TRANSPORT SCOTLAND
CÒMHDHAIL ALBA

CARBON ACCOUNT FOR TRANSPORT

NO. 6: 2014 EDITION

Carbon Account for Transport

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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

1. Introduction
    - 1.1 Policy context
    - 1.2 Purpose of the CAT
2. Historical emissions analysis
    - 2.1 Background
    - 2.2 Total emissions trends for Scotland and the Scottish Transport Sector
    - 2.3 Emissions analysis by transport sector
    - 2.4 Road emissions by vehicle type
    - 2.5 Road emissions by road type
    - 2.6 Comparison of key Scottish and UK transport emission statistics
    - 2.7 Comparison of key Scottish and Nordic transport emission statistics
    - 2.8 Comparison of key Scottish and EU transport emission statistics
    - 2.9 Efficiency of Passenger Vehicles
    - 2.10 Leading indicators
3. Future emissions impact of transport interventions
    - 3.1 Background
    - 3.2 Infrastructure projects
    - 3.3 Fiscal / regulatory measures
    - 3.4 Projected net emissions impact from Scottish projects
4. Conclusions

References

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 2012, the main findings in this latest report are:

- In 2012 Scottish emissions from all sectors amounted to 52.9 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 five years running and have reduced by 1.9 $MtCO_2e$ since the 2007 peak figure of 14.8 $MtCO_2e$.

- Road transport emissions account for 72.4% of all transport emissions and cars account for over half road emissions. Emissions from cars account for 40% of all transport emissions.

- Maritime and aviation each account for 13% of all transport emissions.

- Looking at the entire period 1990-2012:

  Total transport emissions (12.9 $MtCO_2e$) are now below their 1990 level of 13.1 $MtCO_2e$.

  At 5.2 $MtCO_2e$, emissions from cars are below their 1990 level of 5.8 $MtCO_2e$

  Emissions from aviation have risen by 38% since 1990 to stand at 1.7 $MtCO_2e$.

  The significant rise in emissions from good vehicles (from 2.9 $MtCO_2e$ to 3.6 MtCO2e in 2012) is largely a result of the increase in emissions from Light Good Vehicles prior to 2007 with HGV emissions accounting for the increase from 2009.

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

Chapter 1: Introduction

1.1 Policy Context

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

"focus the Government and public services on creating a more successful country, with opportunities for all of Scotland to flourish, through increasing sustainable economic growth" (The Government Economic Strategy 2011, p12).

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].

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 Scotland 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]

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[1] http://www.scotland.gov.uk/Publications/2011/09/13091128/0
[2] http://www.scotland.gov.uk/Topics/Environment/climatechange/scotlands-action/climatechangeact
[3] The Climate Change (Annual Targets) (Scotland) Order 2010, SSI 2010 no.359
[4] http://scotland.gov.uk/Topics/Environment/climatechange/scotlands-action/lowcarbon/rpp
[5] http://www.scotland.gov.uk/Publications/2010/11/15085756/0
[6] http://www.legislation.gov.uk/ssi/2011/353/made
[7] The Second Report on Proposals and Policies

(RPP2). This document set out a possible pathway and options for delivering the necessary emissions 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:

"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 2012
- Emissions efficiency estimates for passenger vehicles
- Key forward looking transport indicators
- Scottish transport infrastructure projects likely to have a significant impact upon emissions

[8] Scotland's National Transport Strategy (2006), The Scottish Executive.

- Assessments of likely impact of Scottish, UK and EU wide regulatory and fiscal measures on Scottish emissions

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 Government or other Scottish public bodies that 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 3.2.

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

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[9] http://www.transportscotland.gov.uk/stag/home

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: 1990-2012'[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, 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

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

[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).

infrastructure and no displaced impacts, such as the emissions generated by the electricity used on electrified railways, are included.

Greenhouse gas emissions for European Union Member States are reported in the 'European Union greenhouse gas inventory 1990-2012 and inventory report 2014'. This is compiled on an annual basis by the European Environment Agency and includes aggregate data for all member countries of the EU[12]. Data from other Member States has been included in the CAT for the purpose of comparing relative performance across countries.

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

In 2012 total Scottish emissions from all sectors amounted to 52.9 mega-tonnes of carbon dioxide equivalent ($MtCO_2e$)[13]. This total represents a 0.4 $MtCO_2e$ or 0.8% increase from the equivalent 2011 figure. Compared to the 1990 base year Scotland has reduced its total emissions by 29.9%.

Transport's share of this Scottish total is 12.9 $MtCO_2e$. After an initial sequence of almost continual increases in transport emissions from 1990, the run peaked in 2007 at 14.8 $MtCO_2e$. Since then transport emissions have fallen year on year and now sit just below the 1990 base year level of 13.0 $MtCO_2e$, 13% or 1.9 $MtCO2_e$ below the 2007 peak.

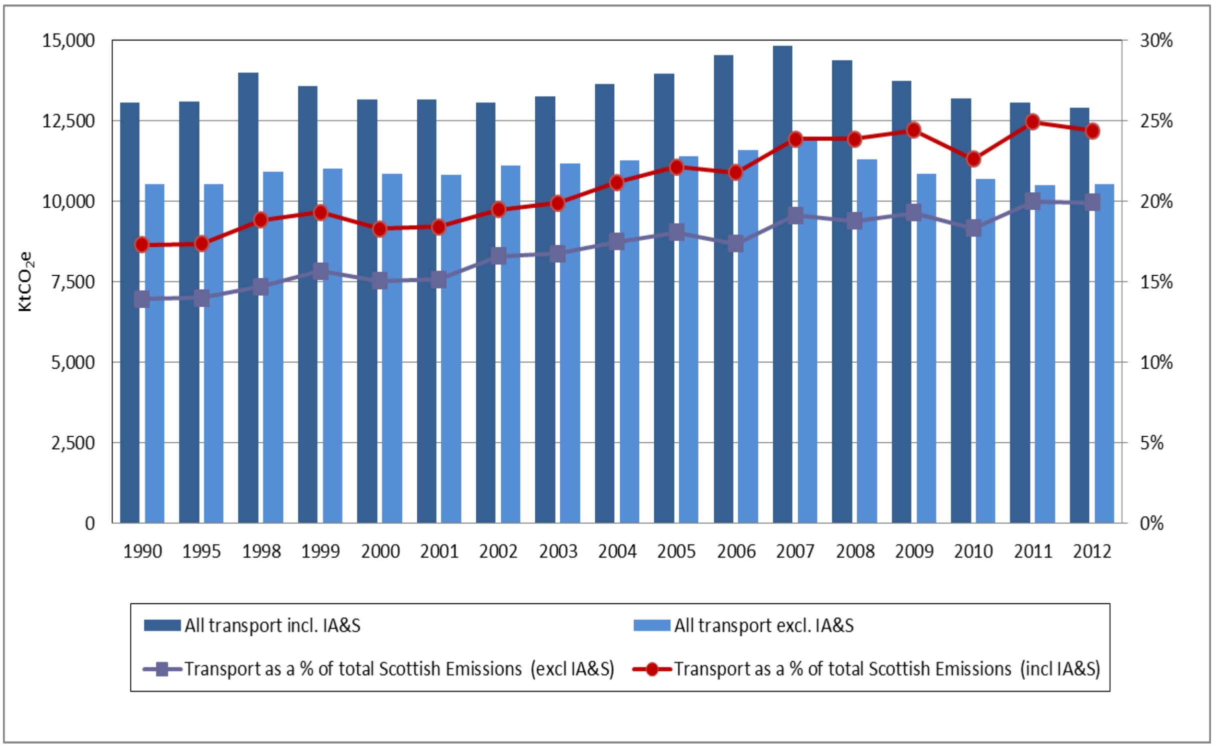
The recent falls in emissions has been as a result of a number of factors. Principal among them are the continuing uneven nature of the recovery in real household incomes, growing investment in public transport infrastructure, improvements in fuel efficiency, government emissions policies, land-use planning and high global oil prices.

[12]'Annual European Union greenhouse gas inventory 1990-…2012 and inventory report 2014', EEA (2013) http://www.eea.europa.eu//publications/european-union-greenhouse-gas-inventory-2014
[13] This calculation uses the unadjusted Scottish emissions total for 2012- 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 a number of quarters of positive GDP growth. The close correlation between GDP and transport emissions suggests that this will put pressure on the continuation of the recent trend of reducing emissions.

With IAS emissions excluded, the transport sector accounts for 20.0% of total Scottish emissions. With them included the proportion rises to 24.4%. The respective shares in 2011 were 18.3% and 22.6%, and in 1990 13.9% and 17.3%. Figure 1 shows the relative importance of transport emissions in Scotland's total emissions.

Figure 1: Total emissions from transport and transport emissions as a percentage of total Scottish emissions, 1990-2012



Source: Greenhouse Gas Inventory, NAEI, 2014, Transport Scotland. Total emissions calculation excludes the impact of the EU Emissions Trading System.

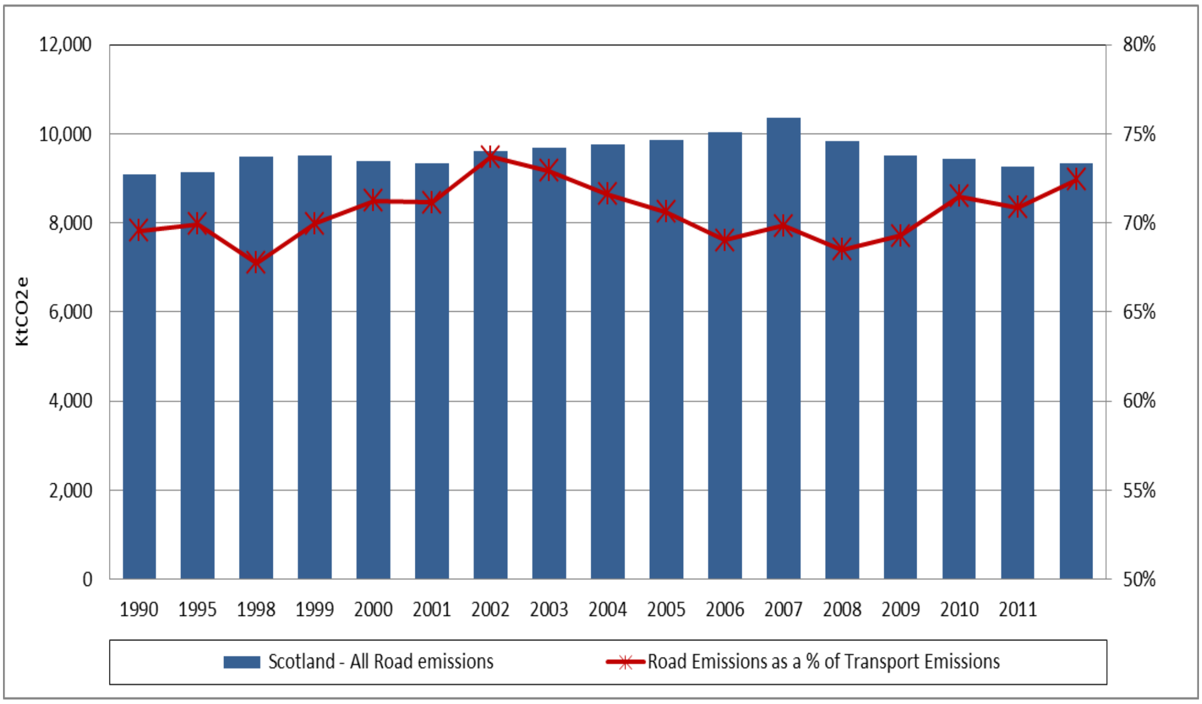
2.3 Emissions analysis by transport sector

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 72.4% of total transport emissions. The 2012 figure is marginally (less than 0.1$MtCO_2e$) higher than the 2011 figure. The fall in car and bus emissions was more than offset by the rise in HGV emissions in particular. LGV emissions also rose marginally.

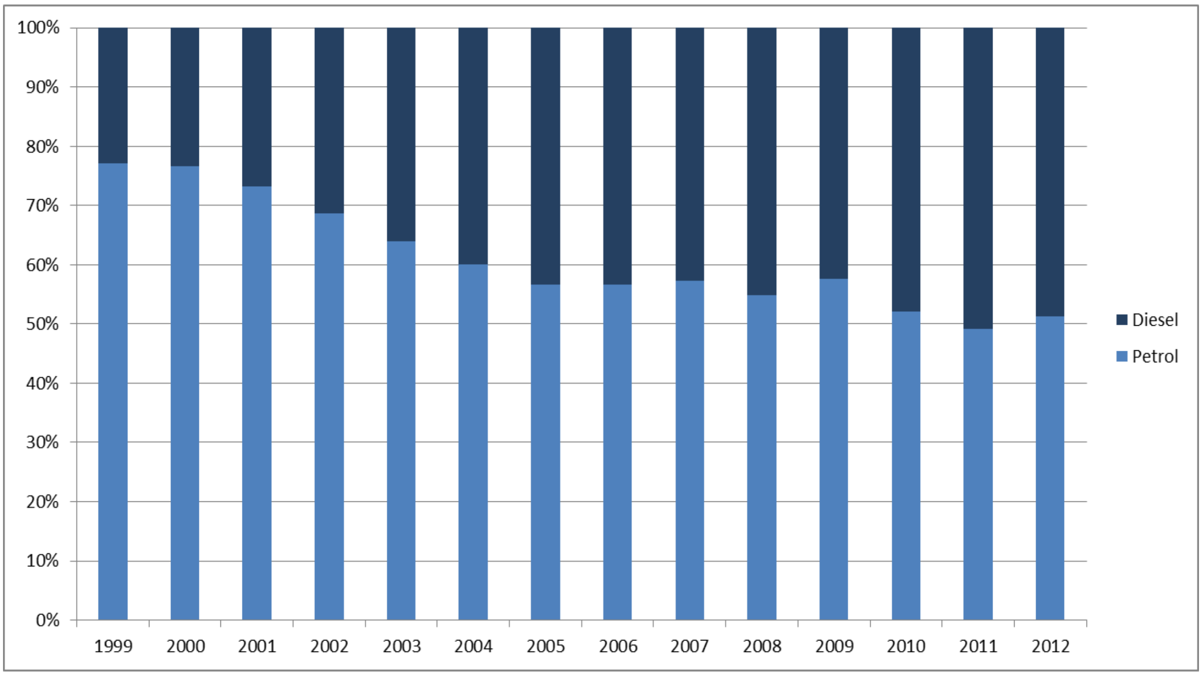
Figure 2 shows that road emission rose almost continuously from 1990 to a peak in 2007 of 10.4 $MtCO_2e$. Since this 2007 peak, road emissions have fallen for four years out of the last five and in 2012 stand 10% below this peak. Road emissions are though still 2.9% above the 1990 equivalent figure.

Figure 2: Road transport emissions 1990-2011 and road transport emissions as a share of total transport emissions



As well as reflecting improvements in car energy efficiency, road transport emissions have been affected by changes in the make-up of the passenger car fleet. 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 3) has improved the emissions situation. Further detailed analysis of road transport emissions by vehicle type and road type is undertaken in sections 2.4 and 2.5.

Figure 3: Distribution of new Scottish registrations between petrol and diesel 1999-2011 – all vehicle body types



2.3.2 Maritime Transport

Emissions from maritime transport[14] in 2012 are estimated to be 1.7 $MtCO_2e$ or 13% of total transport emissions. Figure 4 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 low in 2012. The 2012 estimate is 36% or 0.9 $MtCO_2e$ 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 5 also shows domestic maritime emissions are on a gentle downward pathway.

[14] Includes national navigation and international shipping

Figure 4: Maritime transport emissions and maritime transport emissions as a share of total transport emissions

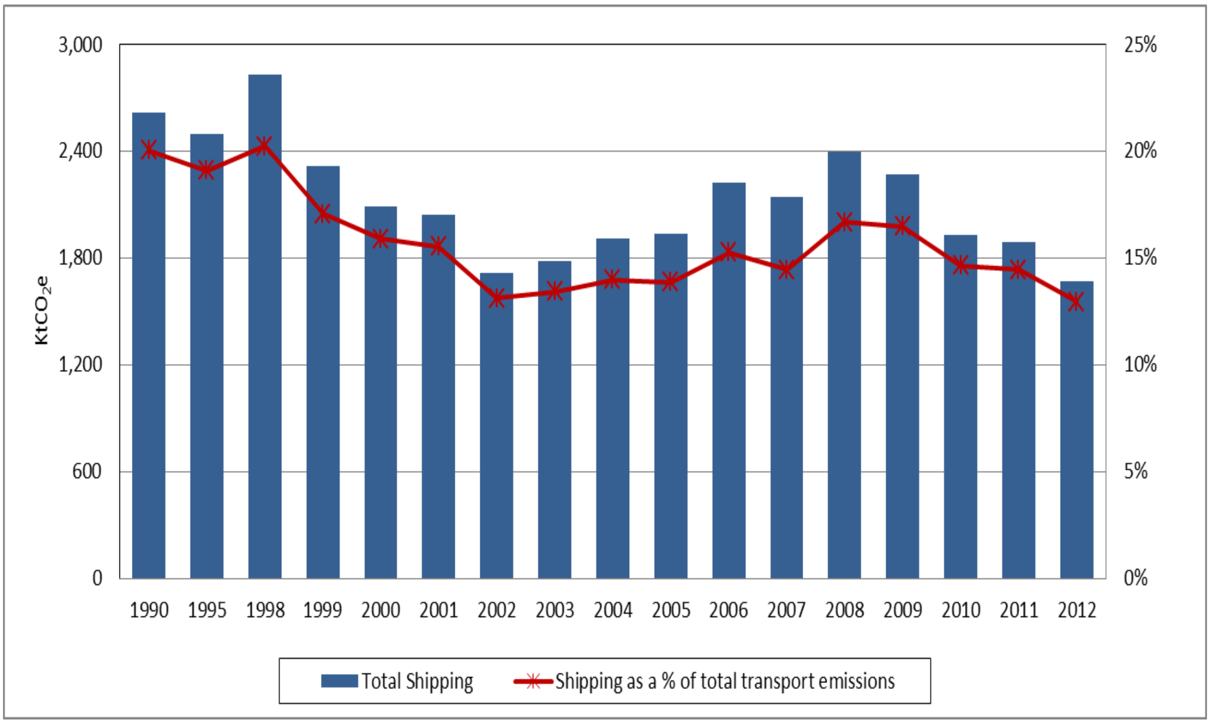
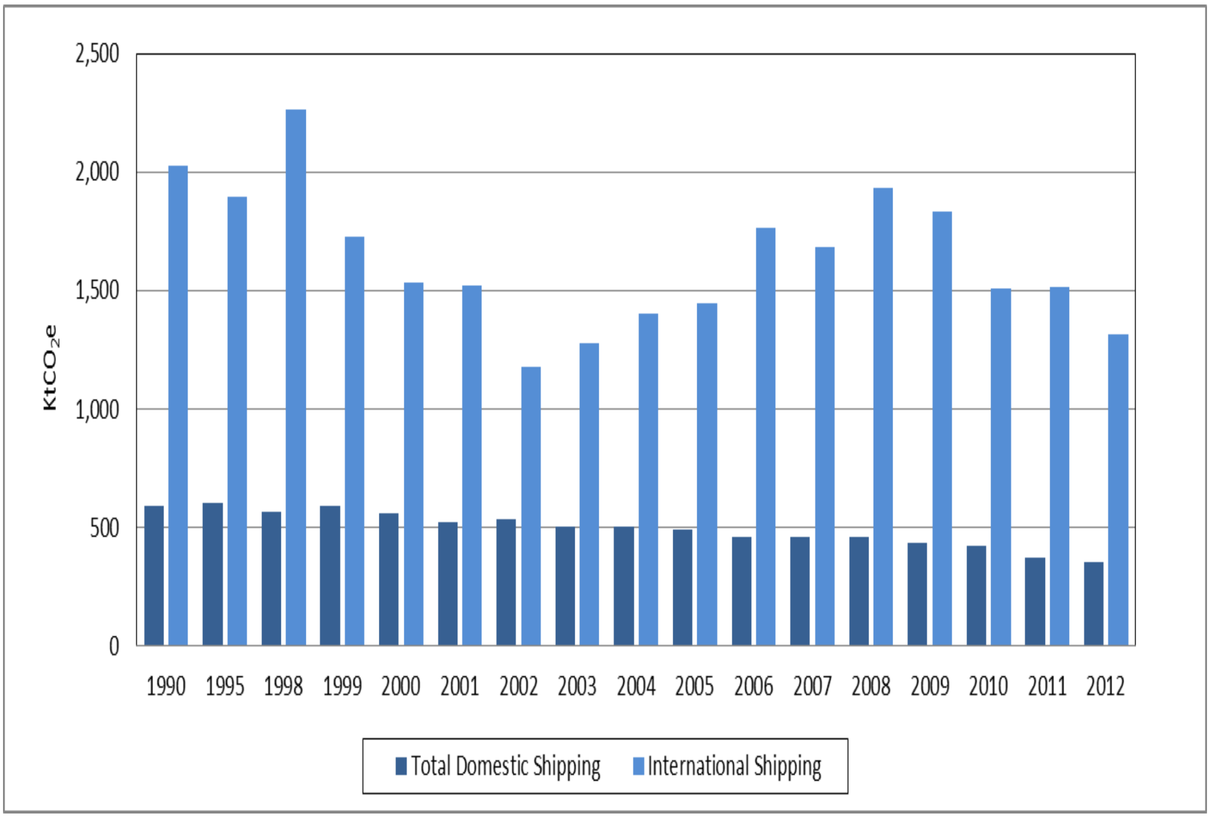


Figure 5: Comparison between domestic and international shipping emissions



2.3.3 Aviation

In 2012 aviation emissions fell by 2.5% over their 2011 level to 1.7 $MtCO_2e$, some 0.5 $MtCO_2e$ or 38% above the 1990 base year. Aviation emissions now represent 13% of total transport emissions. Figure 6 shows the increasing trend in emissions from 1990 out to 2007 (2.2 $MtCO_2e$) before the recent recession lead to lower year on year emissions until 2011.

Figure 6: Aviation transport emissions and aviation transport emissions as a share of total transport emissions

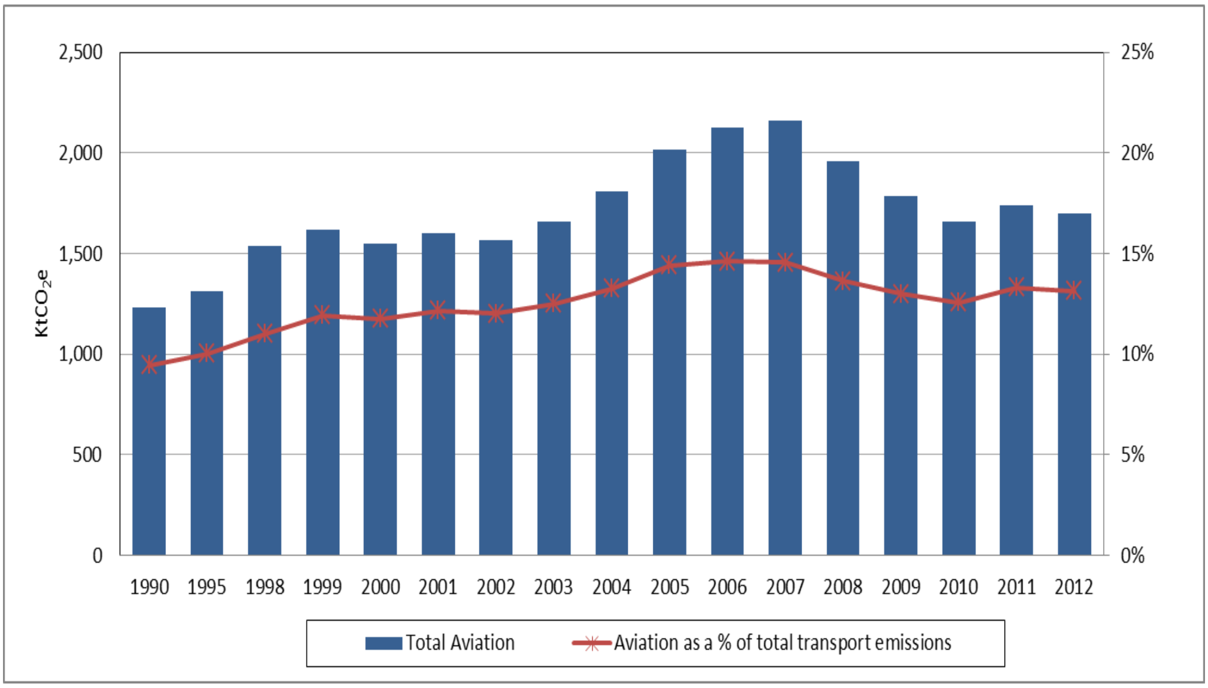
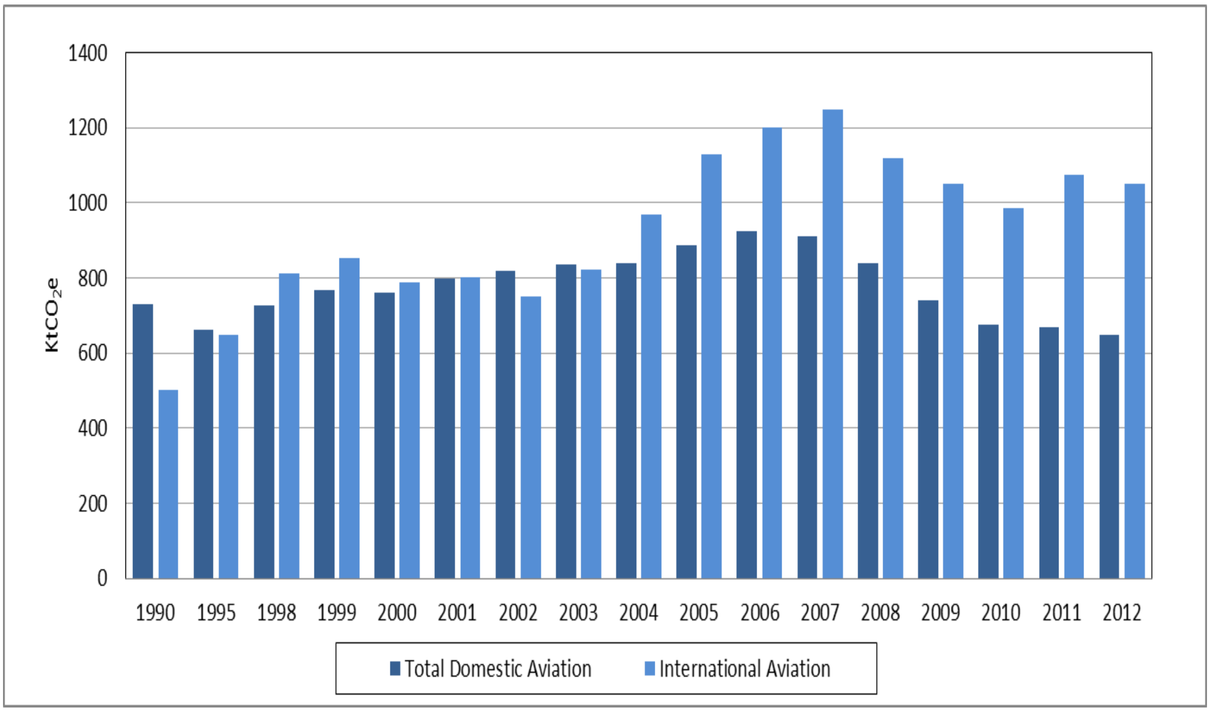


Figure 7 shows that from 1998 to 2003 emissions from domestic and international aviation were very similar and moved together. Since then the series have diverged. In 2012 international aviation emissions are estimated to account for 62% of total Scottish aviation emissions, almost the opposite of the situation in 1990 when domestic aviation emissions accounted for 60% of aviation's total. Between 2011 and 2012 domestic aviation emissions are estimated to have continued to decline (by 3.0%) with emissions from international aviation falling by 2.2%.

Figure 7: Comparison between domestic and international aviation emissions



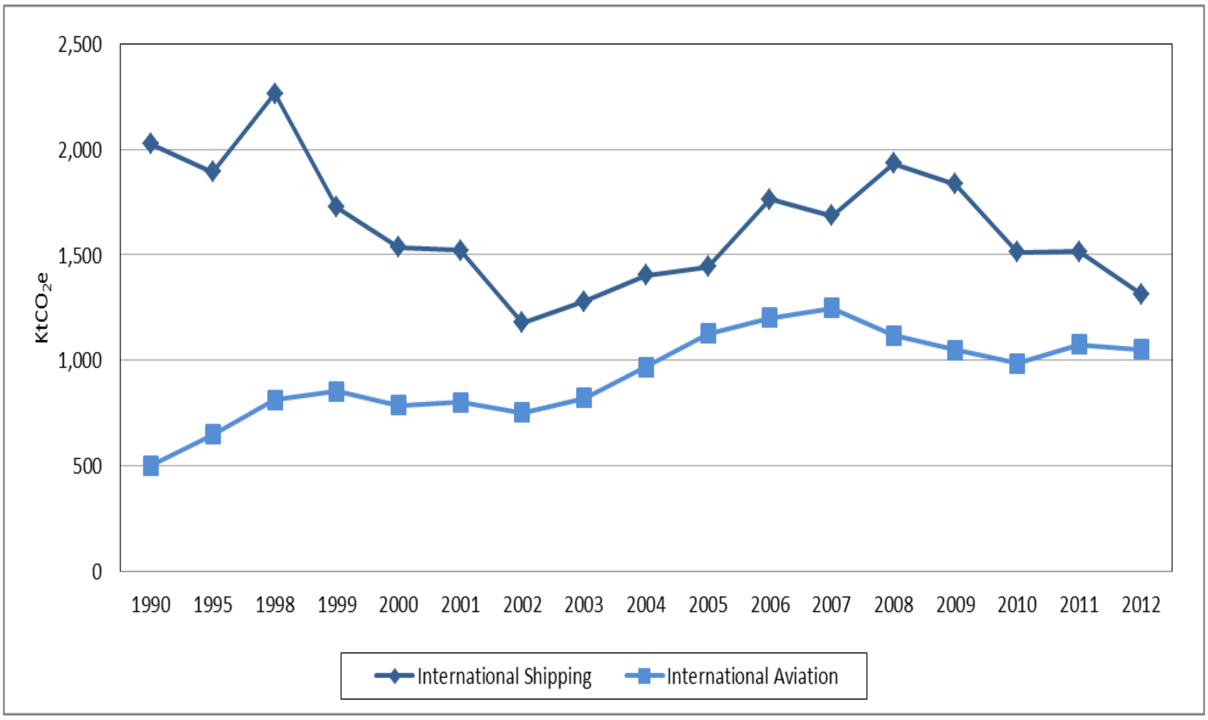
2.3.4 International Aviation and Shipping

After peaking in 2008 at 3.1 $MtCO_2e$, emissions from IAS were almost 0.7 $MtCO_2e$ lower in 2012 at 2.4 $MtCO_2e$. The 2012 figure is 8.7% below the 2011 equivalent and 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 two years since 2010, international flight departures have risen by 11% and international aviation emissions are up by 6.7%.

The estimates for IS emissions fell by 13% in 2012 to 1.3 $MtCO_2e$. This 2012 figure is the lowest figure since 2003 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 over 44% in 2012.

Figure 8: International maritime and aviation emissions 1990-2012

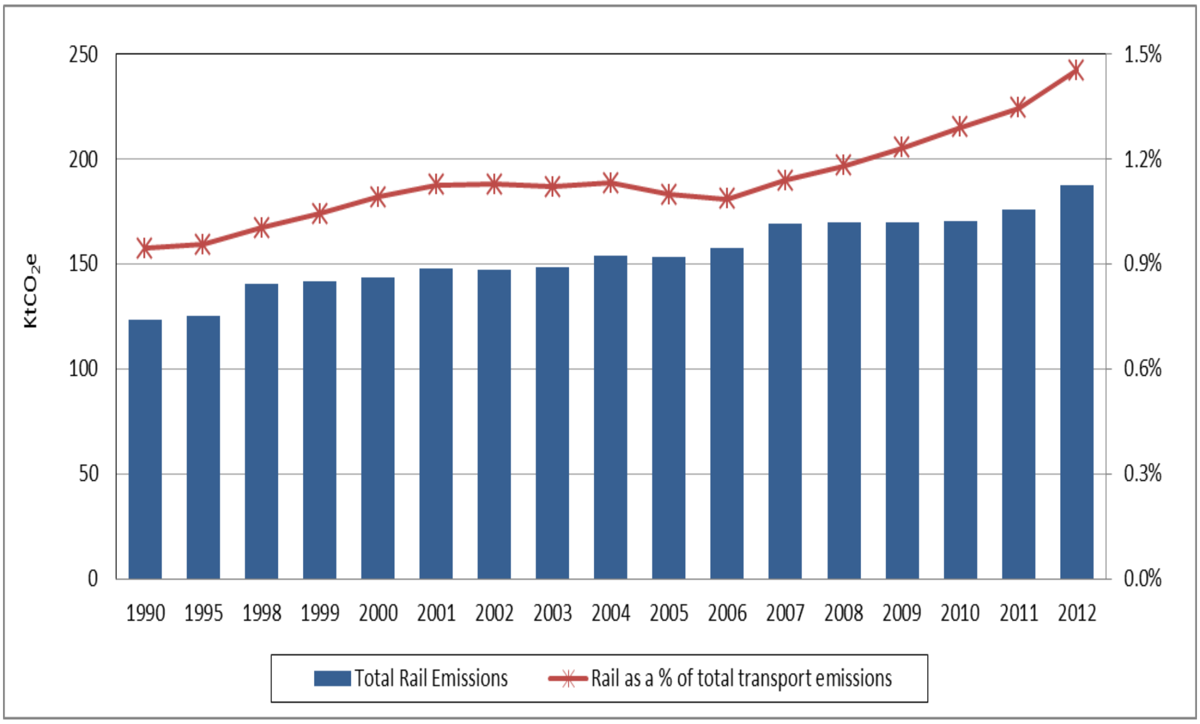


2.3.5 Rail

Rail emissions in 2012 remain under 0.2 $MtCO_2e$, virtually unchanged from 2011. Although rail emissions are 50% 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 over 34% for the period 2003-04 to 2012-13[15] and scheduled train kilometres have increased by 20% over the same period.

[15] Source: Scottish Transport Statistics, No 32, 2013 Edition, Table 7.1

Figure 9: Rail transport emissions and rail transport emissions as a share of total transport emissions



2.4 Road emissions by vehicle type[16]

2.4.1 Cars

Emissions from cars have fallen from a peak of 6.1 $MtCO_2e$ in 2002 to an estimated 5.2 $MtCO_2e$ in 2012, a fall of 15%. Over the same period (2002-2012) 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 0.6 $MtCO_2e$ or 11%. Despite this fall, car emissions continue to account for the greatest proportion of road transport emissions at 56%, and 40% 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 2012, up 5.6% on the 2011 figure. 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 2.3 $MtCO_2e$ in 2007.

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

Emissions then fell in 2008 and 2009 before rises in three most recent years has brought the 2012 emissions figure close to its 2007 peak.

2.4.3 Light Goods Vehicles

There has been a 73% increase in LGV emissions since 1990. At 1.4 $MtCO_2e$ in 2012 LGV emissions account for 15% of road emissions and 11% of total transport emissions. Emissions increased by 1% between 2011 and 2012 in line with the recent steady year on year increase in emissions from this vehicle group.

2.4.4 Buses

Emissions from buses fell by 6.0% between 2011 and 2012 and now account for just under 0.5 $MtCO_2e$. Current bus emissions are though still 0.1 $MtCO_2e$ or 28% above the 1990 base year emissions estimate of just under 0.4 $MtCO_2e$. Both vehicle kilometres and passenger journeys fell in 2012/13 and both are below their equivalent figure a decade ago.

2.4.5 Motorcycles

Motorcycle emissions fell by 1% compared to 2011 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 10, 11 and 12 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 10 shows that goods vehicles were largely responsible for the increase in road emissions to 2007. Since then the decline in emissions from cars has been behind the overall reduction in road emissions. The change in shares by vehicle types between 1990 and 2012 can be seen in Figure 11.

Figure 12 shows five consecutive year-on-year falls in car emissions from 2006. 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.

Figure 10: Breakdown of road emissions by vehicle type 1990-2012

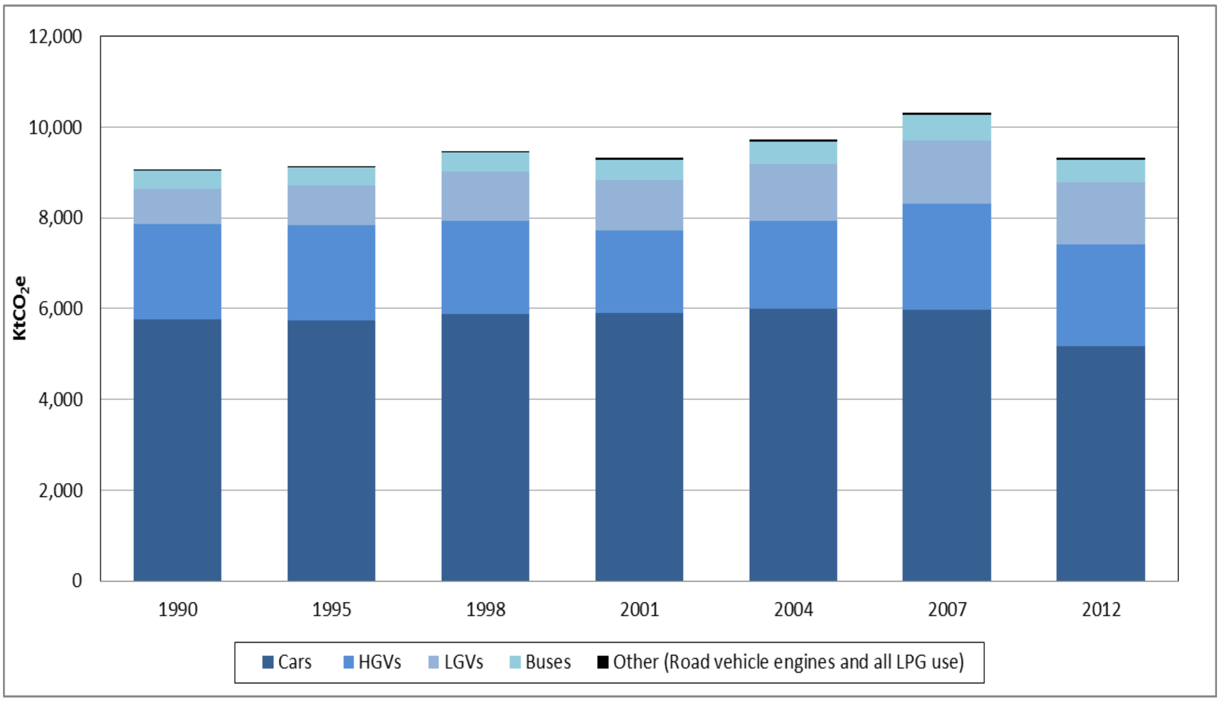
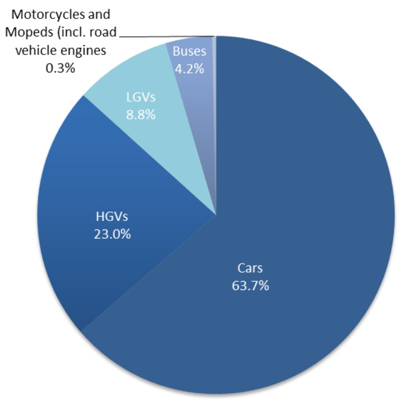


Figure 11: Share of road emissions by vehicle type in 1990 and 2012

1990–total emissions 9.1 $MtCO_2e$



2012–total emissions 9.4 $MtCO_2e$

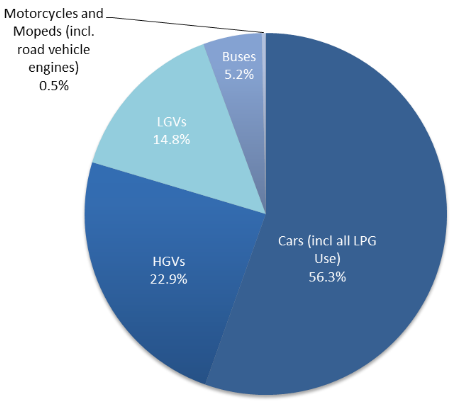
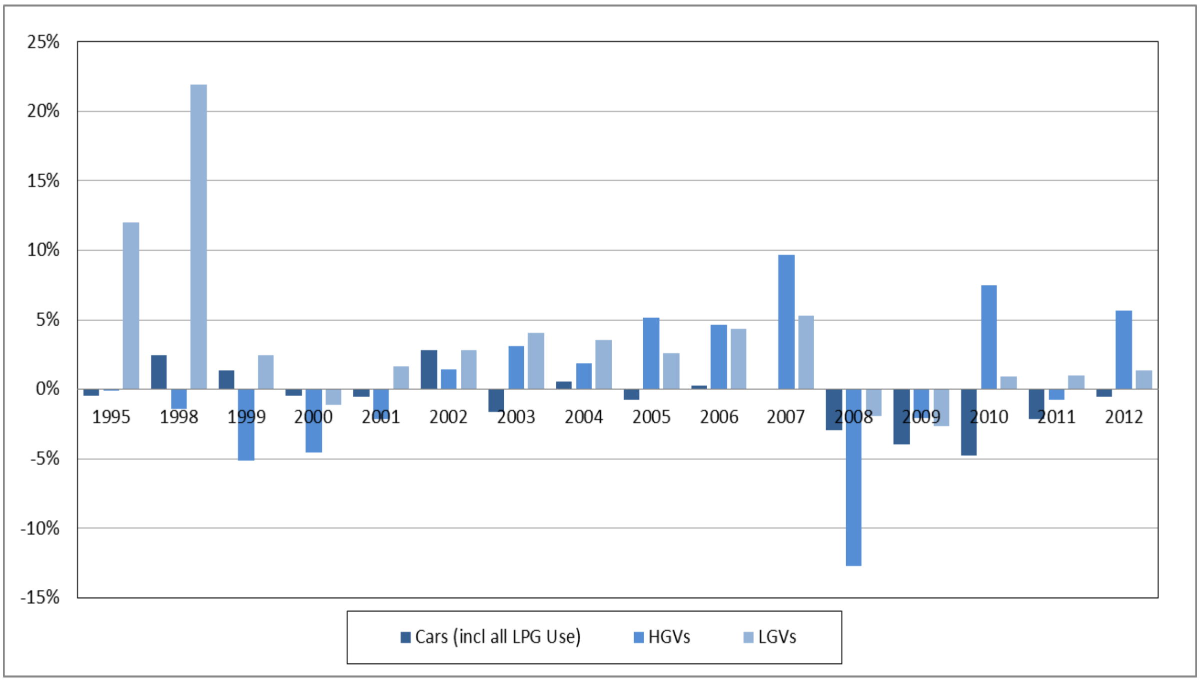


Figure 12: Year in year change in car, HGV and LGV emissions 1995-2011



2.5 Road emissions by road type[17]

2.5.1 Rural

Emissions on rural roads have fallen for five consecutive years since 2007. In 2012 rural road emissions are estimated at 4.6 $MtCO_2e$, 1% below the 2011 figure. The latest year's estimate is almost 0.2 $MtCO_2e$ below the base year figure of 4.8 $MtCO_2e$. Rural emissions account for just under half of total road emissions.

2.5.2 Urban

At an estimated 2.8 $MtCO_2e$ in 2012, urban emissions are 8% below their 1990 level and down from a peak of 3.2 $MtCO_2e$ in 2007. Emissions from urban traffic currently account for 30% of road emissions.

2.5.3 Motorway

Emissions from motorway traffic account for the smallest proportion in road emissions at just 20%. At 1.9 $MtCO_2e$ they are at their highest annual figure and

[17] 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.

almost 0.2 $MtCO_2e$ above the 2011 figure. The share in emissions from motorway traffic has been growing and shows a 51% increase over the share in 1990. The increase in emissions in 2012 is due to a significant extent to a 6% increase in the length of the motorway network, the first significant increase in the motorway network since 2006. The trend of a small annual increase in the length of both the trunk road and total road network in Scotland continues.

Figure 13: Emissions by road type (Index=1990 for each road type)

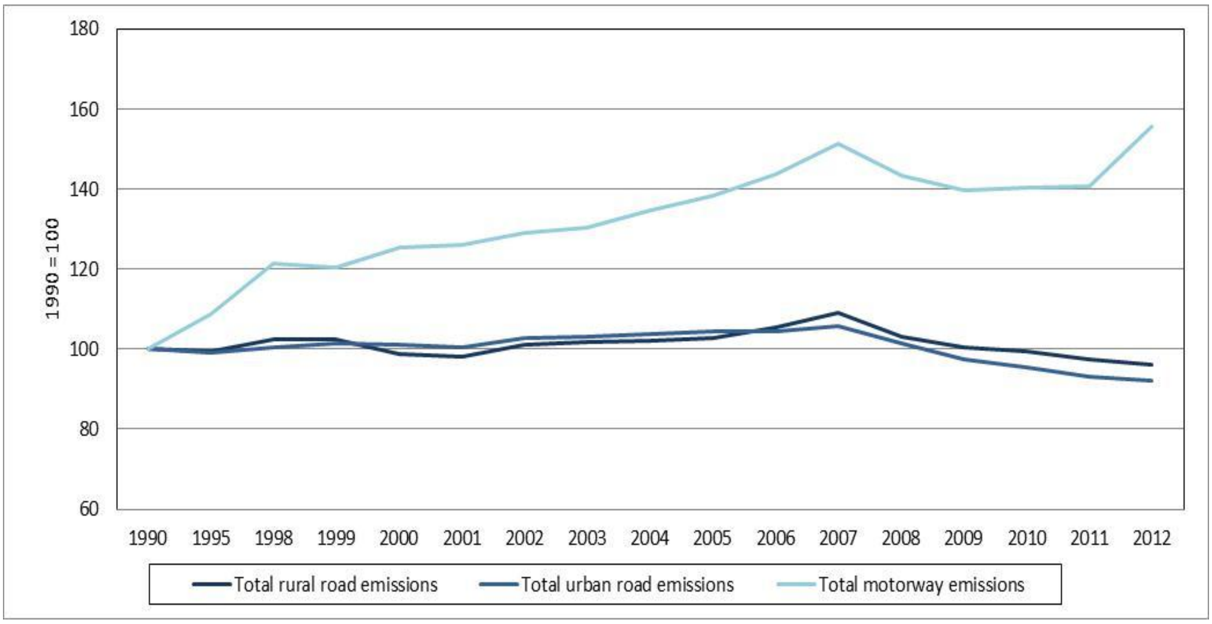
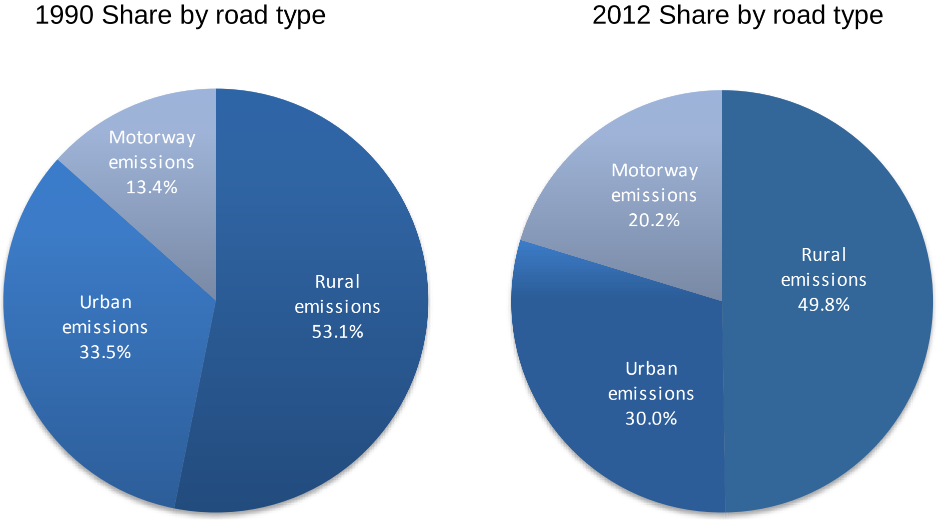


Figure 14: Share of road emissions by road type



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, and over short term and longer term timescales.

Table 1: Comparison of Scottish and UK GHG emissions

	Scottish emissions 2012 (ktCO2e)	Scottish emissions as a % of UK emissions 2012	Change in Scottish emissions (2011-12)	Change in UK emissions (2011-12)	Change in Scottish emissions (1990-2012)	Change in UK emissions (1990-2012)
All Transport	12,904	8.1%	-1.3%	0.6%	-1.2%	10.8%
All Transport (excl. IAS)	10,540	9.0%	0.5%	-0.4%	0.1%	-3.0%
Road Transport	9,348	8.6%	0.8%	-0.2%	2.9%	-1.4%
of which :						
Cars	5,161	8.1%	-0.5%	-1.3%	-10.6%	-11.5%
HGVs	2,252	9.3%	5.6%	3.8%	8.1%	1.1%
LGVs	1,377	9.0%	1.4%	0.9%	73.3%	62.5%
Buses	488	12.4%	-6.0%	-7.6%	27.6%	16.7%
Motorcycles	34	5.3%	-1.2%	0.2%	9.4%	2.6%
Rural	4,625	10.8%	-1.4%	-0.9%	-3.8%	-3.1%
Urban	2,786	7.3%	-1.3%	-1.0%	-8.0%	-13.2%
Motorway	1,886	7.1%	10.7%	2.3%	55.6%	26.0%
Rail Transport	188	8.6%	6.6%	4.9%	52.0%	12.2%
Aviation Transport	647	17.0%	-3.0%	-5.5%	-11.5%	-30.6%
Aviation Transport (incl. IA)	1,697	4.7%	-2.5%	-3.0%	37.6%	70.5%
Maritime Transport	357	11.4%	-4.8%	-5.3%	-39.7%	-16.3%
Maritime Transport (incl. IS)	1,671	14.2%	-11.6%	-12.6%	-36.2%	-5.7%

- In 2011 Scottish transport emissions, including IAS, accounted for an estimated 8.1% of total UK transport emissions and 9.0% 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 aviation including international aviation emissions. The shares in other categories are broadly similar to the overall picture.
- Between the 1990 base year and 2012 transport emissions in Scotland have fallen by 1.2% whereas for the UK as a whole the rise is 10.8%. Without the

inclusion of IAS the improvement for the UK as a whole (-3.0%) is greater than for Scotland alone (0.1%)

- Over time, all sub-categories of Scottish transport emissions have tended to change broadly in line with the equivalent UK series.
- Rail emissions in Scotland have increased significantly since 1990 albeit from a very small absolute base figure. In 2012 Scottish emissions are 52% above the 1990 while overall UK rail emissions are up by 12% over the same period.
- Scottish aviation emissions (with IA included) account for only 4.7% of the total UK aviation emissions but this percentage rises to 17.0% 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 4.8% between 2011 and 2012, similar to the UK reduction over the same period (5.3%). Although maritime emissions in Scotland and in the UK are well below their respective 1990 figures (36.1% and 11.4%) with IS included UK emissions are 5.7% below the 1990 level while Scotland's emissions are over 36% lower.

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 1.2%. This is less of a reduction than in Wales but better than the outcome in England and in N. Ireland.
- Between 2011 and 2012 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 – 2012 and 2011 – 2012

			Road	Rail	Aviation	Aviation (incl.IA)	Maritime	Maritime (incl. IS)	All Transport	All Transport (incl. IAS)
SCOTLAND	Emissions	2012	9,348	188	647	1,697	357	1,671	10,540	12,904
	Change in emissions	2011-12	-1.7%	3.4%	-3.0%	-2.5%	-4.8%	-11.6%	0.5%	-1.3%
		1990-2012	2.9%	42.6%	-11.5%	37.6%	-39.7%	-36.2%	0.1%	-1.2%
ENGLAND	Emissions	2012	89,910	1,854	2,850	33,952	2,429	8,410	97,042	134,126
	Change in emissions	2011-12	-0.3%	4.4%	-6.1%	-3.0%	-4.5%	-11.1%	-0.5%	-1.7%
		1990-2012	-2.6%	6.9%	-34.7%	105.6%	-11.9%	2.0%	-4.1%	10.1%
WALES	Emissions	2012	5,357	105	78	68	230	1,173	5,770	6,780
	Change in emissions	2011-12	-0.6%	7.5%	-9.1%	-17.2%	-15.0%	-24.5%	-1.3%	-5.9%
		1990-2012	-3.4%	53.0%	-55.0%	-9.7%	-16.7%	-1.3%	-4.8%	-3.8%
N.IRELAND	Emissions	2012	3,726	43	221	147	111	518	4,102	4,655
	Change in emissions	2011-12	-0.1%	11.5%	-3.8%	-7.0%	-2.7%	-9.1%	-0.3%	-1.5%
		1990-2012	24.6%	71.6%	10.8%	170.7%	-0.2%	18.7%	23.3%	25.6%

2.7 Comparison of key Scottish and Nordic transport emission statistics

Considering Scotland’s geographic, climatic and demographic similarities with the Nordic States a comparison between the transport emission figures is provided below. The trends in transport emissions are taken from Eurostat and cover road, rail, inland navigation and domestic aviation – i.e. they are not on the exact same basis as the above analysis.

Using this definition, Scotland’s long term emissions performance is in line with that in Finland and Sweden while Denmark and Norway have seen emissions increases. While Scotland’s emissions rose slightly between 2011 and 2012 all other countries for which data is available saw reductions.

Table 3: Comparison of total and percentage change in Scottish and Nordic States GHG emissions KtCO$_2$e 1990-2011[18]

	Base Year 1990	2011	2012	% change 2011-2012	% change 1990-2012
Scotland	10,531	10,489	10,540	0.5%	0.1%
Denmark	10,778	12,852	12,245	-4.7%	13.6%
Finland	12,757	13,228	12,678	-4.2%	-0.6%
Sweden	19,272	20,346	19,106	-6.1%	-0.9%
Norway	11,102	15,239	N/A	N/A	37.3%

Source: European Environment Agency (EEA, Greenhouse Gas Emissions from Transport 2013, http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&init=1&plugin=1&language=en&pcode=tsdtr410

2.8 Comparison of key Scottish and EU transport emission statistics

A further useful performance comparison is with EU member states. Table 4 shows that by 2012 only four countries, Germany, Estonia, Latvia and Lithuania, have reduced their transport emissions by more than 1% against their equivalent 1990 emissions figure. Scotland's performance puts it ahead of 21 EU countries as well as the EU as a whole. Five countries have increases of over 100%.

[18] Data for emissions in Norway in 2012 are not available. Hence for the sake of comparison the 2011 figure is used in the final column.

Table 4: Comparison of change in Transport emissions in Scotland and EU-member states[19]

Member State	% change 1990-2012	Member State	% change 1990-2012
Belgium	20.6%	Hungary	27.3%
Bulgaria	23.9%	Malta	57.9%
Czech Republic	118.0%	Netherlands	29.4%
Denmark	13.6%	Austria	54.2%
Germany	-5.6%	Poland	127.6%
Estonia	-7.4%	Portugal	65.0%
Ireland	112.8%	Romania	18.2%
Greece	11.1%	Slovenia	111.5%
Spain	36.5%	Slovakia	30.9%
France	9.3%	Finland	-0.6%
Croatia	39.4%	Sweden	-0.9%
Italy	2.9%	United Kingdom	-0.4%
Cyprus	73.0%	EU (27 countries)	18.4%
Latvia	-6.8%		
Lithuania	-39.3%		
Luxembourg	139.5%	Scotland	**0.1%**

2.9 Efficiency of passenger vehicles

By measuring the efficiency of passenger vehicles in terms of the CO_2e per passenger kilometre (ppkm)[20] another useful picture for transport emissions emerges to help consider relative efficiencies at mode level within the overall aggregate emissions story. According to Defra's Company Reporting Guidelines[21] an average coach generates just under 30g CO_2e/ppkm, rail 47g CO_2e/ppkm and a bus 109g CO_2e/ppkm. The average diesel and petrol car produces emissions of 123g CO_2e/ppkm and 128g CO_2e/ppkm respectively. Since 1999 average car occupancy has fallen by 9.5% acting as a drag on the improved efficiency of the internal combustion engine. Domestic flights are estimated to be the most polluting per passenger kilometre followed by petrol and then diesel cars.

[19] Source: http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&init=1&plugin=1&language=en&pcode=tsdtr410

[20] 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.

[21] Guidelines to Defra/DECC's GHG Conversion Factors for Company Reporting (2013), produced by AEA for the Department of Energy and Climate Change (DECC) and the Department of Environment, Food and Rural Affairs (Defra).

Table 5: CO_2e emissions per passenger kilometre by mode[22]

Sector	Mode and fuel	gCO₂e/ppkm			
		2012	2013	2014	% Change 2012-2014
Road	Average petrol car	134	131	128	-4.0%
	Average diesel car	124	121	123	-0.8%
	Average petrol hybrid car	89	87	89	0.3%
	Average petrol motorbike	119	119	120	0.5%
	Average bus	112	112	109	-2.2%
	Average coach	29	29	29	2.0%
Rail	National rail	58	49	47	-18.6%
	Light rail and tram	68	60	62	-8.7%
Ferry (Large RoPax)	Average foot and car passengers	116	116	116	0.0%
Aviation	Average domestic flights	180	173	155	-13.9%
	Average short haul international	104	102	88	-15.3%
	Average long haul international	119	120	111	-6.4%

Source: 2014 Guidelines to Defra/DECC's GHG Conversion Factors for Company Reporting, *http://www.ukconversionfactorscarbonsmart.co.uk/*

2.10 Leading indicators

Data on Scottish greenhouse gas emissions emerges around 18 months after the end of the year in question. There are though some lead indicators that help throw some light on the emissions performance between then and the present and these are discussed below and reported in Table 6.

- *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. For the latest two years (2012-13) total road kilometres travelled has increased marginally.

- *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

[22] All car figures assume an average car occupancy rate of 1.51 passengers based on the Scottish Household Survey Travel Diary: 2010-2011. Bus and coach figures assume an average vehicle occupancy rate of 10.8 and 16.2 respectively based on Guidelines to Defra/DECC's GHG Conversion Factors for Company Reporting (2013).

indicator tracks the proportion of vehicles newly registered that are alternatively fuelled. The latest data shows that there has been a small increase in total sales and in the proportion of alternatively fuelled vehicle sold. This trend of increasing sales has continued into 2014.

- *Aviation passengers*: Emissions from international aviation in particular have grown rapidly over the past 20 years. This indicator tracks the total number of aviation passenger - both terminal and transit - and shows another small pick-up in passenger numbers between 2012 and 2013. The indicator shows a continued slow rise in passenger numbers into 2014.

- *2013 UK emissions estimates*: Provisional UK emissions data for 2013 was published in March 2014 while final Scottish data for 2013 will not be published until June 2015. The latest UK transport emissions estimate shows a further small reduction in transport emissions of less than 0.2% in 2013 compared to 2012, continuing the downward trend begun after 2007. As yet there is no estimate available for 2013 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 fall for the UK as a whole 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*: Vehicle fuel efficiency is a key element in emissions reduction. By reducing fuel consumption per vehicle kilometre fewer emissions are emitted. This indicator tracks total transport fuel sales and shows that total sales in 2013 continues on a downward path, despite the small increase in both road and air activity.

- *Average CO_2/km of cars registered in Scotland for first time:* As the fleet becomes more fuel efficient and an increasing proportion of the fleet begins to use other fuel sources so the average emissions for newly registered cars will fall. There has now been a decade of year on year falls in emissions per kilometre for newly registered vehicles and the most recent year saw a sharp drop.

- *Scottish GVA: Q2 2013 to Q2 2014:* over the year to the end of the second quarter of 2014 Scottish GVA grew by 2.6%. 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 Q2 2013 to Q2 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 by 13% from the peak in September 2013. Current prices are back to levels last seen in late 2010/early 2011 and are still falling as the spot price of crude oil continues to drop. While demand for fuel is generally inelastic (price changes have little impact on demand for fuel) the reduction in pump prices is likely to see a small increase in demand for fuel at the forecourts.

Together, the available indicators suggest that downward pressure will continue to be felt on transport emissions in the short term, largely through improving fuel efficiency. A continuing pick-up in airline passenger numbers, road kilometres travelled and general economic performance will though work in the opposite direction.

Table 6: Trends in leading transport indicators

Indicator	2013 level	Average growth p.a. (2003-2013)	Growth (2012-2013)
Road vehicle kilometres travelled (million vehicle kilometres)[23]	43,549	0.4%	0.6%
Proportion of new road vehicles that are alternatively fuelled (%)[24]	1.0%	23%	20%
Aviation passengers (thousand passengers) [25]	23,275	1.0%	4.6%
UK transport emissions (excl. IAS) ($MtCO_2e$)	116.7	-0.8%	-0.2%
UK petroleum consumption by transport (million tonnes)[26]	47.1	-0.6%	-0.9%
Average CO_2/km of cars registered in Scotland for first time	128.4	-2.2%	-3.6%
			Q2 2013 – Q2 2014
Scottish year-on-year GVA growth (to Q2 2014)	-	-	2.6%
Scottish year-on-year change in a) petrol and b) diesel prices[27]			a) -3.4% b) -2.5%

[23] Source DfT Table TRA0203
[24] Definition and series amended to include all vehicles not fuelled entirely by petrol and diesel, excluding mobility scooters. Source: Transport Scotland 2014 data tables Chapter 1 table 1.1
[25] Transport Scotland 2014 data tables Chapter 8 table 8.1
[26] DUKES Table 3.2
[27] 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 after the time period captured by the GHGI (1990–2012). The interventions are separated between infrastructure projects and those that involve fiscal policy or regulation. Emissions impacts are taken from the original appraisal report or subsequent published document, where available, 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 original model used. 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[28] (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[29] that was produced for the Strategic Rail Authority. This is published on the Department for Transport

[28] Design Manual for Roads and Bridges (2009): Highways Agency Design Manual for Roads and Bridges (DMRB)
[29] 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. Where projects do concern other modes, for example the Edinburgh Tram, 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. The Edinburgh tram model is an example where the secondary effects are assessed, and this may be one of the reasons why the assessment suggests an overall emissions increase.

Road

A75 Dunragit Bypass

www.transportscotland.gov.uk/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.transportscotland.gov.uk/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.transportscotland.gov.uk/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.transportscotland.gov.uk/projects/forth-replacement-crossing

- Document: 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 proposed 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 new bridge - 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 that 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. 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.

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
- Anticipated construction completion: 2015
- Estimated emissions impact: Cumulative impact of 32ktCO_2e by 2030, 2ktCO_2e by 2050 and -29ktCO_2e by 2070[30].

This project is to reinstate 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.

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

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

in the early years before removing approximately 29ktCO_2e over the appraisal period to 2070.

Edinburgh-Glasgow (Rail) Improvements Programme

http://www.transportscotland.gov.uk/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 [31]:
- 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 reduction in road emissions of around -3ktCO_2e p.a. which is included in the overall figures presented.

[31] 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

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.

Table 7: 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

Edinburgh Tram Lines 1a and 1b[32]

http://www.tiedinburgh.co.uk/

- Document: STAG part 2 appraisal (2006), Steer Davies Gleave / Colin Buchanan
- Construction completed: operational May 2014
- Estimated emissions impact[33]: +90$ktCO_2e$ p.a. from 2011; +167$ktCO_2e$ p.a. from 2031.

[32] The Edinburgh Tram network is the responsibility of the City of Edinburgh Council who are both Statutory Undertaker and operator of the two proposed tram lines under the respective Edinburgh Tram (Lines One and Two) Acts of 2006.
[33] To be consistent with the scope of this document, these figures relate to emissions in the transport sector only and *exclude* increased emissions resulting from power consumption by the tram. If the

The proposed tram lines, Phases 1a and 1b, are covered by the respective Edinburgh Tram (Lines One and Two) Acts of 2006. Both were intended to open in 2011 but contractual disputes caused severe delays, particularly in terms of certainty for completion and operational dates. Phase 1a, which is intended to run from Edinburgh Airport to Newhaven via Princes Street, has been operational from the Airport to York Place via Princes Street since May 2014. No date has yet been set for the completion of the remaining stage(s) Phase 1b running between Haymarket and Newhaven via the Roseburn corridor has been postponed on affordability grounds.

In the project development stages, an Edinburgh based demand forecasting model was developed to predict use of the tram and the impact on other transport modes. The STAG reports that building the tram network would generate a higher level of development along the tram corridor than not building the network. The effect of this is to increase the overall volume of movements which could potentially include a higher number of car trips. The original modelling work demonstrated that both Phase 1a and 1a+1b would increase the level of CO_2e, as a result of traffic re-routing and demand redistribution.[34],[35]

Table 5 summarises the information from the projects listed above. Whilst this is a useful reference table, it should be reiterated that these emissions estimates are not produced using a single, consistent methodology and, therefore, are not directly comparable. That said, the pattern of expected relatively small increases in emissions from road infrastructure projects (not to forget the other economic benefits delivered in respect of journey time improvements set out in the project appraisal) will be more than compensated for in the long term through the modal shift can be

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CO_2 emissions resulting from power consumption by the tram are added to the additional emissions from road traffic, then the net emissions impact of the project increases by 8ktCO_2 and 11ktCO_2 p.a. in 2011 and 2031 respectively.

[34] It is worth noting that without the tram, it is possible that the developments referred to would take place elsewhere, most likely in peripheral locations with a higher proportion of car usage and longer trip lengths. These ‘dis-benefits’ have not been accounted for. Without the effect of the larger assumed travel market in the ‘with-tram’ scenario, the increases in emissions would be approximately half of those reported.

[35] All figures and analysis for the Edinburgh Trams Lines 1a and 1b refer to modelling of the original project scope and do not take account of decisions to be made through current contractual discussions.

offset through investment in rail. The investment in the Edinburgh- Glasgow Improvement project is expected to generate annual reductions in emissions of around 30 ktCO_2e in the near term from a combination of removing diesel rolling stock and displacing cars from the road.

Table 8: 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
Edinburgh Tram Lines 1a and 1b	+90 ktCO_2e p.a. from 2012
	+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, RPP2 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[36]. 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* [37] 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

[36] http://www.scotland.gov.uk/Publications/2013/06/6387/9
[37] [http://www.transportscotland.gov.uk/files/Switched%20On%20Scotland%20.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.transportscotland.gov.uk/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[38]. The rate of tax varies according to passenger destination and the class of passenger travel. Since 1 November 2009 APD has been structured around four distance bands, set at intervals of 2,000 miles from London.

APD rates were increased in line with inflation in the 2013 Budget and it was announced at the same time that for 2014/15 rates would rise in line with inflation from 1 April 2014. The 2014 Budget announced the abolition of highest APD bands (C and D) from 2015. All flights to countries with a capital city more than 2000 miles from London will then be charged at the Band B rate. Very few current direct flights from Scotland are affected by this change. This change is estimated in increase annual UK emissions by 0.3 MtCO2e.

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

[38] 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[39].

Inclusion of aviation in EU ETS

Key documents and analysis:

http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:008:0003:01:EN:HTML

http://eur-lex.europa.eu/LexUriServ/site/en/com/2006/com2006_0818en01.pdf

http://www.parliament.uk/briefing-papers/SN05533

- Implementation date: 2012
- Estimated emissions impact: up to - 183 $MtCO_2e$ p.a. in 2020 across Europe relative to no cap

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 will allow the sector to take responsibility for its carbon emissions in the most cost effective way and will form the basis for wider, global action. 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 cap could reduce emissions in 2020 by up to 183 million tonnes CO_2e.

In November 2012 the European Commission announced that it would “Stop the Clock” on the implementation 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 European Economic Area (EAA) aerodromes need comply with the Aviation ETS at this time. This suspension is unlikely to have any material effect on the impact of the regulation on Scottish aviation emissions.

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

Fuel duty

Latest documents and analysis: http://www.hmrc.gov.uk/budget2013/tiin-2522.pdf http://hmrc.gov.uk/tiin/2012/tiin1094.pdf

Tax Information and Impact Note 11 December 2012; Tax Information and Impact Note published alongside 2013 Budget 20 March 2013

Implementation date: 1 January and 1 September 2013

- 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 deferred the scheduled 2011 inflation-only increase until 1 January 2012. Subsequently, the increase of 3.02 pence per litre fuel duty increase deferred from August 2012 and due to come into effect on 1 January 2013 was cancelled and the 2013-14 increase due on 1 April 2013 was deferred to 1 September 2013. This rise was also subsequently cancelled as was the increase in the 2014 budget. Together, the removal of measures have been estimated to add 0.5 $MtCO_2e$ per annum to the UK emissions total compared to where it would otherwise have been, although this gross impact from the removal of the fuel duty rise does not take account of the dampening effect on emissions from the rise in wholesale fuel prices. Budget 2014 left fuel duty unchanged and Autumn Statement 2014 confirmed the freeze. Should the recent sharp drop in fuel prices be maintained this will likely increase demand for fuel and consequently emissions.

From 1 April 2015, the government will apply a reduced rate of fuel duty to methanol. The rate will be set at 9.32 pence per litre. The size of the duty differential between the main rate and methanol will be maintained until March 2024. This should encourage the use of methanol over diesel fuel at the margins. The government will review the impact of this incentive alongside the duty incentives for road fuel gases at Budget 2018.

Reform to vehicle excise duty

Latest documents and analysis:
http://www.hmrc.gov.uk/budget2013/ootlar-main.pdf

- Budget 2013 HMRC documentation
- Estimated emissions impact of 2010 change: -0.9 $MtCO_2e$ by 2020

From 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 pay no VED in the first year. Cars emitting over 165 g CO_2e per km pay additional VED in the first year. First year rates are used to encourage the purchase of more fuel-efficient cars. Together, these changes are estimated to result in a cumulative UK saving of 0.9 $MtCO_2e$ by 2020. However, this assessment only includes impacts in the new car market, and these figures will contribute to the delivery of the savings from the EU regulation on CO_2e from cars, rather than constitute additional savings. Budget 2011 announced that VED rates would increase by RPI indexation in 2011-12 with rates for HGVs frozen over the period. HGV rates were subsequently frozen again at the 2013 budget while rates for cars have been increased in line with inflation (RPI) in the latest budget. Cars in Band A (<100g CO_2e per km) pay no VED while those in Band B (100 - 110g CO_2e per km) and C (110 - 120g CO_2e per km) pay no VED at first registration and £20 and £30 respectively thereafter. Budget 2014 increased VED by inflation.

Company car tax

Latest documents and analysis:
http://cdn.hm-treasury.gov.uk/budget2012_complete.pdf
http://www.hmrc.gov.uk/budget2013/ootlar-main.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 further reform of company car tax to provide an incentive to purchase the lowest emitting vehicles on the market. This has been reinforced in recent budgets to incentivise the purchase and manufacture of ultra-low emission vehicles in the UK. From April 2011, the basic threshold for the 15 per cent band of company car tax was reduced by 5 grams of carbon dioxide emitted per kilometre (g CO_2e per km), so that this band applies to cars emitting between 121 and 129g CO_2e per km. This threshold has subsequently been reduced further. For 2015-16, this measure introduces two new appropriate percentage bands for company cars emitting 0-50g of carbon dioxide (CO_2e) per kilometre (5 per cent) and 51-75g CO_2e per km (9 per cent). In addition, as announced at Budget 2012, the remaining appropriate percentages are increased by two percentage points for cars emitting more than 75g CO_2e per km, to a new maximum of 37 per cent.

Budget 2013 also sets out rates for company cars emitting 75g CO_2e per km or less for 2016-17 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 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.

Fuel benefit charge (FBC)
http://webarchive.nationalarchives.gov.uk/20100407010852/http://www.hm-treasury.gov.uk/budget2010_documents.htm
http://www.hmrc.gov.uk/budget2013/ootlar-main.pdf
http://www.legislation.gov.uk/uksi/2013/3033/pdfs/uksiem_20133033_en.pdf

- Anticipated implementation date: 2010
- Estimated emissions impact: Not quantified

The provision of free fuel to company car drivers provides a perverse environmental incentive. The Pre-Budget Report 2009 set out that from 6 April 2010, the multiplier would increase from £16,900 to £18,000. The van fuel benefit charge – on which tax on free van fuel is payable – will also increase from £500 to £550. Budget 2011 and 2012 brought in further above inflation multipliers before the increases fall back to

RPI from 2014-15. The Government also committed to pre-announcing the FBC multiplier one year in advance. The van FBC multiplier will be frozen at £550 in 2012 but will increase by the RPI in 2013–14. The 2014 budget confirmed that the car and multipliers would continue to rise in line with inflation in 2015-16.

Table 6 summarises the previous information. As with Table 5, these emissions are not produced using a single, consistent methodology so are not directly comparable.

Table 9: Net emissions impact estimates of fiscal / regulatory measures

Project title	Published emissions estimate
Air passenger duty	0.3MtCO_2e p.a from 2015-16 (UK)
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)
Reform of Vehicle Excise Duty[40]	-0.9 MtCO_2e total savings by 2020 (UK)
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.

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:

[40] 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.

- It 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.

- It does 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 results in Table 8 therefore cannot 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[41]. 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.

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

A recent updating of the baseline data within LATIS has 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 are shown in Table 10. 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. This is equivalent to an additional 0.4% on annual transport emissions in 2027 relative to where emissions would otherwise have been.

Table 10: Projected net emissions impact of Scottish projects[42]

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

[42] 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). Work has commenced on the production of the next Report on Proposals and Policies, which will demonstrate how our long term targets could be achieved.

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 fifth straight year.

Section 2 also demonstrates through a range of key indicators monitoring public transport use, continued encouraging movements towards more fuel efficient, less emitting 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 intention behind these measures generally is to encourage shifts in travel behaviour towards active and more fuel efficient options through charging more for inefficient practices or offering reduced rates on efficient transport choices.

For the last 3 years, Transport Scotland has published a Sustainability Report, which reports on the corporate operational carbon emission performance. A summary of current progress to reduce operational emissions and the last year performance can be found in the Annual Report[43]. The most recent Sustainability Report[44] identified a need to update certain elements within our Carbon Management Plan[45] and these amendments resulted directly from the need to capture, analyse and report changes in a Sustainability Report. As such, the Sustainability Report production prompts a 'lessons learnt' approach to the Carbon Management Plan.

Transport Scotland continues to operate a Carbon Management System (CMS) for our schemes, with a requirement to capture CMS data included within many of our infrastructure contracts. The CMS was refreshed in 2014 to include the latest carbon emission factors.

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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[43] Transport Scotland Annual Report And Accounts
[44] Transport Scotland: Sustainability Report
[45] Carbon Management Plan

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Further copies of this document are available, on request, in audio and large print formats and in community languages (Urdu; Bengali; Gaelic; Hindi; Punjabi; Cantonese; Arabic; Polish).

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ris an èistear, ann an clò mòr agus ann an cànain
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