EU Fuel and CO_2 Study: Methodology Note for the United Kingdom

Introduction

The EU's Cars and CO_2 Regulation of 2009 set a tailpipe standard for carbon dioxide (CO_2) emissions from cars for 2015, and a more stringent standard is currently under consideration for the year 2020. The existing regulation has already resulted in significant improvements in the average CO_2 performance of new cars sold in the EU, and corresponding improvements in fuel economy.

The study behind this note calculated the fuel cost savings which typical motorists will enjoy in each member state of the EU 15 under a range of assumptions as to the stringency of future standards. To do this, a set of four scenarios of possible future CO_2 reduction targets were established for the whole of the EU. These reflected the current position, future expectations, and the technical potential for further emissions reductions. In order of increasing level of ambition, the four scenarios are as follows:

1. The Cars and CO_2 Regulation passed into law in 2009 set a tailpipe standard for cars of 130g/km in 2015: the baseline case is for no further emissions reductions beyond that date.
2. The Cars and CO_2 Regulation also indicated a target for 2020 of 95g/km. This target is now due for review, but in this scenario, it is assumed that the 95g target is met but that nothing is achieved on fuel economy beyond this: ie no further progress after 2020.
3. As above but with further reductions to a 70g/km limit by 2025.
4. This has a more ambitious 80g/km target for 2020, and 60g/km by 2025.

For each scenario, base case results were calculated for each Member State as set out in the Annex to this note. The base case reflected cost savings for an 'average motorist' – ie the main driver of a typical second hand car driving the average mileage for the country in question. Such drivers have to wait several years to feel the full benefits of tighter emissions standards, so we also modelled the benefits for a driver of a new car, who gets the savings from tighter standards immediately, and is also likely to drive farther in a year than the average motorist.

For clarity, we assumed no 'rebound effect' in the base case (ie that none of the fuel costs savings would be translated into additional distance travelled rather than cash savings). In addition, two other cases were calculated to provide a sensitivity analysis:

- A rebound case in which drivers do not take all the fuel cost savings in cash, but use part of the money gained to drive additional distance instead. The study assumes that 10% of the savings might typically be used in this way[1].
- A high oil price scenario was also developed, based on oil price forecasts set out in earlier work for Greenpeace[2]. As above, this assumed both that tax levels remained unchanged and that distance driven would be unaffected. The original oil price assumptions were as follows, but were rebased to 2012 to reflect the significant price rise from 2010 to 2012:

Year	2010	2020	2030
Skinner et al oil prices:	62.6	88.8	115

NB All prices are per barrel, in US$2008

[1] Skinner I *et al*, 2010, *Steering clear of oil disasters*, Greenpeace European Unit
[2] *ibid*

Results for the United Kingdom

As the Table overleaf illustrates, the average motorist should already be experiencing reduced fuel costs nearly £200 per year by 2015, reflecting progress that has already been made in cutting the average emissions and fuel consumption of cars. Even in Scenario 1, the most pessimistic one, further savings can be expected throughout the 2020s, rising to more than £300 per year by 2030 as improvements in fuel economy permeate the whole car fleet. Predictably, the scale of the savings increases substantially for the more ambitious Scenarios 3 and 4, and again increases steadily over time as the improvements from earlier target years work their way through the car fleet. In these scenarios with the most stringent targets, fuel cost savings of around £1000 per annum can be expected for the average motorist by 2030.

For those driving new cars, the savings do not increase over time in Scenario 1, because these motorists have already enjoyed the benefits of past progress, and in this scenario, no further progress is made after 2015. In the more ambitious Scenarios 3 and 4, however, where continuing progress in improving fuel economy and cutting carbon dioxide emissions is assumed, drivers of new cars continue to enjoy very substantial fuel cost savings — significantly greater than those of the average motorist.

In the rebound case, the pattern of savings is similar but the actual amount of money saved is reduced somewhat because all drivers are assumed to translate some of the reduction in fuel consumption into additional distance driven rather than reduced costs.

In the high oil price case, the costs of fuel rise to reflect the assumed increase in the price of oil (but less steeply because the large taxation element of the price at the pump is not assumed to increase in real terms). Hence all motorists have higher annual fuel bills, but paradoxically also save rather more as a result of the improvements in fuel economy and emissions driven by the tighter targets.

Summary of Fuel Cost Savings for the United Kingdom

Base Case			**Sc1: 130g in 2015 only**			**Sc2: 95g in 2020 only**			**Sc3: 95g in 2020; 70g in 2025**			**Sc4: 80g in 2020; 60g in 2025**		
		2015	**2020**	**2025**	**2030**	**2020**	**2025**	**2030**	**2020**	**2025**	**2030**	**2020**	**2025**	**2030**
Fleet Average Car and Driver	CO_2 Emissions g/km	150.7	138.2	133.9	133.4	129.1	108.8	99.1	129.1	102.3	76.0	125.3	92.9	66.3
	% CO_2 Reduction	10%	17%	20%	20%	23%	35%	41%	23%	39%	55%	25%	45%	60%
	Fuel Cost per Year	£1,557	£1,428	£1,384	£1,379	£1,335	£1,124	£1,024	£1,335	£1,058	£786	£1,295	£960	£685
	Cost Saving	£174	£303	£347	£352	£396	£607	£707	£396	£673	£945	£436	£770	£1,046
Average New Car and Driver	CO_2 Emissions g/km	133.4	133.4	133.4	133.4	97.3	97.3	97.3	97.3	71.6	51.2	82.0	61.4	46.0
	% CO_2 Reduction	8%	8%	8%	8%	33%	33%	33%	33%	50%	65%	43%	57%	68%
	Fuel Cost per Year	£1,713	£1,713	£1,713	£1,713	£1,250	£1,250	£1,250	£1,250	£920	£657	£1,053	£789	£591
	Cost Saving	£139	£139	£139	£139	£602	£602	£602	£602	£932	£1,195	£799	£1,063	£1,261

Rebound 20% Case			**Sc1: 130g in 2015 only**			**Sc2: 95g in 2020 only**			**Sc3: 95g in 2020; 70g in 2025**			**Sc4: 80g in 2020; 60g in 2025**		
		2015	**2020**	**2025**	**2030**	**2020**	**2025**	**2030**	**2020**	**2025**	**2030**	**2020**	**2025**	**2030**
Fleet Average Car and Driver	% CO_2 Reduction	8%	14%	16%	16%	18%	28%	33%	18%	31%	44%	20%	36%	48%
	Fuel Cost per Year	£1,575	£1,458	£1,419	£1,414	£1,374	£1,185	£1,095	£1,374	£1,125	£880	£1,338	£1,037	£790
	Cost Saving	£156	£272	£312	£317	£357	£546	£636	£357	£606	£850	£393	£693	£941
Average New Car and Driver	% CO_2 Reduction	6%	6%	6%	6%	26%	26%	26%	26%	40%	52%	35%	46%	54%
	Fuel Cost per Year	£1,727	£1,727	£1,727	£1,727	£1,310	£1,310	£1,310	£1,310	£1,013	£777	£1,133	£895	£717
	Cost Saving	£125	£125	£125	£125	£542	£542	£542	£542	£839	£1,076	£719	£957	£1,135

High Oil Price Case			**Sc1: 130g in 2015 only**			**Sc2: 95g in 2020 only**			**Sc3: 95g in 2020; 70g in 2025**			**Sc4: 80g in 2020; 60g in 2025**		
		2015	**2020**	**2025**	**2030**	**2020**	**2025**	**2030**	**2020**	**2025**	**2030**	**2020**	**2025**	**2030**
Fleet Average Car and Driver	% CO_2 Reduction	10%	17%	20%	20%	23%	35%	41%	23%	39%	55%	25%	45%	60%
	Fuel Cost per Year	£1,647	£1,614	£1,665	£1,758	£1,508	£1,352	£1,306	£1,508	£1,272	£1,002	£1,463	£1,155	£873
	Cost Saving	£184	£342	£417	£449	£448	£729	£901	£448	£810	£1,205	£493	£927	£1,333
Average New Car and Driver	% CO_2 Reduction	8%	8%	8%	8%	33%	33%	33%	33%	50%	65%	43%	57%	68%
	Fuel Cost per Year	£1,812	£1,936	£2,060	£2,184	£1,413	£1,503	£1,594	£1,413	£1,107	£838	£1,190	£949	£754
	Cost Saving	£147	£157	£167	£177	£680	£724	£768	£680	£1,121	£1,524	£903	£1,279	£1,607

Annex: Details of Calculation Method

The study focused on the fuel consumption of cars covered by the regulation and the fuel costs to their drivers – ie consumption of road fuels excluding those burned by vans, buses and heavy-duty diesel vehicles. Each of the EU15 countries (ie the 'old ' member states) was modelled individually: EU10 countries were not included as they represent only a relatively small market with fewer cars, and data are less good.

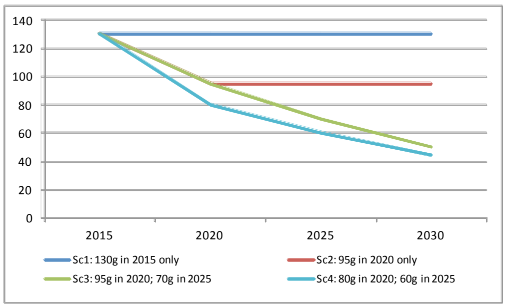
The overall purpose of this exercise was to calculate the amount of fuel and hence of fuel cost that motorists across Europe might save as a result of legislation to reduce car carbon dioxide emissions. To do this, a modelling exercise was undertaken covering the following four main tasks:

- establishing a set of scenarios of possible future CO_2 reduction targets;
- calculating how these will apply to each member state;
- modelling the impact of these scenarios on car fleet average CO_2 emissions reductions; and
- translating these reductions into fuel and cost savings in each member state.

The rest of this Annex briefly describes each of these processes in turn.

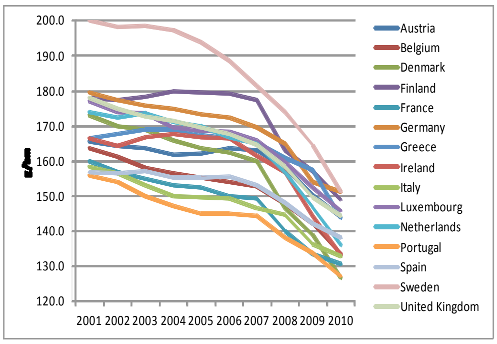
Establishing a Set of Scenarios of Possible Future CO_2 Reduction Targets

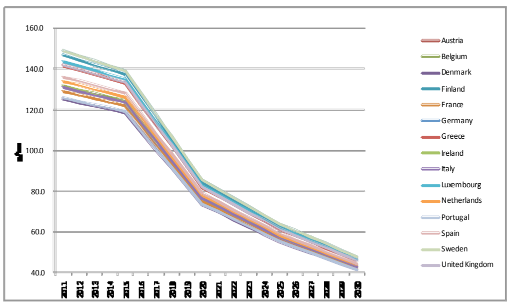
Four scenarios reflecting varying levels of ambition for future car CO_2 targets were agreed as set out in the Introduction to this note. In Scenarios 3 and 4, further broadly linear reductions beyond the specified dates are also assumed. These four scenarios can then be depicted graphically as follows:



Calculating How the Targets Will Apply to Each Member State

All member states in the EU15 have made progress in reducing their new car average CO_2 emissions over the past decade. However, as this graphic illustrates, they all began from different starting points and have made different degrees of progress. Equally, the targets referred to above refer only to the EU as a whole, not to each member state individually. Hence we can expect that future progress will not be totally identical in all member states.





It is therefore likely in particular that those states which currently have the highest new-car averages will continue to do so into the future, and that the burden of meeting future targets will not be exactly equal in each member state. On the other hand, it seems reasonable to expect that the greatest progress should be made in the states with the highest emissions at present, leaving less to be done in those countries where emissions are already quite low. To reflect this, the model developed for this study imposes a degree of 'contraction and convergence' between the targets of the member states but also reflects their different starting points. The figure above illustrates how this has been applied in one of the four scenarios set out above, such that national targets converge while ensuring that the overall EU average target is met.

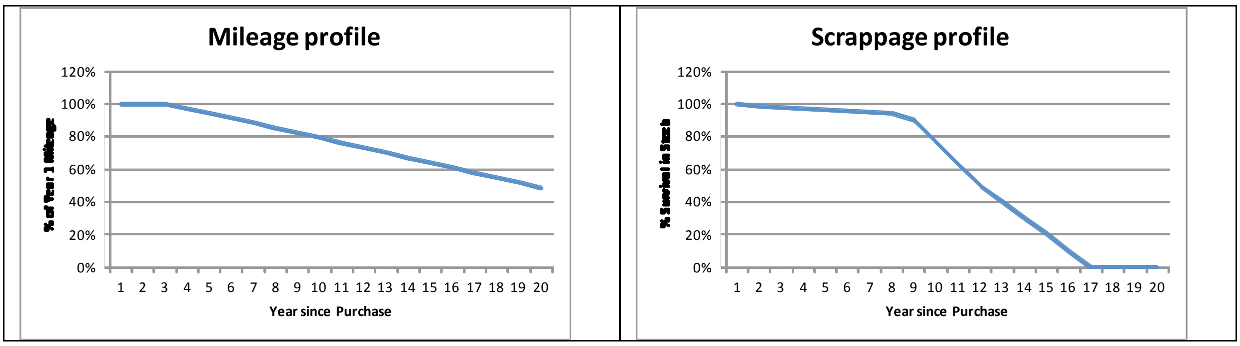
Modelling the Impact of New Vehicles on the Total Vehicle Stock

The key parameter for determining fleet fuel economy and average CO_2 emissions is historical and future average fuel economy of new vehicles entering the fleet. The official figures on this (based on CO_2 emissions) are good for EU15 from 2001 onwards. Vehicles entering the fleet prior to 2001 were assumed to have a fuel economy equal to that in 2001, as there was little or no improvement in average fuel economy prior to that date.

Each year, a certain percentage of all the vehicles in each national car fleet are scrapped (and some are exported), and their place is taken by new vehicles. Where vehicle characteristics are changing over time – in this case, their average CO_2 emissions are reducing and are required to be reduced further – a stock turnover model is needed to calculate how much impact each model year is having on the overall fleet average emissions at any given time, and hence how fast the overall emissions profile is improving.

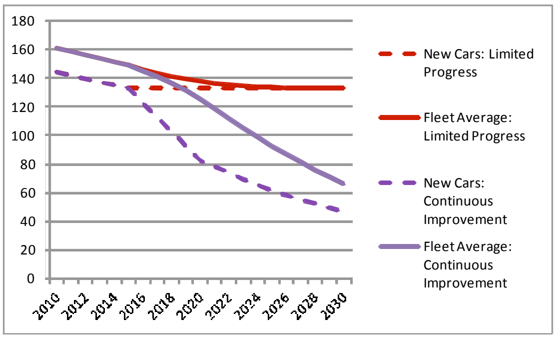
This study required the development of a new stock turnover model capable of reflecting conditions in each Member State and covering data from 2001 (when differentiated CO_2 data for each Member State were first reported) through to the end modelling year (2030). This followed the same basic approach as used in previous similar models created by the author, but was generalised in order to be able to reflect the different conditions in the different member states.

In this model, the contribution of each model year to the total mileage travelled in a given calendar year subsequently is determined by two profiles which can in effect be multiplied together to give the total contribution to the total distance driven: a mileage profile and a scrappage profile.



As shown, the mileage profile reflects the fact that most cars are used to their maximum for about their first three years of use: after this they are commonly sold on second hand to private owners, from which time their annual mileage declines to about half of its initial value by the end of vehicle life. The scrappage profile reflects how long vehicles typically stay in the vehicle fleet. The scrappage rate is typically very low (<1% eg for write-offs after accidents) for approximately the first nine years of life; then about half are scrapped by their twelfth year; with the rest being removed in a rather longer 'tail' out to 15 or 16 years. On average, a car in Europe is typically about 13 years old when scrapped.

Combining these two profiles then gives a realistic picture of what contribution vehicles from a given model year will make to the total distance driven in each year thereafter. These values are based on detailed UK data and other data sources for around Europe, which confirms that there is some variation from country to country and year-to-year, but that the pattern is similar throughout the EU15 and over time.



When emissions levels are being reduced, the fleet average emissions in a given year will always lag behind those of new cars from that year. For example, if 10% of the car fleet is replaced with new cars which are 10g/km better than the fleet average, they will only improve the fleet average by about 1 g/km overall. If the average emissions of new cars entering the fleet levelled off and remained constant over some years, then the fleet average eventually 'catches up' the new car average. However, if the improvement in new car emissions performance is continuous, the fleet average follows a similar emissions profile over time, but always lags behind it. This is illustrated in the graph above left.

The model developed in this way was then applied for each member state, both to its historic emissions performance and to each of the four future scenarios in turn. This produced a profile of fleet average CO_2 emissions year by year and the degree of improvement relative to the baseline year for each of the four emissions scenarios were then calculated.

Calculating the Fuel Cost Savings

EU statistics were used to determine the actual average fuel consumption per car in each country. These vary from country to country reflecting the composition of the car fleet, distances driven and road conditions; however in a few cases the amount consumed seemed implausibly low or high, and in these cases the numbers were adjusted towards the average. These numbers were then multiplied by post-tax fuel prices in each country (as recorded in official statistics for January 2012) to give an estimate of current average fuel costs.

For each country and scenario, it was then possible to calculate the cost savings that would arise from improved fuel economy for a typical main driver of an average car (ie with the fuel economy average of the whole car fleet). Additional figures were also generated to reflect the savings to a driver of a new car (ie one on average less than one year old), who would typically drive a higher average annual mileage and benefit immediately from reductions in CO_2 emissions and improved fuel economy rather than in later years.

Note that the results assume no future increase in the distance driven per vehicle per driver. This is not necessarily a prediction, but allows cost savings to be presented on an 'other things being equal' basis. Results are also presented in money of today, and with tax rates held constant.