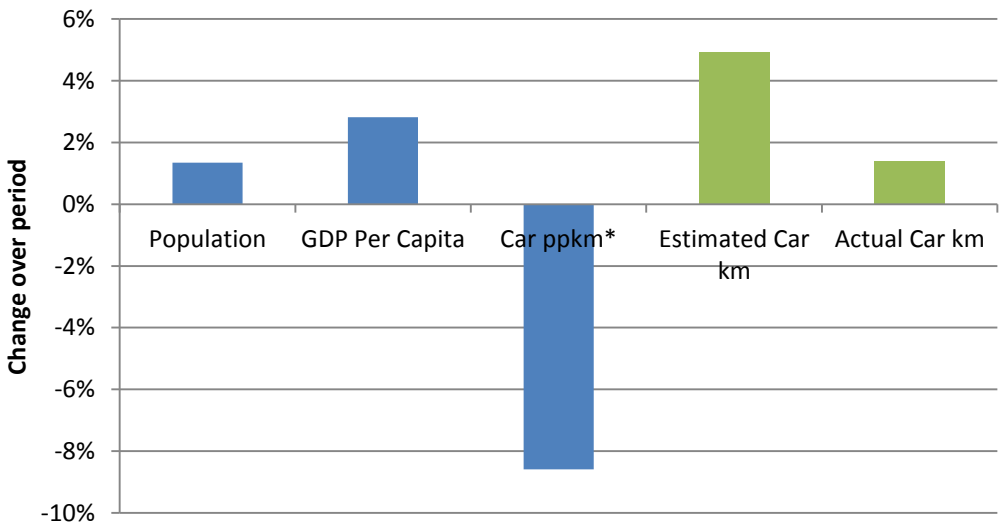
Technical Annex 4: Transport

1. Demand for travel – Modelled vs. outturn

Demand for travel can be projected using elasticities for the drivers of demand; GDP, population, fuel costs and manufacturing output. DfT has published estimates of these elasticites, which are used in the National Transport Model[1]. By comparing these estimates to outturn, we can see how well the elasticities predict demand (Figures A4.1, A4.2 and A4.3).

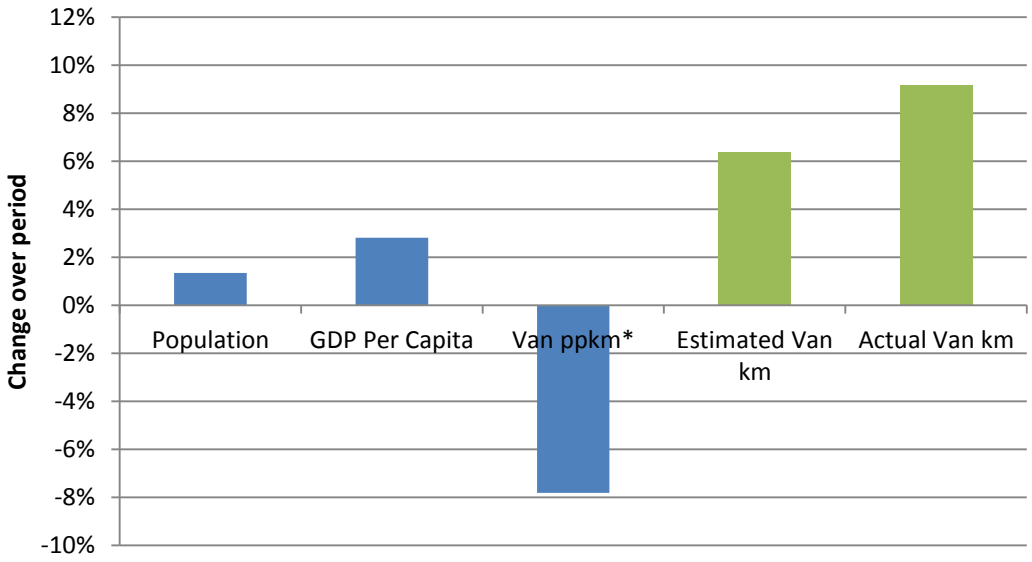
Figure A4.1: Drivers of Car km Demand 2012-2014



Source: CCC calculations based on data from the Office for National Statistics, DfT (2015) Road Traffic Statistics, DfT (2013) Road Traffic Forecasts 2013.
Note: * pence per kilometre

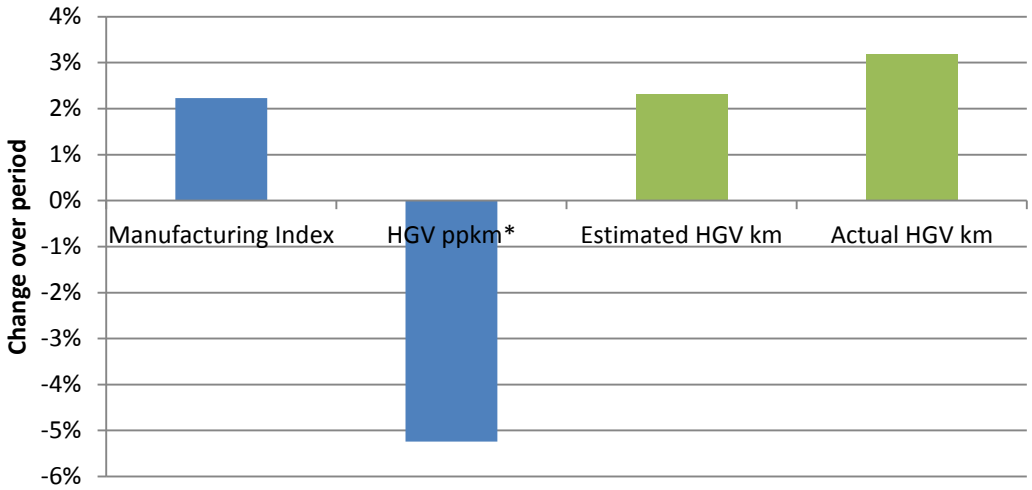
[1] DfT (2013), *Road Traffic Forecasts 2013*.

Figure A4.2: Drivers of Van km Demand 2012-2014



Source: CCC calculations based on data from the Office for National Statistics, DfT (2015) Road Traffic Statistics, DfT (2013) Road Traffic Forecasts 2013.
Notes: *pence per kilometre

Figure A4.3: Drivers of HGV km Demand 2012-2014



Source: CCC calculations based on data from the Office for National Statistics, DfT (2015) Road Traffic Statistics, DfT (2013) Road Traffic Forecasts 2013.
Notes: *pence per kilometre

2. Emissions trends – NAEI estimation methodology

Box A4.1: NAEI methodology

The National Atmospheric Emissions Inventory (NAEI) includes estimates of road transport CO_2 emissions by mode. CO_2 emissions from each mode are estimated with the following steps:

- Fuel consumption factors are defined for petrol and diesel vehicles, for each type of road.
- Total petrol and diesel consumption is estimated based on fuel consumption factors and vehicle km travelled on each type of road.
- Estimated petrol and diesel consumption is adjusted so that total consumption equals official statistics on total petrol and diesel sales in the UK.

There are currently two problems with this methodology:

- Car and van fuel consumption factors are based on speed-emissions curves which do not reflect reductions in gCO_2 /km arising from the latest EU new car and van CO_2 regulations, or the growing gap between test-cycle and real-world emissions. HGV factors are based on data from the DfT's Continuing Survey of Road Goods Transport (CSRGT), which has known methodological issues, such as a persistent underreporting of vehicle-km[2].
- For petrol, any discrepancy between estimated consumption and total sales is allocated proportionally across petrol consuming modes, but for diesel it is allocated entirely to HGVs. This can lead to large year-on-year changes in implied HGV fleet efficiency, raising questions over the robustness of the estimates.

The implication of this issue is that estimates of HGV fleet efficiency, particularly year-on-year changes, should be treated with caution. We are currently working with DECC and DfT to try to improve the NAEI methodology.

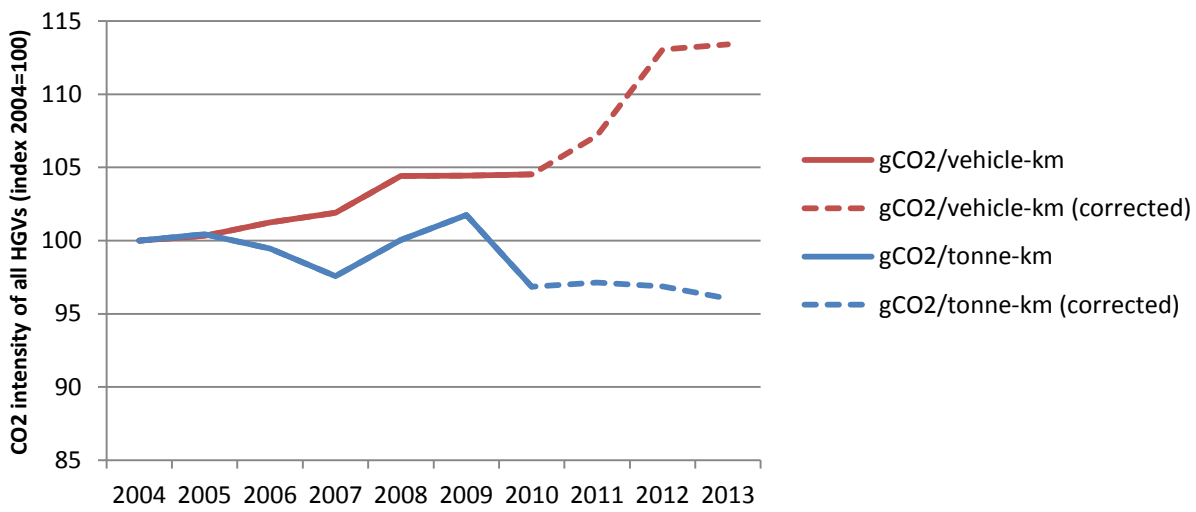
[2] DfT (2011) *Discrepancies between Road Freight and Road Traffic HGV traffic estimates*. Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/230534/hgv-traffic-estimates-report.pdf.

3. Emissions trends – Comparison of HGV gCO_2/vehicle-km and gCO_2/tonne-km

The CO_2 intensity of HGV operations can be expressed in terms of both emissions per km and emissions per tonne-kilometre. An HGV that is fully loaded will have higher emissions per kilometre, but will usually have lower emissions per tonne-kilometre compared to a half-full HGV.

The Continuing Survey of Roads Goods Transport (CSRGT) is an ongoing survey of Great Britain registered freight activity. Data from the CSRGT suggests that while emissions per kilometre increased by nearly 9% between 2009 and 2013, emissions per-tonne-kilometre decreased by about 6% (Figure A4.4). This estimate should be treated with caution, as there was a change in survey methodology in 2011. DfT has published a series of correction factors so that trends before and after the methodology change can be compared.

Figure A4.4: Comparison of HGV gCO_2/v-km and gCO_2/tonne-km, indexed from 2004

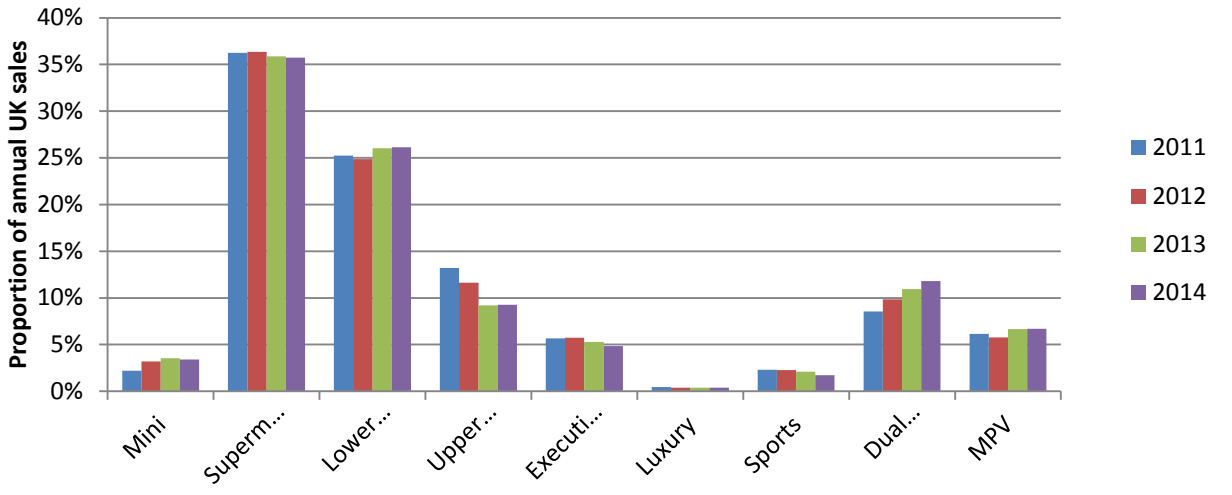


Source: CCC calculations based on DFT (2015) Road Freight Statistics.

4. New car CO_2 and sales

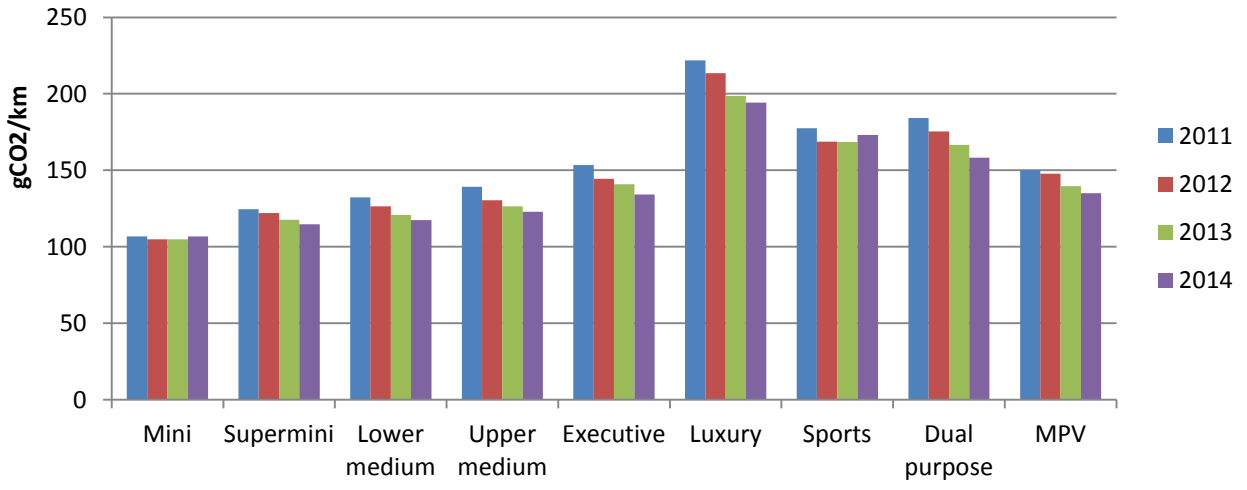
The Society of Motor Manufacturers and Traders (SMMT) publish data on annual sales and gCO_2/km of new cars split by segment and fuel type. Figures A4.5 to A4.8 show the UK share of sales and recorded gCO2/km for different segments and fuel types from 2011 to 2014. These data show that CO2 intensity reductions are being achieved across nearly all segments and fuel types.

Figure A4.5: New car sales segmentation



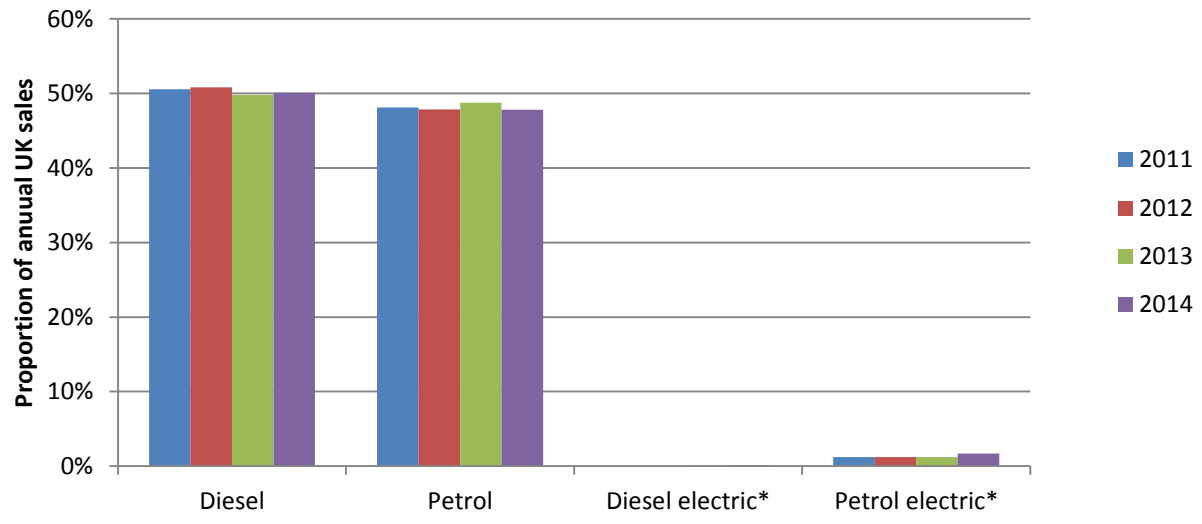
Source: SMMT (2015), New Car CO_2

Figure A4.6: New car CO_2 segmentation



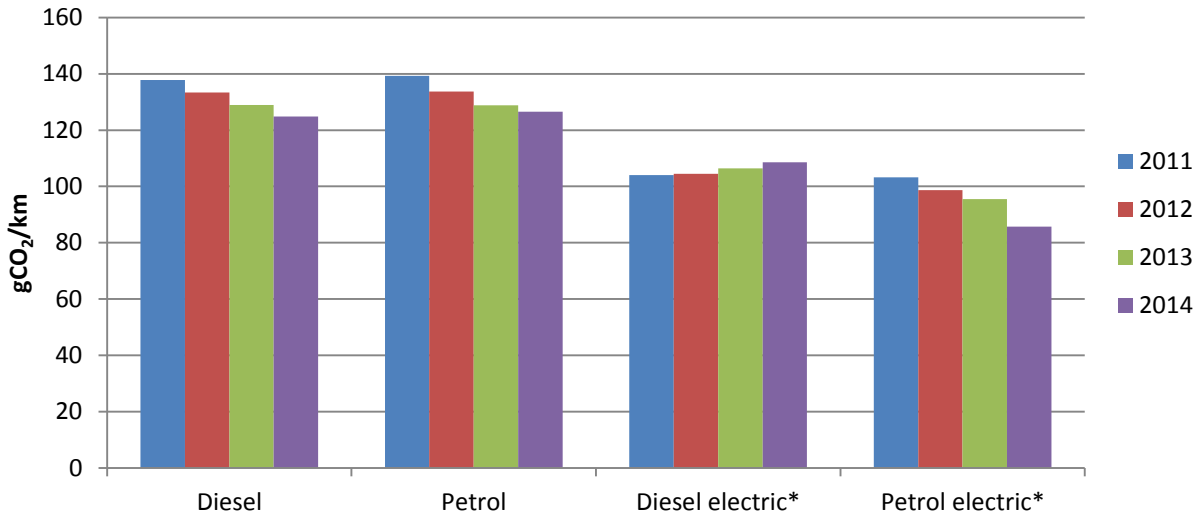
Source: SMMT (2015), New Car CO_2

Figure A4.7: New car sales by fuel



Source: SMMT (2015), New Car CO_2
* Hybrid electric, excludes plug-in electric vehicles

Figure A4.8: New car CO_2 by fuel



Source: SMMT (2015), New Car CO_2
* Hybrid electric, excludes plug-in electric vehicles

5. HGVs – Use of natural gas

Box A4.2: Use of natural gas in HGVs

Methane has been identified as a potential option for reducing the emissions intensity of HGVs. There is a range of potential sources of methane with different lifecycle GHG emissions, which makes it difficult to estimate the benefits relative to conventional diesel fuelled vehicles. In addition, there is some evidence that existing technology can allow methane to leak into the atmosphere from the truck while it is not in use. The GHG impact of this leakage may offset any benefit in reduced tailpipe CO_2 emissions.

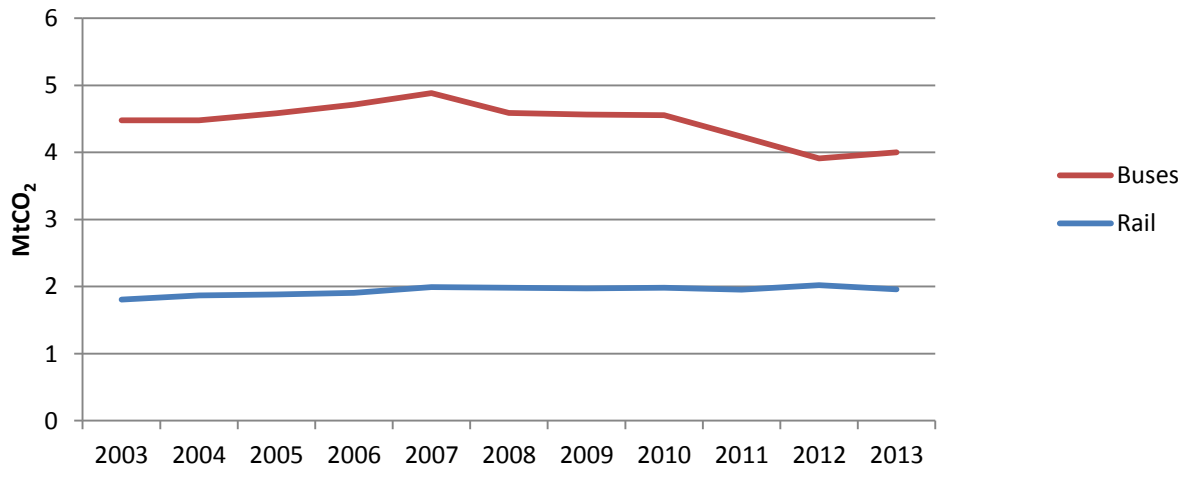
The benefits of biomethane are generally found to be higher than fossil natural gas but the supply is likely to be limited relative to demand across the economy. There would therefore need to be a clear reason for using biomethane in HGVs versus other sectors in the longer term, particularly where there may be potential to use it in combination with carbon capture and storage to deliver 'negative' emissions.

DfT is running a Low Carbon Truck Trial, launched in 2012 to help operators establish and run fleets of low carbon HGVs, with a focus on methane. The Office for Low-Emission Vehicles (OLEV) and Innovate UK are providing £11.3m to fund around 350 vehicles as well as refuelling infrastructure. DfT is overseeing the evaluation of the trial, including GHG emissions, costs and operational performance. No findings have been published since 2013[3] but an updated evaluation of the scheme is expected later this year.

In April 2014, OLEV announced £4 million of funding for gas infrastructure for HGVs as part of its £500 million funding package for low carbon vehicles between 2015 and 2020. We have recommended that the lifecycle GHG benefits of methane fuelled HGVs are fully evaluated before further Government investment in gas refuelling infrastructure.

6. Buses and rail

Figure A4.9: Emissions from buses and rail



Source: SMMT (2015), New Car CO_2
* Hybrid electric, excludes plug-in electric vehicles

[3] Available at: www.gov.uk/government/publications/low-carbon-truck-trial-first-year-executive-summary

Box A4.3: Reducing emissions from buses

Uptake of low carbon buses has been funded through two principle schemes; the Green Bus fund and the Bus Services Operators Grant (BSOG). The Green Bus Fund provided over £88 million in funding towards purchase costs, over four rounds from 2009 to 2013. In addition to this upfront cost subsidy, the BSOG adds a further ongoing payment of 6p per km travelled.

An additional £30 million of funding is planned from 2016 as part of OLEV's £500 million package. It is estimated that this additional funding will increase the percentage of low carbon buses to 6% of the fleet.

Box A4.4: Reducing emissions from rail

Electrification of rail has the potential to reduce emissions relative to equivalent diesel trains. In 2009, DfT set out a programme for increasing rail electrification, committing to an initial £1.1 billion of investment on lines in the North of England and on the Great Western Mainline.

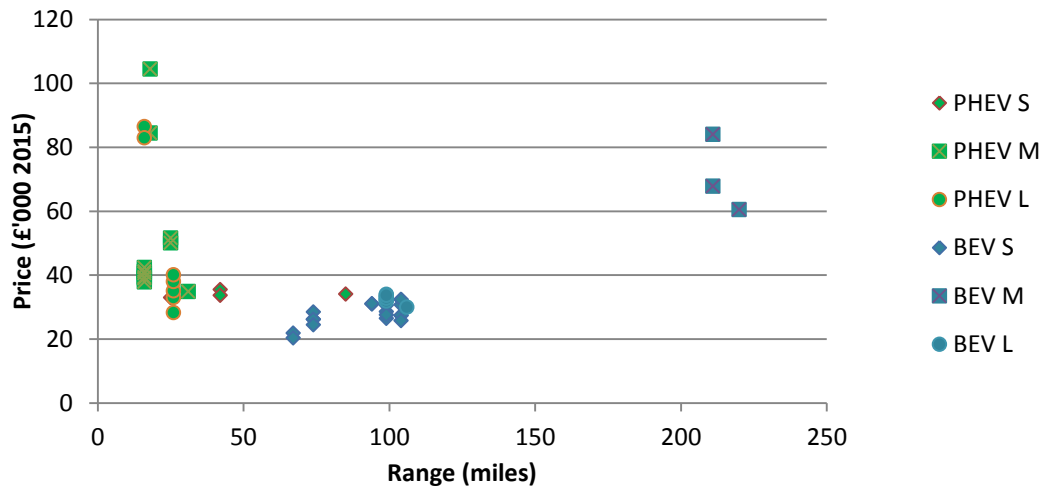
The first of the Northern programmes, running from Manchester to Liverpool and Huyton to Wigan completed in early 2015; Preston to Blackpool is due to be electrified by May 2016; and Manchester to Preston by December of the same year. Electrification on the Great Western Mainline is due to be completed by 2017.

Together, this will deliver emissions savings of around 2.2 $MtCO_2$ over the fourth carbon budget period according to government estimates.

7. Electric vehicles – Range of models available in 2014/15

Next Green Car collects data on the price and electric range of available electric vehicles. Figure A4.10 illustrates the relationship between price and measured electric range. The data are split between plug-in hybrid vehicles (PHEVs) and battery electric vehicles (BEVs) of small (S), medium (M) and large (L) sizes.

Figure A4.10: Range and price of EVs available in 2014/15



Source: NextGreenCar.com

8. Electric vehicles – Details of EV support package

Box A4.5: EV support package

In Budget 2014, the Government announced £500m to promote the uptake of EVs (and other ultra-low emission vehicles). No new support has been announced but further detail has become available on how the money will be allocated.

EV subsidies - At least £200m will be allocated to the Plug-in Car grant out to 2020. The current payment of £5,000 is available for the first 50,000 grant awards, at which point the scheme will be reviewed. At the current rate of uptake 50,000 grants is likely to be reached before the end of 2015.

EV infrastructure - As of June 2015 there were 8,400 publically available charge points in the UK, the majority of which were fast (7-22kW)[4]. OLEV has committed £32m for EV charging infrastructure, with a further £15m coming from Highways England.

- £15m will be provided to support the continuation of the EV Homecharge Scheme; a grant of up to £700 for the installation of a home charger.
- £8m will support the installation of public charger points in towns and cities, as well as an additional £15m from Highways England to improve the coverage of chargers on the road network.
- £9m for other infrastructure priorities, such as ensuring charger maintenance and accessibility.

Softer measures to promote uptake of EVs - There are a variety of schemes in place to promote uptake of EVs through softer measures. Local authorities can compete for funding to promote EV uptake in their area. Funding is available for EVs in taxi and public sector fleets, which will make EVs more visible to the public. The Government is also continuing its "Go Ultra Low" public awareness campaign.

- In December 2014, OLEV launched its City Scheme competition to provide funding to cities to promote a step change in uptake of EVs in their area. Following a competitive bidding process, £35m will be allocated to between two and four cities. Bidders have to demonstrate how they will look to become internationally outstanding examples of the adoption of ULEVs in a local area.
- £45m has been committed to support the rollout of EV taxis. This is partly driven by the need to reduce air pollution in urban centres, where taxis can account for a significant fraction of emissions. A further £5m is being used to promote the use of EVs in public sector fleets. Both of these measures should increase public exposure to EVs and help to raise awareness.
- The Government's "Go Ultra Low" campaign to promote awareness of EVs has expanded, growing from 4 to 7 sponsor car manufacturers. An online tool has been developed to estimate cost-effectiveness of EVs for private consumers and fleet managers.

Research and development - £100m was allocated to research and development. Some of this funding has now been allocated to specific projects.

- £6.3 million research project into fuel cell range extenders for electric light commercial vehicles.
- £10 million to develop future electric vehicle battery production.
- £32 million to a consortium for two projects to research manufacturing technology for electric motors and to develop cleaner internal combustion engines.

[4] Zap-Map statistics. Available at: www.zap-map.com/statistics

9. Demand-side measures

Box A4.6: Eco-driving

Eco-driving can help drivers maximise fuel efficiency, through a range of techniques such as smooth acceleration, appropriate use of gears and speed, anticipating traffic conditions, using engine braking, and turning off the engine when stationary.

We previously tracked take up of eco-driving training as an indicator, though it was difficult to collect comprehensive data and actual take-up was much lower than our indicator. The DVLA has not taken forward our recommendation to make eco-driving part of the driving test.

At the same time, progress has been made in demonstrating the impact of vehicle-technology to encourage eco-driving.

- Gear Shift Indicators (GSIs) have been mandatory for new models of cars sold in the EU since November 2012 and will be mandatory for all new cars from November 2014. The European Commission estimates fuel savings of around 7% per vehicle from use of GSIs if they are actively used, with 1.5% savings across the fleet as a whole, given some drivers will not use them, and others may return to previous driving habits with time[5].
- Fuel Consumption Meters (FCMs) can also be effective in encouraging efficient driving. However a recent proposal to mandate their installation in new cars was rejected by the EC, despite a recent impact assessment produced by the Commission recommending their implementation.

We will continue to monitor the market for technology for encouraging eco-driving and recommend roll-out if effective solutions become available.

Box A4.7: Enforcing the speed limit

Lower air resistance when travelling at 70 mph vs. 80 mph can reduce car emissions by 10-20%. Levels of speeding have fallen slightly since 2008, but remain relatively high. In 2013 speeding fell on both motorways and dual carriageways.

- 47% of cars on motorways broke the speed limit in 2013, down from 48% in 2012.
- The percentage of cars breaking the speed limit on dual carriageways in 2013 was 39%, down from 40% in 2012.

Our scenario for meeting carbon budgets assumes that the 70 mph speed limit is not exceeded from 2013 onwards. Future speeding trends are likely to be influenced by speed limit enforcement as well as congestion, fuel costs, and societal attitudes towards those breaking the speed limit. However, the precise impacts of these factors on future levels of speeding are difficult to estimate, especially as recent historical reductions in speeding are not well understood.

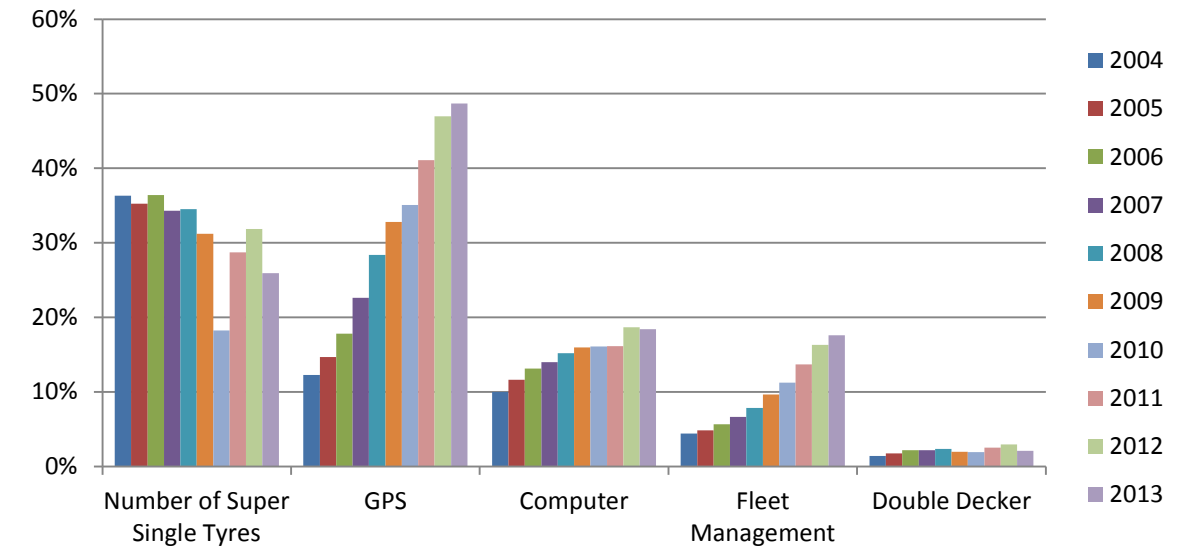
If the average annual percentage reduction in speeding observed over the first budget period is extrapolated, the elimination of speeding would take much longer than our scenario assumes and could add emissions of around 1.5 $MtCO_2$ in 2020 and 1 $MtCO_2$ in 2030, as efficiency of vehicles improves and uptake of EVs increases. This would be made worse by any decision to increase speed limits which should not be done unless there is clear evidence of economic benefit when accounting for carbon and other costs.

[5] EC (2014) *COMMISSION STAFF WORKING PAPER IMPACT ASSESSMENT Accompanying the document Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL amending Regulations (EC) No 715/2007 and (EC) No 595/2009 as regards the reduction of pollutant emissions from road vehicles.*

10. Demand-side measures – Uptake of HGV fuel saving measures

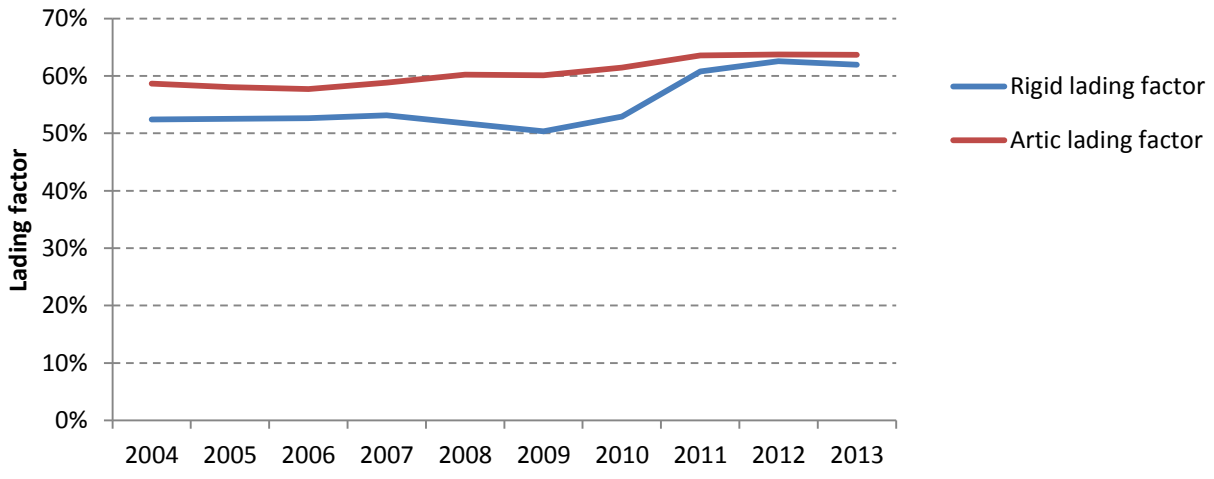
The Continuing Survey of Roads Goods Transport (CSRGT) is an ongoing survey of Great Britain registered freight activity. The survey collates information on operational trends that can reduce fuel consumption, such as adoption of fuel saving measures (Figure A4.11), average lading factor (Figure A4.12) and the proportion of tonne-km moved by high capacity vehicles (Figure A4.13).

Figure A4.11: Uptake of HGV fuel saving measures



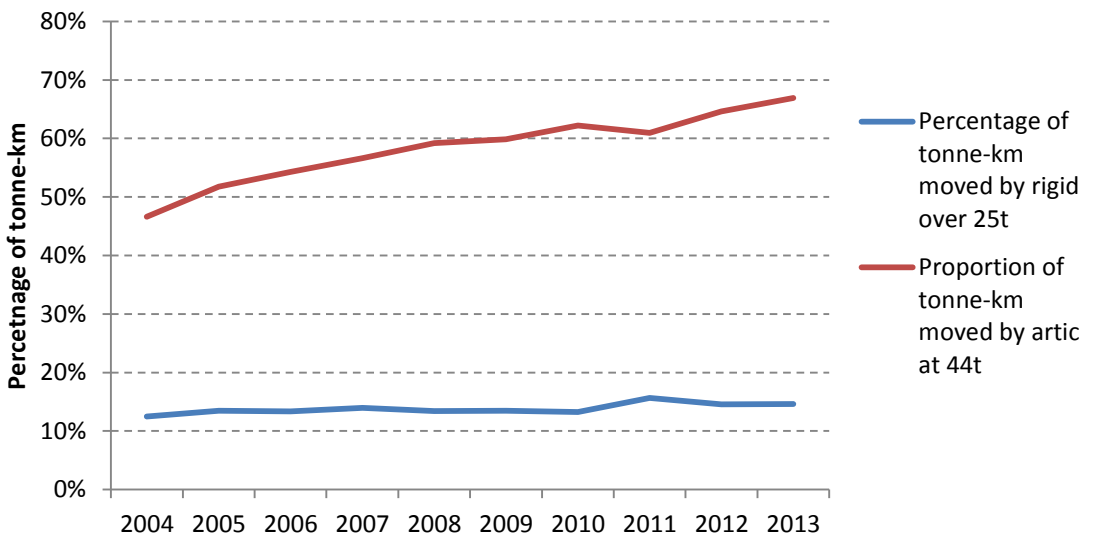
Source: CCC calculations based on DFT (2015) Road Freight Statistics.

Figure A4.12: Average lading factor



Source: CCC calculations based on DFT (2015) Road Freight Statistics.

Figure A4.13: Proportion of tonne-km moved by high capacity vehicles



Source: CCC calculations based on DFT (2015) Road Freight Statistics.

11. Detailed assessment of policies

In Chapter 4 - Transport we set out our assessment of the impact of Government policies intended to reduce emissions in the Transport sector, differentiating between those policies which are expected to deliver (classified as "lower risk") and those at risk of failing to deliver, either due to design and delivery problems, or because they are currently unfunded (classified as "at risk").

Table A4.1 sets out the rationale for classifying lower risk policies as such; Table A4.2 sets out the rationale for at-risk policies; Table A4.3 sets out areas where policy is missing.[6]

Table A4.1: Lower risk policies

Policy	Why the policy is 'lower risk'
New car & van CO_2 (EU regulations)	Regulation with stiff penalties for non-compliance, supported by UK fiscal policies. Targets legislated to 2020. More representative test cycle due to be introduced.
Electric vehicle support package to 2020	Funding package tackles all major barriers with combination of measures shown to be effective in leading markets. £500 million overall, including a minimum £200 million for Plug-in Car Grant (PiCG) to 2017 or 50,000 cars; £32 million for infrastructure; £35 million for city schemes & £20 million for taxis; £100 million for R&D. PiCG of up to £5,000 per car is appropriate in the near term.
Local Sustainable Transport	£600 million of DfT funding to 2015 (62.5% revenue, 37.5% capital), plus £535 million from LAs, for measures to tackle information and organisational barriers (e.g. school & workplace travel plans) and complementary infrastructure investment (e.g. cycle

[6] DECC (2014) Annex D: Policy savings in the projections. Available at: https://www.gov.uk/government/publications/updated-energy-and-emissions-projections-2014

Table A4.1: Lower risk policies	
Fund	lanes). Level of funding per head broadly comparable to successful Sustainable Travel Towns pilot projects. Local Growth Fund providing funding in 2015/16.
HGV Low Rolling Resistance Tyres/ Gear Shift Indicators	Mandated by EU regulation
Low Carbon Buses to 2020	£30 million funding provided by OLEV from 2015-2020 to stimulate uptake of 1,000 Low Carbon buses. Funding will be provided on a declining basis as the cost differential between these and conventional buses narrows.
Rail Electrification	Work is currently ongoing to electrify a number of lines in the North of England, as well as the Great Western Mainline. Electrification is at varying levels of completion, however progress is broadly as expected.

Table A4.2: At risk – policies with design/delivery problems or lack of funding	
Policy	Why the policy is 'at risk'
Biofuels policy	Renewable Transport Fuels Obligation (RTFO) flat-lined at 4.75% (by volume) to 2015/16. Until detail of UK policy to 2020 is announced, in light of recent EU decisions, there remains a risk that the target will not be met sustainably. Currently off-track to deliver levels assumed to 2020.
HGV fuel efficiency policies	The fuel efficiency of new HGVs has not improved significantly in recent years. Furthermore, there has been little progress in developing EU CO2 regulation for HGVs, without which further efficiency improvements are at risk. There is scope for freight operators to improve efficiency through schemes such as the Logistics Carbon Reduction Scheme (LCRS), but these are currently dominated by larger operators and there is no policy addressing barriers for smaller operators.
HGV natural gas policy	The CO2 benefits of using natural gas in HGVs are yet to be proven. Until the Government trials of natural gas use in HGVs are complete, savings from this measure remain at risk.
Low Carbon Buses beyond 2020	Uptake projected by OLEV appears optimistic given experience with Green Bus Fund round 4.

Table A4.3: Missing policies	
Policy	Detail
Electric vehicles beyond 2020	No policy to address upfront cost barrier post-2020.
Biofuels	No policy post-2020 at UK or EU level.
Passenger demand reduction	No policy beyond 2015-2016. Important that measures continue in order to sustain changes in travel behaviour.
HGV demand side reduction	Demand side action expected to be led by the Logistics Carbon Reduction Scheme (LCRS); currently no LCRS target beyond 2015; membership is limited.

12. Surface transport indicators

Table A4.4: The Committee's surface transport indicators					
Road Transport		Budget 2	Budget 3	Budget 4	2013 Outturn
Headline indicators					
Emissions (% change on 2007)	Road	-24%	-36%	-46%	-11%
	Car	-27%	-40%	-54%	-15%
	Van	-13%	-20%	-29%	-0.4%
	HGV	-24%	-34%	-38%	-3%
gCO_2/km (carbon intensity of a vehicle kilometre)	Car	127	101	77	155
	Van	176	144	115	219
	HGV	731	623	580	919
vehicle kilometres (billion)	Car	413	428	452	402
	Van	76	84	93	71
	HGV	26	27	27	26
Supporting indicators					
Vehicle technology					2014 Outturn
New vehicle gCO_2/km	Car	111	95 (by 2020)	57	125
	Van	164	130	89	182
New electric vehicles registered each year		35,000	525,000	1,470,000	15,869
Stock of electric vehicles in fleet		75,000	1,340,000	6,645,000	31,365
Review of financial mechanisms for addressing up-front costs to EVs		2017			
Roll-out of strategic rapid charging network			2020		
Strategy for development of residential off-street charging points		2015			
Action plan for engaging local authorities in providing measures to support EV uptake		2015			
Full evaluation of GHG implications of methane trucks		2015			
Biofuels					
Penetration of biofuels (by energy)		5.9%	8.4%	9.9%	3.0%
Develop trajectory for RTFO to meet EU 2020 target following EU agreement		2015/16			
Demand side measures					
Evaluate effectiveness of LSTF and commit to further funding if appropriate		2016			
Nationwide rollout of Smarter Choices if appropriate			Complete		
Review effectiveness of voluntary industry approach to reduce emissions in freight sector		2016			

13. Aviation monitoring indicators

Table A4.5: The Committee's aviation monitoring indicators

Aviation	Domestic		International*		Total		CCC 2050 planning assumption	2050 forecast range**
	2005	2013	2005	2013	2005	2013	vs. 2005	
Headline indicators								
CO_2 emissions (million tonnes)	2.8	-36%	34.8	-8%	37.6	-10%	~0%	+3% to +37%
Passenger demand (million)***	50.2	-23%	178.0	7%	228.2	0.4%	~+60%	+78% to +118%
Supporting indicators								
Passenger composition								
Proportion of passengers travelling for business	46%	+2pp	22 %	+3pp	27%	+4pp	n/a	
Airline utilisation								
Load factor	n/a				79%	+5pp	n/a	
Wider monitoring								
Non-CO_2 climate science, international/EU policy (e.g. ICAO, EU ETS, SESAR programme), UK policy (e.g. Airports Commission), technology developments (e.g. biofuels, airframe/engines)								

* International emissions are not currently covered by carbon budgets, but are included in the 2050 target
** Airports Commission Strategic Fit: Forecasts (2014)
*** 2005 total passenger demand has been revised downwards in CAA statistics but domestic/international split is only available on old basis. We scale domestic and international demand downwards in proportion to revision to total passenger demand.
**** Only covers UK registered airlines and includes their worldwide activity

14. Shipping monitoring indicators

Table A4.6: The Committee's shipping monitoring indicators

Shipping	Domestic		International*		Total	
	2012	2013	2012	2013	2012	2013
Headline indicators						
CO_2 emissions (million tonnes)**	2.3	-4%	8.9	-3%	11.2	-3%
Tonne-km (billion)***	34	-19%	1134	4%	1168	4%
Supporting indicators						
Demand						
Cargo carried (million tonnes)***	65	-6%	253	5%	318	3%
Fleet						
Ship movements (thousands)***	n/a				144	-2%
Average ship size (thousand deadweight tonnes per ship)	n/a				10.1	-2%
Wider monitoring						
Non-CO2 climate science, international/EU policy (e.g. IMO), industry/market factors (e.g. vessel speeds, relative prices of bunker fuels in UK/non-UK ports), alternative fuels (e.g. biofuels/LNG), technology developments						

* International emissions are not currently covered by carbon budgets, but are included in the 2050 target
** Total emissions measured on the basis of bunker fuel sales
*** Reflects imports/arriving ship movements. International t-km based on CCC analysis of DfT port freight statistics 2013