Using Indicators to Inform and Monitor an Emissions Based Car Tax

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ABSTRACT

Since July 2008, vehicle registration tax and annual motor tax in Ireland are based on environmental impact rather than engine size. This policy measure has significantly changed private car purchasing trends and has attracted international interest. Ireland's national energy authority, Sustainable Energy Authority of Ireland (SEAI) has had an instrumental role in i) providing timely information in the period 2002 - 2006, ii) recommending a taxation option not considered in the consultation 2006 (that was effectively the one adopted), iii) monitoring the impact of the change since July 2008 and iv) sharing the results. This case study paper outlines how energy efficiency indicators were used to inform and then monitor this change in energy policy. Analysis on historical data showed that purchasing trends towards larger cars were offsetting efficiency improvements and suggested that a shift in taxation coupled with a strong price signal could address this. The indicators generated since the tax change was introduced point to a significant shift towards lower emitting vehicles. New private cars with specific CO_2 emissions lower than 155 g/km represented 41% of new private car sales before the tax change and 78% after the change. Consumers responded to the strong price signal by not choosing smaller cars (in fact there was an increase in large cars purchased) but by switching to diesel. The share of new diesel car sales doubled from 27% before the tax change to 54% after. This is a preliminary analysis based on a single year's data and occurred in a time period where overall car sales decreased considerably due to the economic downturn.

Introduction

Private car transport is a significant focus of energy efficiency and climate change policy, with a range of policy measures seeking to encourage modal shifts, technological improvements and behavioural change (Mandell). Technological improvements have certainly been achieved by car manufacturers, which have lead to improved fuel economy of cars and thus improved the overall efficiency of private car fleets in many countries (Clerides and Zachariadis, 2008; Kwon, 2006; Schipper, 2009). In some cases, however these technology improvements have not lead to an improvement in the efficiency of the car stock (Ó Gallachóir et al., 2009; Van den Brink and Van Wee, 2001). In Ireland for example, purchasing trends towards larger and heavier cars can offset the efficiency gains resulting in the overall private car fleet showing a flat or increasing trend in specific fuel consumption (in terms of litres per 100 km).

This paper assesses the role of energy efficiency indicators in developing and monitoring a targeted policy designed to influence car purchasing trends in order to ensure that the efficiency gains achieved by private car manufacturers result in improved overall fleet efficiency. The policy was the change in vehicle registration tax (VRT) and annual motor tax rates in Ireland that were introduced in July 2008. Private car taxation changed from being based on the engine size of cars to the CO_2 performance of cars (g/km). The paper builds on and extends previous analysis by the authors (Ó Gallachóir et al., 2009) that showed the rationale for the policy, namely the failure of efficiency improvements to lead to an improvement in the weighted average performance of new cars entering the Irish private car fleet. The techniques used were informed by Ireland's involvement in the EU ODYSSEE project which has developed energy efficiency indicators over a number of

years(Bosseboeuf et al., 2005) and work by the European Commission in monitoring progress towards the voluntary agreements of car manufacturers (ACEA, 2009). The paper discusses the key role played by energy efficiency indicators in:

- Providing timely information in the period 2002 - 2006 for evidenced based policy support and development
- Recommending a taxation option that was not considered in the consultation on the proposal to introduce emissions based vehicle taxation (in 2006) but was effectively the one adopted
- Monitoring the impact of the change since July 2008

Using Indicators to Provide Information

The National Climate Change Strategy, published in 2000, targeted emissions savings of 2.67 Mt CO_2 by 2010 (transport accounted for 17 Mt CO_2 emissions in 2007). One specific measure, *rebalancing of VRT and annual road tax to favour more fuel-efficient vehicles* was anticipated to deliver 0.5 Mt CO_2 savings.

SEAI responded to this goal by assessing the trends in new car purchases in Ireland with respect to average fuel efficiency and CO_2 emissions. During 2002, SEAI accessed source data (anonymised) on new private car sales in the year 2000 from the Vehicle Registration Unit. In parallel, SEAI sourced test data for each car model of specific fuel consumption (l/100 km), specific energy consumption (MJ / km) and specific CO_2 emissions (g / km) from the UK Vehicle Certification Agency. Combining these two datasets (approx 2,000 car model variants) allowed SEAI to calculate the weighted average specific CO_2 emissions for new private cars entering the Irish fleet in 2000. This energy efficiency (and CO_2 emissions) indicator was first published in an SEAI report on private car transport energy in 2003[1].

Since then, tracking this indicator has demonstrated that technical efficiency gains in cars have been offset by purchasing trends[2]. As shown in Figure 1, the weighted average specific CO_2 emissions of new private cars in Ireland has remained flat over the period 2000 – 2007 and the average engine size of new private cars increased from 1476cc to 1565cc.

[1] SEAI 2002 Energy and CO_2 Efficiency in Transport. Analysis of new car registrations in year 2000. Available from http://www.seai.ie/uploadedfiles/InfoCentre/TransportReport1103.pdf

[2] Various SEAI Energy in Ireland and Energy in Transport Reports. See www.seai.ie/statistics

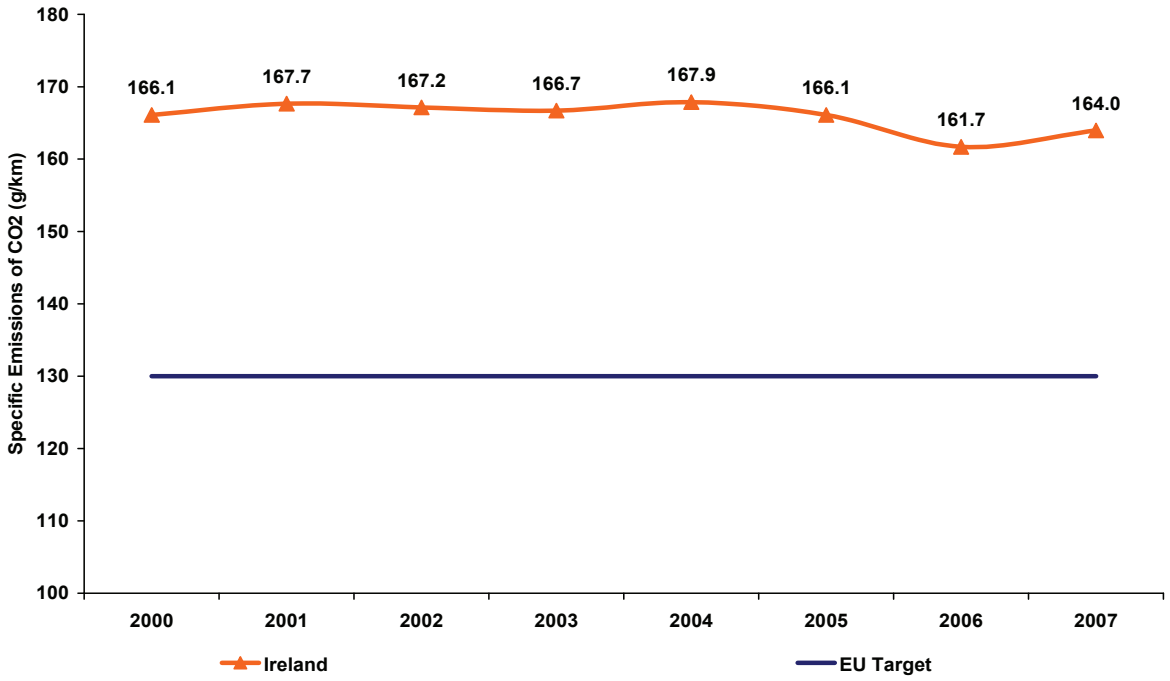


Figure 1. Specific CO_2 Emissions of New Cars 2000 to 2007

Recommending the Policy Measure

The Department of Finance and the Department of Environment, Heritage and Local Government initiated two consultation processes in December 2006[3], seeking respectively submissions regarding

- a proposed revision to the current VRT system to take greater account of environmental issues, in particular Carbon Dioxide (CO_2) emissions and
- a proposal to rebalance annual motor tax to provide an incentive through the motor tax system for the motoring public to drive cleaner cars and to impose penalties in respect of cars with higher CO_2 emission levels.

The VRT and annual motor tax rates in place for prior to the revision are shown in Table 1. There were three distinct engine size bands with different VRT rates, applied as a percentage of the market value, or open market selling price (OMSP) of the car. In addition there were six distinct rates of annual motor tax depending on engine size, applied as a fixed annual tax. Note that there was no change in value added tax (VAT), which is also applied to new private cars.

Table 1. Vehicle Registration Tax and Annual Motor Tax Rates prior to July 1 2008

Engine Capacity (c.c)	VRT(% of OMSP)	Annual Motor Tax (€)
< 1,200	22.5	286
1,201 to 1,400		357
1,401 to 1,500	25%	
1,501 to 1,700		471
1,701 to 1,900		582
1,901 to 2,100	30%	784
> 2,100		1,566

[3] Department of Finance 2006 Vehicle Registration Tax (VRT) - Public Consultation on Options for revising the VRT system to take greater account of CO_2 emission levels. See http://www.finance.gov.ie/documents/publications/other/vrtconsultdoc06.pdf

In the VRT consultation document, the Department of Finance presented four options and requested respondents to submit their views. The overarching theme was that adjustments in the VRT system, as well as the motor tax system, can both affect car buyers' behaviour directly through pricing adjustments favouring lower-emitting cars, but also by making more explicit in their minds the link between their vehicle choice and its environmental impacts. It was deemed essential that any system linking VRT to CO_2 emission levels should be relatively simple, not give rise to unnecessary anomalies, be capable of adjustment over time to maintain appropriate downward pressure on emissions and should be capable of being introduced at a relatively low risk to overall VRT revenue being accrued by Government. The proposals also stated that equity, economic-efficiency and market impact issues were also important. The four options in the Department of Finance document may be summarised as follows

Option 1. adjusting existing engine size bands and VRT rates (accepting a correlation between engine size and specific CO_2 emissions)

Option 2. retain existing engine size bands and VRT rates but apply a (say 5 percentage points) discount for cars below average specific CO_2 emissions (within each engine size band) and a levy for cars above average specific CO_2 emissions (within each engine size band)

Option 3. retain existing engine size bands and VRT rates but apply a (say 5 percentage points) discount for cars below a set specific CO_2 emissions range and a levy for cars above a set specific CO_2 emissions range, the same range applying to all emissions bands.

Option 4. Introduce five engine size bands and VRT rates system as in Option 1 and then apply a (say 5 percentage points) discount and levy, for cars with specific CO_2 emissions below and above a set specific CO_2 emissions range, the same range applying to all engine size bands.

SEAI responded[4] by suggesting that both the amount and the transparency of the price signal was likely to be a key determinant of the behavioural change sought. SEAI also challenged the retention of the engine size bands as the starting point in all of the four options proposed and recommended a tax system based solely on CO_2 emissions, given that the goal was emissions reduction not engine size reduction. SEAI demonstrated that the data did exist to enable the changeover by tracking the trend of new private car sales in Ireland in terms of specific CO_2 emissions bands rather than engine size bands for the period 2000 - 2005, as shown in Figure 2.

[4] SEAI 2007 Response to Department of Finance VRT Consultation.
http://www.finance.gov.ie/documents/publications/vrt/vrtsei.pdf

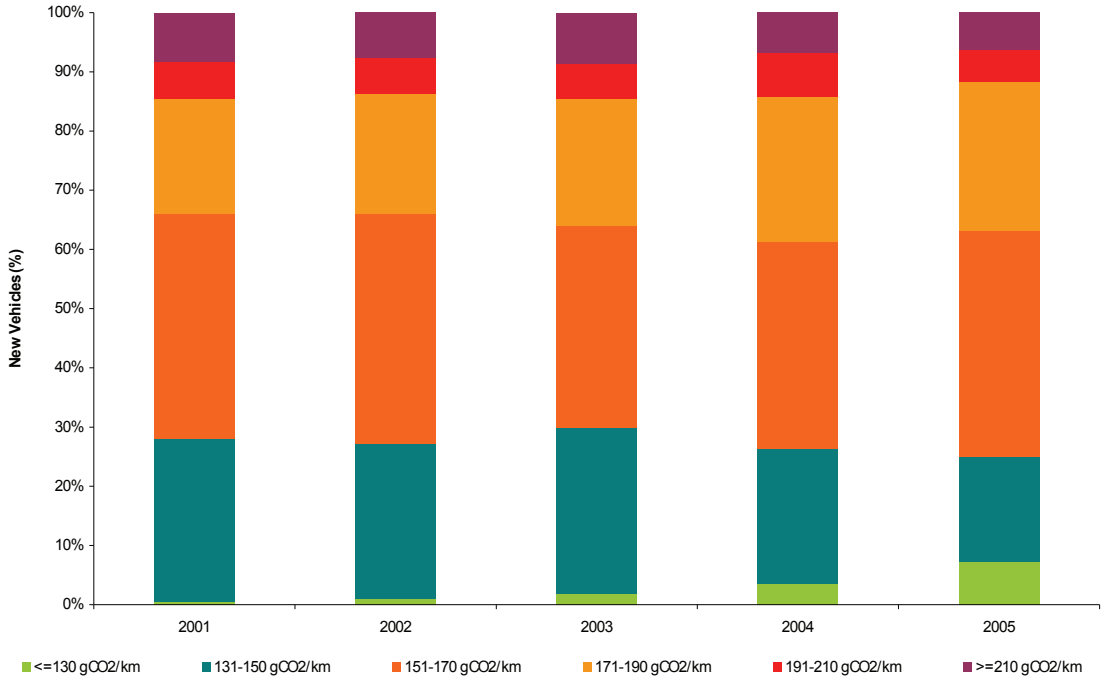


Figure 2 New Cars 2000 to 2005 by Specific CO_2 Emissions Band

In its response to the consultation, as shown in Figure 2, SEAI presented the data for five separate specific CO_2 emissions (CO_2 g/km) bands, each different form the next by 20 g/km with low emissions cars in a band no greater than 130 g/km and high emitting cars in the upper band of greater than 210 g/km. SEAI suggested linking the VRT directly to specific emissions and provided an indicative example where the VRT for cars less than 130 g/km was set as 5% of the OMSP, increasing to 50% for cars with specific emissions greater than 220 g/km.

In the 2008 Budget[5] it was announced that the VRT and AMT systems were to change with effect from the 1st July 2008. The new system, shown in Table 2, links the tax rates directly to specific CO_2 emissions (CO_2 g/km) rather than engine size, as recommended by SEAI. In addition, as shown by the range applied across the bands, the purchasing signal promoting lower emitting cars is strong. A car with a market value of €30,000 for example will have a VRT rate of € 4,200 (and annual motor tax of € 104) if it is in Band A compared with a VRT rate of €10,800 (and annual motor tax of €2,100) if in Band G.

Taking as an example a 1.9L diesel car within emissions band B with a market value of €30,000, the level of VRT would be €7,500 before, and €4,800 after, the tax change. Similarly the annual motor tax would be €582 before and €156 after, the tax change. This provides an indication of the significance of focussing on emissions performance rather than engine size. Effectively the tax change allows consumers to continue to purchase large cars but encourages them to be selective in their choice of large car.

[5] http://www.budget.gov.ie/2008/financialstatement.html#_Toc184577380

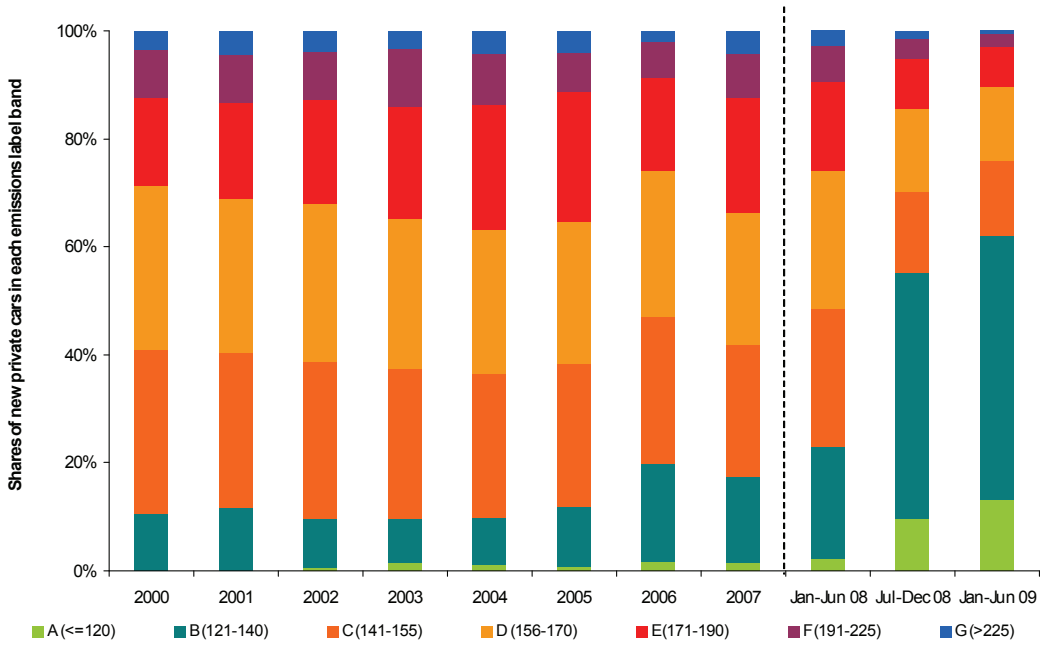
Table 2. CO_2 based Vehicle Registration and Road Tax Bands

Emissions Band	Specific CO_2 Emissions (g/km)	VRT(%OMSP)	AMT (€)
A	≤ 120	14%	104
B	> 120 – 140	16%	156
C	> 140 – 155	20%	302
D	> 155 – 170	24%	447
E	> 170 – 190	28%	630
F	> 190 – 225	32%	1,050
G	> 225	36%	2,100

Monitoring the Impact

Since the change in VRT and AMT, SEAI has been monitoring the impact of the changes by tracking the sales of new private cars and comparing sales by emissions band before and after the change on 1st July 2008. This data is being used to feed into a full ex-post analysis of this tax measure that quantifies the emissions saved and change in VRT received by comparing with a modelled counterfactual.

Figure 3 shows the shares of new-car sales[6] between 2000 and June 2009. Between 2000 and 2005 the share of label bands A, B & C was on average 35% while in 2006/07 it rose to 41%. For the first half of 2008, before the new taxes came into effect, the share of these three bands was 44%. In the period after the introduction of the change, July to December, the share of these bands rose to 73%. In the first six months of 2009 it increased again to 78%. This is a significant shift in purchasing patterns towards lower-emitting vehicles. This has to be tempered by the fact that the motor industry experienced a severe downturn during 2008 and because most car purchases took place in the first semester of the year, before the introduction of the new taxation system.



Source: Based on Vehicle Registration Unit data.

Figure 3. Shares of new cars by emissions label class, 2000 to 2008 (+ 2009 Semester 1)

[6] Licensed as private cars.

Table 3 tabulates the data shown in Figure 2. The largest increase in share was in the B label band, rising from 23% to 41%. More than half of all cars registered after July were in bands A or B. The largest reduction in share was in the D labels, falling from 28% to 14%. The A label band more than tripled its share, from 2.3% to 8.8%, while the G labels fell to 1.3% share in the second half of 2008 and further to 0.6% in the first half of 2009.

Table 3. Shares of new private cars in each emissions band, 2000 – 2008 (+ 2009 Semester 1)

CO_2 band	2000	2005	2006	2007	Jan - Jun 2008	July - Dec 2008	Jan - Jun 2009
A	0.0%	0.9%	1.8%	1.5%	2.4%	8.8%	12.3%
B	11.3%	11.4%	20.3%	16.3%	22.8%	41.3%	45.4%
C	25.6%	23.2%	18.8%	23.4%	18.3%	22.9%	19.8%
D	32.4%	27.6%	30.2%	24.7%	28.1%	13.8%	13.0%
E	17.5%	25.1%	19.3%	21.6%	17.9%	8.5%	6.9%
F	9.5%	7.5%	7.2%	8.4%	7.3%	3.3%	2.1%
G	3.7%	4.2%	2.3%	4.2%	3.2%	1.3%	0.6%

Source: Based on Vehicle Registration Unit data.

In the first half of 2009 the shares of labels A and B strengthened to 12% and 45% respectively (from 9% and 41%) with the shares of all higher emitting labels declining. This indicates there was no rush to purchase higher CO_2 emitting vehicles in advance of the tax change.

Figure 3 shows the evolution of the weighted average specific CO_2 emissions of new cars between 2000 and the first semester of 2009. It also shows the effect during 2008 of the change to the CO_2 taxation. Between 2000 and 2007 the average CO_2 emissions were approximately 166 CO_2 g/km for both petrol and diesel. For 2008 as a whole, there was a 3.5% reduction and a further 9% in the first semester of 2009.

However, if 2008 is taken in isolation, it can be seen that, over the first six months before the changeover, the average emissions for both petrol and diesel cars were approximately at the 2006 level. After the changeover in July, the average emissions fell by 8.6% with a further drop in the first semester of 2009 of 2.3%. As mentioned, this result is tempered by the reduction in the volumes of car sales in this period.

This indicates how the tax change has effectively accelerated progress in Ireland towards the EU goal of weighted average specific CO_2 emissions for new private cars of 130 g/km by 2012, as per Regulation 443/2009.

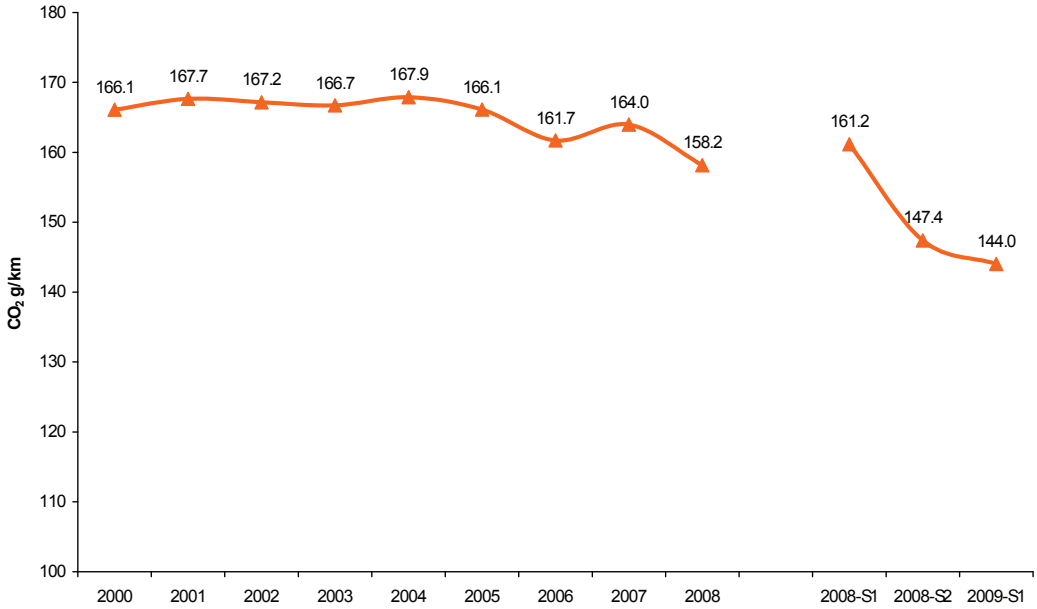


Figure 4. Specific CO_2 emissions of new cars, 2000 – 2009 (Semester 1)

In label terms and with reference to Figure 3, the average new petrol and diesel car before the change would have been a D whereas after July the average new petrol car was a low C and the average new diesel a B.

It had been reported in the media that the changed VRT and AMT systems had resulted in consumers not only purchasing lower-emitting cars but also smaller cars. This is not borne out by the facts, which suggest slightly the opposite. Figure 4 and Table 4 show the profile of new private cars by engine-size bands between 2000 and the end of 2008.

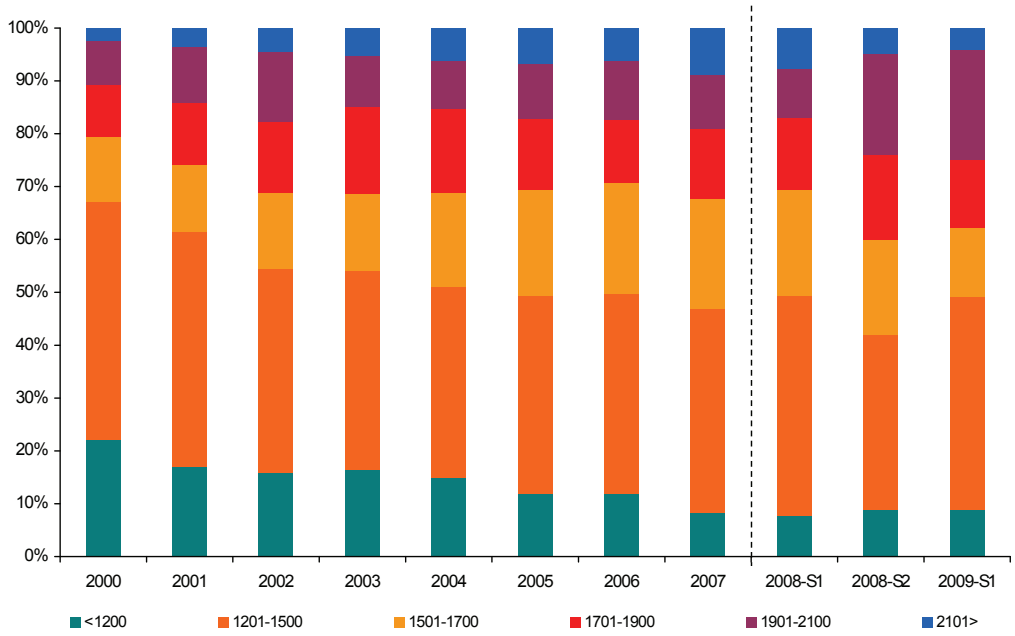


Figure 5. Shares of new cars by engine size, 2000 – 2008 (+ 2009 Semester 1)

Shares of new cars in the two smallest bands, i.e. less than 1500cc, have been falling from around 67% in 2000 to 47% in 2007. The share of these cars rose slightly in early 2008 to 49% but

fell to 42% after July. The bands that increased their share after July were: less than 1200cc, with an increase of 1.1% points: 1701 – 1900cc, increased by 3.4% points, and the 1901 – 2100cc band, up by 9.9% points. Hence there was no significant change but what is notable is the increase in the share of cars with engines larger than 1900 cc.

Table 4. Shares of new private cars by engine size, 2000 – 2008 (+2009 quarter 1)

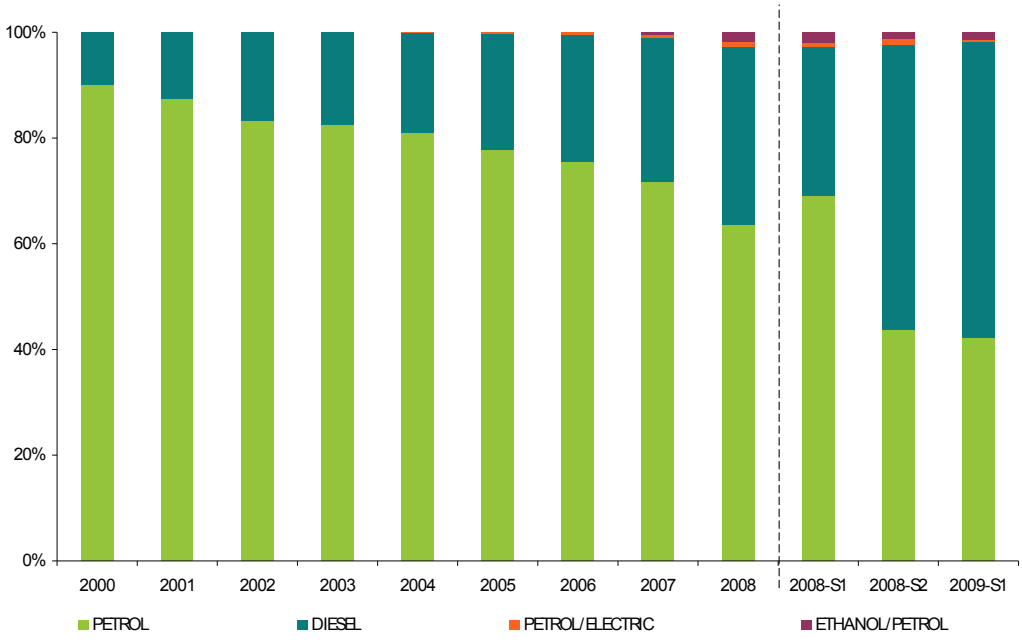
Engine size band	2000	2005	2006	2007	Jan - Jun 2008	July - Dec 2008	Jan - Jun 2009
<1200	22.1%	12.0%	11.8%	8.4%	7.7%	8.8%	8.7%
1201-1500	45.0%	37.3%	38.0%	38.5%	41.6%	33.1%	40.4%
1501-1700	12.2%	20.0%	21.0%	20.8%	19.9%	17.9%	13.1%
1701-1900	10.0%	13.4%	11.8%	13.2%	13.8%	16.2%	12.8%
1901-2100	8.2%	10.6%	11.3%	10.4%	9.2%	19.1%	20.9%
2101>	2.5%	6.7%	6.1%	8.8%	7.7%	4.8%	4.1%

Source: Based on Vehicle Registration Unit data.

The shift to lower-emitting vehicles along with increasing shares of larger engine sizes was actually achieved by a shift towards diesel-fuelled cars. With reference to Table 3 and

Table 5, it can be seen that the share of new cars that are fuelled by diesel has been increasing from 10% in 2000 to 34% in 2008. During the first half of 2008 the share was 28%; after July it increased to 54% of sales. Early indications for 2009 are that the share of diesel in new private cars had increased further to 56%. Other fuels shown in

Table 5 consist of petrol/electric and petrol/ethanol mainly.



Source: Based on Vehicle Registration Unit data.

Figure 6. Profile of new cars by fuel type, 2000 – 2009 (Semester 1)

Table 5. Profile of new cars by fuel type, 2000 – 2009 (Semester 1)

	2000	2005	2006	2007	2008	Jan - Jun 2008	July - Dec 2008	Jan - Jun 2009
Petrol	90.1%	77.8%	75.5%	71.8%	63.5%	69.0%	43.8%	42.3%
Diesel	9.9%	22.0%	24.1%	27.2%	33.8%	28.2%	53.9%	55.9%
Other	0.0%	0.2%	0.4%	1.0%	2.7%	2.8%	2.3%	1.8%

Source: Based on Vehicle Registration Unit data.

The ratio of petrol and diesel cars has been changing over time but the step change in 2008 and continued into 2009 is as a direct result of the new taxation scheme.

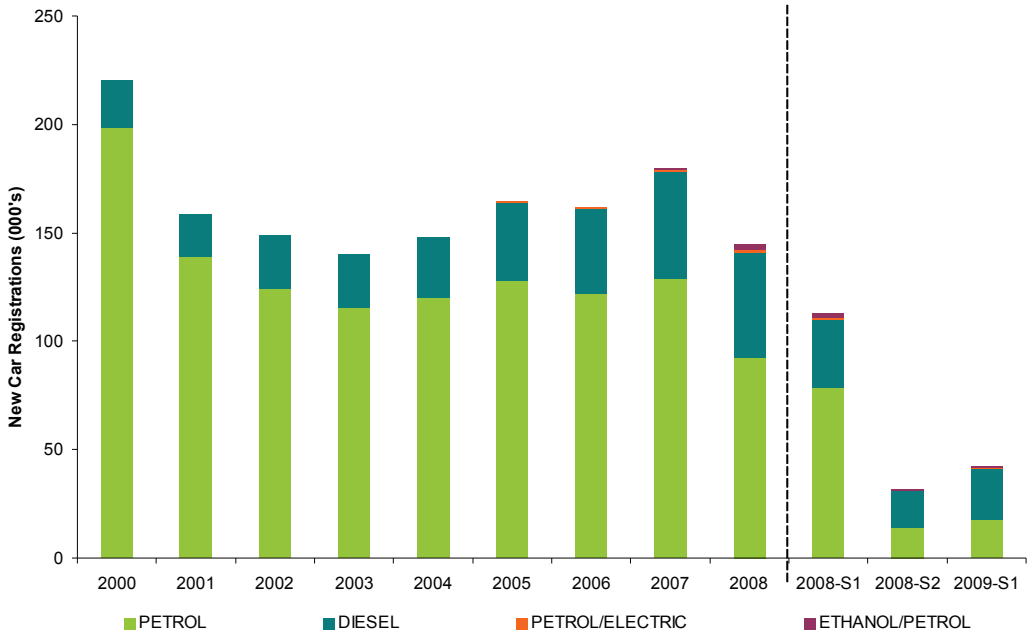


Figure 7. Sales of new cars by fuel type, 2000 – 2009 (Semester 1)

In addition to the 2008 tax change, Ireland entered an economic recession after a period of sustained growth. The recession has had a significant impact on private-car sales in 2008 and the first half of 2009, as shown in Figure 7. The data and discussion thus far in this section have focused on the share of private-car sales by specific emissions band, engine size and fuel type. Figure 7 shows the sales of new private cars by emissions bands in absolute terms: the sales in 2008 fell to close to 2003 levels. It is also notable that sales of low-emitting cars (bands A to C, less than 155 g/km) were lower in 2008 than in 2007.

The significant shift in purchasing trends since July 2008 is still evident but tempered by the volume of sales. This explains why the decrease in sales-weighted specific emissions of new private cars during 2008 (Figure 3) is not as large as might be expected from the drop in the second half of the year relative to the first. This spread of car sales over the year is not unusual, however. While

the second half of 2008 accounted for 18% of new private-car sales that year, this mirrored the trends in car sales in 2007 when 17% of new private-car sales were in the latter half of the year.

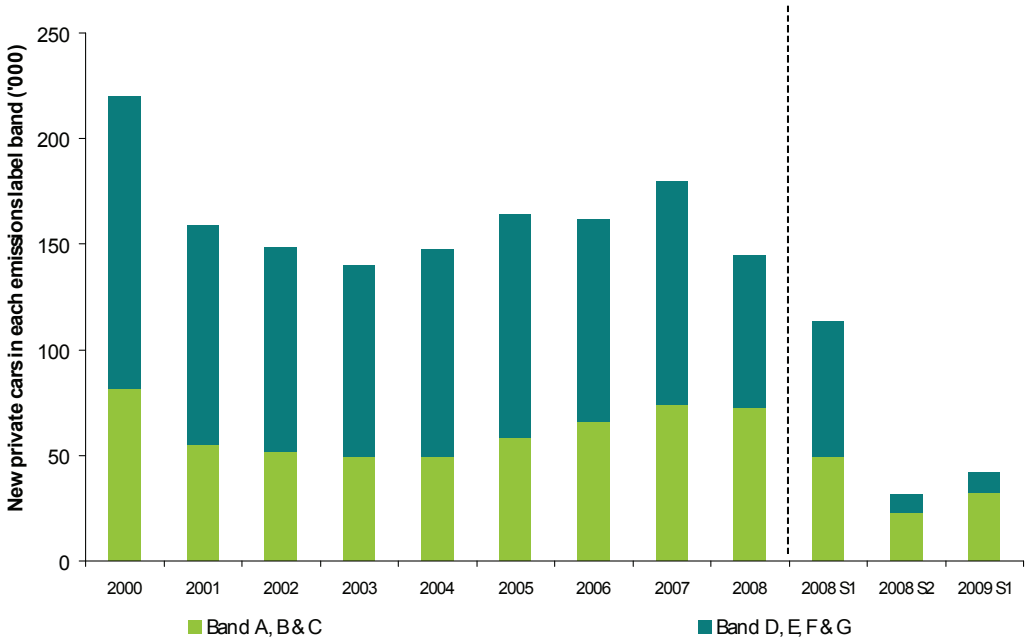


Figure 8. Sales of new private cars by emissions band, 2000 - 2008

Discussion

To quantify the impact of this tax measure in terms of energy savings and emissions avoided, it is important to distinguish between the *recession* effect and the *tax* effect. This is the subject of ongoing ex-post analysis carried out in University College Cork,[7] applying the 2007 monthly shares of cars by emissions band to total monthly car sales in 2008, in order to establish a baseline. This assumes that the recession affected the number of cars sold only while the tax change affected the type of car sold (in terms of specific emissions). The annual CO_2 emissions for the new cars sold in 2008 were then compared with baseline emissions (i.e. emissions of cars sold in 2008, compared with 2007 emissions band shares). The mileage travelled was based on SEAI's weighted average 2007 mileage for individual emissions bands. Initial findings quantify the emissions saved from the change in tax, as calculated using this methodology, as 7.7 kt CO_2. This compares with the target savings in the NEEAP of 54 kt, the annual savings to be achieved by 2020. This suggests that 14% of the target was delivered in the first year during a recession and that the tax measure is likely to have a significantly greater impact by the year 2020.

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