VED. Under this system, all cars emitting up to 130 g CO_2e per km paid no VED in the first year. Cars emitting over 165 g CO_2e per km paid additional VED in the first year. First year rates were introduced to encourage the purchase of more fuel-efficient cars. Together, these changes are estimated to result in a cumulative UK emissions saving of 0.9 $MtCO_2e$ by 2020. Subsequent budgets increased VED rates by inflation but froze HGV rates.

In 2017 a new VED banding system will be introduced. First year rates for newly registered cars will depend on CO_2 emissions. Thereafter all but zero emitting vehicles will pay £140 with a 5 year supplement of £310 for cars costing over £40,000. This is likely to have an initially small but negative impact on the emissions outcome with all but zero rated cars in 2017 seeing an increase in VED over their existing equivalent makes and models. The reverse is true for more polluting cars as newer cars will see a reduced rate of VED.

Company car tax

Latest documents and analysis:
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/443822/OOTLAR_2015.pdf
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/264612/19._Company_car_tax_rates_2016-17.pdf

- Anticipated implementation date: Ongoing
- Estimated emissions impact: Not quantified

The UK Government's June 2010 budget set out to reform company car tax and provide incentives to purchase the lowest emitting vehicles on the market. This has been reinforced in subsequent budgets to incentivise the purchase and manufacture of ultra-low emission vehicles in the UK. Budget 2013 set out rates for company cars emitting 75g CO_2e per km or less from 2016-17 onwards and provides a commitment that in 2017-18 there will be a 3 percentage point differential between the 0-50 and 51-75 g/km CO_2e bands and between the 51-75 and 76-94 g/km CO_2e bands. The 2014 budget further lifted the percentage of a company car list price that would be subject to tax for cars emitting more than 75 g CO_2e /km.

This policy aims to encourage the purchase of ULEVs and hence contribute to the objectives of reducing greenhouse gas emissions from road transport. However, given that the market is at an early stage of development it is not possible to precisely estimate the impact on ULEV sales or emissions savings. That said the savings are likely to be small to begin with.

Fuel benefit charge (FBC)

- https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/294190/OOTLAR_19_March_2014__1_.pdf
- Estimated emissions impact: Not quantified

The provision of free fuel to company car drivers provides a perverse environmental incentive. The aim of the fuel benefit charge is to tax this benefit as though it were income. The figure on which the calculation is based rises each year and for cars currently stands at £22,100. The van fuel benefit charge – on which tax on free van fuel is payable – stands at £594. The Government has committed to pre-announcing the FBC multiplier one year in advance.

Table 7 summarises the previous information. As with Table 6, these emissions estimates are not produced using a single, consistent methodology so are not directly comparable.

Table 7: Net emissions impact estimates of fiscal / regulatory measures

Project title	Published emissions estimate
Air passenger duty	i) -0.3MtCO_2e p.a from 2015-16 (UK) ii) +0.05 MtCO_2ep.a in Scotland from 50% cut in APD
Inclusion of aviation in EU ETS	-183MtCO_2e* p.a. in 2020 (Europe)
Fuel Duty	+0.5 MtCO_2e p.a. by 2013 from two freezes (UK) Negligible impact from Rural Fuel Rebate
Reform of Vehicle Excise Duty[34]	-0.9 MtCO_2e total savings by 2020 (UK) 2017 proposal – impact not quantified
Company car tax	Not quantified
Fuel benefit charge	Not quantified
RPP2 - Decarbonising Vehicles	-2.5 MtCO_2e in 2027
RPP2 - Sustainable Communities	-0.3 MtCO_2e in 2027
RPP2 - Business Transport Measures	-0.5 MtCO_2e in 2027
RPP2 - Network Efficiencies	<-0.1MtCO_2e in 2027
RPP2 - Additional Measures	-0.75 MtCO_2e in 2027

The emission estimates within this table are forecast increases or decreases in carbon dioxide emissions with the policy compared to without the policy in a given future assessment year. These estimates have been calculated using a variety of methodologies and, consequently, it is not statistically valid to aggregate the individual figures or directly compare them with one another.
* Estimate from before the introduction of ‘Stop the Clock’ – see relevant section in EU ETS above

3.4 Projected net emissions impact from Scottish projects

The Carbon Account for Transport collates information from a variety of sources and outputs with one of the key sources being the findings generated from the application of the Scottish Transport Appraisal Guidance (STAG) to transport proposals. Two key concepts in STAG are that an appraisal:

[34] The impacts from both VED and company car tax contribute to the delivery of the savings from the EU regulation on CO_2 from cars, as opposed to representing additional savings.

- should be applied proportionately but comprehensively. The whole process should be used and the level of detail required will be determined by the scale of the impacts of the transport issue being addressed.

- should not prioritise between options. Instead, it is an aid to decision makers in order to make more informed choices. STAG may provide an initial rationale for investment and it is important that the STAG outcomes are revisited as the Business Case for an intervention develops.

As such, a study undertaken using STAG is not required to provide an absolute prediction of all of the outcomes of an intervention. Instead, it provides sufficient information to understand the relative impacts between different options. The individual results cannot therefore simply be summed to produce an aggregate impact.

While these assessments provide one of the key purposes of the CAT - to improve transparency - something further is needed to monitor progress towards the NTS strategic outcome of reduced transport emissions. In 2010 a single model run of the Land-Use and Transport Integration in Scotland (LATIS) service was commissioned to estimate the net impact of all measures within the CAT that fall under the competence of the Scottish Government or other Scottish public body[35]. LATIS includes a strategic transport and land-use model covering all of Scotland and all motorised modes of transport so the use of LATIS to assess the carbon impacts of Scottish transport schemes ensures network consistency and takes full account of the potential displacement of developments between one area and another. The modelling of this set of projects over the timescale of their introductions also provides a greater understanding of the full impact that Scottish interventions are having, or are expected to have, on underlying emissions from transport. The model is not a complete assessment of the likely impact as it does not include the impacts of those measures taken at a reserved level - for example changes to fuel duty or some of the demand side measures outlined in RPP2.

[35] Including those measures whose expected emissions impacts has not been quantified on an individual basis, e.g. Freight Facilities Grant.

The updating of the baseline data within LATIS enabled a revised set of projections to be run ‘with’ and ‘without’ the identified infrastructure projects over which Scotland has direct control. The latest estimates from the revised projection are shown in Table 8. The table shows that the combined impact of the projects generates a small increase in overall emissions, with the long-run impact estimated at an additional 50 $ktCO_2e$ p.a. by 2027. This is equivalent to an additional 0.4% on annual transport emissions in 2027 relative to where emissions would otherwise have been.

Table 8: Projected net emissions impact of Scottish projects[36]

Year	Annual Change in Emissions ($ktCO_2e$)
2017	30
2022	50
2027	50

[36] The reduction in emissions within the non-traded sector that are a result of EGIP have been added to the modelled output, as these benefits sit outside the scope of the modelling framework.

Chapter 4: Conclusions

The Scottish Government is committed to tackling climate change, and has put in place a framework to deliver greenhouse gas emission reductions of 42% by 2020 and 80% by 2050 (compared to a 1990 baseline). RPP2 sets out one pathway that would keep Scotland on the trajectory to achieve this emissions reduction and now we have 2013 inventory data it is possible for the first time to directly compare the actual estimate with that suggested in RPP2. Neither set of data are built in such a way as to allow a line by line comparison but setting the aggregate positions alongside each other will be a helpful way to monitor the level of progress made.

Transport has a significant role to play in meeting Scotland's national targets and RPP2 sets out the wide range of work already underway to bring down transport emissions. Efforts include continued significant investment in public transport infrastructure and service delivery to encourage mode shift, initiatives to encourage active travel, improving the efficiency of freight movements and the demonstration and use of low carbon vehicles. Furthermore, there is strong support from the Scottish Government for those wider measures and initiatives to reduce emissions such as the new car CO_2e regulation and the UK Renewable Transport Fuels Obligation (RTFO). Together, these can help make a long-lasting and permanent reduction in Scotland's transport emissions.

Section 2 of the CAT set out the latest outturn emissions data available. It demonstrated that whilst transport continued to make up a quarter of Scotland's total emissions, transport emissions fell for a sixth straight year.

Section 2 also demonstrates through a range of key indicators monitoring public transport use, continued encouraging movements towards more fuel efficient, less polluting transport behaviours. The challenge remains how best to increase the speed of switching and take up of these new technologies and fuel sources in our every day travel.

Section 3 of the CAT explains the likely future impact from the infrastructure projects underway. While the emissions impacts from these projects are not measured on a like for like basis, and consequently cannot be compared against each other, it is clear that some interventions are expected to increase future emissions albeit by relatively small amounts. The STAG process is though about more than recording emissions impact so an appraisal may show that an infrastructure improvement is, on balance, the best way to achieve the overall Government Purpose. That said, it is still important to quantify and to minimise the emissions impacts of each project.

Section 3 of the CAT also sets out the range of fiscal and regulatory measures, predominantly reserved, that have been committed to usually via the EU or UK Budget process. The move of the UK government away from full emissions impact assessments as part of the budget process has made tracking the magnitude of the impact of policy changes much more difficult. There is though still a need to incentivise and encourage shifts in travel behaviour towards active and more fuel efficient options through charging more for inefficient practices or offering reduced charges on more efficient transport choices.

The purpose of the CAT is to bring greater transparency to Scotland's transport emissions and, therefore, greater emissions accountability in transport policy. This will mean promoting those measures which reduce emissions, as well as minimising the impact of policies and projects that increase emissions. Whilst the underlying factors set out in Chapter 2 will continue to have a major influence on overall transport emissions, the CAT will continue to report the marginal impact that projects and policies are likely to have upon the overall emissions pathway.

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