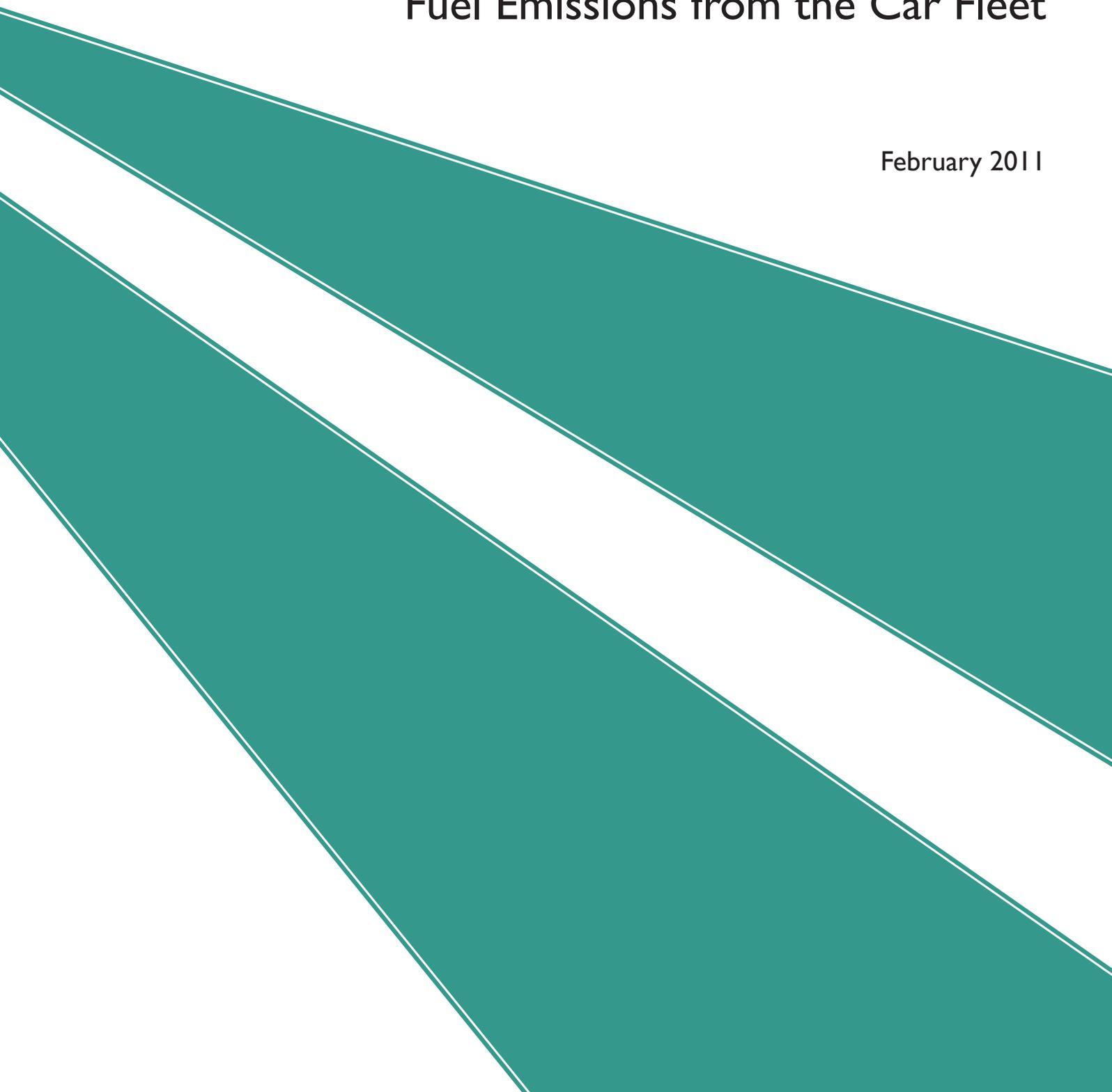


Transport Research & Information Note

Fuel Emissions from the Car Fleet

February 2011



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1. Introduction

- 1.1. Emissions from car use may be categorised as CO₂ and non-CO₂ emissions. With regard to CO₂ emissions, these have tended to grow broadly in line with increasing car numbers. However, changes to the Vehicle Registration Tax (VRT) have favoured the introduction of CO₂ – friendly new vehicles and, in time, this will alter CO₂ emissions from the car fleet as a whole. The VRT changes have favoured diesel vehicles that have a lower specific CO₂ emission rates. As these new vehicles become more commonplace in the total car fleet, CO₂ emissions from the car fleet will fall, other things being equal.
- 1.2. This paper outlines the extent to which CO₂ emissions from the car fleet will decline over the next ten years on foot of these tax changes. It will do this by utilising plausible forecasts for new car sales and car ownership over this period, derived from models developed by the Aecom consortium and calculating the implications for CO₂ emissions and transport energy consumption. Section 2 outlines trends in CO₂ emissions in the car fleet over the past 15 years. Section 3 details the changes to the VRT regime and the impact of these on the car market. Section 4 examines current CO₂ trends in the new car fleet and documents EU targets in relation to CO₂ emissions. Section 5 presents forecasts of the future age profile of the car fleet and Section 6 outlines predictions for CO₂ emissions up to 2020.

2. Trends in CO₂ Emissions in the Car Fleet

- 2.1. CO₂ emissions are directly related to the fuel consumed by vehicles. Consequently, it is not surprising that the strength of the Irish economy over the mid/late 1990s to 2006, the associated rise in household incomes and consequent car ownership resulted in increased fuel sales and CO₂ emissions from the car fleet. The study has used the European Environment Agency's COPERT model to make estimates of annual car emission levels based on the fleet size and the actual level of fuel consumed in the State, stripping out the effect of fuel leakage into Northern Ireland.
- 2.2. The analysis confirmed that CO₂ emissions from cars increased by 96 per cent over the period 1990-2005. Car numbers increased by 109 per cent over the same period, however, increased fuel efficiency of new cars offset some of the negative impact of increased car numbers. However, since 2005 there has been a reversal in the trend of increasing CO₂ emissions, as illustrated in Table 1 below. Rather, over the period 2005 – 2009, for the first time in over 15 years, Ireland experienced a reduction in the overall level of CO₂ emissions emitted from passenger cars.
- 2.3. This reduction largely occurred in 2009, as car travel fell in line with falling incomes and increased unemployment. As the economy improves, car travel will recover, other things being equal. This Paper examines the potential for CO₂ emissions from the car fleet to decline on foot of the VRT changes, even when the economy recovers.

Table 1: Estimates of CO₂ Emissions from Passenger Cars 1990 – 2009

Year	Emissions (000) Tonnes	Emissions per Vehicle (Tonnes)
1990	2,963	3.70
1998	4,592	3.80
2002	5,268	3.59
2004	5,512	3.44
2005	5,804	3.45
2009	5,796	3.02

Source: Aecom consortium

3. The VRT Regime

- 3.1. Vehicle Registration Tax (VRT) is chargeable on all new cars and cars that are imported into Ireland. A vehicle must be registered before it can be licensed for road tax purposes. VRT is a percentage of the expected retail price, including all taxes in the State. This price is known as the Open Market Selling Price or OMSP.
- 3.2. Previous to July 2008, VRT was based on the engine size of the vehicle, with bigger engine sizes paying a higher rate of VRT. The rates of VRT previously applicable to different engine sizes are outlined in Table 2 below.

Table 2: VRT Rates for Cars in Ireland pre July 2008

Category	Engine Size	Rate
A1	Cars up to 1,400cc	22.5% of OMSP
A2	Cars 1,401 to 1,900cc	25.0% of OMSP
A3	Cars over 1,900cc	30.0% of OMSP

- 3.3. From July 2008, VRT for cars is based on CO₂ emissions. Table 3 details the VRT rates currently applicable to cars in Ireland. The change to the VRT regime has impacted the car market and has the potential to significantly change the CO₂ emissions from the car fleet.

Table 3: VRT rates for Cars in Ireland from 1 July 2008

Band	CO ₂ emissions levels	VRT rates
Band A	under 120 grams per kilometre	14% of OMSP (minimum €280)
Band B	121 – 140 grams per kilometre	16% of OMSP (minimum €320)
Band C	141 – 155 grams per kilometre	20% of OMSP (minimum €400)
Band D	156 – 170 grams per kilometre	24% of OMSP (minimum €480)
Band E	171 – 190 grams per kilometre	28% of OMSP (minimum €560)
Band F	191 – 225 grams per kilometre	32% of OMSP (minimum €640)
Band G	over 225 grams per kilometre	36% of OMSP (minimum €720)

- 3.4. The changes to the VRT system had a profound effect on car prices and the structure of the car market. Diesel models tend to have benefited the most from the new VRT rates, as these are more fuel efficient. Some brands (BMW in particular) have seen substantial price drops for a number of their models. Other smaller

models such as the Opel Corsa and Fiat Panda have also experienced price declines. Table 3 details some of the price declines experienced by a number of different models of cars as a result of the VRT changes. These price declines coupled with changes to the annual road tax system which occurred at the same time stimulated a shift to diesel vehicles in the fleet.

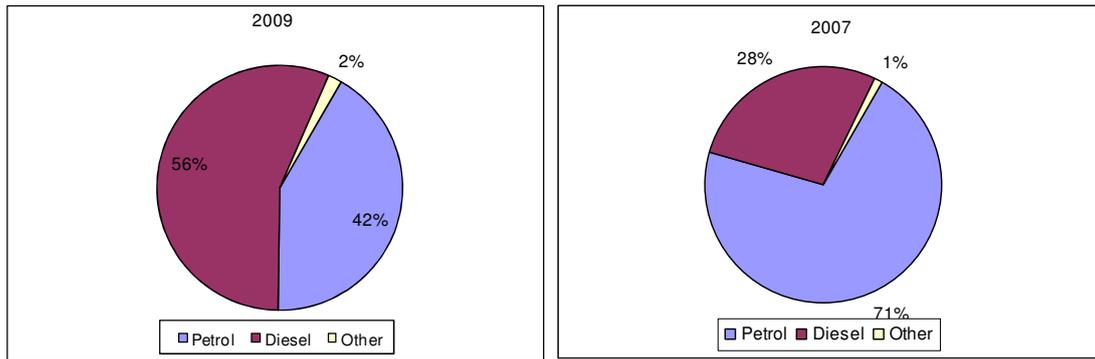
Table 4: Price Changes from VRT and Road Tax Changes 2009

Model	OMSP @ old VRT Rate*(€)	Current OMSP (€)	Difference (€)
Audi A4 (3.2 petrol)	59,869	60,790	921
Audi A4 (3.0 diesel)	61,496	60,550	-946
BMW 325i (3.0 petrol)	53,436	50,970	-2,466
BMW 325d (3.0 diesel)	53,528	49,410	-4,118
Ford Focus (1.4 petrol)	23,290	23,575	285
Ford Focus (1.8 diesel)	24,962	23,165	-1,797
Hyundai i30 (1.4 petrol)	20,519	20,100	-419
Hyundai i30 (1.6 diesel)	23,684	21,600	-2,084
Opel Astra (1.6 petrol)	24,260	23,290	-970
Opel Astra (1.7 diesel)	25,911	24,045	-1,866
Peugeot 407 (2.0 petrol)	26,259	26,663	404
Peugeot 407 (2.0 diesel)	34,010	32,440	-1,570
Fiat Panda (1.1 Petrol)	12,040	11,205	-835
Fiat Panda (1.2 Diesel)	14,560	13,550	-1,010
Opel Corsa (1.2 Petrol)	17,176	16,265	-911
Opel Corsa (1.3 Diesel)	18,445	17,165	-1,280

*Note: OMSP used is from the The Car Sales Guide, May 2009

- 3.5. The move to diesel vehicles is evident in the breakdown of new car sales in the years immediately before and after the VRT change. As Figure 1 illustrates, the proportion of new diesel cars in 2007 was 28 per cent. However, in 2009 56 per cent of new car sales were accounted for by diesel vehicles. For the first time, diesel became the fuel of choice for new car sales. Although there is evidence of a gradual long term move towards diesel vehicles, the changes to the VRT regime stimulated a major shift.
- 3.6. In 2010, diesel vehicles had increased their market share to 66 per cent. This share is currently increasing at rate of three percentage points every six months, so that it is clear that in future the vast bulk of new car sales will be diesels.

Figure 1: Proportion of Diesel and Petrol New Car Sales 2007 & 2009

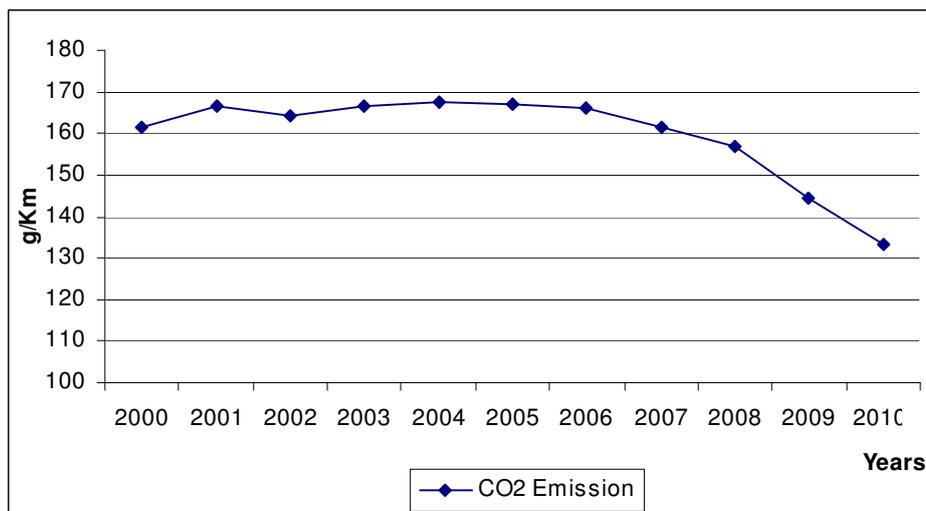


4. Trends in CO₂ Emissions in New Car Fleet

4.1. Since CO₂ emissions are directly related to the fuel consumption, the move to diesel vehicles has resulted in a significant decline in the average CO₂ emissions from new cars. The ACEA (European Automobile Manufacturers Association) documents the average CO₂ emissions ratings for new cars on an annual basis. These ratings are based on CO₂ ratings given to new cars by manufacturers.

4.2. Figure 2 illustrates the CO₂ emissions from new passenger cars in Ireland from 2000-2010. It is evident from the graph that over the years to 2006, there was very little tendency for average CO₂ emissions to change. This stability in the CO₂ emissions of new cars was largely a function of the improvements in fuel efficiency of new cars, arising due to EU legislation, being offset by a tendency to purchase larger vehicles. Since 2006, there is evidence of a decline in CO₂ emissions. However, the fall off in emissions has been most pronounced since 2008. In 2009, the average CO₂ per kilometre fell to 144g/km, declining further in 2010 to 133 g/km. The 2010 CO₂ emission rate from new cars is thus some 17 per cent below its year 2000 level.

Figure 2: CO₂ Emissions from New Passenger Cars in Ireland 2000-2010



Source: ACEA & SIMI

- 4.3. The European Commission 2007 Community Strategy to reduce CO₂ emissions from passenger cars has an objective of 120gCO₂/km for the average new car fleet in the 2012-2015 period. It is envisaged this reduction will come about due to improvements in vehicle motor technology and from 'complementary measures' including a greater use of bio-fuels. Based on the above trends, Ireland is well on track to reach this target.

5. Future Age Profile of the Car Fleet

- 5.1. Trends in CO₂ emissions for the car fleet as a whole will be determined by the rate at which new cars enter the fleet and old cars are scrapped.
- 5.2. The emission rates of new cars have reduced over time thus; as new cars enter the fleet the average emission rates for the fleet as a whole will decline. Both new car sales and the scrappage rate are positively related to economic growth.
- 5.3. The level of new cars sales and scrappage is higher in periods of economic growth, leading to a reduction in the average age of the car fleet. Conversely in poor economic conditions, low levels of new car sales and low levels of scrappage lead to an increase in the average age of the car fleet. Thus, in calculating the trends in CO₂ emissions, it was firstly necessary to determine the age profile of the fleet. The future age distribution of the car fleet is determined by:
- New Car Sales,
 - Scrappage Rates and
 - Import Levels.

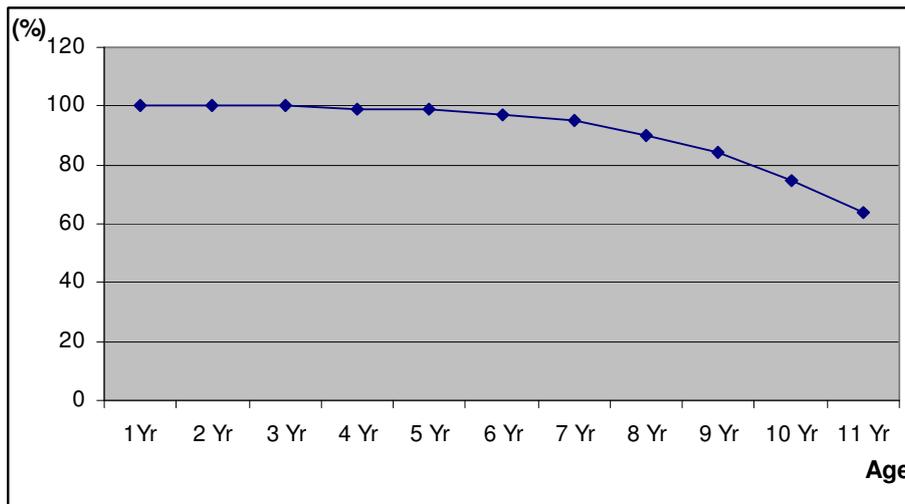
New Car Sales

- 5.4. The study team holds a proprietary New Car Sales model that forecasts new car sales up to 2020. This model has been employed for the past 18 years and has predicted the outturn of new cars sales to within approximately 5 per cent. Current forecasts for new car sales predict moderate growth in new car sales over the long term, reaching approximately 180,000 units by 2020.

Scrappage Rates

- 5.5. Scrappage rates for vehicles of different ages have remained relatively stable over the past 8 years. The exception was 2009 which saw slightly lower levels of scrappage than any of the previous 7 years. The low scrappage rates in 2009 is largely attributable to low levels of new car sales in 2009 resulting in people holding onto cars for longer. Given that scrappage rates are a function of economic growth, and current economic conditions are likely to prevail over the medium term, the 2009 scrappage rates were assumed to prevail over the forecast horizon. Figure 3 illustrates the 2009 survival rates of the car fleet for vehicles aged up to 11 years. The figure highlights the tendency for cars to largely remain in the fleet for the first 7 years before scrappage intensifies.

Figure 3: Average Survival Rates by Age 2009



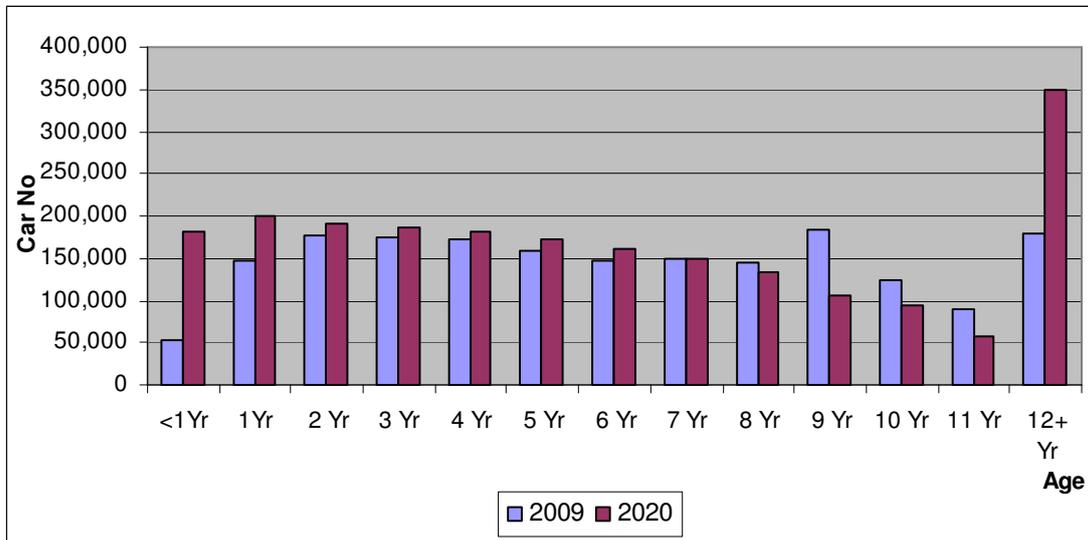
Source: The Aecom Consortium

Import Levels

- 5.6. Vehicle imports have varied greatly over the past 8 years. In addition to variability in the level of imports, there is also evidence of variability in the age profile of imports. Import variability is predominately a function of exchange rate variability as well as economic conditions. Forecasting exchange rates developments over the long term to 2020 proves difficult and is subject uncertainty. Given these uncertainties, the level of imports is assumed to average 30,000 units per annum. The age profile of imports is assumed to follow the 2009 distribution, given that current economic conditions are likely to prevail over the medium term and to ensure consistency with our assumptions of scrappage rates. Applying these assumptions to the current car fleet over the forecast horizon allows the age distribution of the fleet up to 2020 to be determined.
- 5.7. The age profile of the car fleet up to 2020 is determined by applying the age distribution of the fleet to the car numbers derived from the Car Ownership Model maintained by the Aecom consortium. The Car Ownership Model forecasts car numbers to reach approximately 2.1 million in 2020. Figure 4 illustrates the age profile of the fleet in 2009 and 2020 and shows that the age profile of the fleet is different in two respects.
- 5.8. The proportion of vehicles less than 1 year old is much higher in 2020. This is due to the low level of new car sales in 2009 at 54,000, compared with a forecast in 2020 of approximately 180,000 cars in this age bracket. Similarly, the higher proportion of vehicles over 12 years in 2020 is a function of new car sales and low levels of scrappage in the intervening years.
- 5.9. In 2020, vehicles over 12 years relate to cars registered in 2008 and earlier, when new car sales were particularly high. In 2009, vehicles over 12 years refer to vehicles registered in 1997 and before, when new car sales were significantly less.

- 5.10. This gap in the level of new car sales and the low levels of scrappage results in disparity illustrated in Figure 4.

Figure 4: Age Profile of the Car Fleet 2009 & 2020

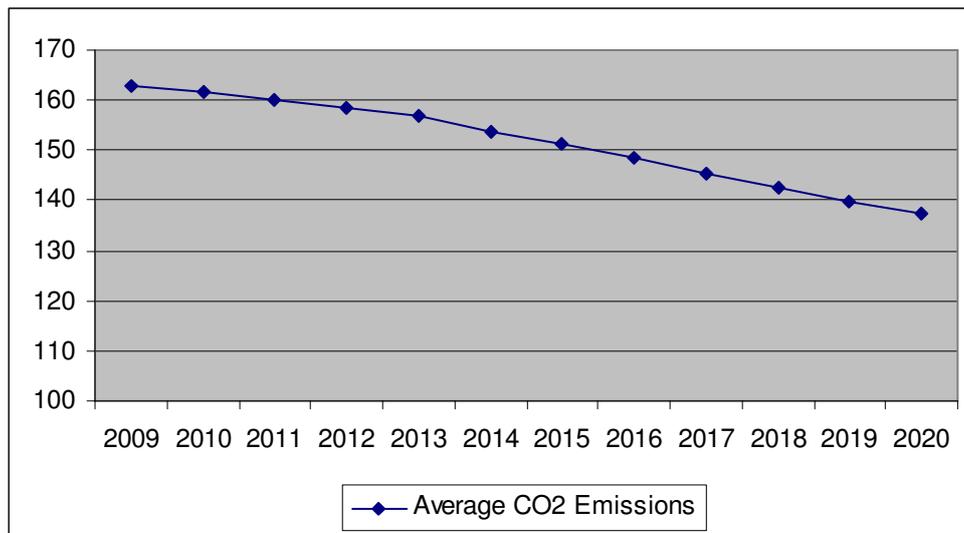


Source: The Aecom Consortium

6. Predictions of CO₂ Emissions from the Car Fleet

- 6.1. Forecasting emissions from the car fleet involves the application of age specific CO₂ emission ratings across the age profile of the fleet. The future age profile of the car fleet has been outlined in Section 5 above. The average CO₂ ratings were obtained from the ACEA and Society of the Irish Motor Industry up to 2010. Two scenarios are presented for future CO₂ emissions, a minimum improvement scenario and an EU improvement scenario.
- 6.2. The minimum improvement scenario assumes that the average CO₂ rating for cars in 2010 remains stable until 2020. Under this scenario, a substantial decline in CO₂ emissions from the car fleet as a whole is envisaged over the next ten years, as illustrated in Figure 5. Over the period as a whole it is estimated that CO₂ emissions from the car fleet will decline by 16 per cent on 2009 levels.

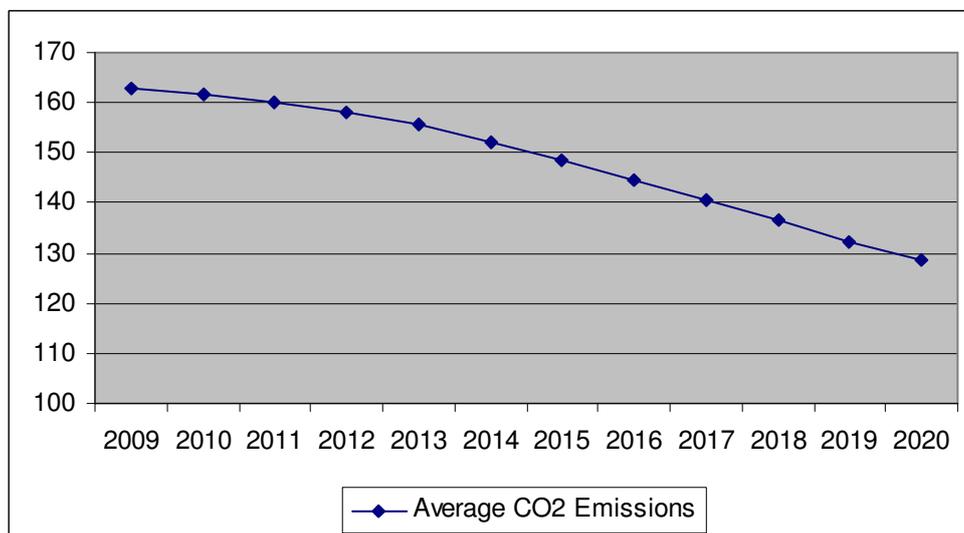
Figure 5: Trends in CO₂ Emissions 2009 to 2020 (Minimum Scenario)



Source: The Aecom Consortium

- 6.3. The EU scenario assumes that the target of 120g/km in respect of new cars, as set down by the European Commission 2007 Community Strategy, is achieved by 2015 and stabilises thereafter. Figure 6.2 illustrates the trend in CO₂ emissions under such a scenario. Should this decline in CO₂ emissions materialise, there will be a 21 per cent reduction in CO₂ emissions from the car fleet over the next ten years.

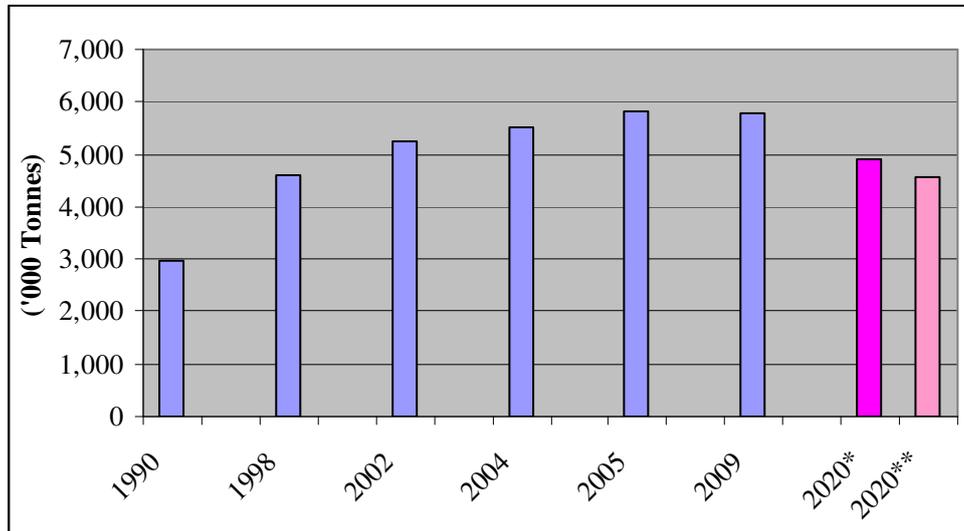
Figure 6: Trends in CO₂ Emissions 2009 to 2020 (EU Scenario)



Source: The Aecom Consortium

6.4. This decline in CO₂ emissions outlined above is based on the ratings given to new cars at the time of manufacture. An estimate of the “on-the-road” emissions from the car fleet in 2009 was given in Table 1 as 5,796,000 tonnes, which represents 57 per cent of total transport emissions. Assuming that the 16 per cent reduction in CO₂ envisaged here becomes a reality, this implies a reduction of approximately 907,000 tonnes of CO₂ by 2020.

Figure 7: Trend in on Road CO₂ Emissions 1990-2020



Source: The Aecom Consortium. (*Minimum Scenario ** EU Scenario)

6.5. If the 21 per cent reduction in CO₂ materialises, there will be a reduction of approximately 1.2 million tonnes of CO₂ by 2020. Figure 7 illustrates the predicted trends in on road CO₂ emissions up to 2020.

6.6. The reductions in CO₂ emissions estimated above will not occur, if there are offsetting reductions in fuel costs that give rise to increased travel. The savings in emissions identified above are broadly correlated with savings in fuel consumption that will arise. Thus, fuel operating costs are likely to be between approximately 16 and 21 per cent lower in 2020, ceteris paribus. This will encourage increased fuel consumption and road travel. However, previous research has indicated that motorists are not very responsive to changes in fuel costs, at about an increase of 1.2 per cent for every 10 per cent reduction in fuel prices. Thus, the offsetting increase in road travel should amount to no more than 2.5 per cent.

7. Conclusions

- CO₂ emissions from cars in Ireland increased by 96 per cent over the period 1990-2005 to reach 5.8m tonnes in the latter year.
- In 2009, there was a reduction in the overall level of CO₂ emissions emitted from passenger cars for the first time, as car travel fell in line with falling incomes and increased unemployment.
- When the economy improves, this trend is unlikely to be reversed, as changes in the composition of the car fleet on foot of changes in the VRT regime will cause a decline in CO₂ emissions.

- The VRT changes have reduced the retail price of diesel models and thus, stimulated a shift to fuel-efficient diesel vehicles in the fleet. Some 66 per cent of new car sales were accounted for by diesel vehicles in 2010, as against 28 per cent in 2007.
- The move to diesel vehicles has resulted in a significant decline in the average CO₂ emissions of new cars. Between 2007 and 2009, the average CO₂ g/km for new cars declined by 20 per cent.
- Trends in CO₂ emissions for the future car fleet as a whole will be determined by the rate at which new cars enter the fleet and old cars are scrapped.
- The future trend in CO₂ emissions was projected under two scenarios. Under the minimum improvement scenario CO₂ emissions are estimated to decline by 15 per cent by 2020. Under the EU improvement scenario CO₂ emissions are estimated to decline by 21 per cent. This amounts to a saving of between 0.9m tonnes of and 1.2m tonnes of CO₂ annually by 2020.