SUSTAINABLE ENERGY AUTHORITY OF IRELAND

Energy in Transport

2014 Report

Energy in Transport

2014 Report

Report prepared by
Dr Denis Dineen, Martin Howley and Mary Holland
Energy Policy Statistical Support Unit

October 2014

Sustainable Energy Authority of Ireland

The Sustainable Energy Authority of Ireland was established as Ireland's national energy authority under the Sustainable Energy Act 2002. SEAI's mission is to play a leading role in transforming Ireland into a society based on sustainable energy structures, technologies and practices. To fulfil this mission SEAI aims to provide well-timed and informed advice to Government, and deliver a range of programmes efficiently and effectively, while engaging and motivating a wide range of stakeholders and showing continuing flexibility and innovation in all activities. SEAI's actions will help advance Ireland to the vanguard of the global green technology movement, so that Ireland is recognised as a pioneer in the move to decarbonised energy systems.

SEAI's key strategic objectives are:

- Energy efficiency first – implementing strong energy efficiency actions that radically reduce energy intensity and usage;
- Low carbon energy sources – accelerating the development and adoption of technologies to exploit renewable energy sources;
- Innovation and integration – supporting evidence-based responses that engage all actors, supporting innovation and enterprise for our low-carbon future.

The Sustainable Energy Authority of Ireland is financed by Ireland's EU Structural Funds Programme co-funded by the Irish Government and the European Union.

Energy Policy Statistical Support Unit (EPSSU)

SEAI has a lead role in developing and maintaining comprehensive national and sectoral statistics for energy production, transformation and end use. This data is a vital input in meeting international reporting obligations, for advising policy makers and informing investment decisions. Based in Cork, EPSSU is SEAI's specialist statistics team. Its core functions are to:

- Collect, process and publish energy statistics to support policy analysis and development in line with national needs and international obligations;
- Conduct statistical and economic analyses of energy services sectors and sustainable energy options;
- Contribute to the development and promulgation of appropriate sustainability indicators.

Acknowledgements

SEAI acknowledges the contribution of Liam P. Ó Cléirigh, Tom Cleary and Shane Malone of Byrne Ó Cléirigh Consulting to the writing and editing of this report.

SEAI also acknowledges the data processing work of Kevin O'Keeffe, CIT student.

SEAI gratefully acknowledges the co-operation of the following organisations in providing the data that made this analysis possible.

- Applus (National Car Test)
- Central Statistics Office
- Department of Transport, Tourism and Sport
- Department of the Environment, Community and Local Government
- Department of Communications, Energy and Natural Resources
- Dublin Airport Authority
- Iarnród Éireann
- Road Safety Authority (Commercial Vehicle Roadworthiness Test services)

Highlights

General Status

- The transport sector was responsible for the largest share of primary energy demand of any sector of the economy in 2013, accounting for 33% (4,326 ktoe).
- The transport sector was responsible for the largest share of final energy consumption in 2013, accounting for 40% (4,279 ktoe).
- The transport sector was responsible for the largest share of energy-related CO_2 emissions of any sector of the economy in 2013, accounting for 35% (12.6 $MtCO_2$).
- In 2013 energy use in the transport sector was 97.5% dependent on oil products, all of which are imported.
- In 2013 the estimated cost of imports of oil products for the transport sector was €3.5 billion. This accounts for just over half of the estimated total cost of fuel imports across the entire economy.
- The share of energy demand between the different modes of transport in 2013 was: private cars 43%, road freight 21%, aviation 14%, public passenger transport 5% and other 17%.

Overall Trends 2007 to 2013

- Between 2007 and 2013 transport sector final energy consumption fell 25% to 4,280 ktoe.
- In the same period transport sector CO_2 emissions fell 26% to 12.6 $MtCO_2$.
- Between 2007 and 2013 the average age of the private car fleet increased from 6.6 to 8.8 years and the average age of goods vehicles increased from 5.9 to 8.8 years.

Overall Trends 1990 to 2013

- Despite the reductions in both energy usage and CO_2 emissions in the period 2007 to 2013, the overall trend between 1990 and 2013 has been of exceptionally high growth.
- Between 1990 and 2013, transport final energy consumption increased by 112% (2,261 ktoe), the largest growth of any sector both in absolute and in percentage terms.
- CO_2 emissions increased by 108% (6.6 $MtCO_2$) between 1990 and 2013. The scale of this increase is in stark contrast to that of energy-related CO_2 emissions in the other sectors of the economy.

Private Cars

- The total number of private cars in 2013 was 1.91 million, up 140% from 1990 and down just 0.7% from a high of 1.92 million vehicles in 2008.
- The total number of private cars licensed for the first time in Ireland fell 49% between 2007 and 2013 from 239,473 to 121,516.
- Of these, the number of new private cars licensed for the first time fell 61% between 2007 and 2013 from 180,754 to 71,348.
- The number of used imports licensed for the first time fell 15% from 58,719 in 2007 to 50,168 in 2008. Used imports accounted for 41% of all new private car registrations in 2013, up from 25% in 2007.
- Changes to the taxation of private cars introduced in 2008 together with obligations on car manufacturers to improve the efficiency of their new car fleets have contributed to a profound change in the purchasing patterns of new cars.
- In 2007 1.5% of all new cars were in the A emissions band while 17.7% were in the combined A & B emissions bands. For the first half of 2014 67.2% of all new cars were in the A band and 94.8% were in the combined A & B emissions band.
- The average specific CO_2 emissions of all new cars purchased in 2013 was 120.7 gCO_2/km, which is in the B1 band, marginally above an A rating (<120 gCO_2/km). In 2007 the average was 164.0 gCO_2/km which was in the D band.
- The average new diesel car purchased has a larger engine size than the average new petrol car (1.84 versus 1.28 litre), has slightly lower specific energy consumption (1.70 versus 1.75 MJ/km) and slightly higher specific CO_2 emissions (121.1 versus 120.5 gCO_2/km).
- The ratio of petrol to diesel new cars purchased in 2007 was 72% versus 28%. In 2013 the ratio had almost exactly switched to 27% versus 73%.

- On average the annual mileage of the private car fleet was 23,700 km for diesel cars and 14,700 km for petrol cars in 2013.
- Estimated private car final energy demand was down 9.5% between 2007 and 2013, from 2,036 ktoe to 1,843 ktoe.

Heavy Goods Vehicles

- The activity of heavy goods vehicles as measured in million tonne-kilometres (Mtkm) fell 51% from 18.7 Mtkm in 2007 to 9.9 Mtkm in 2013, which is 78% above 1990 levels.
- The category of freight which contributed most (34%) to the decrease in tonne-kilometres (tkm) in the period 2007 to 2013 was "Delivery of goods to road works and building sites". This category had been responsible for greatest share of the increase (26%) in the period 1990 – 2007.
- The estimated final energy demand of HGVs was down 49% in the period 2007 to 2013, from 1,132 ktoe to 581 ktoe.

Light Goods Vehicles

- A new data source on light goods vehicles (LGV) is available from Commercial Vehicle Roadworthiness Tests and this has allowed SEAI estimate the activity and energy demand of LGVs for the first time. Data are available from 2008.
- Between 2008 and 2013 the activity of LGV freight as measured in million vehicle kilometres (Mvkm) fell 10% from 6,816 to 6,109 Mvkm.
- In the same period the estimated final energy demand of LGVs fell 21% from 408 to 320 ktoe.
- 34% of all new LGVs licensed in 2013 were in the A or B carbon emissions band.

Public Transport

- The number of licensed taxis fell 22% from a high of 29,008 vehicles in 2008 to 22,751 vehicles in 2013.
- The estimated final energy demand of road public-passenger transport (bus, hackney & taxi) fell 7.5% from 164 ktoe in 2007 to 151 ktoe in 2013.
- Rail transport passenger kilometres (pkm) fell 20% between 2008 and 2013, from 1.98 to 1.58 Gpkm .
- The estimated final energy demand of rail fell 11.6% from 47 ktoe in 2007 to 42 ktoe in 2013.

Air and Sea Transport

- Air passenger numbers were also down 20% between 2008 and 2013, from 29.9 to 23.8 million passengers.
- The estimated final energy demand of aviation fell 42% from 1,045 ktoe in 2007 to 607 ktoe in 2013.
- The estimated energy demand of coastal and inland waterway navigation fell 10.2% from 64 ktoe in 2007 to 57 ktoe in 2013.

Fuel Tourism

- Fuel tourism fell 61% from 635 ktoe in 2007 to 250 ktoe in 2013.

Renewable Energy in Transport

- The weighted share of biofuels as a percentage of petrol and diesel energy use was 4.8% in 2013, up from 0.5% in 2007 and 3.9% in 2012.
- The un-weighted share of biofuels was 2.8% in 2013, up from 2.4% in 2012.
- The amount of renewable electricity in the transport fuel mix remains negligible.

Electric Vehicles

- At the end of 2013 there were 420 Electric Vehicles (EVs) in Ireland, including 251 private cars.
- This represents less than 1% of the revised target for 2020 of 50,000 vehicles.
- There has been a significant increase in the numbers of new EVs registered in 2014, with 215 registered between January and August 2014 compared to 54 for the whole of 2013.

Energy Efficiency in Transport

- The ODEX indicator of energy efficiency fell 15% in the period 2007 – 2012, indicating a corresponding increase in energy efficiency.

Table of Contents

Table of Figures

Table of Tables

1 Introduction

In the years since the publication of the previous *Energy in Transport* report in 2009 there has been a significant change in the trends in energy consumption in the transport sector. The uninterrupted increase in final energy demand witnessed between 1990 and 2008, during which time energy consumption almost tripled, was reversed following the economic recession and energy demand declined year on year from 2009 to 2012, though it returned to growth in 2013.

The economic recession affected energy consumption across the entire sector, with road freight in particular being affected due to the downturn in construction activity. In terms of policy instruments aimed at improving energy efficiency and reducing emissions, changes to the taxation of private cars introduced in 2008 together with obligations on car manufacturers to improve the efficiency of their new car fleets have contributed to a significant shift in purchasing patterns towards more efficient and less carbon intensive car models, with the result that year to date figures for 2014 show that over 67% of new cars registered are now in the "A" band, up from just 1.5% in 2007 prior to scheme's introduction.

Primary energy use[1] in the transport sector grew by 185% (6.4% per annum on average) between 1990 and 2007 but subsequently decreased by 26% between 2007 and 2013 to 4,328 ktoe[2]. Despite the decrease in primary energy consumption the transport sector remains Ireland's most significant fuel consumer, accounting for 32% of Ireland's primary energy demand in 2013, higher than any other sector. A key characteristic that distinguishes energy use in transport is the almost total dependence on imported oil as a fuel – over 97%. The estimated cost of oil imports used directly in the transport sector was €3.5 billion in 2013, accounting for just over half of the estimated total cost of fuel imports across the entire economy. The sector was responsible for 33% (12,612 kt CO_2)[3] of Ireland's energy-related CO_2 emissions, again higher than any other sector.

Given these facts there is a clear imperative for policy makers to develop and implement measures and programmes that maximise energy efficiency and renewable energy deployment.

The report is structured as follows:

- Section 2 provides context by exploring the major policy developments which have, or are intended to have, an impact on energy use and emissions in the transport sector at international, European and national level.
- Section 3 provides further context by presenting data on fuel prices and the overall trend in transport energy demand up to 2013 and its relationship to GDP. Section 3 goes on to highlight the importance of transport energy demand within the national energy balance by providing data on the overall trends in transport energy demand in relation to the economy as a whole, along with data on transport sector energy-related CO_2 emissions.
- Section 4 profiles the transport sector by mode, with a particular focus on private car and road freight. Data are provided on the trends for the size and composition of fleet of vehicles, including data on the dramatic shift in purchasing patterns of private cars towards lower emissions bands since 2008.
- Section 5 profiles private car and taxi/hackney average annual mileage, based on results from an updated analysis of NCT data as well as introducing new analysis of light goods vehicles (LGV) using newly available data from the Commercial Vehicle Roadworthiness Tests.
- Section 6 presents the latest data on energy demand and carbon emissions for the transport sector. These are presented by mode of transport and in terms of fuel type. These data are also discussed in terms of specific policy targets, some relating specifically to the transport sector but also some cross-sectoral targets.
- Finally, section 7 concludes.

Where possible all data in this report are up to the end of 2013, and in some cases with provisional figures for 2014. Energy data drawn from the national energy balance presented in this report are drawn from *Energy in Ireland 1990 – 2012*[4], updated to provisional 2013 data. The energy balance is updated whenever more accurate information is known. To obtain the most up-to-date balance figures, visit the statistics publications section of the SEAI website (www.seai.ie/Energy-Data-Portal/Energy%20Data%20Publications/). A new Data Portal on this website links to interactive energy statistics, forecasts and other data developed by SEAI.

Feedback and comment on the report are welcome and should be addressed by post to the address on the back cover or by email to epssu@seai.ie.

1 The total primary energy requirement (TPER), this is the total requirement for all uses of energy, including energy used to transform one energy form to another(e.g. burning fossil fuel to generate electricity) and energy used by the final consumer.
2 Thousand (kilo) tonnes of oil equivalent.
3 Thousand (kilo) tonnes (kt).
4 SEAI, 2013, *Energy in Ireland 1990–2012*, www.seai.ie

2 Policy Context - National and International

The overwhelming scientific evidence of the contribution of energy use to climate change and air-quality degradation coupled with the growth in energy demand and related emissions have prompted governments and policy makers to introduce policies and measures designed to manage energy more effectively and to move towards less polluting sources of energy.

This section briefly identifies the major policy developments relevant to transport and new initiatives since the publication of the previous *Energy in Transport* report in 2009.

2.1 EU Directives and Corresponding National Action Plans for Ireland

2.1.1 The Energy Services Directive and Ireland's National Energy Efficiency Action Plan

Directive 2006/32/EC[5] of the European Parliament and of the Council on energy end-use efficiency and energy services was transposed into Irish legislation as S.I. 542 of 2009. This legislation commits Ireland to achieving a 9% reduction in energy use by 2016 and seeks to promote cost-effective end-use energy efficiency through various promotional, awareness and support measures, as well as the removal of institutional, financial and legal barriers. The 9% target is set on the basis of a reduction of average demand over the period 2001 – 2005. While it does encompass transport consumption, it specifically excludes aviation and bunker fuels, as well as energy use regulated via the EU Emissions Trading Scheme (ETS).

Member States are obliged to submit three Energy Efficiency Action Plans to the Commission over a period of seven years to describe the measures planned to meet the 9% target.

Ireland's first National Energy Efficiency Action Plan (NEEAP) to 2020[6] was published in May 2009 and reaffirmed the target originally introduced in the 2007 White Paper of energy efficiency saving equivalent to 20% of the average primary energy used over the period 2001 – 2005 , to be achieved in 2020.

Ireland's second NEEAP[7] was launched in February 2013 and the third and final NEEAP was released in August 2014[8]. All three action plans maintain a commitment to meeting the overall 20% energy savings target in 2020, as well as a 33% reduction in public service energy use. The 2014 report notes that although substantial savings have been made in the last three years *"it is clear that a significant acceleration of effort is required if we are to realise our 2020 targets"*. All three reports set specific targets for the transport sector[9], with the most recent report targeting savings of 4,548 GWh (391 ktoe) in 2020.

2.1.2 The Energy Efficiency Directive

On 25th October 2012, Directive 2006/32/EC was repealed by Directive 2012/27/EU[10] of the European Parliament and of the Council on energy efficiency[11]. The new Directive places energy efficiency at the core of the EU Energy 2020 strategy and requires Member States to further decouple energy use from economic growth and sets out a common framework of measures for the achievement of the EU's headline 20% energy efficiency target (by 2020).

It stipulates that Member States shall set an indicative national energy efficiency target and shall report annually on their progress towards the target. In April 2013, Ireland submitted a report to the Commission reaffirming its commitment to the 20% target, as described in the second NEEAP.

5 Full details are available at http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2006:114:0064:0064:en:pdf
6 Full details are available at http://www.dcenr.gov.ie/NR/rdonlyres/FC3D76AF-7FF1-483F-81CD-52DCB0C73097/0/NEEAP_full_launch_report.pdf
7 Full details are available at http://www.dcenr.gov.ie/NR/rdonlyres/B18E125F-66B1-4715-9B72-70F0284AEE42/0/2013_0206_NEEAP_PublishedversionforWeb.pdf
8 http://www.dcenr.gov.ie/NR/rdonlyres/20F27340-A720-492C-8340-6E3E4B7DE85D/0/DCENRNEEAP2014publishedversion.pdf
9 Many of these are also set out in the Government's transport policy for the period 2009-2020, Smarter Travel – A Sustainable Transport Future
10 Full details are available at http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2012:315:0001:0056:EN:PDF
11 Directive 2012/27/EU also repealed Directive 2004/8/EC (cogeneration) and amended Directives 2009/125/EC (eco-design of energy-related products) and 2010/30/EU (labelling of energy-related products).

2.1.3 The Renewable Energy Directive & Ireland's National Renewable Energy Action Plan

Directive 2009/28/EC[12] of the European Parliament and of the Council on the promotion of the use of energy from renewable sources was signed into law on 23rd April 2009. This Directive establishes the basis for the achievement of the EU's previously agreed 20% renewable energy target by 2020 and sets out individually binding renewable energy targets for Member States, which will contribute to the achievement of the overall target. Ireland's target is to achieve 16% of energy from renewable sources by 2020. Each Member State is mandated to ensure 10% of transport energy (excluding aviation and marine transport) by 2020 comes from renewable sources.

Article 3 of Directive 2009/28/EC details a methodology for including the renewable component for electricity used in electric vehicles. It provides a weighting factor of 2.5 for renewable generated electricity used in transport, effectively signalling a stimulus for electric vehicles powered by renewable energy in preference to vehicles using first generation biofuels. Article 21 stipulates that the contribution of biofuels produced from wastes, residues, non-food cellulosic material and ligno-cellulosic material be considered twice that made by other biofuels.

Ireland's National Renewable Energy Action Plan[13] also sets out a series of national targets relating to specific forms of renewable energy, including a transport target of 10% contribution from renewable sources by 2020, of which 16% is targeted to be from renewable electricity used primarily for electric vehicles. This is based on an electric vehicle target penetration rate of 10% of all passenger vehicles by 2020 (equivalent to 230,000 vehicles). The remaining 84% of the 10% transport target is to be satisfied by replacing fossil fuels with biofuels. In order to count towards the transport target, the biofuel must be verified as being sustainable, as per Articles 17 & 18 of Directive 2009/28/EC. There are three key sustainability criteria:

- The greenhouse gas emissions savings from biofuels must be at least 35% compared to fossil fuels. This requirement increases to 50% from January 2018.
- Biofuels must not be produced from raw materials obtained from land with high biodiversity value.
- Biofuels must not be produced from raw materials obtained from land with high carbon stock.

If a biofuel does not meet the sustainability criteria, it cannot be counted towards the renewable energy targets.

The European Parliament is currently drafting amendments to Directive 2009/28/EC, which are likely to:

- Set a limit on the contribution from food-derived biofuels;
- Establish a separate target for 'advanced biofuels';
- Revise how advanced biofuels will be eligible for multiple counting;
- Make some provision for reporting the effects of indirect land use change.

2.1.4 Non-ETS Greenhouse Gas Emissions Reduction Target

In order for the EU to meet its goal of 20% greenhouse gas emissions reduction by 2020 relative to 1990, two pieces of legislation were introduced in 2009. Directive 2009/29/EC[14] (a revision of Directive 2003/87/EC on emissions trading) sets targets for those involved in the Emissions Trading Scheme (ETS) to reduce their emissions by 21% below 2005 levels by 2020. The complementary Decision No 406/2009/EC[15] sets a 10% reduction target for emissions of entities outside of the ETS (Non-ETS); this has significant implications for transport energy.

The target for emissions trading companies must be achieved by the companies themselves. The target for non-ETS is shared between the targets of individual Member States, based on levels of economic growth and assumptions on compliance costs. In the case of Ireland, the target is to achieve a 20% reduction in emissions for non-ETS sectors by 2020, relative to 2005 levels. The bulk of projected emissions for non-ETS sectors in Ireland occur in agriculture, transport and direct fuel use in buildings.

The Environmental Protection Agency (EPA) are the body responsible for regulating and reporting on greenhouse gas (GHG) emissions in Ireland. Their most recent report on GHG emissions projections[16] finds that Ireland is not

12 Full details are available at http://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1401881317196&uri=CELEX:02009L0028-20130701

13 Submitted to the European Commission in July 2010 under Article 4 of Directive 2009/28/EC - see http://www.dcenr.gov.ie/NR/rdonlyres/C71495BB-DB3C-4FE9-A725-0C094FE19BCA/0/2010NREAP.pdf

14 European Union, 2009: *Directive 2009/29/EC of the European Parliament and of the Council of 23rd April 2009 amending Directive 2003/87/EC so as to improve and extend the greenhouse gas emission allowance trading scheme of the Community*. Official Journal of the European Union 5.6.2009 L 140/63-87.

15 European Union, 2009: *Decision No 406/2009/EC of the European Parliament and of the Council of 23rd April 2009 on the effort of Member States to reduce their greenhouse gas emissions to meet the Community's greenhouse gas emission reduction commitments up to 2020*. Official Journal of the European Union 5.6.2009 L 140/136-148.

16 Environmental Protection Agency, 2014, *Ireland's Greenhouse Gas Emission Projections; 2013 – 2030*, www.epa.ie

on a pathway to a low-carbon economy and that there is a significant risk that Ireland will not meet its 2020 EU targets even under the most ambitious emission reduction scenario. The transport sector, along with agriculture, is identified as a key contributor to Ireland's inability to meet the non-ETS target, with emissions projected to increase by 23% up to 2020 in the "With Measures" scenario.

2.2 EU Non-Governmental Targets

2.2.1 EU Emissions Trading Scheme

The EU Emissions Trading Scheme (ETS) is a 'cap and trade' scheme for 11,000 large emitters of greenhouse gases throughout Europe. Upon its commencement, emitters were allocated free allowances. The scheme ran for an initial pilot phase (2005 – 2007) followed by a second phase between 2008 and 2012. Over this period, the price of allowances fluctuated widely – from ~€30 per tonne at its peak to near zero on occasions. The scheme's third phase, which runs from 2013 to 2020, introduces significant changes.

Emissions from aviation have been included since the start of 2012, under legislation originally introduced in 2008. Unlike fixed installations, aircraft operators operating within the European Economic Area (EEA) will continue to receive the large majority of their emission allowances for free throughout the third phase of the ETS. The allocation of allowances is based on the tonne-kilometres flown by operators in 2010 using an EU wide benchmark allocation of 0.6422 tonnes CO_2 per 1,000 tonne-km flown within the EEA.

There were 311 aircraft operators in Ireland in 2012, of which 132 had reportable emissions in the year – totalling 9.33 million tonnes CO_2. However, just six of these operators accounted for 99.99% of the total.

The EU is in the process of simplifying the ETS scheme for aircraft operators. In the future, operators with emissions of less than 1,000 tonnes CO_2 per year will not be obliged to report their emissions. The EPA estimates that this will reduce the number of operators required to report emissions in Ireland to 25.

2.2.2 EU Regulations on CO_2 Emissions from Passenger & Light Commercial Vehicles

Prior to 2007 the European Commission had a three pillar strategy for reducing CO_2 emissions from cars. The three pillars were:

- Voluntary commitments from car manufacturers to cut emissions;
- Improvements in consumer information;
- Promotion of fuel-efficient vehicles by means of fiscal measures.

It was recognised in 2007 that the objective of achieving average new car emissions of 130 g CO_2/km by 2012, as agreed with European, Japanese and Korean car manufacturers, would not be met without additional measures.

Legislation on CO_2 from passenger cars was officially published in June 2009 in the form of Regulation (EC) No. 443/2009 setting emission performance standards for new passenger cars. The regulation applies to car manufacturers and specifies an overall average CO_2 emissions target for the new car fleet in a given year. In 2012, the average carbon emissions of the most efficient 65% of all new cars registered for each car manufacturer had to be less than 130 g CO_2/km. The percentage of the fleet included rises each subsequent year to 2015 when the average emissions of all new cars registered in the EU is required to be below 130 g CO_2/km. Note that this implies that manufacturers can still produce car models that emit more than 130 g CO_2/km, as long as the overall average of all new cars registered is less than the target. Note also that as this is an EU wide target on manufacturers the target does not have to be met in each individual Member State, and the overall average emissions of new cars registered in a given Member State may be above the target.

Equivalent legislation setting average emissions targets for the fleet of new light commercial vehicles has been introduced in the form of Regulation (EU) No 510/2011. This came into effect in 2014, during which it is required that the average carbon emissions of the most efficient 70% of each manufacturer's newly registered light commercial vehicle fleet must be less than 175 gCO_2/km. The proportion of the fleet included will rise each year to 100% of all new light commercial vehicles in 2017.

A further 10 g CO_2/km reduction is to be obtained by using other technical improvements. The other technical improvements[17] are expected to come from:

- Setting minimum efficiency requirements for air-conditioning systems;
- Compulsory fitting of accurate tyre pressure monitoring systems;
- Setting maximum tyre rolling resistance limits in the EU for tyres fitted on passenger cars;
- The use of gear shift indicators, taking into account the extent to which such devices are used by consumers in real driving conditions;
- Increased use of biofuels maximizing environmental performance.

From 2020 onwards, the Regulations set targets of 95 g CO_2/km as average emissions for the new car fleet and 147 g CO_2/km for the new light commercial vehicle fleet.

2.3 Irish Government Policies

2.3.1 2007 Energy White Paper

The 2007 Energy White Paper[18] describes the actions and targets for Ireland's energy policy framework to 2020, to support economic growth and meet the needs of all consumers. The policy is underpinned by the three pillars of competitiveness, environment and security of supply. The White Paper sets out the following key targets:

- 20% savings in energy usage by 2020 in line with EU targets, with a further indicative target of 30%;
- 10% of Ireland's road[19] and rail transport energy requirements to come from renewable sources by 2020.

It also lists a number of programmes and measures intended to assist in achieving these targets. Many of these are underway and are described in this section.

2.3.2 2014 Energy Green Paper

In May 2014, the Department of Communications, Energy & Natural Resources published its Green Paper on Energy Policy in Ireland[20] , which identifies a range of issues that need to be addressed to meet existing and future energy challenges. There will be a full consultation process after which a new Energy Policy White Paper will be published.

2.3.3 National Transport Infrastructure Investment

The National Development Plan 2007 – 2013 (NDP) detailed proposed government spending for the period 2007 to 2013. It set out planned investment in transport infrastructure over the period of nearly €33 billion, including multi-billion euro investments in national roads, non-national roads and public transport (particularly in the Greater Dublin Area), as well as other significant investments in the Rural Transport Initiative, in air-transport facilities and in strategic ports facilities and regional harbours. Several of the larger projects, especially roads, were delivered via public private partnerships (PPPs). The sustainable energy and energy research sub-programmes of the NDP also targeted the transport sector.

The Department of Public Expenditure & Reform's Infrastructure & Capital Investment 2012 – 2016: Medium Term Exchequer Framework[21] was published in late 2011. While acknowledging that "over the medium-term, there will be a lower level of resources available for capital investment", it sets out the following priorities relevant to transport:

- Maintenance of the national road network, and targeting the improvement of specific road segments, where there is a clear economic justification.
- Development of the Luas Cross City Line. Utility works associated with this scheme commenced in June 2014. It is expected that the main infrastructure works will commence in 2015 and the new line will be commissioned in 2017.
- The Railway Safety Programme, replacement of buses, upgrade of existing quality bus corridors and important cycling and pedestrian projects.
- Investment in the tourism sector.

17 Commission of the European Communities, 2007, *Results of the review of the Community Strategy to reduce CO_2 emissions from passenger cars and light-commercial vehicles COM(2007) 19 final*.
18 Full details are available at www.dcenr.gov.ie/NR/rdonlyres/54C78A1E-4E96-4E28-A77A-3226220DF2FC/30374/EnergyWhitePaper12March2007.pdf
19 Including non-road mobile machinery
20 Full details are available at http://www.dcenr.gov.ie/Energy/Energy+Planning+and+Electricity+Corporate+Division/
21 Full details are available at www.per.gov.ie/comprehensive-review-of-expenditure/

2.3.4 Smarter Travel Policy

The Government's transport policy for the period 2009 – 2020, *Smarter Travel – A Sustainable Transport Future*[22], is the framework under which energy and emissions savings will be achieved in the sector.

This action plan sets out forty-nine measures whereby, by 2020, thousands more people will be walking, cycling, using public transport and leaving their cars at home. With this plan, the Government aims to change the transport mix in Ireland so that by 2020 the car share of total commutes drops from 65% to 45%.

This will require new ways of approaching many aspects of policy making in Ireland – for example, how schools and school curricula are planned and where residential areas and centres of employment are developed. It also opens up social and employment opportunities for people with reduced mobility. A key goal is to return urban spaces to people rather than cars.

The forty-nine actions in *Smarter Travel – A Sustainable Transport Future* can be grouped under four main headings:

- Actions to reduce the distance travelled by private car and to encourage smarter travel, including focusing population and employment growth predominantly in larger urban areas.
- Actions aimed at ensuring that alternatives to the car are more widely available, mainly through a much improved and more accessible public transport service and through the promotion of cycling and walking.
- Actions aimed at improving the fuel efficiency of motorised transport through improved fleet structure, energy efficient driving and alternative technologies.
- Actions aimed at strengthening institutional arrangements to deliver the targets.

The National Transport Authority (NTA) is charged with devising and implementing projects to enhance sustainable travel in Ireland, in line with government policy. It has responsibility for capital investment in the Greater Dublin Area, and for projects that promote sustainable transport nationwide – including through the provision of funding to Iarnród Éireann, the Railway Procurement Agency and Dublin Bus.

Measures implemented to improve energy performance in the sector include:

- Introduction of the 'leap card' integrated ticketing scheme, which can be used on Dublin Bus, Luas, Dart, commuter rail and selected Bus Éireann, Wexford Bus, Swords Express and Matthew's Coaches services.
- Implementation of real time passenger information system for bus services in the Greater Dublin Area and in Cork, Galway, Limerick and Waterford.
- Launch of the National Transport Authority's national journey planner[23], which helps people plan journeys using public transport and / or walking.
- Development of a National Cycle Manual to guide planners and engineers in the provision of cycling routes and investment in cycling infrastructure throughout the country.
- Establishment of mobility management initiatives including Smarter Travel Workplaces, Green Schools Travel and CarSharing.ie.
- Establishment and subsequent expansion of the Dublin bikes scheme, and recent announcement of a similar scheme to be developed in Cork, Galway and Limerick cities.
- Introduction of latest-generation diesel-engine rail rolling stock, improved matching of train sizes to demand and implementation of regenerative braking systems on electric traction services.
- Bus route network redesign and bus fleet modernisation in Dublin.

2.3.5 Tax Incentives for Employee Travel to Work

The TaxSaver Commuter Ticket Scheme was established in 2000 as a tax incentive for employees to use public transport. It is operated by Bus Éireann, Dublin Bus, Iarnród Éireann and approved transport providers in conjunction with the Revenue Commissioners. Employees can save between 31% and 52% in tax, PRSI and USC, while employers can save up to 10.75% in employers' PRSI.

The Cycle To Work Scheme was introduced from the beginning of 2009 and grants income tax exemption for the benefit-in-kind arising from the provision of a bicycle to an employee by an employer. The bicycle must be used for travelling to/from work and the employee can enter into a salary sacrifice arrangement with the employer to cover

22 Full details are available at http://smartertravel.ie/sites/default/files/uploads/pdfs/NS1264_Smarter_Travel_english_PN_WEB.pdf
23 Available at http://www.journeyplanner.transportforireland.ie/

the costs of the purchase. A limit of €1,000 applies and the exemption can only be used once (per employee) within a five year period.

2.3.6 National Climate Change Policy & Legislation

The National Policy Position and final Heads of the Climate Action and Low-Carbon Development Bill[24] were published in April 2014. The National Policy Position expresses a long term vision based on an aggregate reduction in emissions of at least 80% by 2050 (from 1990 levels) in the power generation, built environment and transport sectors, coupled with "an approach to carbon neutrality in the agriculture and land-use sector, including forestry, which does not compromise capacity for sustainable food production". The purpose of the Bill is to put in place structures by which Ireland can meet its obligations on climate change and attain the transition to a low carbon, climate-resilient and environmentally sustainable economy in the period up to and including 2050.

The evolution of policy in this area will be an iterative process, based on a series of national plans over the period to 2050. Mitigation and adaptation will be addressed through the development and implementation of parallel national plans – the National Low-Carbon Roadmaps and National Climate Change Adaptation Frameworks. The Bill provides for the establishment of a national Expert Advisory Body on Climate Change, a key role of which will be to conduct regular reviews of the roadmap and adaptation framework, and to recommend adjustments to Government if the rate of progress is insufficient to meet the 2050 objectives.

There are no transport-specific provisions in the Bill. However, the national roadmap will itself be compiled from a series of sectoral roadmaps. In December 2013, the Department of Transport, Tourism & Sport published a consultation paper[25] on a low carbon roadmap for transport, which addressed four key areas: engines and fuels; travel demand; modal shift; and aviation and maritime.

2.3.7 Carbon Tax

The carbon tax was introduced in the 2010 Budget and enacted through the Finance Act 2010. The tax[26] was initially applied to road transport petrol and diesel from December 2009 and was subsequently extended to other fuel types in phases. The tax is calculated on the basis of €20 per tonne of CO_2 emitted, with the individual unit rates (in €/litre) for different fuel types being set out in the Act. There are several exemptions and reliefs currently available, including for biofuels and farm diesel.

2.3.8 Mineral Oil Tax Relief Scheme and Biofuel Obligation Scheme

In order to provide incentives to achieve the 2020 target for renewable energy in transport, a Mineral Oil Tax Relief Scheme was introduced in 2005. Thereafter, in 2010 a biofuel obligation scheme was established which required fuel suppliers and consumers to include on average 4.166% biofuel, by volume, (equivalent to approximately 3% in energy terms) in their annual sales. The biofuel obligation scheme is a certificate based scheme which grants one certificate for each litre of biofuel placed on the market in Ireland; two certificates are granted to biofuel which is produced from wastes and residues.

Oil companies and consumers are required to apply to the National Oil Reserves Agency (NORA) for certificates and demonstrate that the quantities of biofuel for which they are claiming certificates are accurate. Since the introduction of the Sustainability Regulations (SI 33 of 2012) in 2012, the companies are also required to demonstrate that the biofuel that is being placed on the market is sustainable. Biofuel which is not deemed to be sustainable is not awarded certificates and cannot be counted towards the biofuel obligation.

The obligation was increased to 6.383% for 2013 and 2014; no targets have yet been established for 2015 and beyond, but they will be influenced by the share of diesel and petrol on the market and the quantity of biofuel that will be eligible for double counting by virtue of being produced from wastes or residues. The target will also be influenced by the degree of market penetration of electric vehicles and by future amendments to Directive 2009/28/EC.

24 Full details are available at http://environ.ie/en/Environment/Atmosphere/ClimateChange/NationalClimatePolicy/News/MainBody,37848,en.htm

25 Climate Change Mitigation - Preparation of Low-Carbon Roadmap for Transport - Issues Paper for Consultation, which is available at http://www.dttas.ie/sites/default/files/publications/corporate/english/low-carbon-roadmap-transport-sector-issues-paper-december-2013/issues-paper-consultation-preparation-low-carbon-roadmap-transport.pdf

26 The tax is variously referred to as a tax (e.g. in budgets), a levy and a charge (e.g. in the Finance Act).

2.3.9 Emissions-based Vehicle Registration and Road Tax Bands

A new system of assessing private cars for Vehicle Registration Tax (VRT) and annual motor tax came into effect from July 2008 for vehicles purchased in 2008 or later. The system moved away from assessing vehicles based on engine size to one that is based solely on the CO_2 emissions per kilometre. Seven tax bands were originally used for the assessment with the bands corresponding to the EU labelling system. The number of bands was extended in January 2013 to eleven.

2.3.10 Diesel Rebate Scheme

The diesel rebate scheme, which came into effect in July 2013[27], provides for the repayment of part of the mineral oil tax paid on road diesel that is purchased by qualifying road haulage and bus operators and is used for business purposes. The amount of the repayment depends on the prevailing average price of road diesel and is calculated in accordance with a sliding scale that ranges from zero repayment when the diesel price is below €1.23 per litre to 7.5 cent per litre when the price is €1.54 per litre or over. The average price is calculated for three-month repayment periods in accordance with data provided by the Central Statistics Office.

2.3.11 Car Scrappage Scheme

A vehicle scrappage scheme was introduced in 2010 for cars of ten years or older, in instances where the car was being scrapped and a new vehicle in emissions band A or B was being purchased. The scheme ran until June 2011, but with reduced relief from January 2011.

2.3.12 Electrification of Irish Motoring

In November 2008, Government set out its plans for the mass deployment of electric vehicles in Ireland. A national task force was subsequently established, which made recommendations with respect to the infrastructure options and the provision of subsidies. The key actions undertaken since then are:

- Tax incentives for business: The accelerated capital allowance (ACA) is a tax incentive scheme incorporated within SEAI's Triple E framework which encourages companies that pay corporation tax to invest in electric vehicles (and other energy efficient equipment) by enabling them to write off 100% of the purchase value of qualifying vehicles and equipment against profit in the year of purchase. The ACA was introduced in the Finance Act 2008 for a trial period of three years and was subsequently extended until 31st December 2014 via the Finance Act 2011. The scheme includes ten different equipment categories, one of which is electric and alternative fuel vehicles.
- The European Union (Energy Efficient Public Procurement) Regulations 2011 (SI No. 151 of 2011) oblige all public bodies, when purchasing electric vehicles (and other relevant equipment), to only do so from the Triple E register.
- Government and ESB agreed a memorandum of understanding with several vehicle manufacturers to ensure a supply of electric vehicles to the Irish market.
- SEAI developed a buyer's guide and an online comparison calculator to inform purchasers, and published an electric vehicles roadmap to 2050.
- SEAI also implemented a €1 million programme to undertake research, development and demonstration on key aspects of electric vehicle roll out for the Irish market.
- SEAI administers a grant support scheme (since 2011) that offers grants of up to €5,000 to assist in the purchase of both battery electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs). Vehicles must be purchased and registered before the end of 2014.
- Certain BEVs are also eligible for relief from VRT up to €5,000, while PHEVs qualify for VRT repayment/remission up to €2,500.
- ESB is rolling out electric vehicle charge points throughout Ireland, with a target of 2,000 home charge points and 1,500 public charge points, including fast chargers at 60 km intervals along main interurban routes. It is also implementing the IT and payment systems required to support this roll out.

27 Full details are available at http://www.revenue.ie/en/tax/excise/diesel-rebate-scheme/index.html?utm_source=twitter&utm_medium=social&utm_content=863358

3 Energy in the Transport Sector: Overall Context & Trends

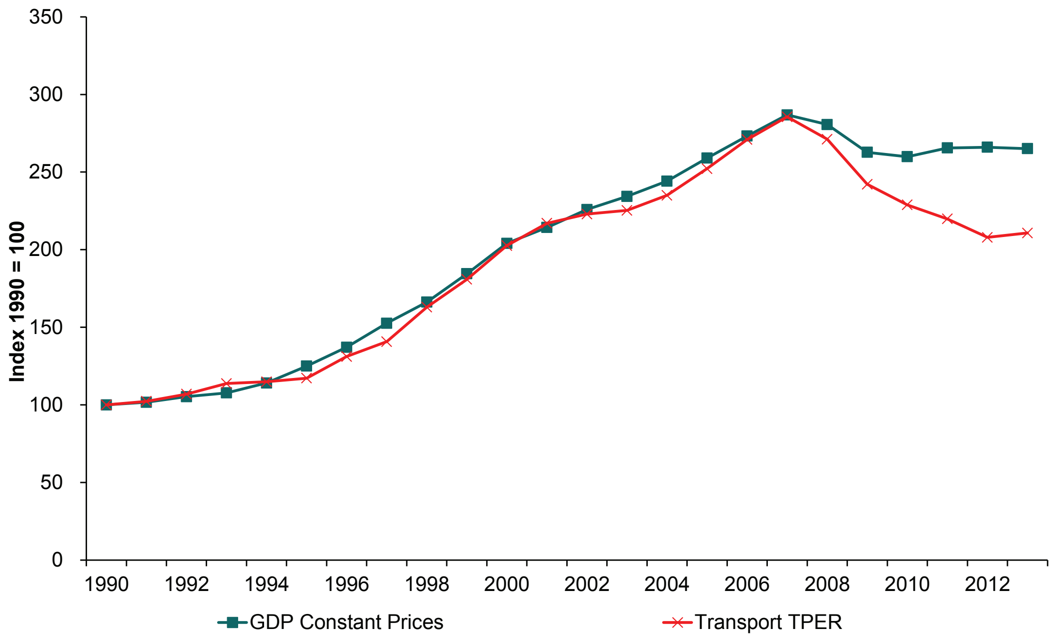
This section provides an overview of energy trends in Ireland, covering the period 1990 to 2013, with an emphasis on the transport sector. A more detailed discussion of energy trends in Ireland generally is available in the latest edition of *Energy in Ireland*[28].

3.1 Transport Energy and Macroeconomic Factors

The main driver of transport energy demand growth in Ireland is economic activity, as shown in *Figure 1* and *Table 1*, which track changes in economic growth as measured by GDP[29] and transport TPER[30]. *Table 1* also shows overall national TPER and transport related carbon dioxide (CO_2) emissions.

Overall in the period 1990 to 2007 transport TPER was strongly coupled to GDP, with the former growing by 286% while the latter grew by 287%. Between 2007 and 2012 transport TPER declined 27% or 6.1% per annum compared to GDP which declined 7% or 1.5% per annum. The decoupling of transport TPER from GDP is particularly evident from 2010 onwards with transport energy use continuing to fall even as GDP grew slightly. In 2013 the recent trends were reversed with transport TPER increasing slightly and GDP falling slightly.

Figure 1 *GDP and transport energy 1990 – 2013 – Index*



Source: CSO and SEAI

Table 1 *GDP, transport primary energy requirement and CO_2 growth rates*[31]

	Growth %	Average annual growth rates %				
	1990 – 2013	'90 – '13	'00 – '05	'05 – '10	'10 – '13	2013
GDP	165.1	4.3	4.9	0.1	0.7	-0.3
National TPER	37.7	1.4	2.8	-1.3	-4.1	-1.2
Transport TPER	110.7	3.3	4.5	-2.2	-2.2	2.9
Transport CO_2 (incl. aviation)	108.6	3.2	4.4	-2.5	-2.1	2.3

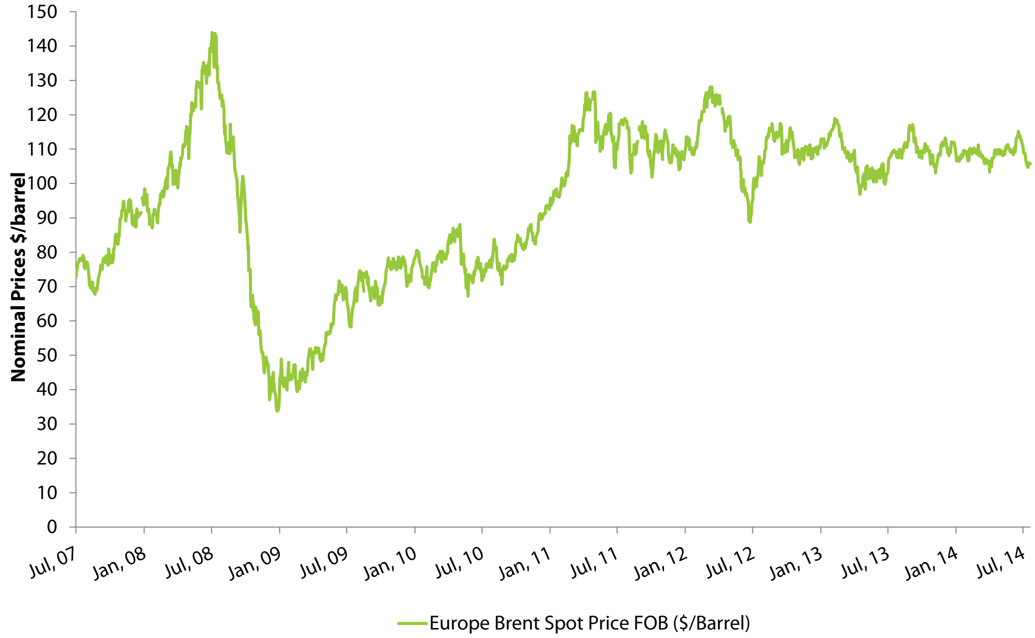
Source: CSO and SEAI

28 SEAI, 2013, *Energy in Ireland 1990–2012*, www.seai.ie.
29 Gross Domestic Product (GDP) in constant prices.
30 Total Primary Energy Requirement (TPER) includes all the fuels used directly by each sector plus the primary energy used to generate electricity attributed to each sector in proportion to its electricity demand.
31 Throughout the report, where annual growth rates are across multiple years they always refer to *average annual growth rates*.

3.2 Fuel Prices

Figure 2 shows the trend in crude oil prices since 2007. Crude oil prices doubled between July 2007 and July 2008. During the first half of 2008, nominal crude oil prices increased by 39%. After July 2008, there was a sharp decline in the price of crude oil to a low of around $34/barrel in late December 2008. Average oil prices rose steadily during the second half of 2010 and peaked at $127/barrel at the start of May 2011. During the first half of 2012 the average price of crude oil was $113/barrel and settled back to $110/barrel during the second half of the year. The price of crude oil fell further to average around $109/barrel during 2013 and this average has been maintained in 2014 up to mid July. The most recent peak in price occurred in mid June 2014 when prices reached $115/barrel in the wake of conflict in Iraq involving the expansion of the Islamic State in the region.

Figure 2 *Crude oil prices July 2007 – July 2014*



Source: SEAI

Figure 3 shows the trend in petrol and diesel prices since 2002. The crude oil price movement is reflected in the peaks in petrol and diesel prices in late 2008, of €1.34 and €1.44 per litre, respectively, in the forecourts and to a low of approximately €0.97 per litre for both petrol and diesel in January 2009. There was been a steady increase in the price of both petrol and diesel until August 2012 when diesel reached a high of €1.61 per litre and October 2012 when petrol reached €1.70 per litre.

Figure 3 *Evolution of petrol and diesel prices April 2007 – April 2014*

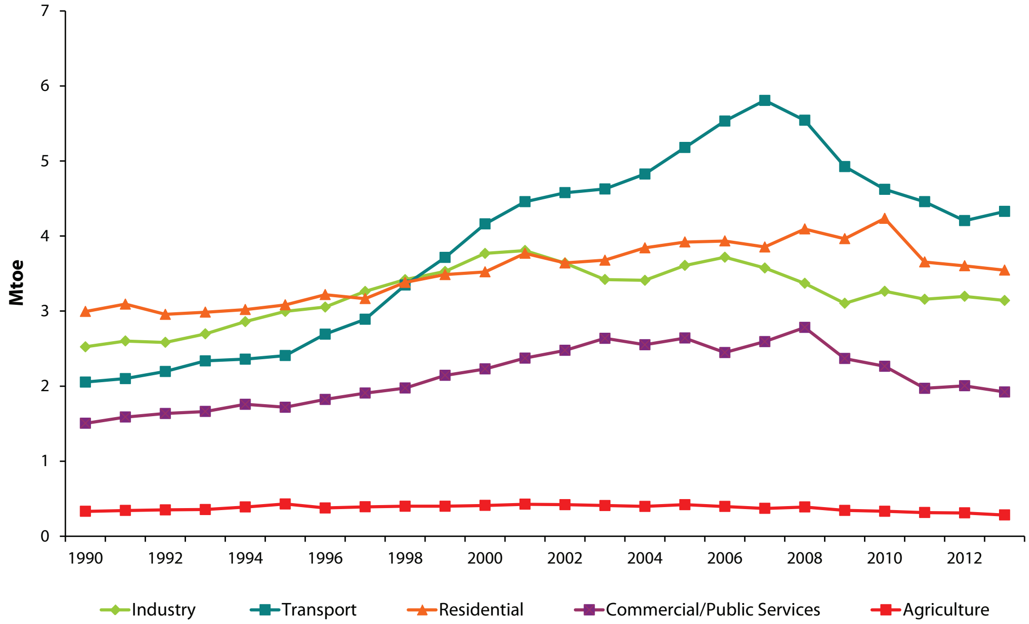
Source: CSO

3.3 Transport Sector in the Context of National Energy Use and Energy-related CO_2 Emissions

3.3.1 Total Primary Energy Demand

Figure 4 shows the TPER for Ireland split by sectors of the economy. The dramatic increase in transport energy demand both in absolute terms and as a share of the total is clear. To put this further in context, the increases and shares of all sectors are shown in *Table 2*. Transport experienced the largest growth by far between 1990 and 2013, growing almost four times the rate of the next highest growth sector, commercial and public services. This led to it increasing its share of the total from 22% in 1990 to 33% in 2013 and in the process going from third placed to the largest sector by TPER. All of this despite the fact that transport energy demand reduced by 25% between 2007 and 2013.

Figure 4 *Total primary energy demand in Ireland by sector*



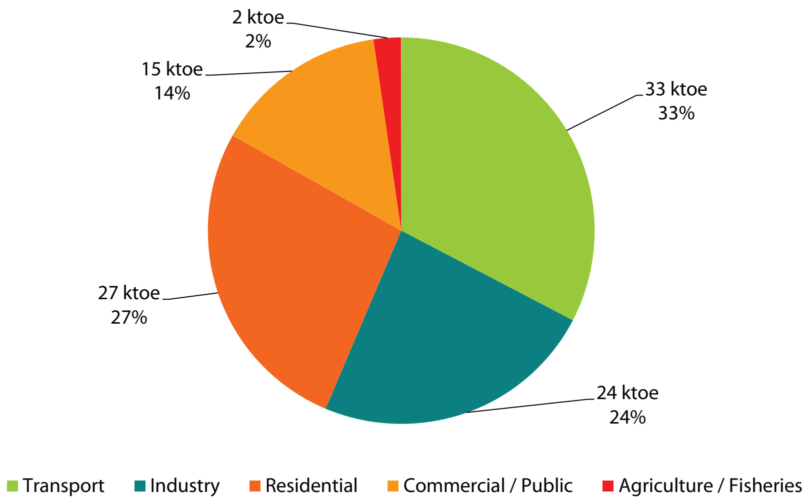
Source: SEAI

Table 2 *Growth rates and shares of TPER by sector*

	Growth %	Average annual growth rates %					Quantity (ktoe)		Shares %	
	1990 – 2013	'90 – '13	'00 – '05	'05 – '10	'10 – '13	2013	1990	2013	1990	2013
Industry	24.5	1.0	-0.9	-2.0	-1.3	-1.7	2,524	3,143	26.8	23.7
Transport	110.7	3.3	4.5	-2.2	-2.2	2.9	2,054	4,326	21.8	32.7
Residential	18.6	0.7	2.2	-5.7	-5.7	-1.6	2,995	3,552	31.8	26.8
Commercial / Public	27.8	1.1	3.5	-5.4	-5.4	-4.3	1,504	1,922	16.0	14.5
Agriculture / Fisheries	-8.1	-0.4	2.7	-5.3	-5.3	-8.9	331	304	3.5	2.3

Source: SEAI

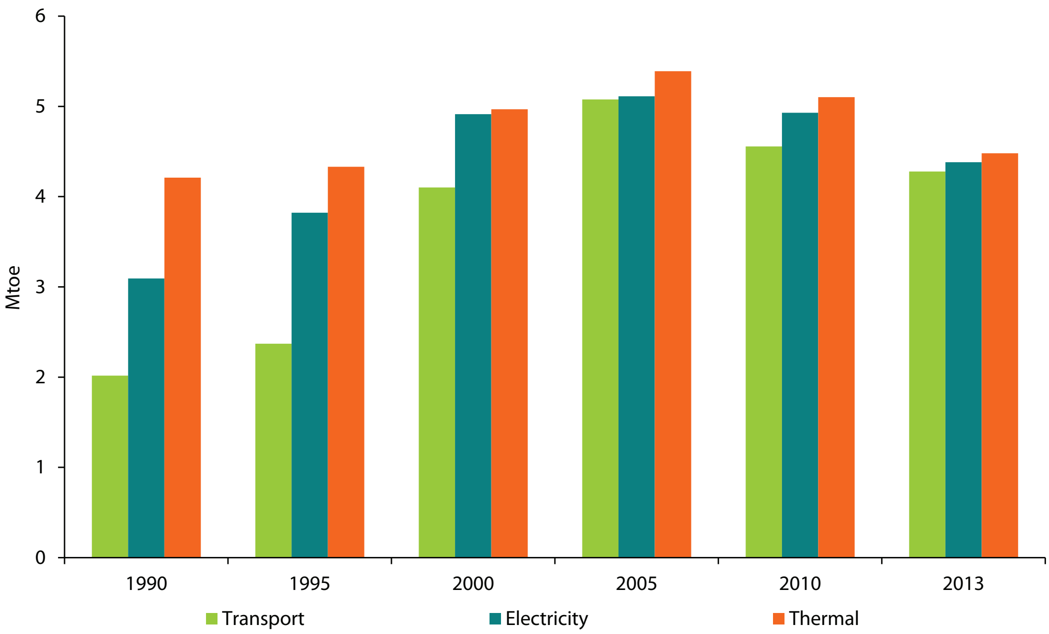
Figure 5 *Total primary energy demand by sector in 2013*



Source: SEAI

National energy use can also be categorised by its mode of application; that is, whether it is used for mobility (transport), power applications (electricity) or for thermal uses (space or process heating). Where thermal or transport energy is provided by electricity (e.g. electric heaters and electric vehicles) this energy is considered under electricity, and not under thermal or transport, so that double counting is avoided. Therefore these three modes represent three distinct energy markets. *Figure 6* shows the total primary energy requirement for Ireland by mode of application. Again the increase in transport energy demand both in absolute and relative terms is evident.

Figure 6 *Total primary energy by mode of application*



In 1990 transport (excluding electricity) accounted for just 22% (2,017 ktoe) of total primary energy demand, with thermal uses accounting for the largest proportion of all primary energy at 45% (4,211 ktoe), while electricity accounted for 33% (3,094 ktoe). This contrasts with the situation in 2013 when the transport share had risen to 33% (4,275 ktoe), thermal had fallen to 34% (4,430 ktoe) with the share of energy use for electricity generation remaining at 33% (4,382 ktoe).

3.3.2 Total Final Energy Consumption

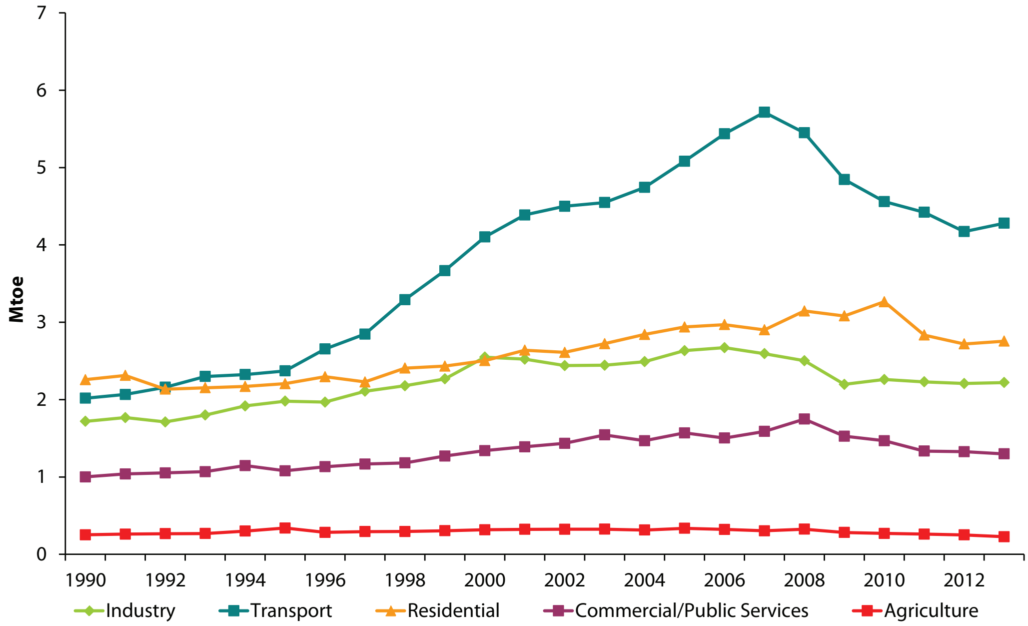
Figure 7 and *Table 3* show the total final energy consumption (TFC) in Ireland split by sectors of the economy. TFC is a measure of the useful energy delivered to the end user and is essentially total primary energy less transformation losses incurred in order to transform primary sources such as crude oil and other fossil fuels into forms suitable for end use consumers such as refined oils, electricity, patent fuels, etc[32]. It is also referred to as final energy demand.

Table 3 *Growth rates and shares of TFC by sector*

	Growth %	Average annual growth rates %					Quantity (ktoe)		Shares %	
	1990 – 2013	'90 – '13	'00 – '05	'05 – '10	'10 – '13	2013	1990	2013	1990	2013
Industry	29	1.1	0.7	-3.0	-0.6	0.6	1,720	2,222	23.7	20.6
Transport	112	3.3	4.4	-2.1	-2.1	2.5	2,019	4,279	27.8	39.6
Residential	22	0.9	3.3	2.2	-5.5	1.3	2,258	2,763	31.2	26.6
Commercial / Public	30	1.1	3.2	-1.3	-4.1	-2.5	1,001	1,299	13.8	12.0
Agriculture / Fisheries	-1	-0.1	3.9	-5.1	-5.5	-8.9	252	249	3.5	2.3

Source: SEAI

Figure 7 *Total final energy consumption in Ireland by sector*



Source: SEAI

The dominance of the transport sector is again clear, accounting for 40% of TFC in 2013, down from 44% in 2007. The main source of transformation losses in the energy system is in electricity generation. Therefore sectors of the economy that use a large proportion of electricity have significantly higher primary energy demand than final energy consumption. Conversely, as is the case for the transport sector, sectors of the economy that consume relatively low amounts of electricity have primary energy demands closer in magnitude to their final energy consumption. This is the reason why transport accounts for a higher proportion of TFC than it does of TPER.

3.3.3 Fuels Used and Import Dependency

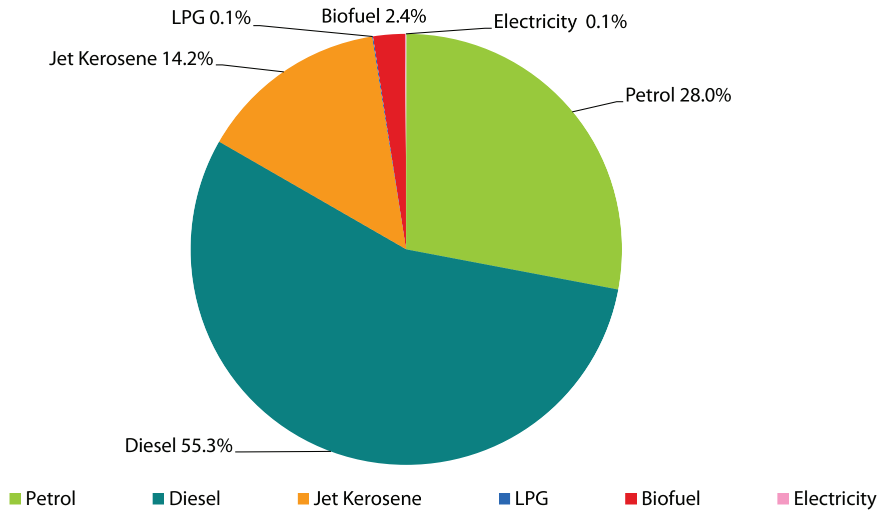
Shown in *Figure 8* is the share of total final energy demand in the transport sector for each fuel type in 2013. Diesel has the largest share, accounting for over half of fuel use in the sector. The biofuels consumption is predominantly due to the blending of liquid biofuels with petrol and diesel by suppliers in order to comply with the biofuels obligation scheme which requires that motor fuels are at least 6.383% by volume from renewable sources.

32 For further information see the latest Energy in Ireland report, *Energy in Ireland 1990–2012*, www.seai.ie

The key feature to be noted is that 97.5% of total fuel usage in the sector was supplied by oil-based products. Of all sectors in the economy this near total dependence on a single fuel source is unique, and has implications for security of supply[33]. Transport exhibits by far the highest fossil fuel dependency and lowest degree of electrification of any sector.

The import costs of oil products used in the transport sector are estimated to have been €3.5 billion in 2013. This accounts for 69% of the estimated import cost of oil products for the whole economy (€5.1 billion) and 51% of the estimated import costs of all fuels for the whole economy (€6.8 billion).

Figure 8 *Share of transport final energy demand by fuel type for 2013*



Source: SEAI

3.3.4 CO_2 Emissions

Figure 9 and *Table 4* show energy-related CO_2 emissions in Ireland split by sectors of the economy. The transport sector was the largest source of energy-related CO_2 emissions accounting for 35% or 12,612 ktCO_2 in 2013, down from 37% or 17,139 ktCO_2 in 2007. Once again what sets the transport sector apart in respect of CO_2 emissions is the growth rate over the time period, having grown by 6,569 ktCO_2 or 109% since 1990. The sector with the next largest absolute and relative growth over the period was industry which grew by just 166 ktCO_2 or 2.1%. If the transport sector is omitted then energy-related CO_2 emissions would have reduced by 725 ktCO_2, rather than the overall increase of 5,844 ktCO_2 that took place.

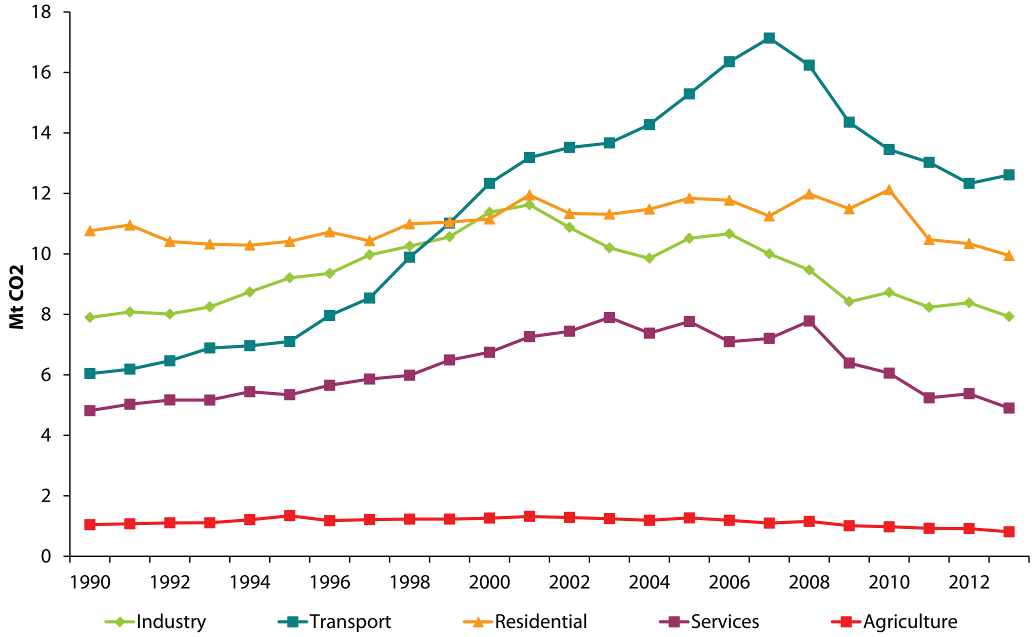
Table 4 *Growth rates and shares of energy-related CO_2 emissions by sector*

	Growth %	Average annual growth rates %					Quantity (ktCO_2)		Shares %	
	1990 – 2013	'90 – '13	'00 – '05	'05 – '10	'10 – '13	2013	1990	2013	1990	2013
Industry	2.1	0.1	-1.6	-3.6	-2.8	-5.1	7,899	8,065	25.8	22.1
Transport	108.7	3.3	4.4	-2.5	-2.1	2.3	6,043	12,612	19.8	34.6
Residential	-7.6	-0.3	1.2	0.5	-6.4	-3.8	10,764	9,948	35.2	27.3
Commercial / Public	1.8	0.1	2.8	-4.8	-6.8	-8.8	4,817	4,901	15.8	13.5
Agriculture / Fisheries	-15.2	-0.7	2.3	-5.7	-5.6	-10.6	1,046	886	3.4	2.4
Total	**19.1**	**0.8**	**1.8**	**-2.4**	**-4.2**	**-3.0**	**30,569**	**36,413**	**100.0**	**100.0**

Source: SEAI

33 The issue of security of supply is examined in detail in a separate SEAI report: SEAI, 2011, *Energy Security in Ireland: A Statistical review - 2011 Report*, www.seai.ie .

Figure 9 *Energy-related CO_2 emissions in Ireland by sector*



Source: SEAI

4 Profiling the Transport Sector by Mode

4.1 Analysing the Transport Sector

The International Energy Agency (IEA)[34] identified that energy use in the transport sector depends primarily on the following factors:

- Transport activity: the level of demand for personal mobility and for the transport of goods
- Modal mix: the chosen mix of transport modes, such as cars, buses, planes, ships, aircraft, etc
- Fuel mix: the types and the mix of fuel used in each transport mode
- Energy intensity, including the fuel efficiency of the different modes.

This report attempts to quantify these factors for Ireland, to provide a basis for evidence-based policy formation. The transport sector is split into the following modes:

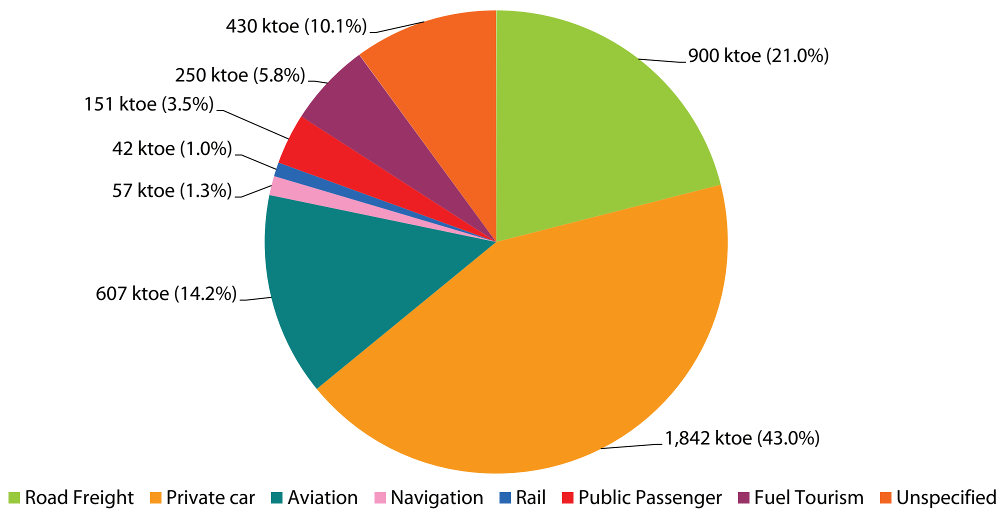
- Road private car, comprising cars taxed as private for the purposes of motor tax
- Road freight, both heavy goods vehicles (HGV) and light goods vehicles (LGV)
- Public-service vehicles (PSV), including road-going public and private buses, touring and coach vehicles, also referred to as large PSV, and including taxi and hackney vehicles, also referred to as small PSV
- Rail, including both passenger and freight
- Aviation, which accounts for aviation fuel (kerosene) sold in Ireland
- Navigation, which accounts for fuel used by watercraft or sea going vessels operating in coastal or inland waters, excluding that used for international sea transport of passengers or freight or by fishing vessels[35]
- Fuel tourism, which is defined as fuel that is bought within the State by motorists and hauliers but consumed outside the State
- Unspecified, which accounts for the difference between the sum of the energy demand estimates for each individual mode listed above and data from the national energy balance on the overall fuel consumption of the transport sector. It includes fuel consumption by modes for which insufficient data are available to estimate energy demand, for example motorcycles, service vehicles (ambulances, etc), construction vehicles (excavators and load-alls, etc), and previously light goods vehicles. The unspecified figure also, by default, accounts for any discrepancy between the estimated and the real world energy demand of individual modes. Inaccuracies and simplifications contained in the methodologies or the data used for the estimations will result in either over or under-estimates of the actual energy demand.

In this section each of these modes is examined individually and the data that are available on the drivers for energy demand in that subsector are presented and discussed. The relative share of each of these modes in 2013 is shown in *Figure 10*. It can be seen that in 2013 the mode with the largest share of final energy demand was private car, accounting for 43% of energy demand in the sector, followed by road freight accounting for 21%. By contrast combined rail passenger and rail freight accounted for just under 1% of TFC.

34 IEA, 2006, *Energy Technology Perspectives Scenarios & Strategies to 2050*, www.iea.org

35 International sea passenger and freight transport energy use is counted under international marine bunkers and is not considered under the national energy balance; energy use in fishing vessels is accounted for under agriculture and fisheries.

Figure 10 *Share of transport energy demand by mode for 2013*

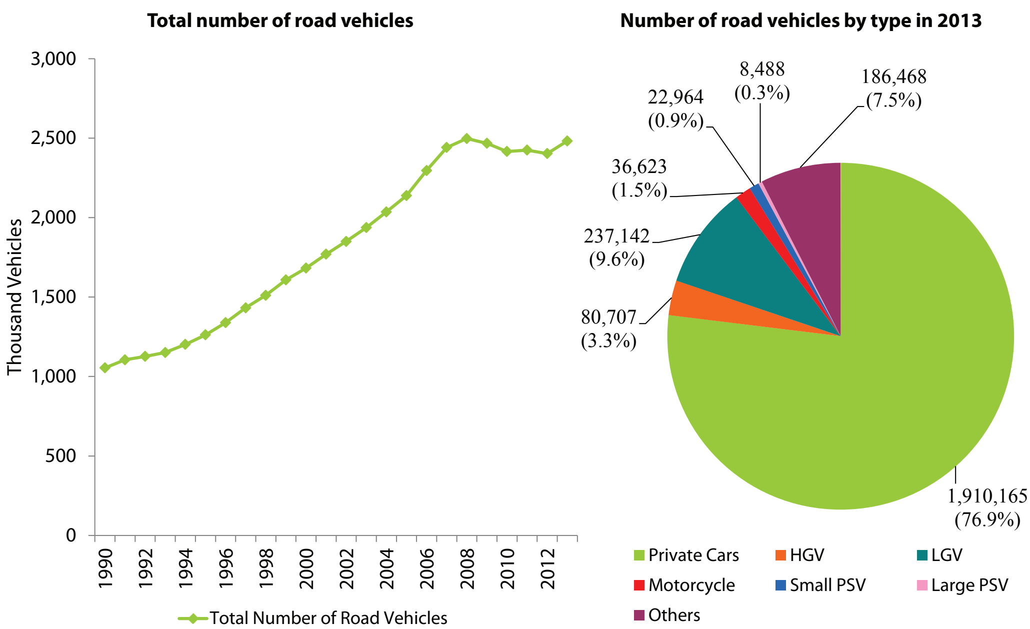


Source: SEAI

The main focus of this section is on road transport modes, due both to the relative importance of these modes in the transport energy mix and also due to the availability of data. *Figure 11* and *Table 5* profile the number of road vehicles by vehicle type in Ireland between 1990 and 2013.

Over the period 1990 to 2008 the total number of vehicles increased by 137% (4.9% per annum) to reach 2,497,568 vehicles. This declined by 3.8% to 2,403,223 in 2012 and in 2013 increased 3.3% to 2,482,557. Note that 54% of the increase in vehicle numbers in 2013 occurred in the "others" category which includes vintage vehicles, agricultural tractors, construction machinery and others. It is assumed that this is in large part due to a change in the arrangements for declaring a vehicle off the road for motor tax purposes which took place in 2013[36].

Figure 11 *Road vehicle fleet 1990 – 2013*



Source: Department. of Transport, Tourism & Sport

36 For details on the change in procedure see section on Motor Tax at www.dttas.ie/roads/english/motor-taxvehicle-registraton-nvdf

Table 5 *Growth rates and shares of road vehicle fleet, 1990 – 2013*

	Growth %	Average annual growth rates %					Quantity (no.)		Shares %	
	1990 – '13	'90 – '13	'00 – '05	'05 – '10	'10 – '13	2013	1990	2013	1990	2013
Private Cars	139.8	3.9	4.7	2.4	0.7	1.5	796,408	1,910,165	75.5	76.9
HGV	211.3	5.1	7.5	4.3	0.5	5.6	25,922	80,707	2.5	3.3
LGV	102.3	3.1	6.7	2.2	-1.4	1.9	117,244	237,142	11.1	9.6
Motorcycle	61.0	2.1	2.3	2.1	-1.3	4.3	22,744	36,623	2.2	1.5
Small PSV	361.4	6.9	9.9	4.0	-4.9	-5.0	4,977	22,964	0.5	0.9
Large PSV	109.7	3.3	1.9	1.6	1.0	2.7	4,047	8,488	0.4	0.3
Others	124.9	3.6	3.5	2.6	9.1	29.6	82,917	186,468	7.9	7.5
Total	**135.5**	**3.8**	**4.9**	**2.5**	**0.9**	**3.3**	**1,054,259**	**2,482,557**	-	-

Source: Based on Department of Transport, Tourism & Sport

The majority of vehicles in each year are private cars. Although private car transport accounted for 77% of vehicles on the road in 2013 it accounted for only 43% of total transport energy demand. In contrast heavy goods vehicles accounted for just 3% of vehicles on the road but accounted for 14% of total transport energy consumption. Total goods vehicles accounted for 13% of vehicles on the road and for 21% of total energy demand. In 2013, there were 24 times more private cars than heavy goods vehicles licensed in Ireland but private cars consumed only 3 times as much energy.

4.2 Private Car

4.2.1 Private Car Purchasing Patterns

4.2.1.1 Ownership Rates

In 2013, 78% of the 2,403,223 vehicles on Irish roads were private cars. *Table 6* and *Figure 12* show the car density during the period 1990 to 2013. Two commonly used indicators are shown. The first relates to private car ownership per 1,000 population. This reached a peak of 430 cars per 1,000 population in 2007/2008, declined to 411 in 2012 and rose to 416 in 2013. To compare with international figures in 2010 Irish ownership was 411 cars per 1000 population while the EU-27 average was 477 (14% higher) and the UK was 458 (10% higher). The second indicator is private car ownership per 1,000 adults[37]. For Ireland this reached a peak of 539 cars per 1,000 adults in 2007, compared in that year to 592 for the EU 15 average (10% higher) and 578 for the UK (7% higher). In Ireland this fell to 524 cars per 1,000 adults in 2012 before rebounding to 533 in 2013.

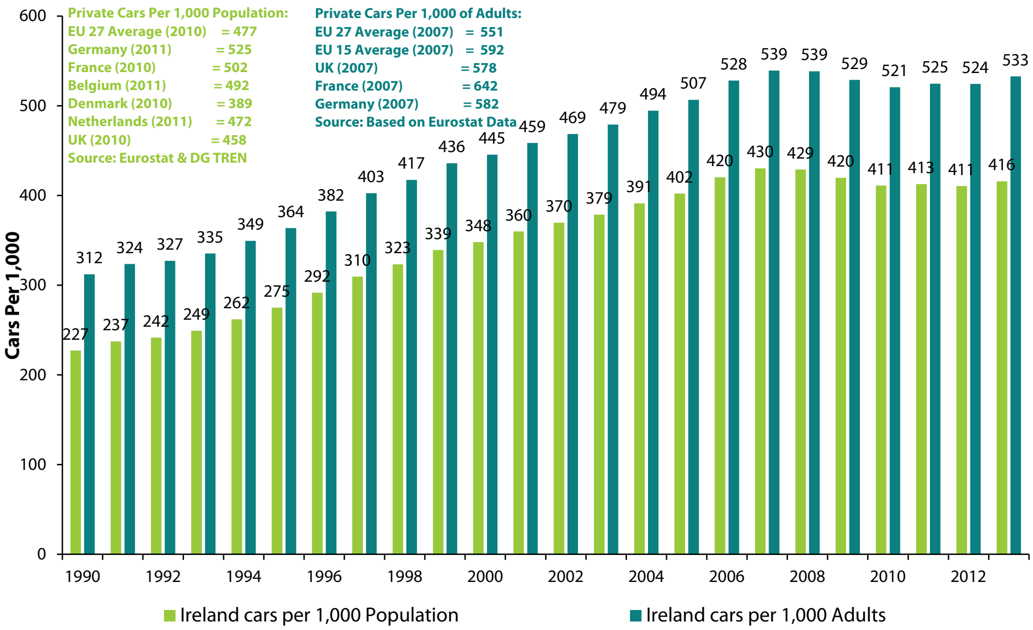
Table 6 *Growth rates of private car ownership 1990 – 2013*

	Growth %	Average annual growth rates %					Quantity (no.)	
Car ownership	1990 – '13	'90 – '13	'00 – '05	'05 – '10	'10 – '13	2013	1990	2013
Cars/1,000 (population)	83.1	2.7	2.9	0.4	0.4	0.8	227	416
Cars/1,000 (adults)	70.7	2.4	2.6	0.5	0.8	1.5	312	533

Source: Eurostat and DG Tren

37 In this case, an adult is defined in Ireland as a person over 15, the closest category match in Census data to the legal car-driving age of 17.

Figure 12 *Private car ownership rates for Ireland 1990 – 2013, with select data for other EU Member States*



Source: SEAI, CSO & Eurostat

Another metric used to examine car density is the number of cars per household or permanently occupied dwelling[38]. In 1998 the number of private cars exceeded the number of permanently occupied dwellings in Ireland for the first time. The number of private cars per permanently occupied dwelling was 1.26 in 2007, representing a 59% increase on 1990. In 2013 the ratio was estimated as 1.16 cars per permanently occupied dwelling.

The number of driving licences per 1,000 adults, an indicator of potential growth in the number of cars per 1,000 adults and population, has also increased over the period, from 447 in 1990 to a high of 744 in 2012 (66%). In 2013 the figure reduced to 737 licences per 1,000 adults.

4.2.1.2 Registrations of New Cars and of Used Imports

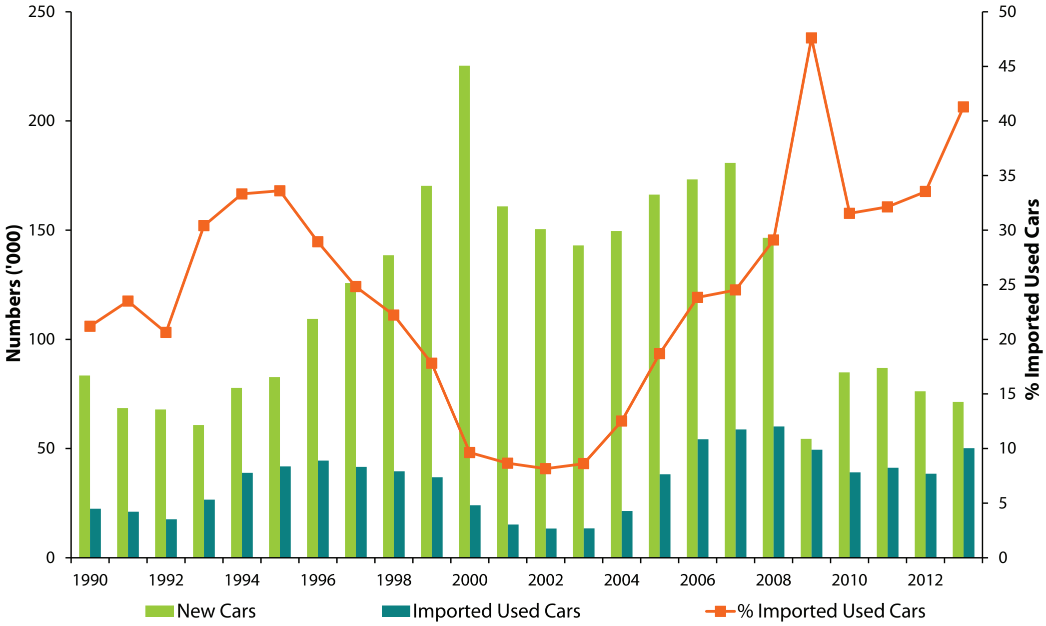
Each year the structure of the private car fleet is altered to some extent by the cars entering the fleet for the first time. These cars can be either new or second-hand imports. *Figure 13*, *Table 7* and *Table 8* show data on the numbers of new cars licensed for the first time in Ireland from 1990 to 2013.

With regard to the numbers of registrations of new vehicles, there are a number of striking features to be seen. The first is the rapid growth in the second half of the 1990s, culminating in the spike in sales in the year 2000. The average annual sales for the first five years of the decade, 1990 – 1994, were 71,676 units. Taking this as a baseline, by 1999 annual sales were 138% higher at 170,322 units and in the year 2000 this increased to 225,269 units or 214% higher than the 1990 – 1994 figure. Anecdotal evidence suggests for the year 2000 in particular there was a 'millennium year' effect, in that it was seen as desirable to buy a new car in that year and to have '00' on the registration plate.

After the 2000 spike passed sales dropped again reaching a low in 2003 of 142,992 units before returning to growth until 2007 with sales of 180,754 units. Sales dropped in 2008 to 146,470 units but the full effect of the recession was not seen until 2009 when sales collapsed down to 54,432 units, a fall of 70% on the 2007 figure and a 63% drop in 2009 alone. Sales recovered slightly in 2010 and 2011, partly due to government support in the form of a scrappage scheme which operated in those years, with sales of 86,932 units in 2011. Sales dropped again between 2011 and 2013 reaching 71,348 units in 2013. Data for the first six months of 2014 suggest a return to growth, with 62,280 registrations up to the end of June, compared to 49,503 for the same period in 2013, an increase of 26%.

38 A proxy for the number of households, which is not available.

Figure 13 *New cars & used imports 1990 – 2013*



Source: Based on Department of Transport, Tourism & Sport data

Table 7 *Annual numbers of new cars and used imported cars licensed for the first time for selected years*

	Quantities (numbers)						
	1990	2000	2005	2007	2009	2010	2013
New	83,420	225,269	166,270	180,754	54,432,	84,907	71,348
Used Imported	22,429	24,003	38,207	58,719	49,464	39,103	50,168
Total	105,849	249,272	204,477	239,473	103,896	124,010	121,516
% Imported	21.2	9.6	18.7	24.5	47.6	31.5	41.3

Source: Based on Department of Transport, Tourism & Sport data

Table 8 *Growth rates for new cars and licensed for the first time*

	Growth %	Average annual growth rates %					
	'90 – '13	'90 – '13	'90-'00	'00– '05	'05 – '10	'10– '13	2013
New	-14.47	-0.68	10.44	-5.89	-12.58	-5.63	-6.44
Used Imported	123.7	3.56	0.68	9.74	0.46	8.66	30.41

Source: Based on Department of Transport, Tourism & Sport data

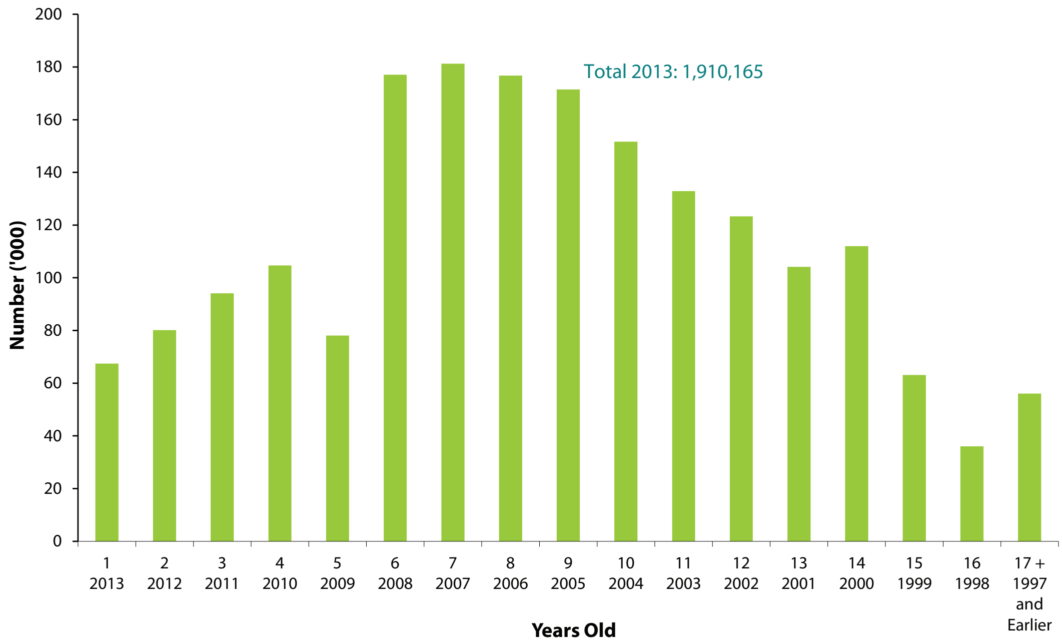
The purchasing pattern of second-hand imports differs considerably from that of new vehicles bought within the state. The significance of second-hand imports has varied over time. *Figure 13* shows the numbers of new and second-hand (used) imports between 1990 and 2013.

The number of used imports reached a low in 2002 of 13,352 cars or 8.1% of all new registrations. This rose after 2004 reaching a high of 60,091 vehicles in 2008, accounting for 29% of new registrations. The following year, 2009, the number of used imports almost reached parity with the number of new vehicles accounting for 48% of new registrations, though this was largely due to the much reduced numbers of new cars registered in that year. 2013 saw further growth in the share of used imports, increasing in numbers by 30% from 38,469 in 2012 to 50,168 in 2013, when used imports accounted for 41% of all new registrations.

4.2.1.3 Age Profile of the Private Car Fleet

Each year the Department of Transport, Tourism & Sport publishes the stock of private cars and goods vehicles by the year they were first licensed. The age of private cars in 2013 is presented in *Figure 14*. The lower number of cars that were purchased since the economic downturn is evident in the numbers of one to five year old cars. At the end of 2007, 42% of private cars were less than five years old, while 83% were less than 10 years old. At the end of 2013 the figures were 18% and 59% respectively. At the end of 2013, the average age of a private car in Ireland was 8.6 years.

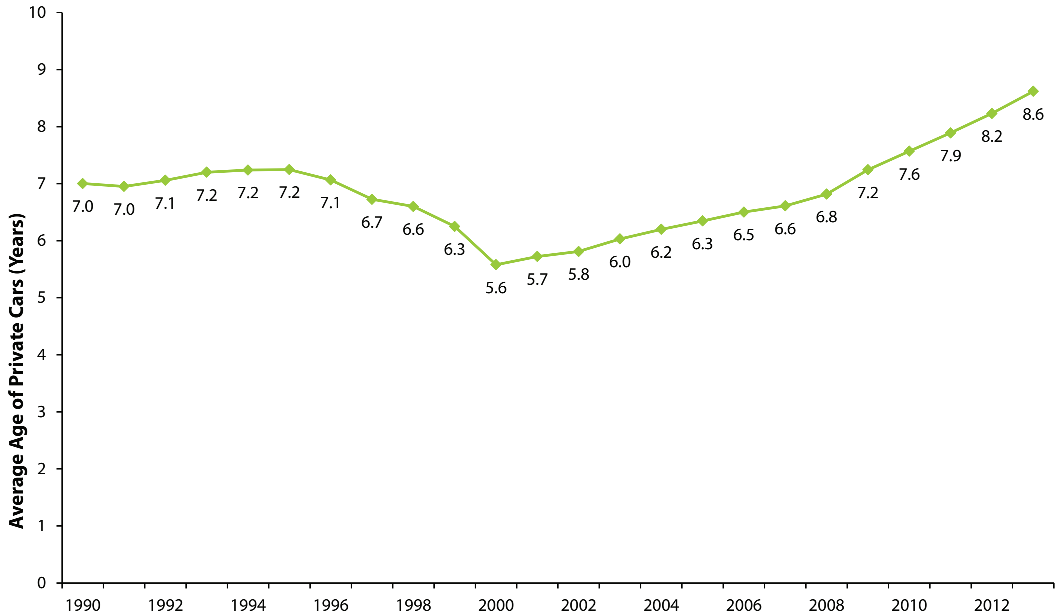
Figure 14 *Age profile of private cars 2013*



Source: Based on Department of Transport, Tourism & Sport data

Using these data it is also possible to calculate the average age of the private car stock in each year. The trend in the average age of private cars over the period 1990 to 2013 is shown in *Figure 15*. It can be seen that the average age declined and reached a low of 5.6 years in 2000 and has since risen to 8.6 years in 2013. This ageing of the fleet is to be expected due to the low turnover in the car stock since 2008, with fewer new cars being bought and consequently older cars being kept on the road for longer.

Figure 15 *Average age of private cars 1990 – 2013*



Source: Based on Department of Transport, Tourism & Sport data

4.2.1.4 Emissions Bands

A new system of assessing private cars for Vehicle Registration Tax (VRT) and Annual Motor Tax (AMT) came into effect from July 2008 for vehicles purchased in 2008 or later. The system moved away from assessing vehicles based on engine size to one that is based solely on the CO_2 emissions per kilometre. Seven tax bands were originally used for the assessment with the bands corresponding to the EU labelling system. The number of bands was increased in January 2013 to twelve. The new bands are shown in *Table 9*.

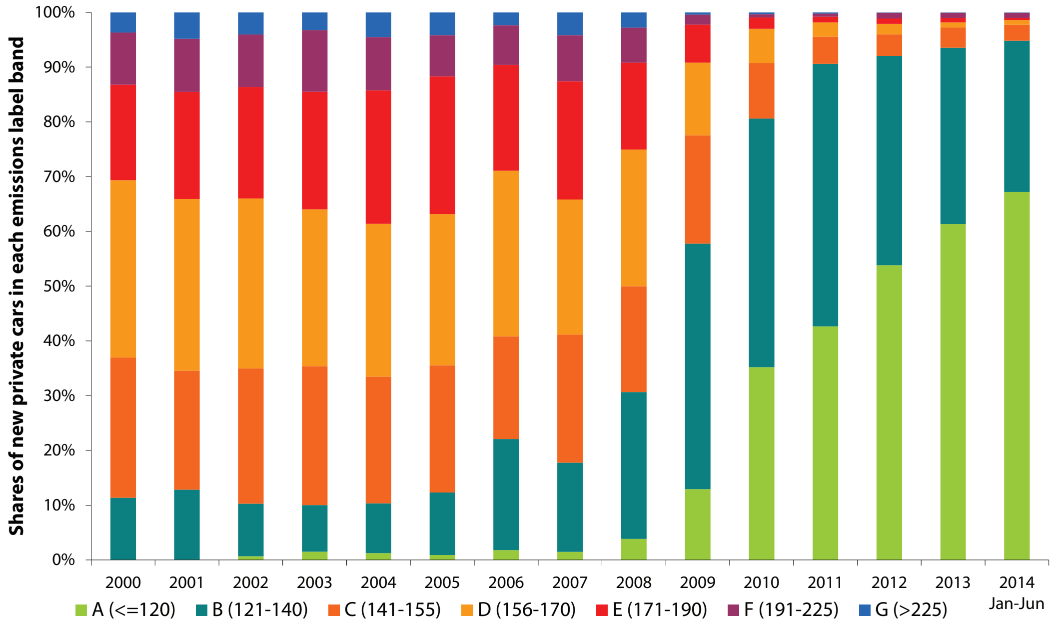
Table 9 *CO_2-based vehicle registration and road tax bands*

Band	CO_2 emissions (CO_2 g/km)	VRT(% OMSP)	Annual Motor Tax (€)
Band A0	zero to 1	14%	120
Band A1	greater than 1 and less than or equal to 80	14%	170
Band A2	greater than 80 and less than or equal to 100	15%	180
Band A3	greater than 100 and less than or equal to 110	16%	190
Band A4	greater than 110 and less than or equal to 120	17%	200
Band B1	greater than 120 and less than or equal to 130	18%	270
Band B2	greater than 130 and less than or equal to 140	19%	280
Band C	greater than 140 and less than or equal to 155	23%	390
Band D	greater than 155 and less than or equal to 170	27%	570
Band E	greater than 170 and less than or equal to 190	30%	750
Band F	greater than 190 and less than or equal to 225	34%	1,200
Band G	greater than 225	36%	2,350

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.

Figure 16 and *Table 10* show the shares of new car sales[39] between 2000 and June 2014 classified by emissions label band.

Figure 16 *Shares of new cars by emissions label class 2000 – 2014*



Source: Based on Department of Transport Vehicle Registration Unit data

39 Licensed as private cars.

Table 10 *Shares of new private cars in each emissions band 2000 – 2013*

CO_2 band	2000	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014 Jan-Jun
A	0.0%	0.9%	1.8%	1.5%	3.8%	12.7%	35.1%	42.5%	53.8%	61.3%	67.2%
B	11.3%	11.4%	20.3%	16.3%	26.8%	44.1%	45.2%	47.8%	38.2%	32.2%	27.6%
C	25.6%	23.2%	18.8%	23.4%	19.3%	19.5%	10.1%	5.0%	4.0%	3.7%	2.9%
D	32.4%	27.6%	30.2%	24.7%	25.0%	13.1%	6.2%	2.6%	1.9%	0.9%	0.9%
E	17.5%	25.1%	19.3%	21.6%	15.9%	6.8%	2.0%	1.0%	1.0%	0.8%	0.4%
F	9.5%	7.5%	7.2%	8.4%	6.4%	1.8%	0.6%	0.6%	1.0%	1.0%	1.0%
G	3.7%	4.2%	2.3%	4.2%	2.8%	0.4%	0.3%	0.2%	0.1%	0.1%	0.1%

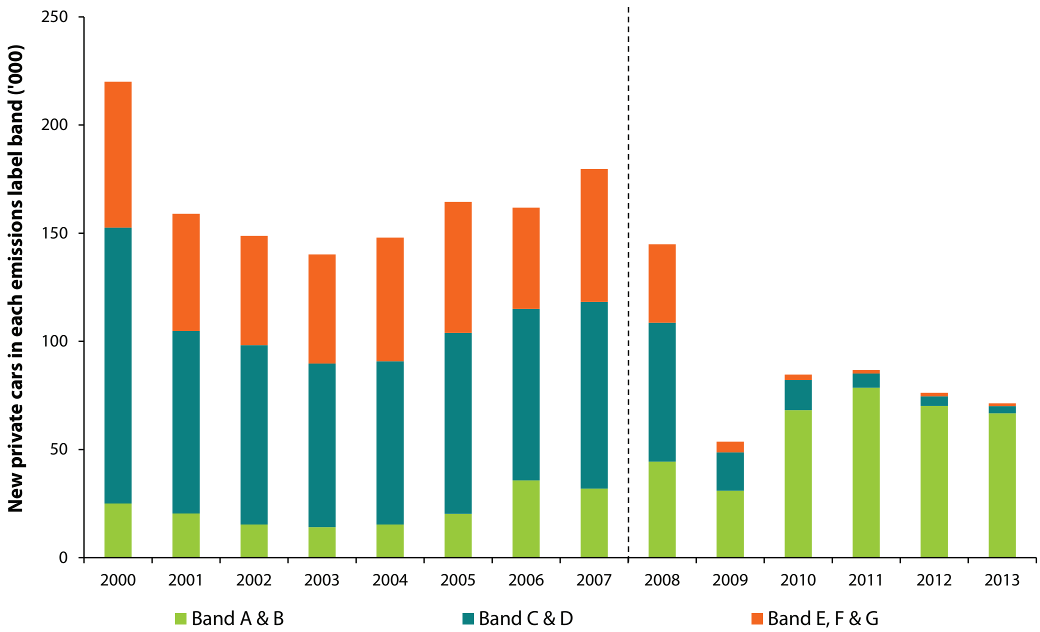
Source: Based on Department of Transport Vehicle Registration Unit data

Between 2000 and 2005 the share of label bands A & B was on average 11%. For the first half of 2008, before the new taxes came into effect, the share of these two bands was 25%. Upon introduction the taxes had an immediate effect: for the second half of 2008 the share of the A & B bands rose to 50%. Conversely, the combined share of bands E, F & G fell from 28% in early 2008 to 13% after the change. This was a significant shift in purchasing patterns towards lower-emissions vehicles in such a short time period, though it was tempered by the fact that the motor industry experienced a severe downturn during 2008/2009 and that most car purchases in 2008 (78%) took place in the first six months, before the introduction of the new taxation system. *Figure 17* shows the sales of new private cars by emissions band in absolute terms, which highlights the effect of the post 2008 downturn in sales.

Despite the reduction in the number of vehicles sold, the combined effect of the EU legislation obligating manufacturers to reduce average fleet emissions and the changes to the Irish taxation system for private cars was to continue to steadily drive down the average new car fleet emissions year on year since 2008. In 2010 a further incentive towards the purchase of A & B band vehicles came in the form of a government scrappage scheme which applied if a car ten years or older was being scrapped and the new car being purchased was in emissions band A or B. This scheme ran until June 2011 but with reduced relief from January 2011.

In 2013 the share of A & B cars was 94% and for the first 6 months of 2014 it was 95%. The largest increase in share was in the A label band which rose from just 1.5% in 2007 to 60% of the new private cars sold in 2013. Data for the first half of 2014 show that this trend has continued with A vehicles making up 67% of all new registrations up to the end of June. The share of high emitting cars in label bands E, F and G only amounted to 1.8% of new cars sold during 2013 and to 1.4% of new cars for the first 6 months of 2014, in the latter case just 659 cars out of a total of 62,280.

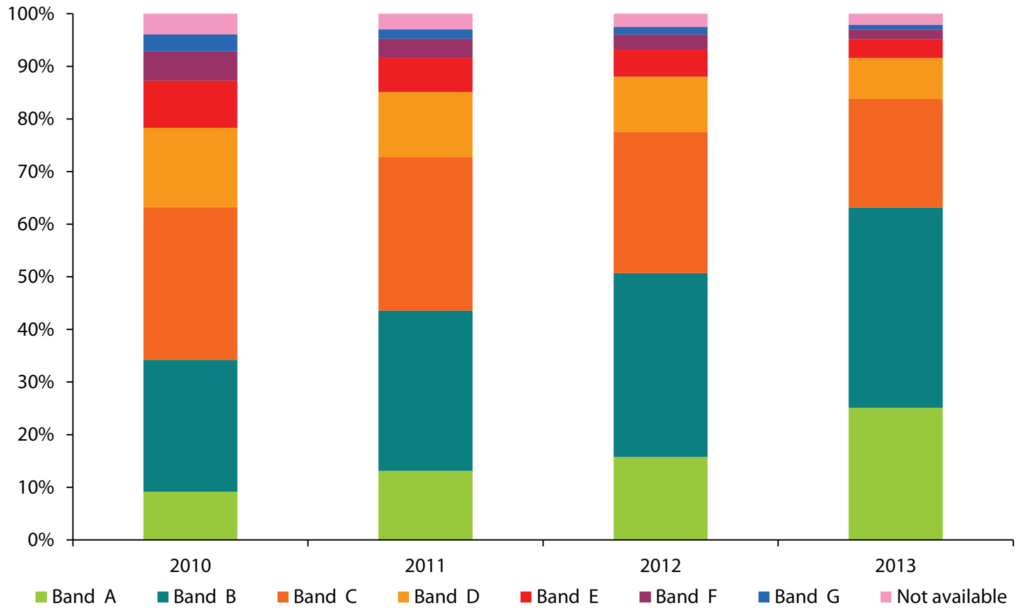
Figure 17 *Annual numbers of new private cars by emissions band 2000 – 2013*



Source: Based on Department of Transport Vehicle Registration Unit data

Data on imported used cars by emissions band are available since 2008, but for 2008 and 2009 the large proportion of cars marked as unclassified makes the data less useful. From 2010 onwards a large majority of cars are classified by emissions label and these data are presented here. The proportion of imported used cars in the A & B emissions bands increased from 34% in 2010 to 63% in 2013.

Figure 18 *Share of imported used cars in each emissions band 2010 – 2013*

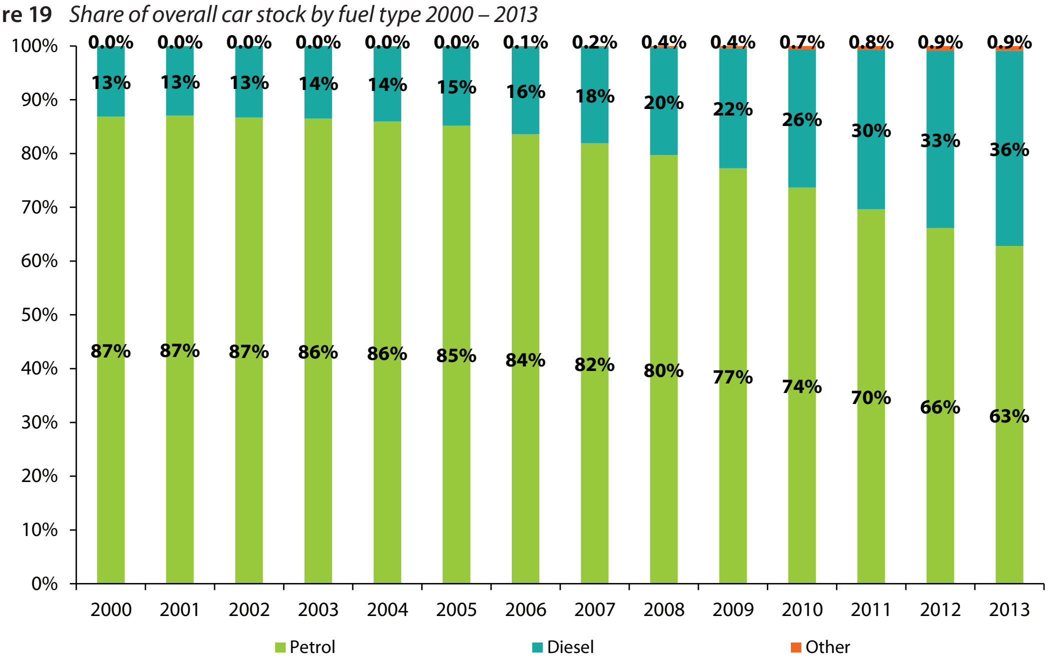


Source: Based on Department of Transport Vehicle Registration Unit data

4.2.1.5 Fuel Type

The private car fleet is dominated by two fuels, petrol and diesel. Between them they accounted for 99.99% of the total car stock in the mid 2000s and remain at 99.1% in 2013. Within these two fuel types there has been a shift in the make up of the overall car fleet from petrol to diesel cars. As shown in *Figure 19* and *Table 11* the overall shares of petrol cars in the private car fleet have fallen from 87% in 2000 to 82% in 2007 and more rapidly thereafter to 63% in 2013. Correspondingly, diesel cars have increased their share of the overall private car fleet from 13% in 2000 to 36% in 2013.

Figure 19 *Share of overall car stock by fuel type 2000 – 2013*



Source : Based on Department of Transport Vehicle Registration Unit data

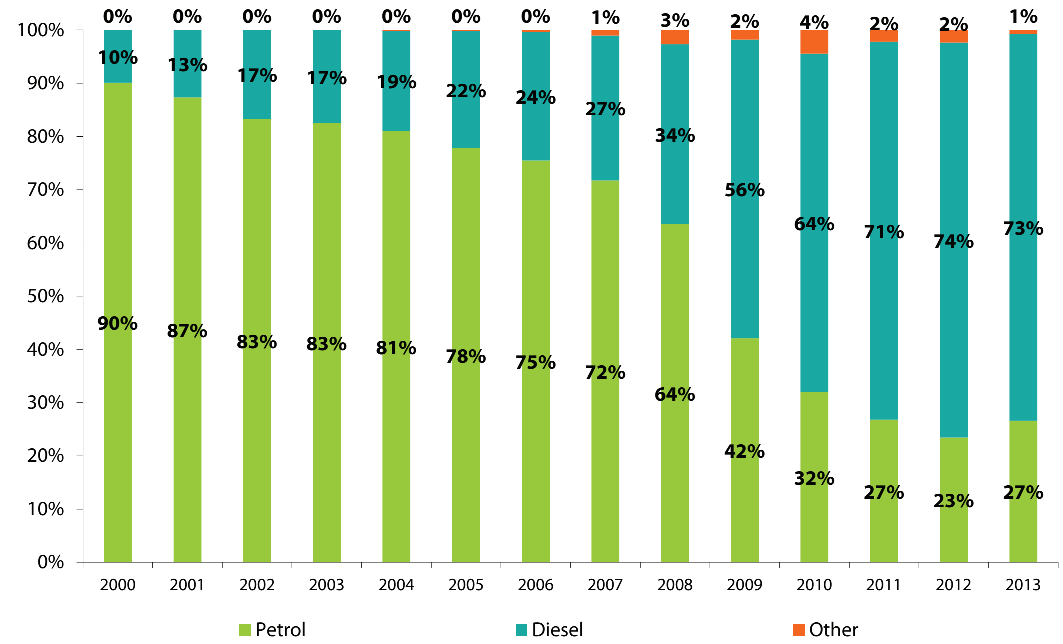
Table 11 *Profile of total car stock by fuel type 2000 – 2013*

Fuel Type	Number of Vehicles (1,000)									
	2000	2005	2006	2007	2008	2009	2010	2011	2012	2013
Petrol	1,146	1,415	1,487	1,542	1,534	1,470	1,380	1,314	1,245	1,199
Diesel	173	246	291	338	383	424	480	559	621	694
Other	0	1	1	3	7	8	12	14	16	17

Source: Based on Department of Transport Vehicle Registration Unit data

The shift towards diesel is more pronounced when considering the numbers of new cars licensed each year. *Figure 20* shows the profile of the change in share of new petrol and diesel private cars entering the fleet over the period 2000 to 2013. The share of new cars that are fuelled by diesel increased from 10% in 2000 to 27% in 2007 and then to 73% in 2013. There has also been a corresponding fall in the share of new petrol cars from 90% share in 2000 to 27% share in 2013. The share of petrol cars had been decreasing since 2000 but the most significant change can be seen to have happened either side of the switch to emissions-based registration and road tax in 2008, whereby the petrol/diesel split went from 72%/27% in 2007 to 42%/56% in 2009. Other fuels consist mainly of petrol-electric and petrol-ethanol.

Figure 20 *Shares of new petrol and diesel cars 2000 – 2013*



Source: Based on Department of Transport Vehicle Registration Unit data

Table 12 *Profile of new cars by fuel type 2000 – 2013*

Fuel Type	Number of new vehicles licensed									
	2000	2005	2006	2007	2008	2009	2010	2011	2012	2013
Petrol	198,284	127,988	122,142	128,950	92,032	22,783	27,112	23,209	17,796	19,030
Diesel	21,734	36,146	39,034	48,918	48,933	30,381	53,724	61,502	56,352	51,880
Other	-	309	615	1,029	1,171	280	712	539	593	559

Source: Based on Department of Transport Vehicle Registration Unit data

Data on used imported cars by fuel type are only available from 2010 onwards, but a trend towards an increasing share of diesel is still evident. Note also that diesel makes up a larger share of used imports than for new cars in every year.

Table 13 *Profile of used imported cars by fuel type 2010 – 2013*

	Numbers				% Share			
Fuel Type	**2010**	**2011**	**2012**	**2013**	**2010**	**2011**	**2012**	**2013**
Petrol	10,741	7,713	6,086	7,485	28.0%	18.9%	16.0%	14.9%
Diesel	27,686	33,017	32,015	42,683	72.0%	81.1%	84.0%	85.1%

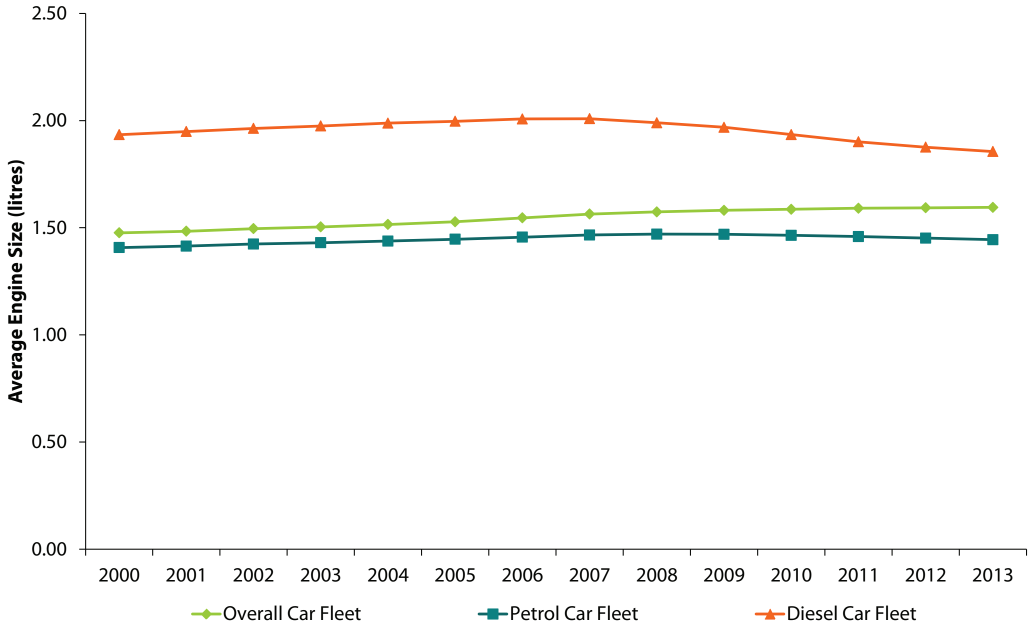
Source: Based on Department of Transport Vehicle Registration Unit data

The trend in purchasing patterns of both new and used imported cars towards diesel vehicles in recent years has had an effect on the make up of the overall car stock by fuel type, as shown in *Figure 19* and *Table 11*.

4.2.1.6 Engine Size

Estimates of the average engine size for the petrol car stock, the diesel car stock and the combined petrol and diesel stock of private cars for the period 2000 to 2013 are shown in *Figure 21*. Using Department of Transport, Tourism & Sport data on numbers of vehicles in each 100cc engine size band ranging from 900cc to over 5,000cc, the estimates assume that the median value for each engine size range is 10cc below the maximum limit of the band. While this may not be the case for all engine size bands, it does allow for a comparison to be made. Therefore the trend is more important that any actual yearly value.

Figure 21 *Estimated average engine size for petrol cars, diesel cars and the overall fleet 2000 – 2013*



Source: Based on Department of Transport, Tourism & Sport Vehicle Registration Unit data

Table 14 *Change in car engine size – petrol, diesel and overall*

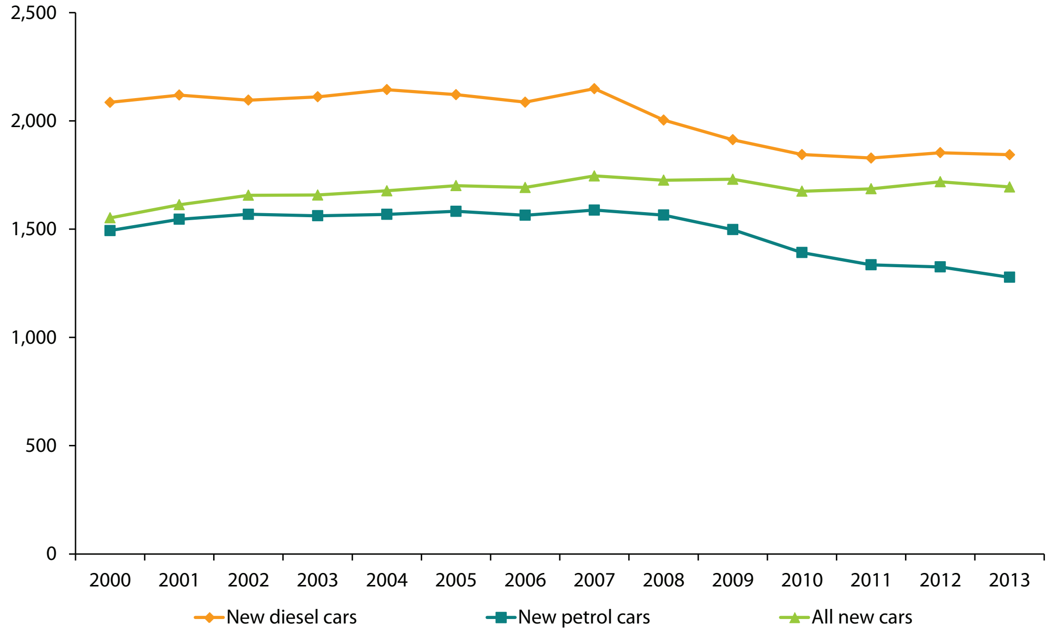
	Average engine size of car fleet			Growth %		Average annual growth %	
Fuel Type	**2000**	**2007**	**2013**	**2000 – '07**	**2007 – '13**	**2000 – '07**	**2007 – '13**
Petrol	1.41	1.47	1.44	4.19	-1.50	0.59	-0.25
Diesel	1.93	2.01	1.86	3.86	-7.62	0.54	-1.31
Overall	1.48	1.56	1.59	5.92	2.00	0.83	0.33

Source: Based on Department of Transport, Tourism & Sport Vehicle Registration Unit data

Firstly it can be seen that the average engine size of diesel cars is greater than that of petrol, and that the overall average engine size has historically been closely weighted towards that of petrol cars, but has recently shifted more towards diesel. The average engine size for all three categories increased between 2000 and 2007. With the introduction of the changes to VRT in 2008 the average engine size of both the petrol and diesel car stocks have decreased, falling by 1.5% and 7.6% respectively between 2007 and 2013. Despite this the overall average has increased by 2.0% in that time period. This is due to the switching from petrol to diesel cars discussed in section *4.2.1.5*.

Shown in *Figure 22* and *Table 15* is the annual average engine size of new cars registered each year, broken down by fuel type. It can be seen that for new car sales, the trend in overall average engine size has remained relatively flat, despite the average engine size of both new petrol and new diesel cars falling, due to an overall switching from petrol to diesel.

Figure 22 *Estimated average engine size for new petrol cars, new diesel cars and all new cars 2000 – 2013*



Source: Based on Department of Transport, Tourism & Sport Vehicle Registration Unit data

Table 15 *Change in car engine size – petrol, diesel and overall*

	Average engine size of new cars			Growth %		Average annual growth %	
Fuel Type	**2000**	**2007**	**2013**	**2000 – '07**	**2007 – '13**	**2000 – '07**	**2007 – '13**
Petrol	1,494	1,588	1,278	3.0	-14.2	0.4	-2.5
Diesel	2,086	2,149	1,844	6.3	-19.5	0.9	-3.6
Overall	1,552	1,726	1,695	12.5	-2.9	1.7	-0.5

Source: Based on Department of Transport, Tourism & Sport Vehicle Registration Unit data

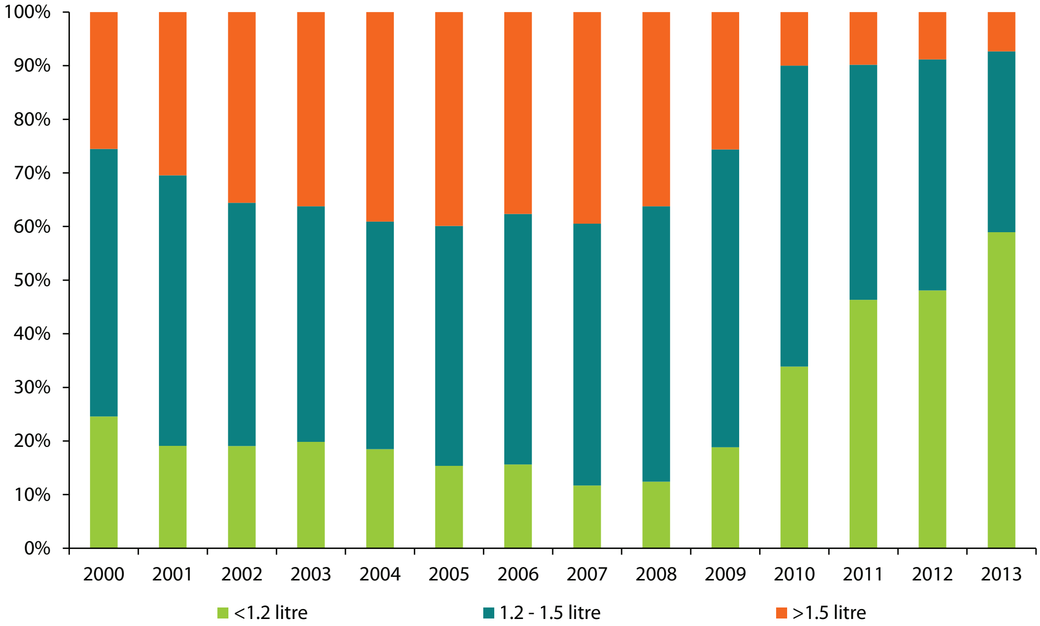
Shown in *Figure 23* and *Table 16* is the annual profile of engine size of new petrol cars registered. Three engine size bands are chosen to highlight the trends for petrol cars: less than 1.2 litres, from 1.2 to 1.5 litres and lastly greater than 1.5 litres. The shift to smaller engine sizes post the introduction of the 2008 changes to VRT can be seen from the fact that in 2007 cars with engine size of less than 1.2 litres made up just 12% of new petrol car registrations; by 2013 this had risen to 59%.

Table 16 *Change in petrol car engine size – growth rates & shares (numbers on the road)*

	% of petrol cars registered in			Number of petrol cars registered in		
Engine size band	**2000**	**2007**	**2013**	**2000**	**2007**	**2013**
<1.2 litre	25%	12%	59%	48,700	15,090	11,218
1.2 – 1.5 litre	52%	49%	34%	98,998	62,953	6,416
>1.5 litre	24%	39%	7%	47,215	50,904	1,396

Source: Based on Department of Transport, Tourism & Sport Vehicle Registration Unit data

Figure 23 *Share of annual new licensed petrol cars by engine size band*

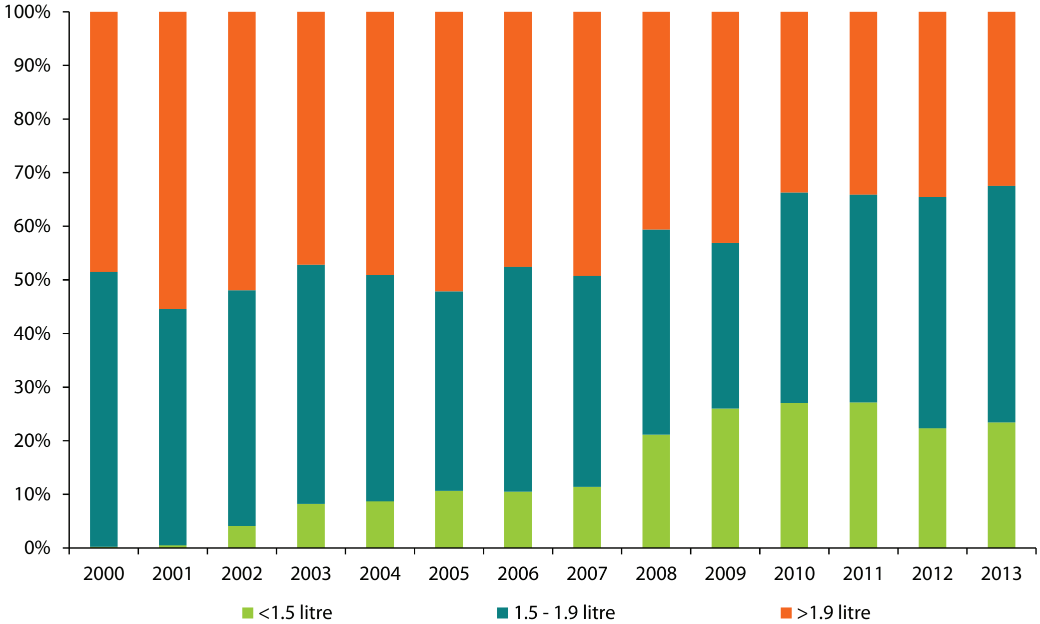


Source: Based on Department of Transport, Tourism & Sport Vehicle Registration Unit data

Shown in *Figure 24* and *Table 17* is the annual profile of engine size for new diesel cars registered. Note that the three engine size bands chosen here are not the same as those shown in *Figure 23* and *Table 16*. Due to the larger average engine sizes of diesel cars the bands chosen here are less than 1.5 litres, from 1.5 to 1.9 litres and finally greater than 1.9 litres. The most striking trend here is the increase in share of the less than 1.5 litre engine size band, from 0.2% (just 48 vehicles) in the year 2000 to 11% in 2007 and a more rapid increase thereafter to account for 23% of all diesel cars registered in 2013.

Overall, since 2008 there has been a shift in the profile of new cars away from larger engine petrol cars (>1.5 litre) and into smaller engine diesel cars (<1.5 litre).

Figure 24 *Share of annual new licensed diesel cars by engine size band*



Source: Based on Department of Transport, Tourism & Sport Vehicle Registration Unit data

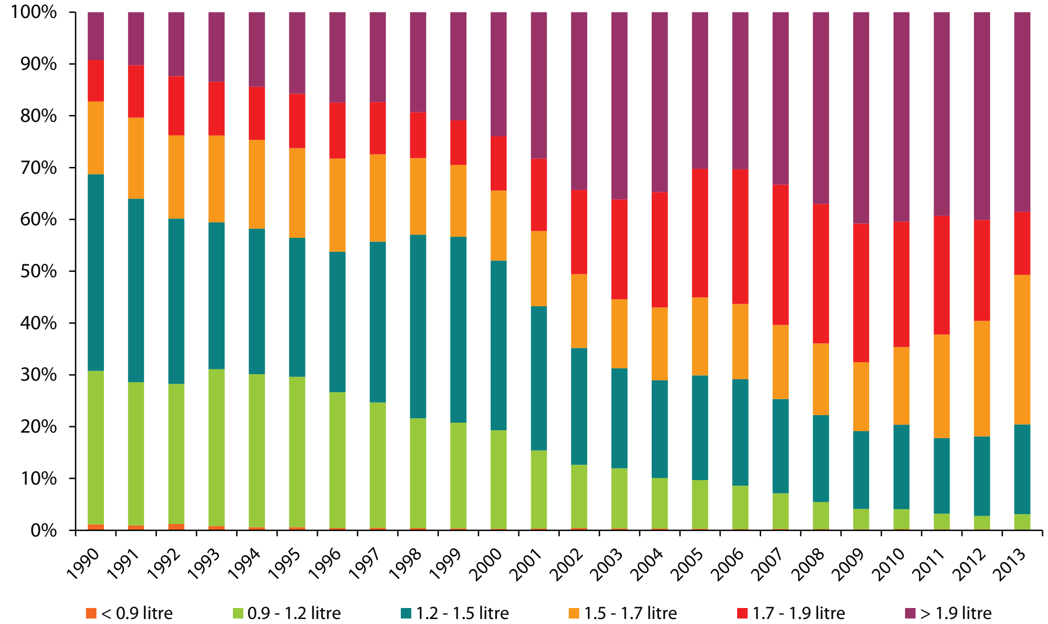
Table 17 *Change in diesel car engine size – growth rates & shares (numbers on the road)*

	% of diesel cars registered in			Number of diesel cars registered in		
Engine size band	**2000**	**2007**	**2013**	**2000**	**2007**	**2013**
<1.7 litre	0%	11%	23%	48	5,588	12,137
1.7 – 1.9 litre	51%	39%	44%	11,148	19,244	22,907
>1.9 litre	48%	49%	32%	10,538	24,086	16,836

Source: Based on Department of Transport, Tourism & Sport Vehicle Registration Unit data

For used imported cars, data are available for the average engine size of all imports, regardless of fuel type. Data on engine size split by fuel type are available only from 2010 onwards. *Figure 25* shows the percentage share of used imports (aggregate petrol and diesel), by engine size band between 1990 and 2013. *Figure 26* also shows these data split by fuel types for 2010 to 2013. *Table 18* provides more detailed data on absolute numbers and growth rates.

Figure 25 *Percentage share of used imports by engine size band 1990 – 2013*



Source: Department of Transport, Tourism & Sport

Table 18 *Growth rates & shares of used imports 1990 – 2013*

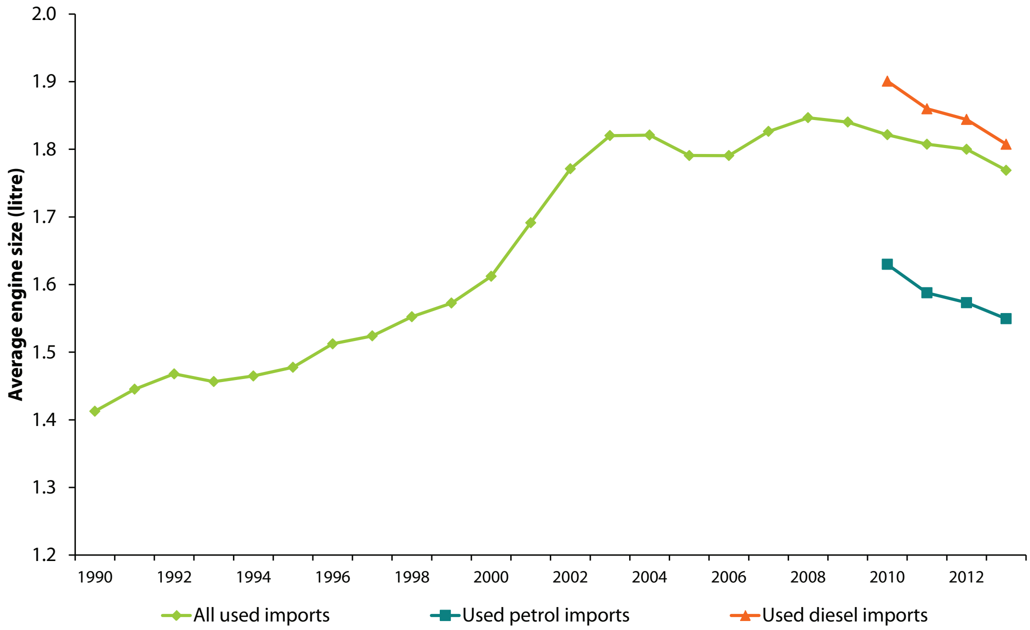
	Growth %	Average annual growth rates %					Quantities (numbers)		Shares %	
CC bands	**1990 – 2013**	**'90 – '00**	**'00 – '05**	**'05 – '10**	**'10 – '13**	**2013**	**1990**	**2013**	**1990**	**2013**
<900cc	-63.3	-4.3	-11.5	11.5	-1.6	-5.9	218	80	1.1	0.2
900 - 1.2 litre	-74.3	-5.7	-3.5	-3.5	-0.4	20.8	5,775	1,485	29.7	3.0
1.2 - 1.5 litre	17.6	0.7	0.9	0.9	11.1	45.7	7,394	8,698	38.0	17.3
1.5 - 1.7 litre	430.0	7.5	13.6	13.6	35.4	77.1	2,732	14,480	14.0	28.9
1.7 - 1.9 litre	290.3	6.1	32.1	32.1	-13.5	-35.1	1,561	6,093	8.0	12.1
>1.9 litre	975.8	10.9	16.4	16.4	7.1	20.2	1,797	19,332	9.2	38.5
Total	157.6	4.2	11.2	11.2	8.8	22.6	19,477	50,168	-	-

Source: Department of Transport, Tourism & Sport

It can be seen that there was a shift from smaller to larger engines sizes over the period, with the largest percentage growth in the greater than 1.9 litre band and the greatest percentage decline in the 0.9 to 1.2 litre band. However this overall trend has changed in more recent years, with strong percentage growth occurring in the mid range bands of 1.2 to 1.5 litre and 1.5 to 1.7 litre and with significant decline in the 1.7 to 1.9 litre band.

A number of factors are likely to be at play. *Figure 26* shows the average engine size for all used imported cars from 1990 to 2013, as well as the data split by petrol and diesel for 2010 to 2013.

Figure 26 *Average engine size of used imported cars 1990 – 2013*



Source: Department of Transport data

Again it can be seen that there has been a trend towards larger engine size throughout the 1990s and with particularly strong growth from 2000 to 2003. It is likely that following the rise in prosperity from the mid 1990s onwards the demand for larger, more prestigious models of car increased significantly, and consumers sought used imports of such models so as to mitigate to some extent the typically high costs associated with them. Since 2007, with the economic downturn and the changes to VRT, the average engine size has started to reduce in line with the trend seen for new cars as shown in *Figure 22*.

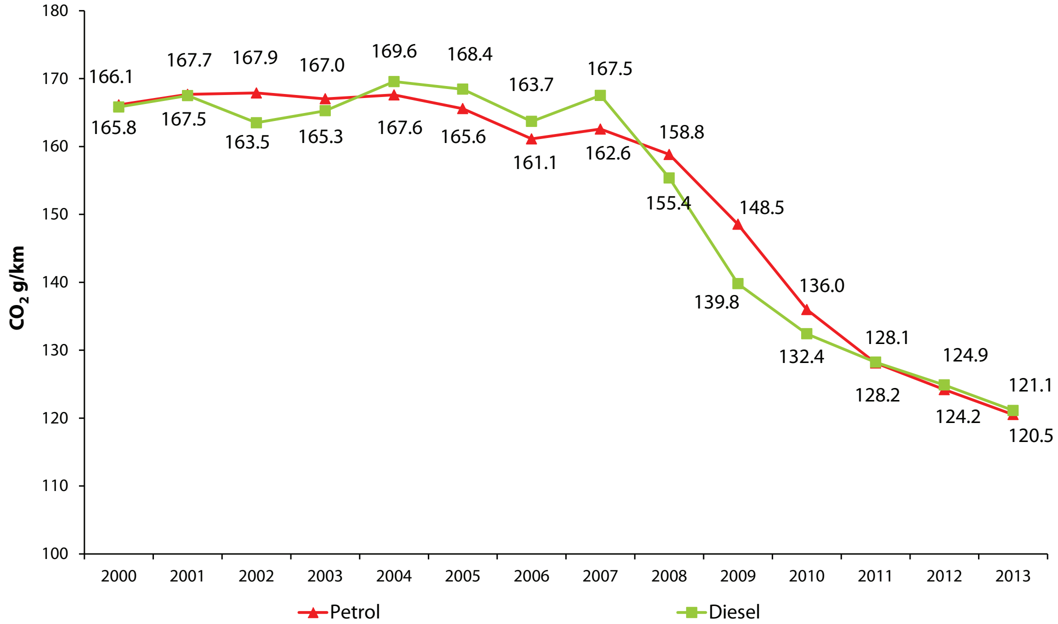
It is also possible that there was a steady shift from petrol to diesel imports over the time period, which would have had the effect of increasing the average engine size as was the case in *Figure 21*. *Table 13* shows that there has at least been some shift towards diesel in more recent years. It can also be seen from the short time period for which disaggregated petrol and diesel data are available, 2010 to 2013, that the overall aggregate engine size decreased by less than either the petrol or diesel figures due to a switching to diesel.

4.2.2 Private Car Carbon Emissions and Energy Efficiency

4.2.2.1 Specific CO_2 Emissions of New Cars

The aim of the changes introduced to the vehicle registration and annual motor taxes in 2008 was to change the basis of tax assessment away from engine size to CO_2 emissions and in turn to drive down the specific CO_2 emissions of new cars in Ireland, while also improving fuel efficiency. All new cars have associated fuel consumption and CO_2 emissions figures measured under test conditions. *Figure 27* shows the weighted average specific CO_2 emissions from new petrol and diesel cars purchased in Ireland between 2000 and 2013.

Figure 27 *Specific CO_2 emissions of new cars 2000 – 2013*



Source: SEAI

Table 19 presents data on the specific CO_2 emissions by engine size band for the year 2000 and from 2005 to 2013. It is important to note that similar sized petrol and diesel engines have different performances and are not directly comparable.

Between 2000 and 2007 the average CO_2 emissions for all cars was approximately 166 CO_2 g/km which is within band D. Following the change to CO_2 taxation in July 2008 the weighted average emissions went from 161 gCO_2/km for the first six months of 2008 to 147 gCO_2/km for the second half of the year (8.7% reduction).

Through the combined effects of the taxation change and the obligation on manufacturers to reduce overall fleet emissions the average emissions of the new car fleet in Ireland continued to drop reaching 121 CO_2 g/km in 2013 which is within band B1. This was 27% below the level in 2007. It is estimated that the average emissions of new cars purchased in 2014 is 119 CO_2 g/km.

In 2013, 22.2% of the stock of private cars had been purchased in 2009 or later. This means that a significant portion of the stock of cars on the road is more efficient than the older cohort.

Table 19 *Specific CO_2 emissions (petrol and diesel by engine size band) 2000, 2005 – 2013*

Fuel	Engine size band	Average of CO_2 g/km									
		2000	2005	2006	2007	2008	2009	2010	2011	2012	2013
Petrol	< 0.9 litre	157	126	131	129	121	-	-	98	95	111
Petrol	0.9 - 1.2 litre	143	137	133	134	133	130	125	123	119	116
Petrol	1.2 - 1.5 litre	163	158	155	154	153	146	137	129	126	124
Petrol	1.5 - 1.7 litre	176	174	173	172	169	166	161	143	140	140
Petrol	1.7 - 1.9 litre	198	186	181	187	180	176	169	161	148	145
Petrol	1.9 – 2.1 litre	219	202	195	193	183	180	170	167	160	158
Petrol	> 2.1 litre	262	248	236	243	247	234	238	235	214	228
Petrol	Overall	166	166	161	163	159	149	136	128	124	121

Fuel	Engine size band	Average of CO_2 g/km									
		2000	2005	2006	2007	2008	2009	2010	2011	2012	2013
Diesel	< 1.2 litre							103	102	103	104
Diesel	1.2 - 1.5 litre	120	130	129	131	131	129	125	122	119	115
Diesel	1.5 - 1.7 litre	131	137	136	133	130	129	122	120	119	115
Diesel	1.7 - 1.9 litre	153	155	154	150	148	141	144	142	135	131
Diesel	1.9 – 2.1 litre	165	170	168	167	158	144	143	139	130	127
Diesel	> 2.1 litre	231	217	210	219	214	178	166	160	155	153
Diesel	Overall	166	168	164	168	155	140	132	128	125	121

Fuel	Engine size band	Average of CO_2 g/km									
		2000	2005	2006	2007	2008	2009	2010	2011	2012	2013
Petrol-Electric	1.2 - 1.5 litre	-	104	104	105	106	109	109	99	96	99
Petrol-Electric	1.7 - 1.9 litre	-	-	167	-	-	92	92	93	93	93
Petrol-Electric	1.9 – 2.1 litre	-	-	251	217	-	-	-	-	-	-
Petrol-Electric	> 2.1 litre	-	192	191	192	194	140	140	141	140	141
Petrol-Electric	Overall	-	116	148	143	135	122	109	105	99	100

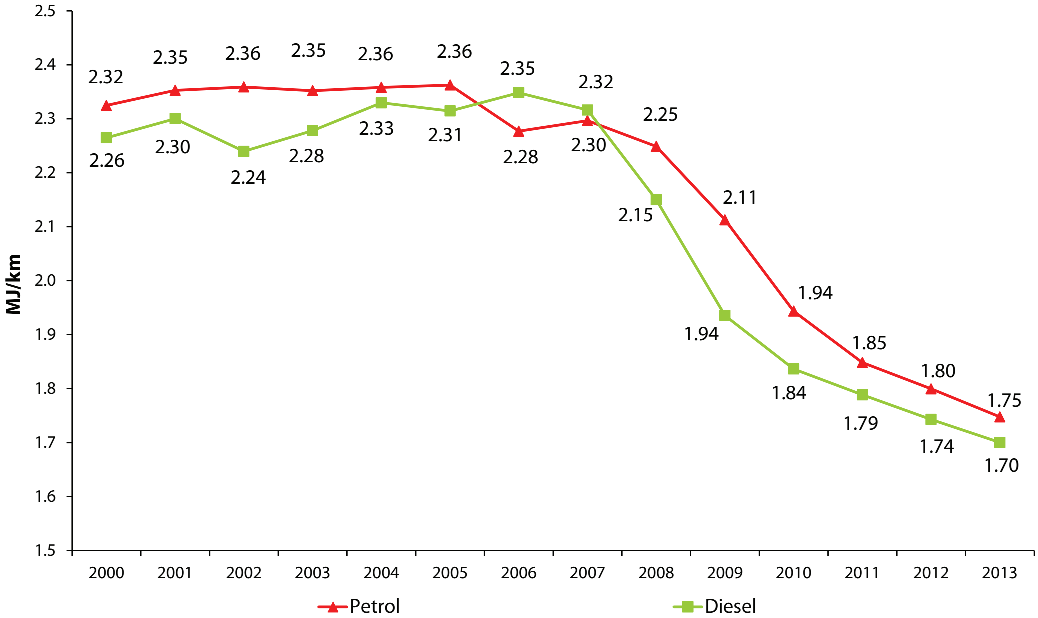
Source: SEAI

4.2.2.2 Specific Energy Consumption of New Cars

The specific energy consumption of a vehicle is a measure of the amount of energy used per kilometre travelled. The amount of energy used is measured in Mega Joules (MJ) giving an overall unit of Mega-Joule per kilometre (MJ/km). The specific energy consumption is calculated from data on the specific fuel consumption of new vehicles and the energy content of the fuels used.

Shown in *Figure 28* is the average specific energy consumption of new petrol and diesel cars from 2000 to 2013.

Figure 28 *Specific energy consumption of new cars 2000 – 2013*



Comparing *Figure 28* and *Figure 27* it can be seen that the overall trends are very similar, evident again is the switch to more fuel efficient cars after 2008. Between 2007 and 2013 the specific energy consumption of new petrol cars decreased by 24% and new diesel cars by 27%, while that of petrol-electric hybrids also reduced by 27%.

It should be remembered also that the lower specific energy consumption of diesel cars compared to petrol is despite the fact that, on average, diesel cars purchased in Ireland tend to be larger than petrol cars.

Table 20 provides data on the specific energy consumption of petrol, diesel and also hybrid petrol-electric cars further split by engine size band for the year 2000 and years 2005 to 2013.

Table 20 *Specific energy consumption by fuel type 2000, 2005 – 2013*

Fuel	Engine size band	Specific energy consumption combined cycle (MJ/km)									
		2000	2005	2006	2007	2008	2009	2010	2011	2012	2013
Petrol	< 0.9 litre	2.05	1.75	1.82	1.82	1.79	-	-	1.41	1.38	1.61
Petrol	0.9 -1.2 litre	2.00	1.93	1.90	1.90	1.89	1.85	1.80	1.77	1.73	1.69
Petrol	1.2 -1.5 litre	2.28	2.22	2.18	2.18	2.16	2.07	1.96	1.87	1.83	1.79
Petrol	1.5 -1.7 litre	2.47	2.60	2.45	2.42	2.39	2.35	2.29	2.06	2.02	2.02
Petrol	1.7 – 1.9 litre	2.78	2.62	2.56	2.64	2.56	2.50	2.41	2.33	2.17	2.16
Petrol	1.9 – 2.1 litre	3.07	2.85	2.72	2.72	2.58	2.54	2.43	2.40	2.28	2.29
Petrol	> 2.1 litre	3.66	3.49	3.33	3.43	3.49	3.32	3.39	3.37	3.09	3.28
Overall		2.32	2.36	2.28	2.30	2.25	2.11	1.94	1.85	1.80	1.75

Fuel	Engine size band	Specific fuel consumption combined cycle (MJ/km)									
		2000	2005	2006	2007	2008	2009	2010	2011	2012	2013
Diesel	< 1.2 litre	-	-	-	-	-	-	1.49	1.43	1.44	1.45
Diesel	1.2 -1.5 litre	1.65	1.82	1.78	1.81	1.81	1.79	1.74	1.69	1.65	1.61
Diesel	1.5 -1.7 litre	1.78	1.91	1.88	1.84	1.80	1.79	1.69	1.68	1.67	1.62
Diesel	1.7 – 1.9 litre	2.09	2.11	2.11	2.07	2.05	1.95	1.98	2.12	1.89	2.18
Diesel	1.9 – 2.1 litre	2.24	2.34	2.33	2.31	2.19	1.99	1.99	1.93	1.82	1.77
Diesel	> 2.1 litre	3.17	2.99	2.91	3.03	2.96	2.47	2.30	2.23	2.15	2.15
Overall		2.26	2.31	2.35	2.32	2.15	1.94	1.84	1.79	1.74	1.70

Fuel	Engine size band	Specific fuel consumption combined cycle (MJ/km)									
		2000	2005	2006	2007	2008	2009	2010	2011	2012	2013
Petrol-Electric	1.2 -1.5 litre	-	1.45	1.45	1.47	1.49	1.55	1.55	1.54	1.48	1.45
Petrol-Electric	1.7 – 1.9 litre	-	-	2.36	-	-	1.35	1.35	1.36	1.35	1.35
Petrol-Electric	1.9 – 2.1 litre	-	-	3.57	3.08	-	-	-	-	-	-
Petrol-Electric	> 2.1 litre	-	2.73	2.71	2.73	2.77	2.62	2.62	2.51	2.62	2.34
Overall		-	1.62	2.09	2.02	1.90	2.04	1.74	1.66	1.51	1.48

Source: Based on DEHLG data

4.2.2.3 Specific Fuel Consumption of New Cars

The traditional method of measuring and comparing the energy efficiency of vehicles is to consider the specific fuel consumption, for instance miles per gallon (m.p.g.) or more recently litres per kilometre (l/km). The significant disadvantage of this approach is that different fuel types contain different amounts of energy for the same volume of fuel, for instance a litre of diesel contains more energy than a litre of petrol, therefore it is not possible to use this metric to compare vehicles across different fuel types. Nevertheless it is still common practice to discuss energy efficiency in terms of specific fuel consumption and the available data for the specific fuel consumption of new cars is presented here for completeness.

The first SEAI transport report[40] presented a method for measuring the specific fuel consumption by calculating the overall efficiency of new cars entering the fleet. The analysis is updated here with more recent data. All new cars have associated fuel consumption figures[41] (measured under test conditions), quoted for urban, extra-urban and combined driving.[42] An average specific fuel consumption figure for new cars entering the national fleet may be calculated by weighting the test values by the sales figures for each individual model.

40 Sustainable Energy Authority of Ireland, 2003, *Energy and CO_2 Efficiency in Transport – analysis of new car registrations in year 2000*, www.seai.ie.

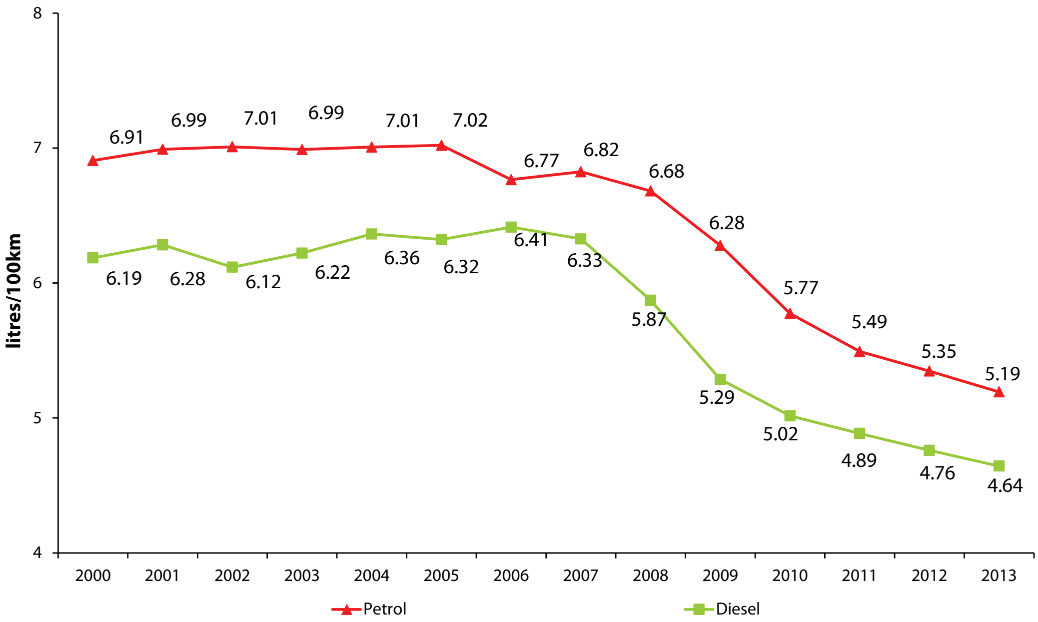
41 Fuel consumption and CO_2 emissions data were sourced from the Vehicle Certification Agency. The database can be downloaded at http://www.dft.gov.uk/vca/fcb/new-car-fuel-consump.asp

42 Details for the methodology for the test cycles can be found in section 4 of the following paper:

Ó Gallachóir BP and Howley M, 2004: *Changing Fleet Structure versus Improved Engine Performance – Energy and CO_2 Efficiency of New Cars Entering the Irish Fleet*, http://www.ucc.ie/serg/pub/VAFSEP.pdf

Figure 29 presents the weighted average specific fuel consumption (combined urban and extra-urban test values)[43] of new private cars first registered in the years 2000 to 2013. This was calculated by SEAI using an extract from the Vehicle Registration Unit's national database and the test data on fuel consumption of individual models.

Figure 29 *Specific fuel consumption of new cars 2000 – 2013*



Source: Based on Department of Transport data

The specific fuel consumption for new petrol cars on the road in Ireland in 2013 was 5.19 litres/100km (54.4 m.p.g.). This represented a decrease of 23% (or increase in fuel efficiency) on the average consumption in 2000. For diesel cars, the average specific fuel consumption increased by 2.4% over the period 2000 – 2007, to 6.33 litres/100 km. In 2008 there was a significant improvement, due in part to the changed taxation system, as the average fuel efficiency of new diesel cars improved by 7.3% to 5.87 litres/100km (48.4 m.p.g.). Specific consumption of new diesel cars continued to fall to 4.64 litres/100 km (60.9 m.p.g.) in 2013. This was a drop of 26% on the 2000 level.

Table 21 presents the change in specific fuel efficiency of different engine size bands in the years 2000 to 2013 for both petrol and diesel cars. It can be seen that there has been a decrease for all petrol engine size bands over the time period, the largest being a 26% reduction in the 1.9 – 2.1 litre category while the least improvement was in the greater than 2.1 litre category which reduced by 10%.

For all diesel engine size bands, fuel consumption per 100 km increased up to 2005. Between 2005 and 2013 there was an improvement in the fuel efficiency of all engine size bands with the exception of 1.7 to 1.9 litre. The largest reduction in specific fuel consumption occurred in the largest engine size category where the weighted average went from 8.2 litres/100km to 5.9 litres/100km, a reduction of 28%.

43 It is estimated based on an analysis for France that these are approximately 20% less than 'on road' consumption. Personal communication, 2006, between SEI and Mr Didier Bosseboeuf, ADEME.

Table 21 *Specific fuel consumption (petrol and diesel by engine size band) 2000, 2005 – 2013*

Fuel	Engine size band	Specific fuel consumption combined cycle (litres/100km)									
		2000	2005	2006	2007	2008	2009	2010	2011	2012	2013
Petrol	< 0.9 litre	6.1	5.2	5.4	5.4	5.3	-	-	4.2	4.1	4.8
Petrol	0.9 -1.2 litre	6.0	5.7	5.6	5.7	5.6	5.5	5.3	5.3	5.1	5.0
Petrol	1.2 -1.5 litre	6.8	6.6	6.5	6.5	6.4	6.2	5.8	5.6	5.4	5.3
Petrol	1.5 -1.7 litre	7.3	7.7	7.3	7.2	7.1	7.0	6.8	6.1	6.0	6.0
Petrol	1.7 – 1.9 litre	8.3	7.8	7.6	7.9	7.6	7.4	7.2	6.9	6.5	6.4
Petrol	1.9 – 2.1 litre	9.1	8.5	8.1	8.1	7.7	7.6	7.2	7.1	6.8	6.8
Petrol	> 2.1 litre	10.9	10.4	9.9	10.2	10.4	9.9	10.1	10.0	9.2	9.7
Overall		6.9	7.0	6.8	6.8	6.7	6.3	5.8	5.5	5.3	5.2

Fuel	Engine size band	Specific fuel consumption combined cycle (litres/100km)									
		2000	2005	2006	2007	2008	2009	2010	2011	2012	2013
Diesel	< 1.2 litre	-	-	-	-	-	-	4.1	3.9	3.9	3.9
Diesel	1.2 -1.5 litre	4.5	5.0	4.9	4.9	4.9	4.9	4.7	4.6	4.5	4.4
Diesel	1.5 -1.7 litre	4.9	5.2	5.1	5.0	4.9	4.9	4.6	4.6	4.6	4.4
Diesel	1.7 – 1.9 litre	5.7	5.8	5.8	5.7	5.6	5.3	5.4	5.8	5.2	6.0
Diesel	1.9 – 2.1 litre	6.1	6.4	6.4	6.3	6.0	5.4	5.4	5.3	5.0	4.8
Diesel	> 2.1 litre	8.6	8.2	8.0	8.3	8.1	6.8	6.3	6.1	5.9	5.9
Overall		6.2	6.3	6.4	6.3	5.9	5.3	5.0	4.9	4.8	4.6

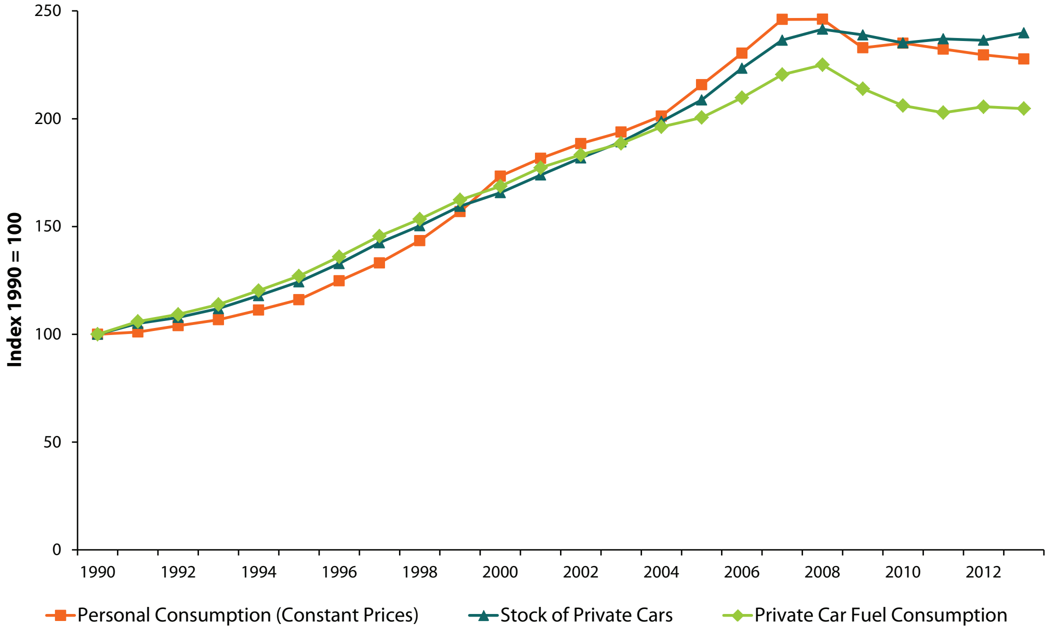
Fuel	Engine size band	Specific fuel consumption combined cycle (litres/100km)									
		2000	2005	2006	2007	2008	2009	2010	2011	2012	2013
Petrol-Electric	1.2 -1.5 litre	-	4.3	4.3	4.4	4.4	4.6	4.6	4.6	4.4	4.3
Petrol-Electric	1.7 - 1.9 litre	-	-	7.0	-	-	4.0	4.0	4.0	4.0	4.0
Petrol-Electric	1.9 - 2.1 litre	-	-	10.6	9.1	-	-	-	-	-	-
Petrol-Electric	> 2.1 litre	-	8.1	8.1	8.1	8.2	7.8	7.8	7.5	7.8	6.9
Overall		-	4.8	6.2	6.0	5.7	6.1	5.2	4.9	4.5	4.4

Source: Based on DEHLG data

4.2.3 Estimation of Private Car Energy Demand

SEAI estimate the fuel consumption of private cars based on annual mileage data by engine size band taken from National Car Test (NCT) results (discussed further in section *5*) and fuel consumption per distance travelled data for vehicles in each engine size band (discussed further in section *4.2.2.3*). The methodology is discussed further in Appendix A.1. The results of this analysis for the period 1990 to 2013 are shown in *Figure 30* and *Table 22*, with the data in *Figure 30* presented as an index with respect to the year 1990.

Figure 30 *Private car fuel consumption, personal consumption and private car stock 1990 – 2013*



Source: CSO and SEAI

Table 22 *Private car fuel consumption, personal consumption and private car stock 1990 – 2013*

	Growth %	Average annual growth rates %					Quantity (no.)	
	1990 – '13	'90 – '13	'00 – '05	'05 – '10	'10 – '13	2013	1990	2013
Fuel Consumption of private cars (ktoe)	105	3.16	3.52	0.55	-0.65	-0.41	926	1,896
Personal Consumption (million €, 2012 prices)	128	3.64	4.47	1.73	-3.10	-0.81	35,914	81,797
Stock of Private Cars	140	3.88	4.73	2.41	2.00	1.47	796,338	1,910,165

Source: CSO and SEAI

It can be seen that the estimated fuel consumption grew continuously between 1990 and 2008, from 926 to 2,084 ktoe, an increase of 125%. Between 2008 and 2013 the estimated fuel consumption has declined by 9% to 1,896 ktoe.

4.2.4 Macroeconomic Indicators & Drivers

Also shown in *Figure 30* and *Table 22* are data on the personal consumption of goods and services[44] and on the total number of vehicles in the private car stock for the period 1990 to 2013, both expressed as an index with respect to 1990 on the graph. Economic growth has significantly increased the average individual's prosperity and disposable income in Ireland. This has contributed to the very significant increase in private car sales and energy use, as can be seen from the close relationship in the growth rates for all three indices over the time period.

Over the period 1990 to 2005 personal consumption of goods and services increased by 116% (5.3% per annum); the stock of private cars grew by 109% (5.0% per annum); fuel consumption increased by 104% (4.9% per annum). All three indices reached a peak in 2008. Between 2005 and 2008 personal consumption of goods and services grew by 14% (4.5% per annum); the stock of cars grew by 16% (5.0% per annum); private car fuel consumption increased by 12% (3.9% per annum). The period between 2008 and 2013 witnessed both the economic recession and the changes to the taxation of private cars. In this period personal consumption of goods and services fell by 8% or 2.6% per annum, the stock of cars fell by just 0.7% or 0.2% per annum while the private car fuel consumption reduced by 9% or 3.1% per annum.

44 Constant prices chain-linked to 2012.

4.3 Road Freight

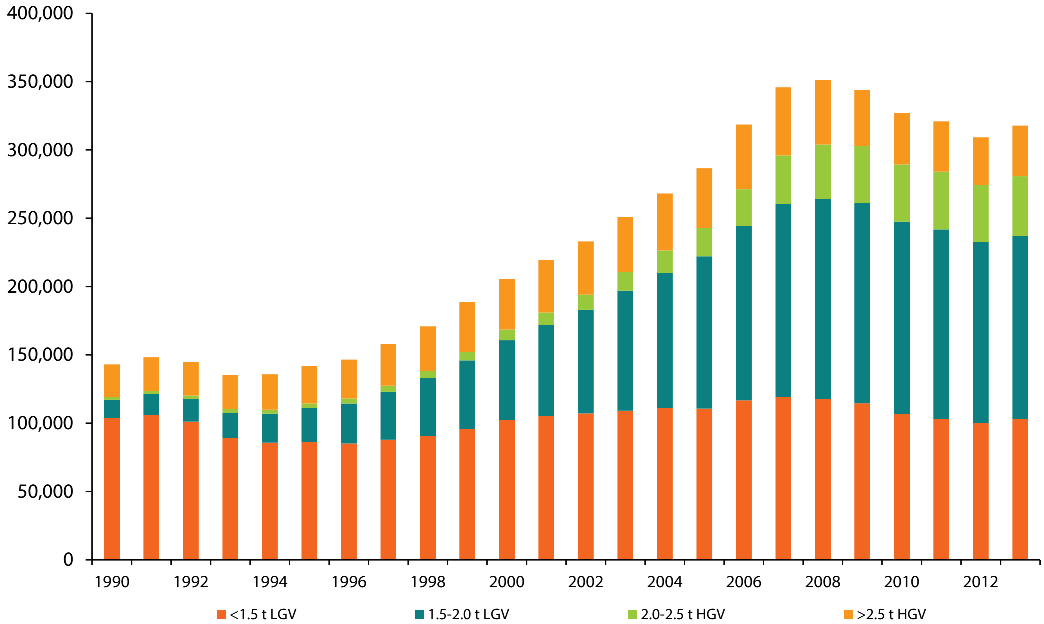
4.3.1 Goods Vehicles Classed By Unladen Weight: Heavy and Light

For road freight we broadly consider two classes of vehicle, heavy goods vehicles (HGV) and light goods vehicles (LGV). The data available to distinguish the two is the unladen weight of the vehicles. We use the CSO classification which considers vehicles with an unladen weight of greater than 2 tonnes to be HGVs, and less than 2 tonnes to be LGVs.

Table 23 and *Figure 31* present data on the goods vehicle fleet categorised by unladen weight from 1990 to 2013, split into four unladen weight bands: LGVs less than 1.5 tonne, LGVs between 1.5 and 2.0 tonne, HGVs between 2.0 and 2.5 tonnes and HGVs over 2.5 tonnes. Over the period, the total number of goods vehicles increased by 122% from 143,063 in 1990 to 317,787 in 2013. It can be seen that LGVs make up a significant majority of the fleet by number of vehicles, consisting of 82% of all goods vehicles in 1990 and 75% in 2013. The total number of LGVs increased by 102% between 1990 and 2013, from 117,141 to 237,080 vehicles while the total number of HGVs increased by 211% from 25,922 in 1990 to 80,707 in 2013.

It is interesting to note that the majority of new vehicles in the freight fleet fall into a middle band between 1.5 and 2.5 tonnes. While the total fleet size increased by 174,724 vehicles, 162,099 of this increase (93%) fell into this band. The share of these vehicles has increased from 11% (15,476 vehicles) in 1990 to 56% (177,575 vehicles) in 2013. Data from the Commercial Vehicle Roadworthiness Test (CVRT), which is discussed further in section *5.2*, suggests that the most common vehicle types in this band are large SUVs such as the Toyota Land Cruiser and cargo vans such as the Ford Transit range.

Figure 31 *Goods vehicles fleet by unladen weight 1990 – 2013*



Source: Based on Department of Transport, Tourism & Sport data

Table 23 *Growth rates and shares of goods vehicle fleet 1990 – 2013*

	Growth %	Average annual growth rates %					Quantity (no.)		Shares %	
	1990 – '13	'90 – '13	'00 – '05	'05 –'10	'10 – '13	2013	1990	2013	1990	2013
<1.5 t LGVs	-1	0.0	1.3	-0.7	-1.2	3.0	103,774	103,134	72.5	32.5
1.5 – 2.0 t LGVs	902	10.5	11.4	4.8	-1.6	1.0	13,367	133,946	9.3	42.1
All LGVs	102	3.1	5.5	2.2	-1.4	1.9	117,141	237,080	81.9	74.6
2.0 – 2.5 t HGVs	1,969	14.1	17.4	15.3	1.4	4.7	2,109	43,629	1.5	13.7
>2.5t HGVs	56	1.9	2.9	-3.0	-0.6	6.8	23,813	37,078	16.6	11.7
All HGVs	211	5.1	6.2	4.3	0.5	5.6	25,922	80,707	18.1	25.4
All GVs	122	3.5	5.7	2.7	-1.0	2.8	143,063	317,787	-	-

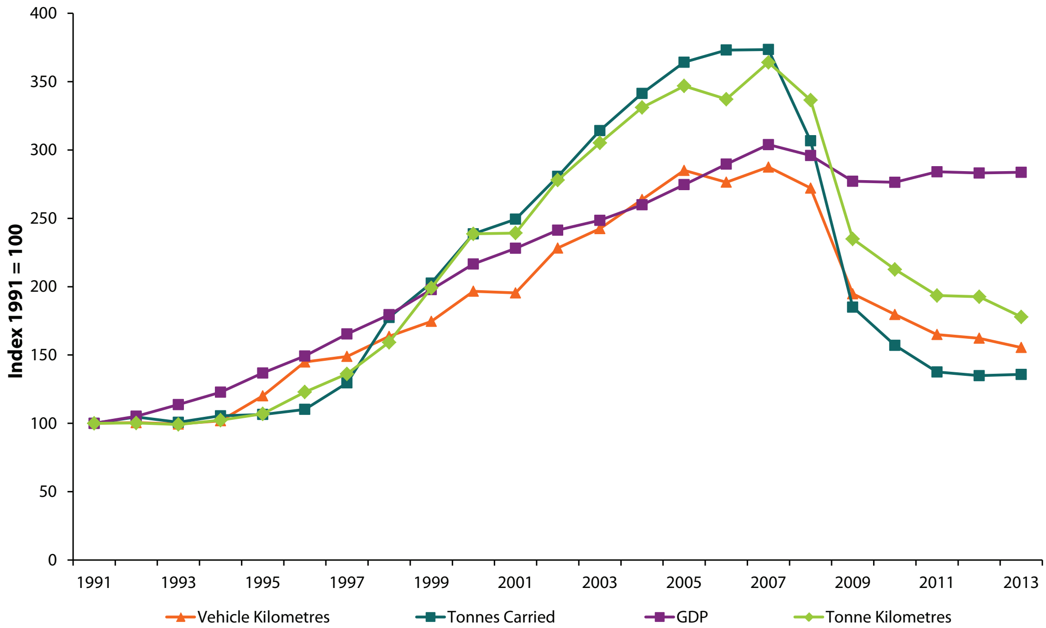
Source: Based on Department of Transport, Tourism & Sport data

4.3.2 Heavy Goods Vehicles

4.3.2.1 Macroeconomic Indicators and Drivers for Freight Activity

Three metrics which measure activity in the road freight sector are tonne-kilometres, vehicle kilometres and tonnes carried. *Figure 32* presents data on these three metrics along with GDP as an index with respect to 1991. The data are taken from the CSO's *Road Freight Survey* for 1991 to 2012 which considers vehicles taxed as goods vehicles, over 2 tonnes unladen weight, and which are actually used as goods vehicles, rather than for instance service type work.

Figure 32 *Road freight activity 1991 – 2013*



Source: CSO

Table 24 *Road freight activity 1991 – 2013*

	Growth %	Average annual growth rates %				Quantity		
	'91 – '13	'00 – '05	'05 –'10	'10 – '13	2013	1991	2007	2013
Mega-Tonne Kilometres	78	7.8	-9.3	-5.8	-7.7	5,138	18,707	9,138
Kilo-Tonnes Carried	36	8.8	-15.5	-4.7	0.7	80,137	299,307	108,831
Mega-Vehicle Kilometres	55	7.7	-8.8	-4.7	-4.2	811	2,332	1,261
GDP (million € @2012 prices)	184	4.9	0.1	0.9	0.2	61,011	185,432	173,054

Source: CSO

It can be seen that all metrics increased significantly since the data set began in 1991 until 2007. Tonne-kilometres increased by 264% (8.4% per annum) over the period 1991 to 2007, vehicle kilometres increased by 188% (6.8% per annum) and total tonnes carried increased by 273% (8.6% per annum). Also included are data for GDP[45] which increased by 204% between 1991 and 2007. It should be noted that both tonne-kilometres and tonnes carried increased significantly more than GDP in this period.

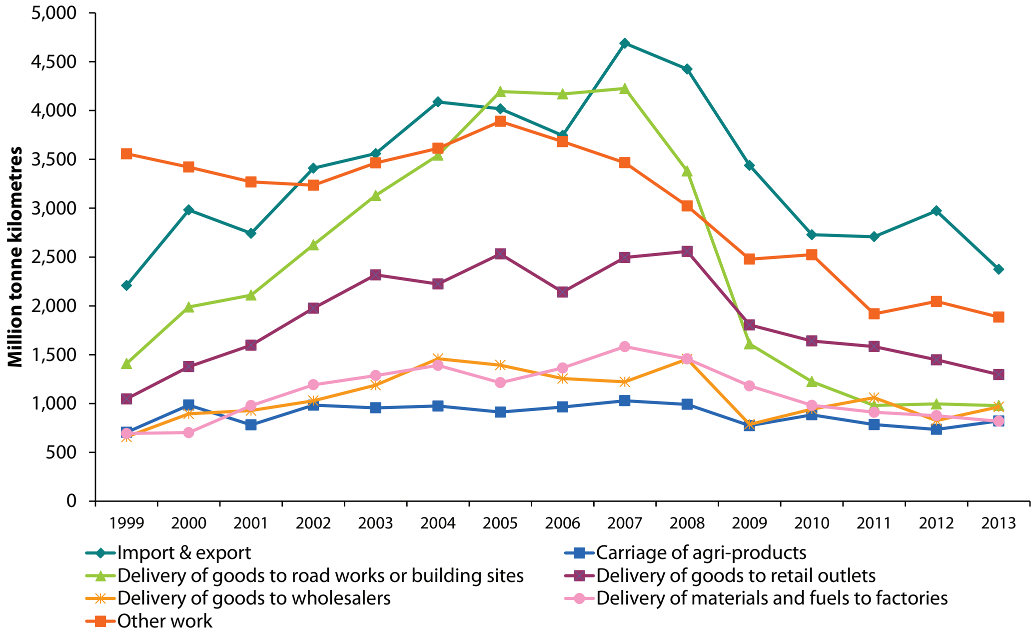
Between 2007 and 2013 GDP fell by 7%. In that time period the overall tonnes carried fell sharply back to 1997 levels, a fall of 64% (15.5% per annum). Tonne-kilometres fell by 46% (9.7% per annum) and vehicle kilometres travelled fell by 46% (9.7% per annum). Again it should be noted that all three transport metrics contracted much more severely than GDP post the economic crisis of 2008.

4.3.2.2 Tonne-Kilometres Classified by Main Type of Work Done

It is important to understand why freight has been so responsive to economic drivers in the past so as to be able to estimate how it will respond to potential future economic trends, particularly whether the dramatic rise in tonne-kilometres transported and the corresponding increase in energy demand experienced in the period 1990 – 2007 is likely to be repeated should there be a return to significant economic growth. To do this it is useful to analyse in more detail which sectors of the economy contributed to the changes in tonne-kilometres transported in the period 1990 – 2013.

The CSO's annual *Road Freight Survey* provides data on the total road freight activity measured in millions of (Mega) tonne-kilometres (Mtkm), disaggregated by the main type of work done by the vehicle.[46] A continuous annual time series of data is available for the years 1999 to 2013, as shown in *Figure 33*. Some data are available pre-1999 but not for all years, therefore these data are omitted from the graph. Data are available for 1990 however and these data are included in *Table 25*. Data are also given for 1999 as this is the first year of the continuous data set; 2007 as this is the year during which the peak in transport activity occurred and the year from which we measure peak to trough growth rates; and for 2013, being the most recent data available. To highlight which subcategories contributed most in absolute terms to both the increase in activity between 1990 and 2007 and the contraction from 2007 to 2013, these data are shown in *Figure 34*.

Figure 33 *Road freight activity by main type of work done 1999 – 2013*



Source: CSO

45 Constant prices chain-linked to 2011.

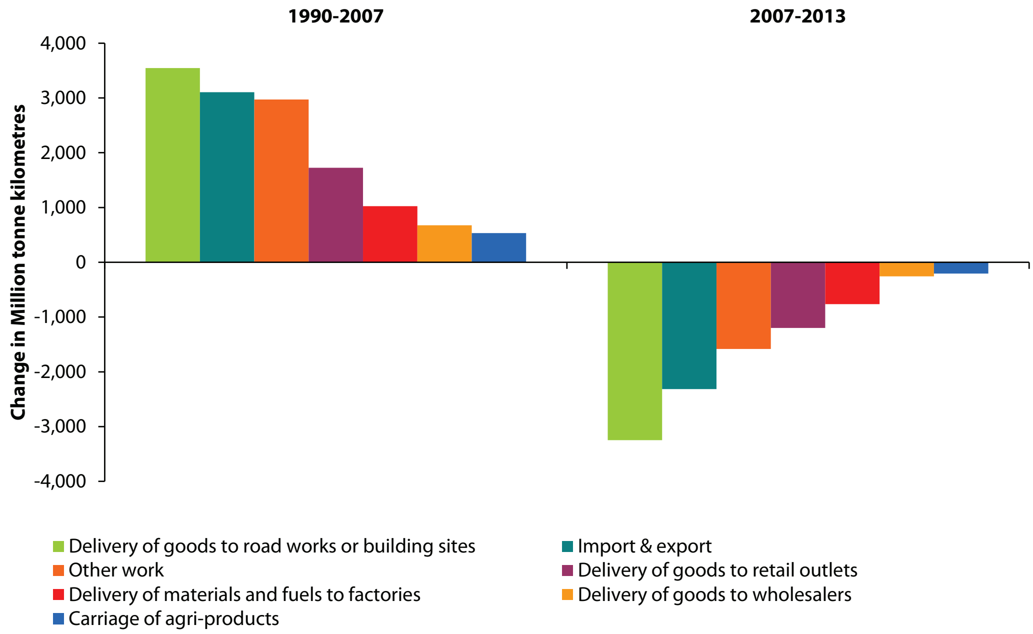
46 The CSO split the data by ten subcategories, but for simplification we have reduced this to seven. The categories "Carriage of livestock", "Carriage of fertilisers, feeding stuffs etc to farms" and "Carriage of other farm produce from farms" have been combined to give "Carriage of agri-products" while the minor category "Delivery of goods to households" has been combined with the "Other work" category.

Table 25 *Road freight activity by main type of work done 1990 – 2013*

	Quantity (Mt)				% Change			% Annual Average Change	
	1990	1999	2007	2013	'90 – '13	'90–'07	'07-'13	'90 – '07	'07-'13
Import & export	1,585	2,208	4,689	2,374	50	196	-49	6.6	-10.7
Carriage of agri-products	494	704	1,028	821	66	108	-20	4.4	-3.7
Delivery of goods to road works or building sites	681	1,409	4,226	978	44	521	-77	11.3	-21.6
Delivery of goods to retail outlets	771	1,047	2,495	1,296	68	224	-48	7.2	-10.3
Delivery of goods to wholesalers	546	657	1,221	965	77	124	-21	4.8	-3.8
Delivery of materials and fuels to factories	557	693	1,582	818	47	184	-48	6.3	-10.4
Other Work	495	3,557	3,466	1,885	281	600	-46	12.1	-9.7
Total	5,129	10,275	18,707	9,137	78	265	-51	7.9	-11.3

Source: CSO

Figure 34 *Absolute change in road freight activity by main type of work done 1990 – 2013*



Source: CSO

The subcategory "Delivery of goods to road works or building sites" experienced the largest absolute increase (3,545 Mtkm) and the second largest percentage increase (521%) between 1990 and 2007 and subsequently experienced both the largest absolute decrease (3,248 Mtkm) and the largest percentage decrease (77%) between 2007 and 2012. Of the total increase in freight transport activity from 1990 to 2007 (13,578 Mtkm) "delivery of goods to road works and building sites" was responsible for 26%, the highest share, while of the total reduction in activity from 2007 to 2013 (9,570 Mtkm) it was responsible for 34%, again the largest share.

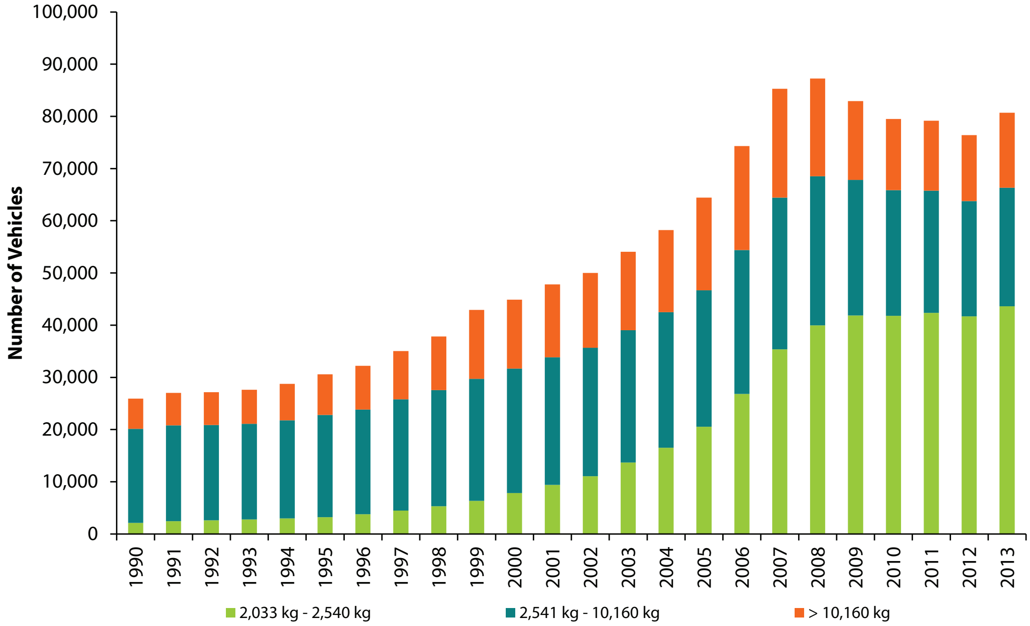
The next biggest contributor to both the rise and fall of transport activity was "Import & export" which between 1990 and 2007 accounted for 3,104 Mtkm (23%) of the total increase and between 2007 and 2013 it accounted for 2,315 Mtkm (24%) of the total reduction.

4.3.2.3 Number of Heavy Goods Vehicles

As might be expected given the large increase in transport activity described in section *4.3.2.1* there was a significant growth in the number of HGVs between 1990 and 2013. Data on the number of HGVs (taken as the number of licensed goods vehicles exceeding 2,032 kg[47] unladen weight) is shown in *Figure 35* and further in *Table 26*. The data are shown for three unladen weight bands.

It must be noted that not all vehicles shown in *Figure 35* and *Table 26* are necessarily involved in transport of freight. Some are likely to be involved in other service type work, particularly those of lower unladen weight. The CSO has estimated in its 2012 Road Freight Transport Survey that of all HGVs it surveyed in that year, 31% were "non-relevant", which is to say not involved in transport of freight, while for the 2 – 5[48] tonne unladen weight band that figure rose to 40%. The CSO does not include the activity of these vehicles in its statistics on the activity of road freight.

Figure 35 *Heavy goods vehicles fleet by unladen weight 1990 – 2013*



Source: Department of Transport, Tourism & Sport

Table 26 *Heavy goods vehicles by unladen weight 1990 – 2013*

	Growth %	Average annual growth rates %					Quantity (no.)		Shares %	
Unladen Weight	1990 – '13	'90 – '13	'00 – '05	'05 – '10	'10 – '13	2013	1990	2013	1990	2013
2,033 - 2,540 kg	1,969	14.1	17.4	15.3	1.4	4.7	2,109	43,629	8.1	54.1
2,541 - 10,160 kg	26	1.0	1.6	-1.6	-1.9	2.9	18,027	22,719	69.5	28.1
> 10,160 kg	148	4.0	5.1	-5.1	1.7	13.6	5,786	14,359	22.3	17.8

Source: Department of Transport, Tourism & Sport

The largest growth in both absolute and relative terms was in the 2,033 kg to 2,540 kg band, which increased by a factor of 20 (1,969%) between 1990 and 2013 (14.1% per annum), from 2,109 to 43,629 vehicles, increasing its share from 8% to 54%. Data from the CVRT suggests the most popular vehicle type in this unladen weight band are cargo vans such as the Ford Transit range. The number of larger HGVs in the greater than 10,160 kg band also increased significantly, increasing by 148% between 1990 – 2013, from 5,786 to 14,359 vehicles. The number of vehicles in the 2,541 kg to 10,160 kg band grew at a more moderate rate over the time period, increasing by 26% from 18,027 to 22,719 vehicles.

47 Note that 1,000 kg is equivalent to 1 tonne

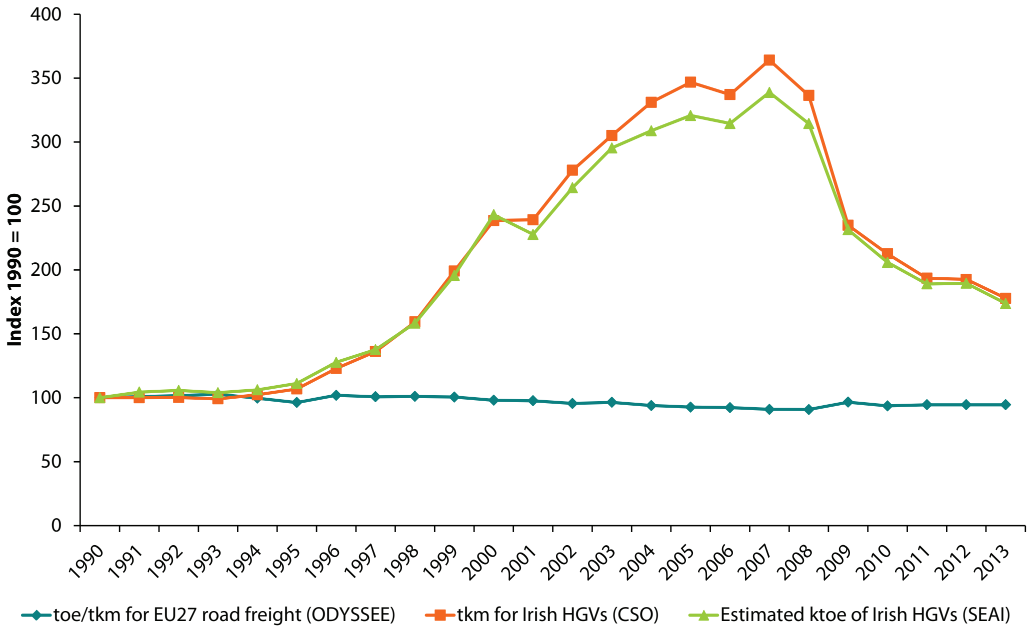
48 The CSO publishes data on HGVs (which it classifies as goods vehicles over 2 tonnes unladen weight) and gives data in terms of five unladen weight bands, the lowest of which is 2-5 tonnes. The Department of Transport provides data on the number of goods vehicles, given in terms of 27 unladen weight bands, 20 of which are over 2,032 kg. For this section SEAI have simplified these 20 weight bands down to the three shown in *Figure 35*.

4.3.2.4 Estimation of Heavy Goods Vehicles Energy Demand

SEAI estimate the energy demand of road freight as being the product of activity by the energy intensity. The most appropriate activity metric for HGVs is tonne-kilometres (tkm). Tonne-kilometres are defined as the aggregate weight of goods carried, multiplied by the total distance they were carried. The CSO publish data on the annual tonne-kilometres for HGV in Ireland in their annual Road Freight Transport Survey report.

The energy intensity of road freight is a measurement of the average energy required to transport one tonne of goods one kilometre and is measured in tonnes of oil equivalent per tonne-kilometre (toe/tkm). This figure is influenced by factors such as the average efficiency of the HGV vehicle fleet, and the share of kilometres travelled on motorway versus on minor roads. Data on the energy intensity of HGV road freight specific to Ireland is not available. In its absence data from the ODYSSEE project on the technical energy intensity of freight transport for the EU-27[49] is used. The results of this estimation are shown in *Figure 36*.

Figure 36 *HGV energy demand, activity level and technical energy intensity 1990 – 2013*



Source: SEAI

The technical energy intensity of EU27 road freight remained almost constant in the period 1990 – 2013, fluctuating from a high of 2.8% above 1990 levels in 1993 to a low of 9.2% below 1990 levels in 2008 and reaching 5.5% below 1990 levels in 2013. Note that it is likely that between 2002 and 2007 the energy intensity of Irish road freight in particular increased more than the EU27 value due to the much heavier loads being transported for the construction industry.

Driven by the increase in activity, between 1990 and 2007 the estimated energy demand of Irish road freight increased 239% from 334 ktoe to 1,132 ktoe. 2007 saw the maximum recorded freight energy demand and it decreased each year from 2008 to 2013, reaching 581 ktoe in 2013, a drop of 49% from 2007 levels. Energy demand in 2013 was 74% higher than in 1990.

4.3.2.5 Economic Energy Intensity of Heavy Goods Vehicles Freight

Figure 37 presents an index of the economic energy intensity of road freight. This is defined in terms of the amount of energy used per unit of gross domestic product[50] (ktoe/GDP) . An increasing index implies that energy usage of HGV road freight is increasing faster than GDP, and vice versa, thus a decreasing index represents an improvement in the economic energy intensity of HGV road freight. As tonne-kilometres is the main driver of energy demand for HGVs, the economic energy intensity is closely linked to the ratio of tonne-kilometres to GDP shown in *Figure 32.*

Since 2008 the economic energy intensity of road freight has fallen sharply and in 2013 it was 27% lower than in 1990 and 43% lower than in 2007. During this period the share of heavy, low value cargo such as heavy road and

49 See Appendix A.3
50 In constant money

building materials made up a decreasing share of the total of goods carried. In other words, while freight activity fell in general, the relative value of the cargo being carried increased.

Figure 37 *Road freight energy intensity 1990 – 2013*

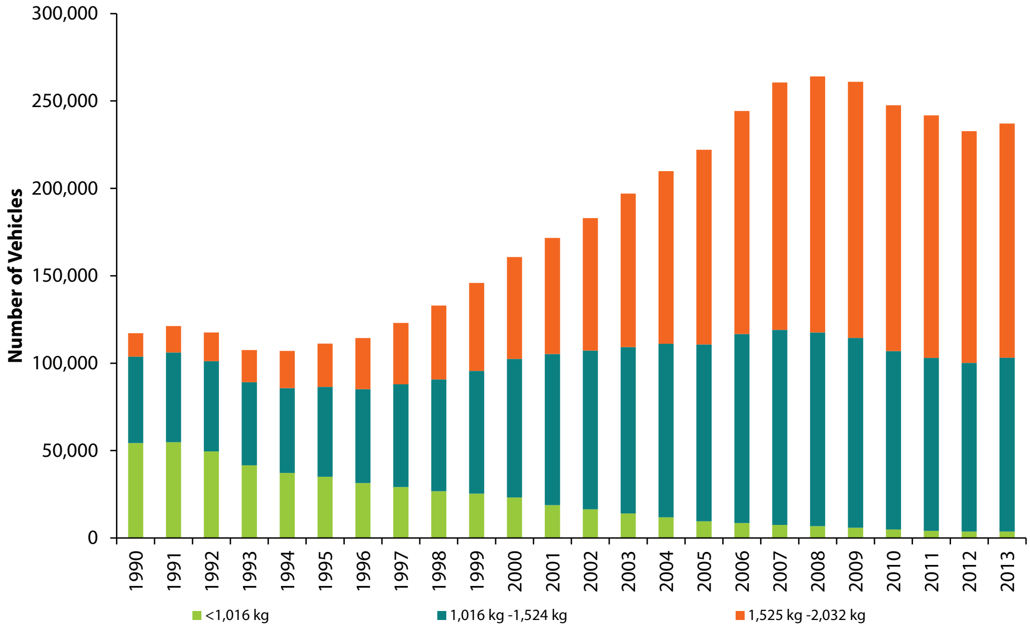
Source: Based on CSO Data

4.3.3 Light Goods Vehicles

4.3.3.1 Number of Light Goods Vehicles

As for HGVs, there was a significant increase in the total number of LGVs over the period 1990 – 2013. *Figure 38* and *Table 27* show data from the Department of Transport, Tourism & Sport on the numbers of licensed goods vehicles split into three unladen weight bands, less than 1,016 kg, between 1,016 and 1,524 kg and between 1,525 and 2,032 kg (note that goods vehicles greater than 2,032 kg are classed as HGV).

Figure 38 *Light goods vehicles fleet by unladen weight 1990 – 2013*



Source: Department of Transport, Tourism & Sport

Table 27 *Light goods vehicles by unladen weight 1990 – 2013*

	Growth %	Average annual growth rates %					Quantity (no.)		Shares %	
Unladen Weight	1990 – '13	'90 – '13	'00 – '05	'05 – '10	'10 – '13	2013	1990	2013	1990	2013
< 1,016 kg	-93	-11.1	-13.8	-12.5	-9.0	0.3	54,327	3,671	46.4	1.5
1,016 – 1,524 kg	101	3.1	4.1	0.2	-0.9	3.1	49,447	99,463	42.2	42.0
1,525 – 2,032 kg	902	10.5	11.4	4.8	-1.6	1.0	13,367	133,946	11.4	56.5

Source: Department of Transport, Tourism & Sport

The total number of LGVs increased from 117,141 in 1990 to a maximum of 264,062 vehicles in 2008 (125%) and subsequently decreased to 237,080 vehicles in 2013, a fall of 10%, though still more than double the number in 1990. It can be seen that there was a shift in the unladen weight profile of LGVs between 1990 and 2013 towards heavier vehicles. In 1990 46.4% of the fleet was below 1,016 kg unladen weight but by 2013 this had dropped to just 1.5%. The share of the fleet greater than 1,525 kg increased from 11.4% to 56.5%. In absolute terms between 1990 and 2013 the number of vehicles less than 1,016 kg reduced by 93% to 3,671 vehicles while the number of vehicles in the 1,525 to 2,032 kg band increased 902% to 133,946 vehicles. Data from the CVRT suggests the most popular vehicle type in the 1,525 – 2,032 kg band are large SUVs such as Toyota Land Cruisers.

4.3.4 New Light Goods Vehicles by Emissions Band

Currently the annual motor tax on goods vehicles in Ireland is based on the unladen weight of the vehicle rather than according to their emissions as is the case for private cars. All vehicles under 3,000 kg unladen weight pay a flat rate of €333 per annum. Nonetheless new LGV vehicles licensed for the first time have their CO_2 emissions band recorded by the Vehicle Registration Unit. The emissions bands used are the same as for private cars. Data on numbers of new LGVs licensed by emissions band is available since 2009, but for 2009 and 2010 the majority of vehicles are unclassified which makes the data for these years less reliable. In 2013 98% of new LGVs licensed were categorised by emissions band, up from 30% in 2009. With this caveat in mind the data for 2009 to 2013 is shown in *Table 28*. From 2011 onwards a majority of LGVs are classified by emissions label and these data are presented in *Figure 39*.

In 2013 34% of new LGVs licensed were in the A or B emissions band. This is twice the share that A and B vehicles made up of the new private car fleet in 2007, prior to the introduction of emissions based taxation. Possible reasons for this may include that manufacturers have focused on increasing the market share of more efficient vehicles in anticipation of the introduction of carbon emissions targets for new light commercial vehicles in 2014. It is also possible that the success of the private car taxation changes in increasing the market share of energy efficient vehicle models in the private fleet has had a knock on effect on the commercial vehicles market.

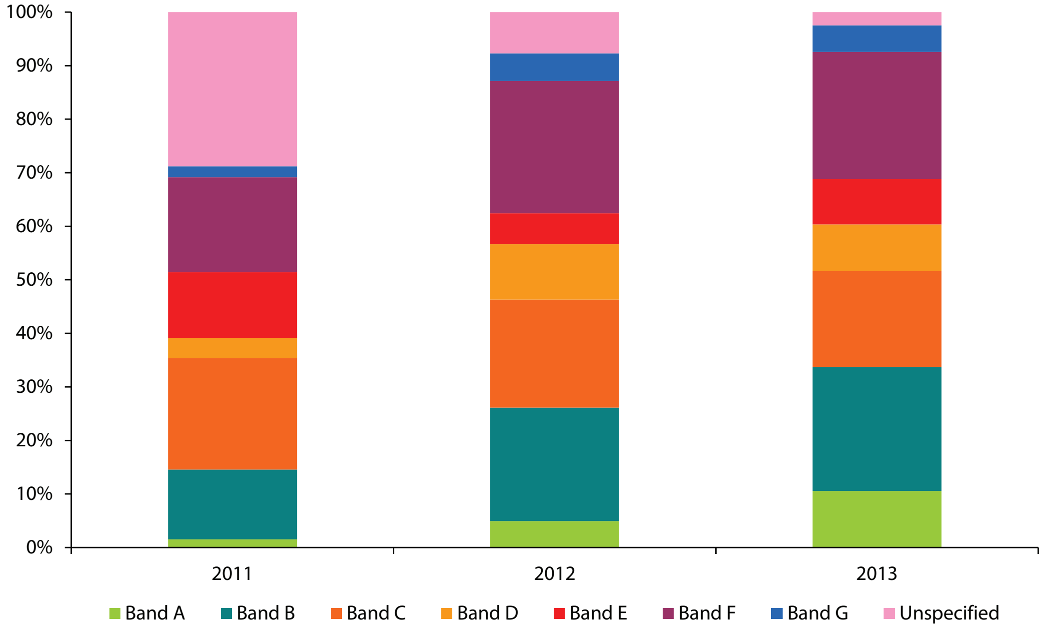
Nevertheless 37% of new LGVs licensed in 2013 were in the E, F or G emissions band. This suggests that there remains significant scope for further policy measures to encourage purchasing of low emission LGVs and thus to improve the overall carbon emissions performance of the LGV fleet.

Table 28 *Number of annual new light goods vehicles registered classified by emissions band 2009 – 2013*

Emissions Band	Numbers of new LGVs licensed				
	2009	2010	2011	2012	2013
Band A (0-120 gCO_2/km)	103	160	126	394	814
Band B (121-140 gCO_2/km)	845	491	1,068	1,685	1,782
Band C (141-155 gCO_2/km)	284	306	1,706	1,608	1,375
Band D (156-170 gCO_2/km)	97	591	307	821	672
Band E (171-190 gCO_2/km)	48	576	1,006	461	651
Band F (191-225 gCO_2/km)	498	468	1,452	1,965	1,829
Band G (>225 gCO_2/km)	284	180	169	412	382
Unspecified	4,978	4,869	2,358	613	190
Total Registered	**7,137**	**7,641**	**8,192**	**7,959**	**7,695**
% vehicles classified by emissions band	30%	36%	71%	92	98%

Source: Based on Department of Transport Vehicle Registration Unit data

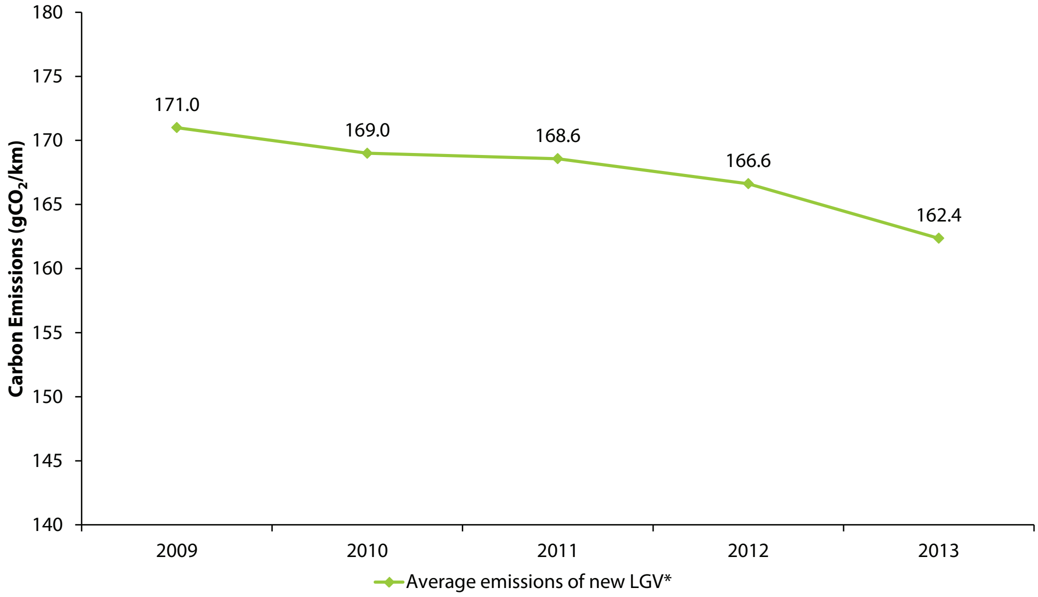
Figure 39 *Share of light goods vehicles in each emissions band 2011 – 2013*



Source: Based on Department of Transport Vehicle Registration Unit data.

Figure 40 shows the estimated average carbon emissions of new LGVs licensed between 2009 and 2011, excluding vehicles which were not classified by emissions band. As can be seen from *Table 28* a significant proportion of new LGVs licensed between 2009 and 2011 were not classified and so the estimate for these years are not as reliable as those for 2012 and 2013 when over 90% of vehicles were classified.

Figure 40 *Average carbon emissions of new LGVs 2009 – 2013*



*Average excluding vehicles for which an emissions rating is not specified. 70% of new LGVs were unspecified in 2009 falling to just 2% in 2013

Source: Based on Department of Transport Vehicle Registration Unit data.

For 2013 the estimated average emissions of new LGVs licensed in Ireland was 162.4 gCO_2/km. This is lower than the estimated EU average of 180.2 gCO_2/km[51] and also lower than the target average carbon emissions for the fleet of new light commercial vehicles of 175 gCO_2/km set for vehicle manufacturers in 2017.

51 European Environment Agency, for more information see http://www.eea.europa.eu/highlights/co2-emissions-from-new-vans?&utm_campaign=co2-emissions-from-new-vans&utm_medium=email&utm_source=EEASubscriptions

4.3.4.1 Estimation of Light Goods Vehicles Energy Demand

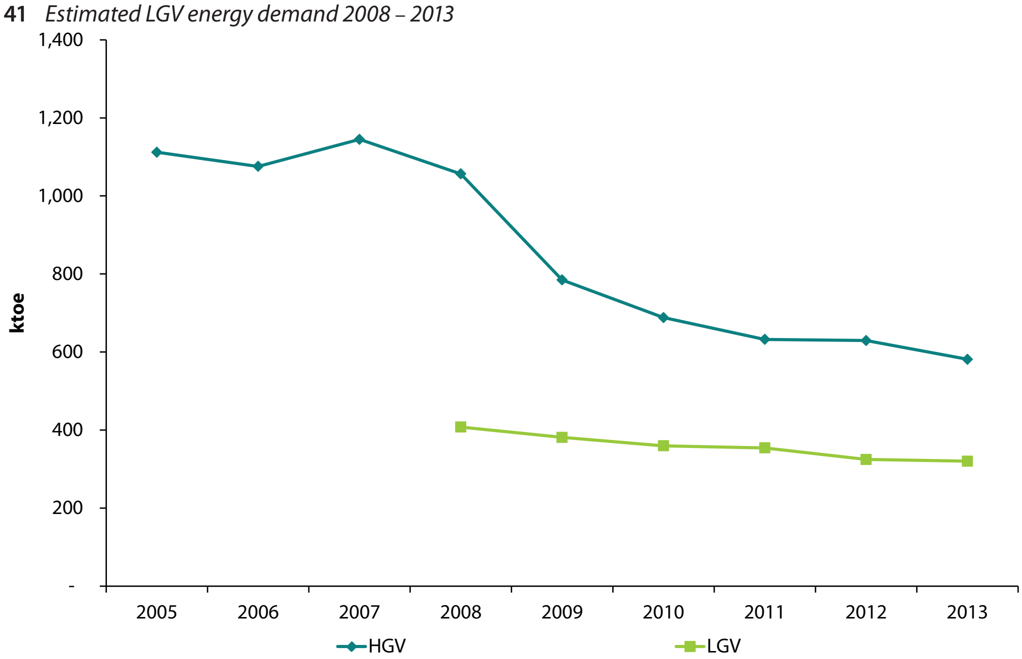
The light goods vehicle (LGV) category accounts for goods vehicles of less than 2,033kg unladen weight and includes small rigid lorries, delivery vans, etc. In previous reports it was not possible to make an estimate of the energy demand of LGVs due to lack of available data and therefore its share of total transport energy demand was accounted for in the "Unspecified" category. In this report, for the first time we present the results of a new analysis carried out by SEAI using newly available data from the Department of Transport, Tourism & Sport to estimate the energy demand of LGVs.

Due to the relatively low weight of the goods transported the most appropriate activity metric for these vehicles is vehicle kilometres (vkm), i.e. mileage, as was the case for private cars, rather than tonne-kilometres, as was the case for HGVs. Therefore the method adopted for estimating the energy demand of LGVs is similar to that used for private cars. It is based on data for the annual vehicle kilometres of the LGV stock broken down into a number of bands and then multiplied by corresponding data on the specific fuel consumption for each band, with an allowance made for the difference between test values and on-road consumption.

Whereas private cars were broken down by engine size band for LGVs we consider unladen weight bands. For each unladen weight band data on the annual average mileage was taken from the Road Safety Authority database for the results of Commercial Vehicle Roadworthiness Testing (CVRT) which is the commercial vehicle equivalent of the NCT for private cars.[52] Data on the fuel consumption (l/100km) for each band was calculated by combining data from the CVRT database on the profile of vehicle models in the stock with data from the UK Vehicle Certification Agency (VCA) on the fuel consumption of particular models. The data required for this methodology is fully available back to 2011. In order to estimate over a longer time series we assume that the average fuel consumption of each unladen weight band remained constant from 2008 to 2010, which allows us to extend the estimation back to 2008.

The results of this analysis for the period 2008 to 2013 are shown in *Figure 41*, along with the estimation of HGV energy demand described earlier for comparison.

Figure 41 *Estimated LGV energy demand 2008 – 2013*



Source: SEAI

It can be seen that the estimated energy demand of LGVs has decreased steadily over the time period considered, from 408 ktoe in 2008 to 320 ktoe in 2013, a fall of 21% or 4.7% per annum. This is primarily due to a decrease in the activity, as measured in vkm, which fell by 18% between 2008 and 2013. This compares to the decrease in the activity of HGVs, as measured in tkm, of 51% between 2007 and 2013.

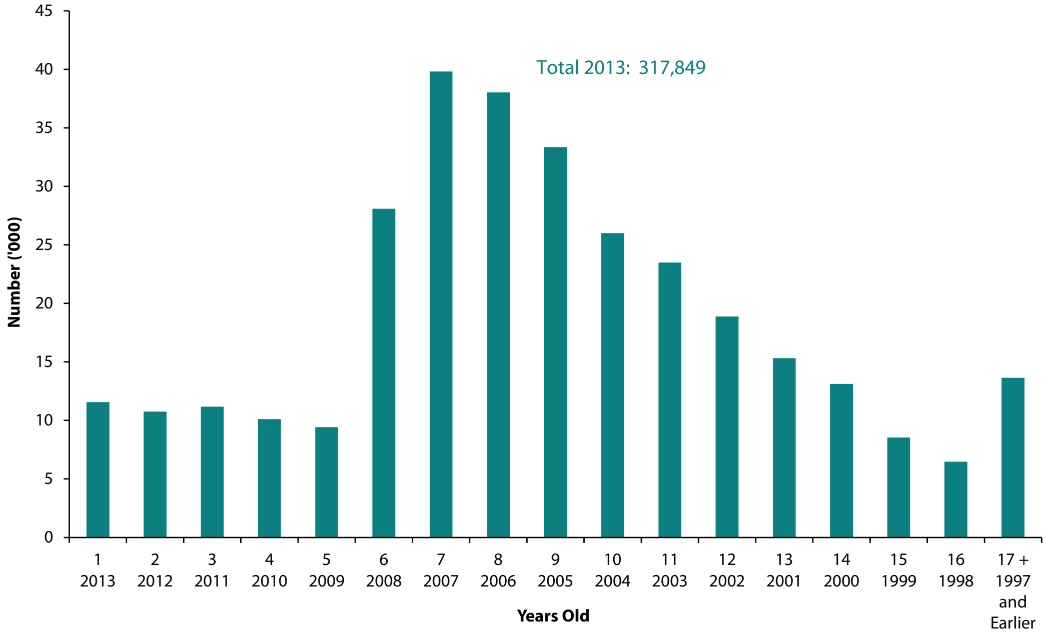
It is interesting to note that even though LGVs make up the majority of the goods vehicle fleet, accounting for 75% of all freight vehicles in 2013, HGVs still consume more energy, accounting for 64% of freight energy demand in 2013, down from 72% in 2008, the first year for which a comparison is possible.

52 Note that in future the CSO may publish data on the distance travelled by LGVs and if this is the case the CSO data will be used from then on.

4.3.5 Age of Road Freight Vehicle Stock

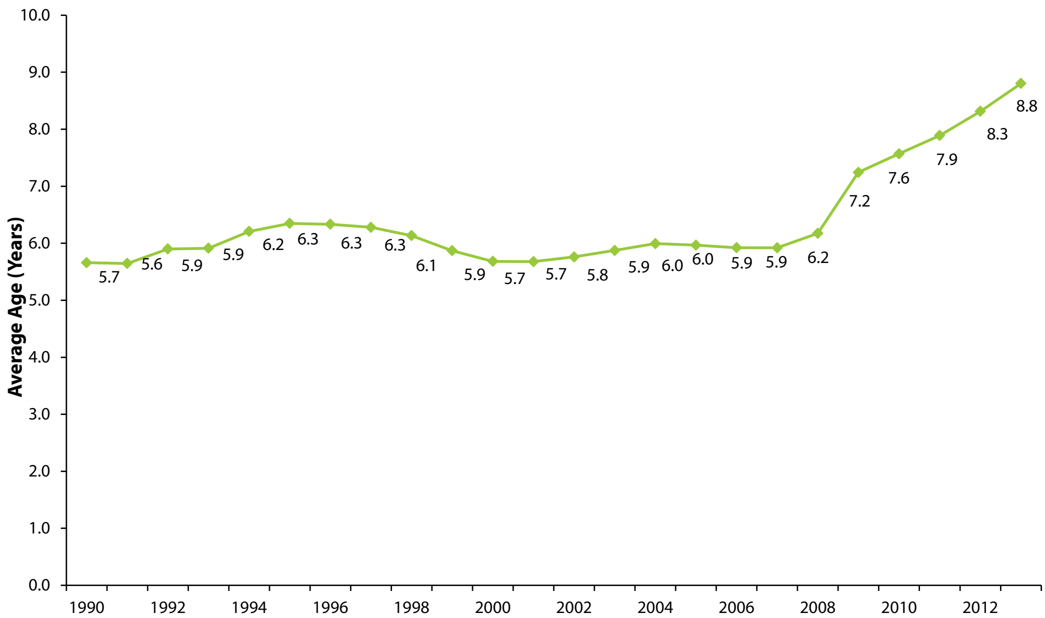
As for private cars annual data are provided by the Department of Transport, Tourism & Sport on the stock of goods vehicles by the year in which they were first licensed and this can be used to calculate the average age of the goods fleet over time. *Figure 42* shows the age of the freight vehicle fleet at the end of 2013 while *Figure 43* graphs the trend in the average age of goods vehicles over the period 1990 to 2013. Note that these data are for all goods vehicles, both LGV and HGV.

Figure 42 *Age of goods vehicles 2013*



Source: Department of Transport, Tourism & Sport

Figure 43 *Average age of goods vehicles 1990 – 2013*



Source: Department of Transport, Tourism & Sport

In 2007, 52% of goods vehicles were less than five years old, while 87% were less than 10 years old. Following the economic crisis the numbers of new goods vehicles being licensed each year fell and this is reflected in the low numbers of one to five year old vehicles shown in *Figure 42*. In 2013, just 14% of goods vehicles were less than five years old and 61% were less than 10 years old. At the end of 2013 the average age of a goods vehicle in Ireland was 8.8 years, up from 5.9 in 2007.

4.4 Public-Passenger Vehicles

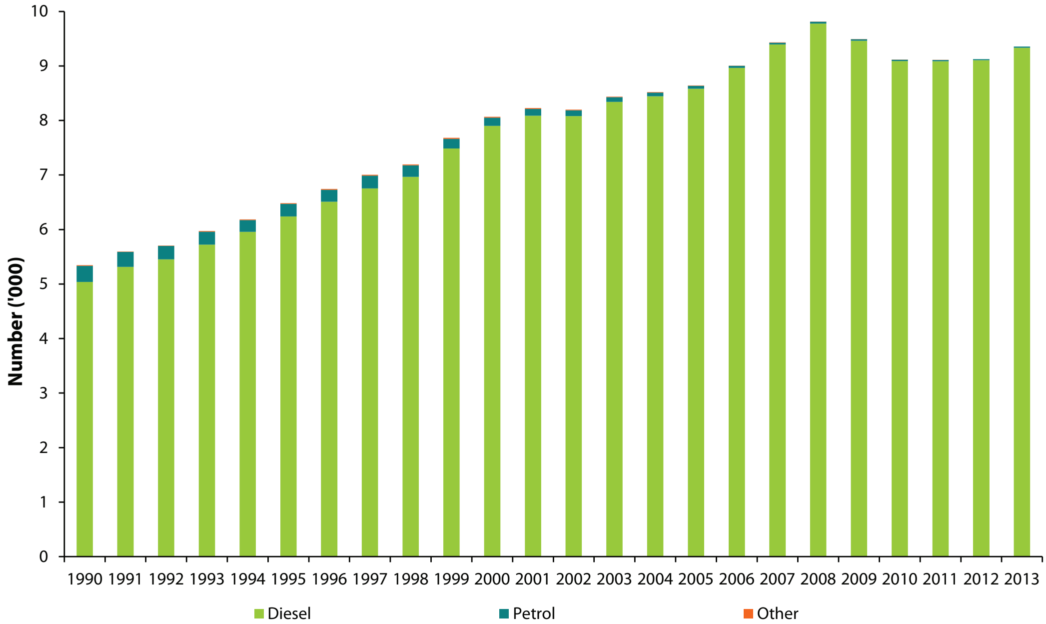
This section profiles the public-passenger vehicles mode, which includes bus (private and public) and taxi/hackney vehicles.

4.4.1 Buses

4.4.1.1 Number of Buses

Figure 43 records the trend in the stock of buses over the period 1990 to 2013. The total number increased by 74% from 5,352 to 9,356. It can also be seen that the vast majority (over 99%) of buses are fuelled by diesel.

Figure 44 *Stock of buses by fuel type 1990 – 2013*



Source: Department of Transport, Tourism & Sport

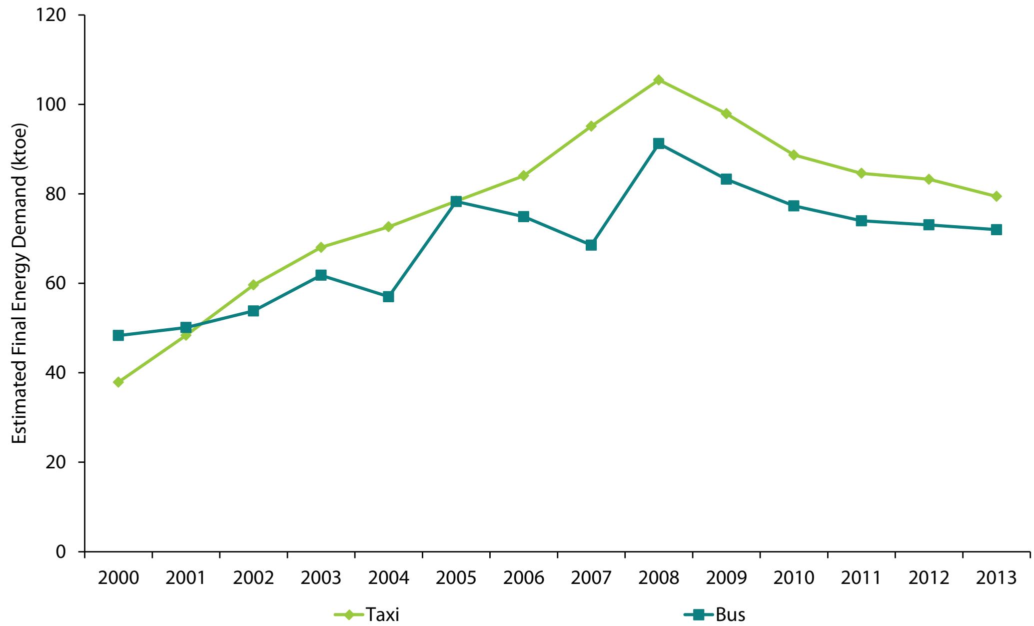
A complete dataset is not available for the number of vehicle kilometres travelled by buses in Ireland, but data are available for scheduled Bus Éireann services for 1998 to 2012. During that period, the total number of vehicle kilometres rose from 117 million to a high of 163 million in 2008, an increase of 39%.[53] This has fallen back to 148 million kilometres in 2012 - a fall of 10% since 2008.

4.4.1.2 Estimation of Bus Energy Demand

Up until 2008 estimates of the energy demand of the bus fleet were made based on data provided by the Revenue Commissioners from a fuel excise rebate scheme for diesel. This rebate scheme finished in 2009 but a new scheme came into effect in mid 2013. Therefore this data source was unavailable for the period 2009 to 2013. During this period the estimation of bus energy demand is based on data provided from CIE which accounts for the fuel consumption of both Bus Éireann and Dublin Bus. The fuel consumption of independent bus operators is estimated based on its historical share of total bus fuel consumption. The estimated energy demand in the period from 2009 to 2013 is, therefore, less reliable than that for previous years. Shown in *Figure 45* is the estimated annual fuel consumption of buses over the period from 2000 to 2013.

53 CSO, 2008, *CSO Statistical Yearbook 2007*, CSO, Skehard Road, Cork or www.cso.ie.

Figure 45 *Energy demand of bus, hackney & taxis 2000 – 2013*



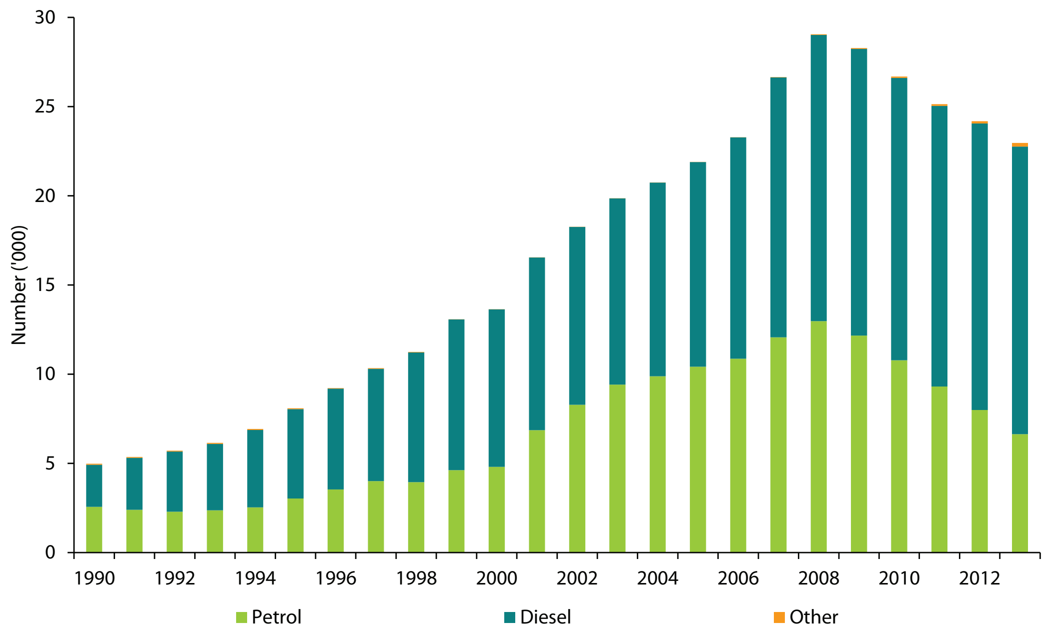
Source: SEAI

4.4.2 Hackney and Taxis

4.4.2.1 Number of Hackney and Taxis

The number of hackney & taxi vehicles[54] licensed over the period 1990 to 2013 is shown in *Figure 46*, which shows that the stock of hackney & taxi vehicles has increased significantly in that time period.

Figure 46 *Stock of taxi/hackney vehicles by fuel type 1990 – 2013*



Source: Department of Transport, Tourism & Sport

54 This category is defined in the DEHLG statistics as Small Public Service Vehicles (SPSV) and in addition to taxis/hackneys includes a small proportion of limousines and small minibuses.

Table 29 *Number of taxi/hackney 1990 – 2013*

	Growth %	Average annual growth rates %					Quantities (numbers)		Shares %	
CC bands	1990 – 2013	'90 – '13	'00 – '05	'05 – '10	'10 – '13	2013	1990	2013	1990	2013
Petrol	159.3	4.2	16.7	0.7	-14.9	-16.9	2,560	6,638	51.4	28.9
Diesel	583.0	8.7	5.4	6.7	0.6	0.3	2,359	16,113	47.4	70.2
Other	267.2	5.8	-3.6	71.4	42.2	67.7	58	213	1.2	0.9
Total	361.4	6.9	9.9	4.0	-4.9	-5.0	4,977	22,964	-	-

Source: Department of Transport, Tourism & Sport

The total number of taxi/hackney vehicles in 1990 was 4,977. By the year 2000 this had increased 174% to 13,637. The taxi industry was deregulated in the year 2000 allowing many more entrants to the market. The total number of taxi & hackney vehicles continued to increase to 29,053 vehicles in 2008, an increase of 118% from 2000 and an increase of 484% from 1990. Between 2008 and 2013 the numbers of taxis/hackneys fell by 21%. There was a 5% fall in the numbers of taxis/hackneys registered in 2013. The share of diesel in the taxi fleet, in contrast to private cars, decreased from 65% in 2000 to 52% in 2004/2005 but rebounded to 70% in 2013. A further 29% of taxis ran on petrol, with the remainder petrol-LPG or hybrid powered vehicles.

4.4.2.2 Estimation of Taxi and Hackney Energy Demand

The energy demand of taxis/hackneys is estimated in the same way as for private cars (the methodology is detailed in Appendix A.1). Shown in *Figure 45* is the estimated annual fuel consumption over the period 2000 to 2013. Between 2000 and 2008 the energy demand of taxi/hackneys increased 178% from 38 ktoe to 105 ktoe. Between 2008 and 2013 energy demand declined by 25% to 79 ktoe.

4.5 Rail

4.5.1 Rail Transport Activity

The CSO provides data on rail transport activity for both passenger and freight services. *Figure 47* shows the trend in passenger traffic as measured by passenger kilometres (pkm) and rail freight traffic, measured by tonne-kilometres (tkm), as an index. Data are for Iarnród Éireann services for the period 1990 to 2012 and Luas pkm data from 2006 onwards. Further information on rail transport activity is published by Iarnród Éireann[55] and the National Transport Authority[56].

Rail freight traffic declined by 85% (8.1% per annum) over the period 1990 – 2012, from 589 million tkm in 1990 to 91 million tkm in 2012. While the demand for rail freight has declined over the period, combined rail and road freight has increased significantly, indicating a modal shift. In 1991, the first year for which comparable data are available, total road and rail freight traffic was 5,738 million tkm. Rail accounted for 10% of the total. In 2008 total road and rail freight traffic had increased to 17,392 million tkm, but with rail accounting for only 0.6%. In 2012 total road and rail freight traffic was 9,986 million tkm, with rail accounting for 0.9%.

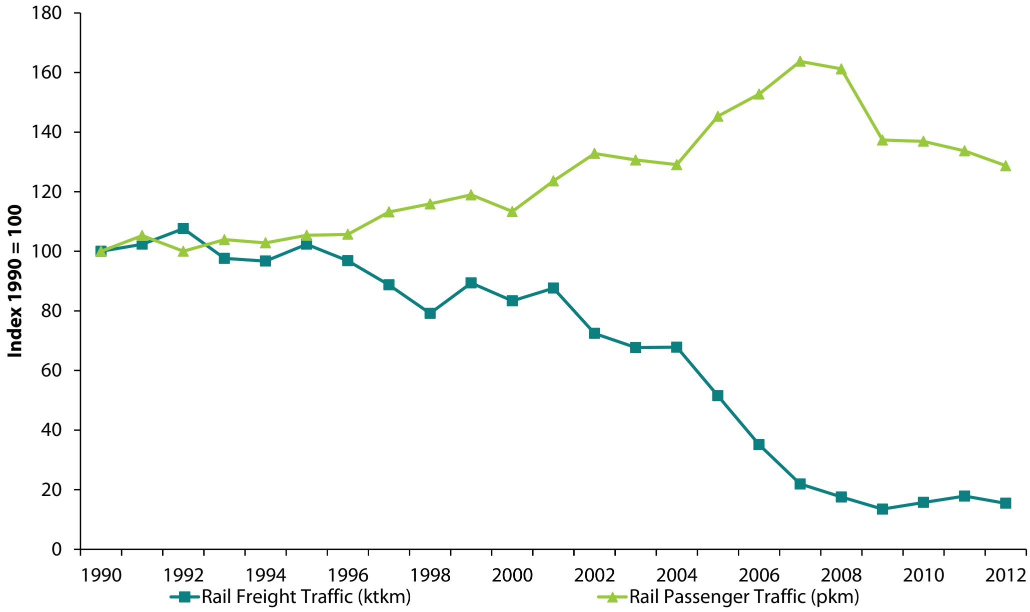
Over the period 1990 to 2007, the number of pkm increased from 1,223 million to 2,007 million[57], an increase of 64% (3% per annum). Passenger travel by rail has been falling since and in 2012 was 21% lower than in 2007, down to 1,578 million passenger kilometres.

55 For further information see website http://www.irishrail.ie/ and latest annual report http://www.irishrail.ie/media/ie_annual_report_2013.pdf?v=ga3dcce

56 For further information see website http://www.nationaltransport.ie/ and latest Rail Statistics for Ireland report http://www.nationaltransport.ie/wp-content/uploads/2013/10/Rail_Statistics_for_Ireland_June_2014.pdf

57 Including Luas data from 2006.

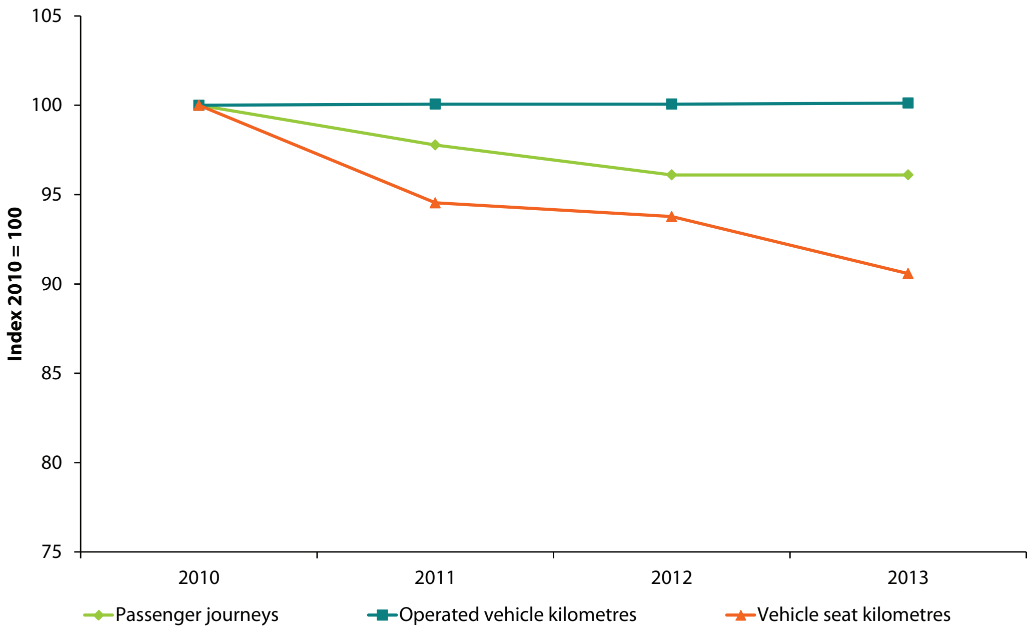
Figure 47 *Rail passenger and tonne-kilometres 1990 – 2012*



Source: CSO

Iarnród Éireann notes in its annual report that the energy demand for passenger rail services is dictated by the train schedule, not the number of passengers carried. The primary drivers for energy demand are the distance covered, the number of stops and the line speed. Therefore the metric vehicle kilometres (vkm) is a better indicator of energy use than pkm. A further useful metric is "vehicle seat kilometres" which takes into account the carrying capacity of different trains and is equal to the number of seats and standing room available on each service multiplied by the distance travelled by that service. Data from the National Transport Authority on operated vehicle kilometres, vehicle seat kilometres and passenger journeys is provided in *Figure 48*. Data are available from 2010 to 2013.

Figure 48 *Iarnród Éireann passenger journeys, vehicle kilometres and vehicle seat kilometres 2010 – 2013*



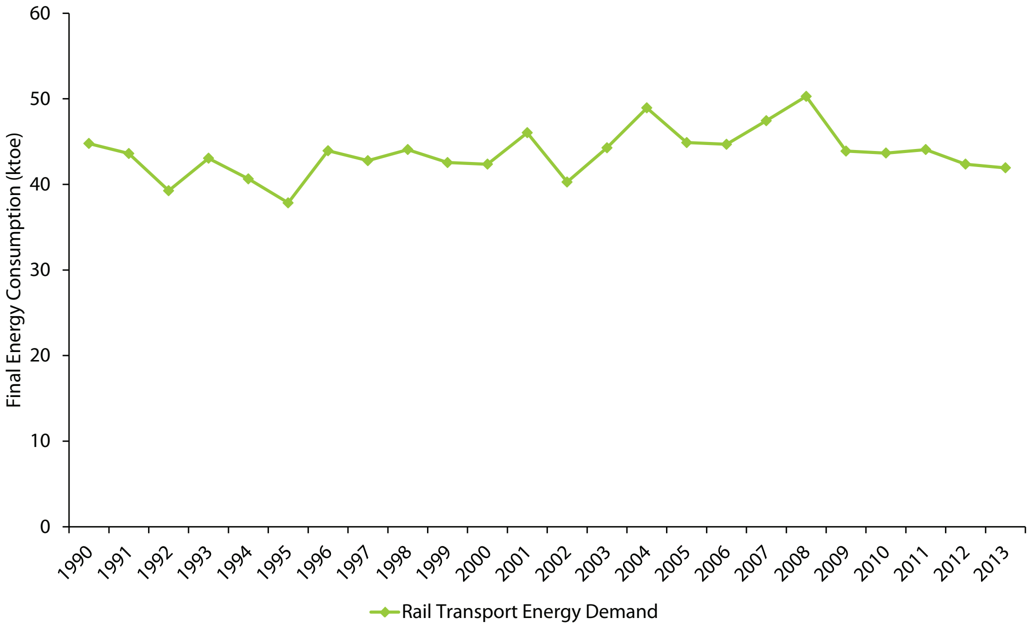
Source: National Transport Authority

It can be seen that the number of passenger journeys decreased over the time period. Despite this the number of vehicle kilometres travelled remained stable, this is because there was no reduction to the service provided in terms of routes offered or trains per day. However the number of vehicle seat kilometres decreased more so than passenger journeys. This is due to reconfiguring of the trains to better match the number of carriages on each service to the predicted passenger demand and has the effect of improving the energy efficiency of the service, per passenger transported. Further reconfiguration of trains to match capacity demand was carried out in late 2013. The overall energy efficiency of the diesel fleet has improved significantly since 1990, particularly with the introduction in 2007 of a new inter-city rail car fleet.

4.5.2 Estimation of Rail Transport Energy Demand

Rail transport in Ireland uses both diesel and electricity. Diesel is used for mainline and commuter services while electricity is used for the DART and Luas services. Diesel usage data for rail transport is sourced from Iarnród Éireann while electricity use is sourced from the relevant suppliers. *Figure 49* shows final energy demand of rail transport in Ireland from 1990 to 2013.

Figure 49 *Rail transport energy demand 1990 – 2013*



Source: SEAI

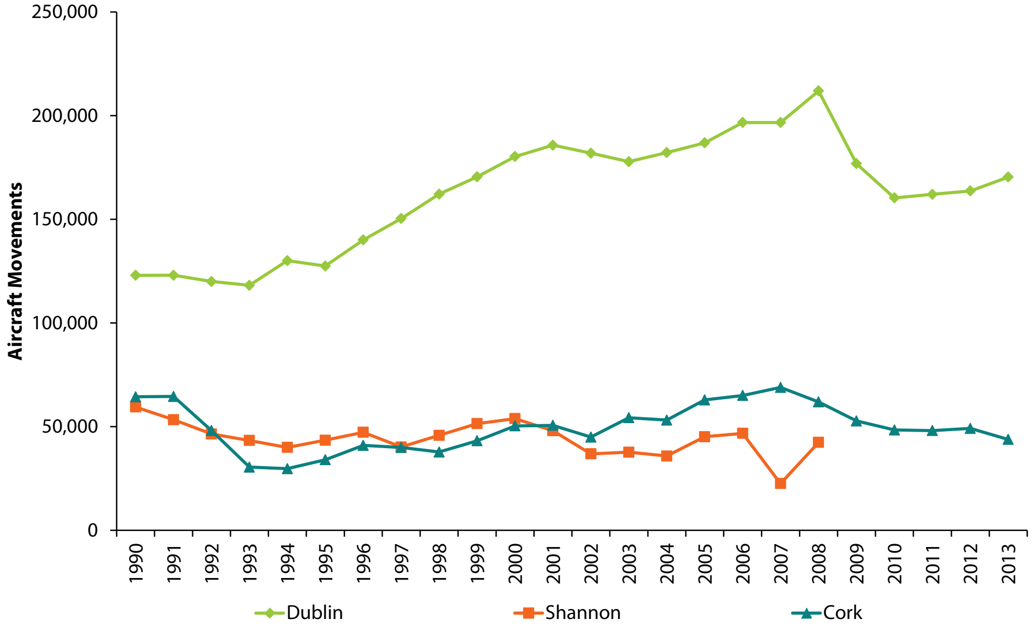
Compared to other modes of transport, overall rail energy demand has remained relatively stable over the time period, reaching a maximum of 50 ktoe in 2008, a 12% increase on the 45 ktoe consumed in 1990. Consumption decreased by 17% between 2008 and 2013 to 42 ktoe. Overall, fuel consumption by rail fell by 6.4% (0.3% per annum) over the period 1990 to 2013.

4.6 Air

4.6.1 Air Transport Activity

Figure 50 presents aircraft movements over the period 1990 to 2013. Data for Shannon airport post 2008 was not available at the time of writing. Total movements increased by 28% (1.4% per annum), from 246,777 in 1990 to 316,125 in 2008. Between 2008 and 2013 aircraft movements at Dublin airport reduced by 20% from 211,890 to 170,357 while those at Cork reduced by 29% from 61,876 to 43,790.

Figure 50 *Aircraft movements 1990 – 2013*



Source: Dublin Airport Authority

Figure 51 and *Table 30* show the number of passengers who travelled through Ireland's three main airports[58] over the period 1990 to 2013. Passenger numbers rose from 7.8 million in 1990 to a maximum of 29.8 million in 2008, an increase of 281% (7.7% per annum). In 2013 passenger numbers were 23.8 million, down 20% from 2008 (-4.4% per annum). Travel to mainland Europe has become the dominant category, accounting for over 50% of all passenger numbers in 2013 for the first time, having increased by 699% since 1990. Domestic travel in contrast reduced by 97% between its peak in 2007 of over 2.1 million passengers to a low of just under 67,000 in 2012. However domestic travel increased by 21% in 2013 to just under 81,000 passengers.

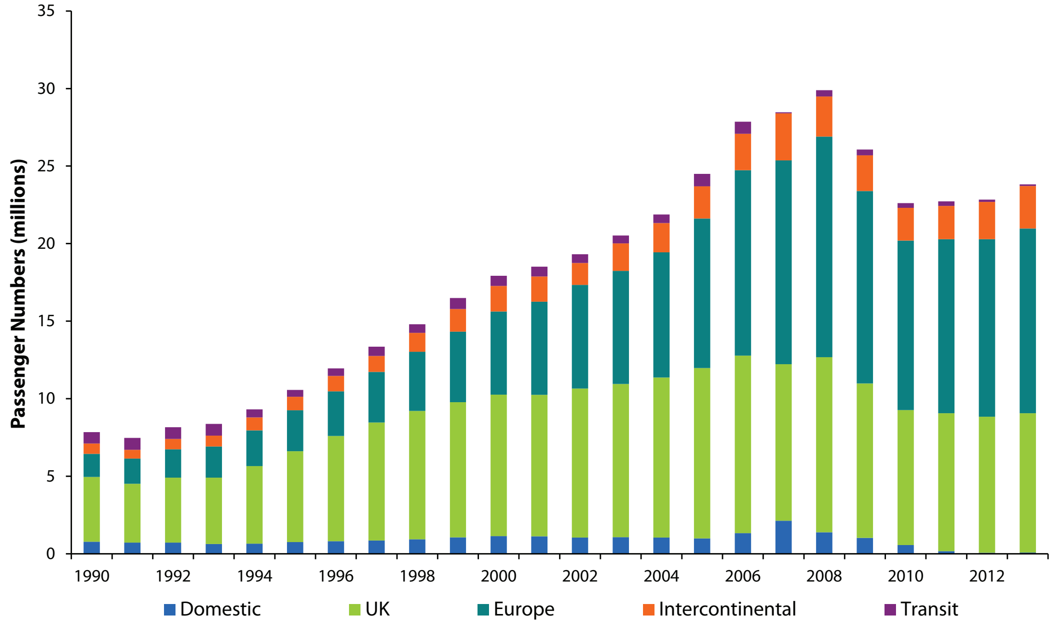
Table 30 *Air passenger travel 1990 – 2013*

	'000 Passengers			% Share		% Growth			% Annual Growth	
	1990	2008	2013	1990	2013	'90 – '13	'90 – '08	'08– 13	'90 – '08	'08– '13
UK	4,178	11,296	8,985	53	38	115	170	-20	5.7	-4.5
Europe	1,490	14,221	11,904	19	50	699	854	-16	13.4	-3.5
Intercontinental	664	2,585	2,743	8	11	313	289	6	7.8	1.2
Domestic	773	1,385	81	10	0	-90	79	-94	3.3	-43.3
Transit	742	409	112	9	1	-85	-45	-73	-3.3	-22.8
Total	7,847	29,896	23,825	-	-	204	281	-20	7.7	-4.4

Source: Dublin Airport Authority

58 Cork, Dublin and Shannon.

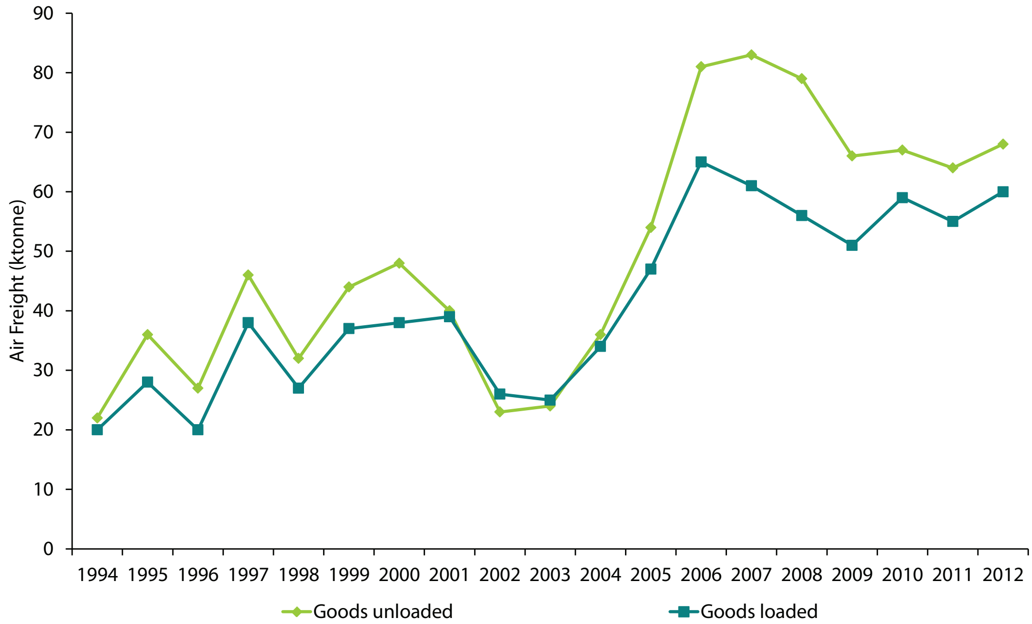
Figure 51 *Air passenger travel 1990 – 2013*



Source: Dublin Airport Authority

Figure 52 and *Table 31* show data from Eurostat[59] on the total tonnage of air freight loaded and unloaded in Ireland for the period 1994 to 2012. Total air freight reached a maximum in 2007 of 133 kt. This reduced to 112 kt in 2009 and was 127 kt in 2012.

Figure 52 *Tonnes of air freight flown into and out of Ireland 1994 – 2012*



Source: EuroStat

59 For further details see http://epp.eurostat.ec.europa.eu/portal/page/portal/transport/data/database

Table 31 *Air freight through Ireland 1994 – 2012*

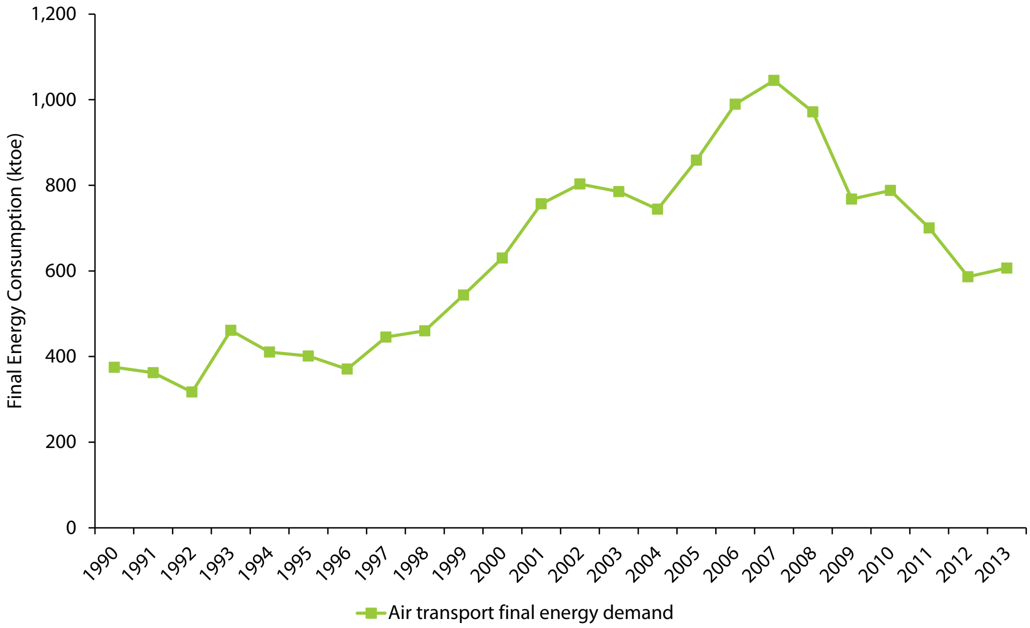
	Air Frieght (kt)									
	1994	2000	2005	2006	2007	2008	2009	2010	2011	2012
Freight Unloaded	22	48	54	81	83	79	66	67	64	68
Freight Loaded	20	38	47	65	61	56	51	59	55	60
Total Freight	43	77	89	132	133	127	112	122	113	127

Source: EuroStat

4.6.2 Estimation of Air Transport Energy Demand

The energy demand of aviation is estimated based on the sales of jet kerosene. The total demand is apportioned into international and domestic based on internal take-off and landing cycles and distances covered. The estimated aviation energy demand is shown in *Figure 53*. Between 1990 and 2007 it grew 179% from 375 ktoe to 1,045 ktoe (6.2% per annum). This was followed by a decline to 587 ktoe in 2012, a fall of 44% while 2013 saw an increase of 3.4% to 607 ktoe.

Figure 53 *Estimated aviation energy demand 1990 – 2013*



Source: SEAI

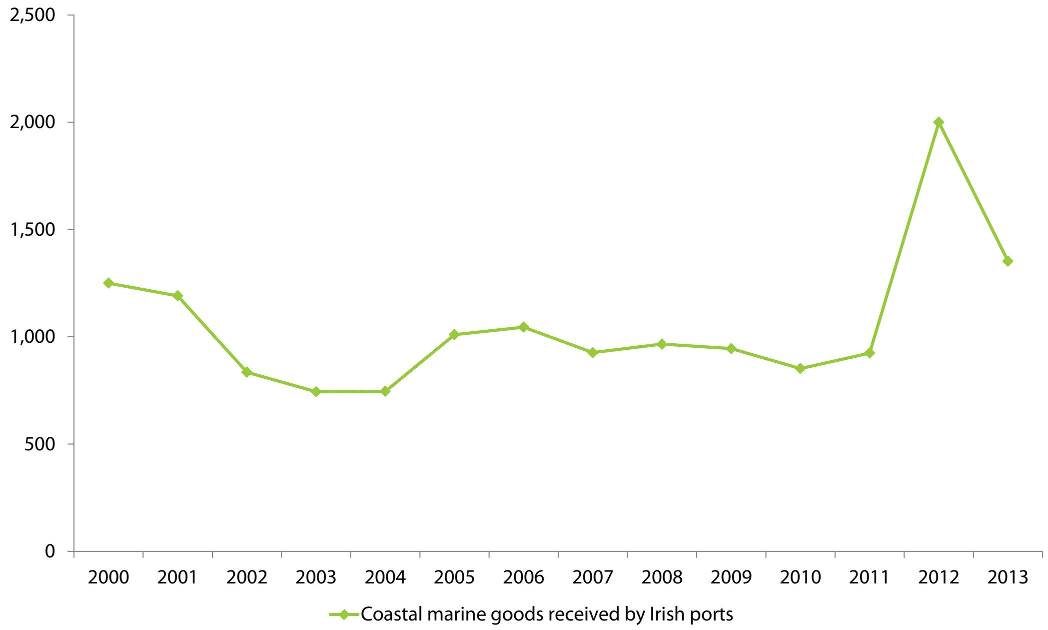
4.7 Coastal Marine and Inland Waterway Navigation

Coastal marine and inland waterway navigation, also known simply as “Navigation”, accounts for fuel used by watercraft or sea going vessels operating in coastal or inland waters, excluding that used for international sea transport of passengers or freight or by fishing vessels. International sea passenger and freight transport energy use is counted under international marine bunkers and is not considered under the national energy balance. Energy use in fishing vessels is accounted for under agriculture and fisheries.

4.7.1 Navigation Activity

Less data are available on this subsector than others both in terms of metrics of activity and in terms of data required for a robust estimation of the energy demand. *Figure 54* shows data from the CSO on the tonnage of coastal marine freight transport received at Irish ports between 2000 and 2013. No data are available on the activity levels of other forms of marine navigation such as private leisure craft.

Figure 54 *Tonnes of coastal marine freight passing through Irish ports 2000 – 2013*



Source: CSO

4.7.2 Estimation of Navigation Energy Demand

Navigation energy demand is estimated based on sales of marine diesel. *Figure 55* below shows the estimated final energy consumption for the period 1990 to 2013. Estimated energy demand increased from a low base in the early 1990s of approximately 7 ktoe to a peak of 81 ktoe in 2008, declining to 57 ktoe in 2013. The trend for energy demand in this mode is currently poorly understood.

Figure 55 *Estimated navigation energy demand 1990 – 2013*

Source: SEAI

4.8 Fuel Tourism

Fuel tourism is an added factor affecting transport energy use in Ireland. Fuel tourism is defined as fuel that is bought within the State by private motorists and hauliers but consumed outside the State. Fuel price differences between states act as an incentive for fuel tourism, for both freight hauliers and private motorists. Assessments of transport energy demand in Ireland should normally seek to exclude fuel tourism in order to correctly link trends with underlying factors. This is complicated by the fact that UNFCCC reporting guidelines relating to greenhouse gas emissions require that emissions be reported on the basis of domestic sales rather than domestic consumption. In this report, fuel consumption and emissions refer to the amount sold as opposed to used in the Republic of Ireland (ROI).

4.8.1 Fuel Price Differentials Between the Republic of Ireland and the UK

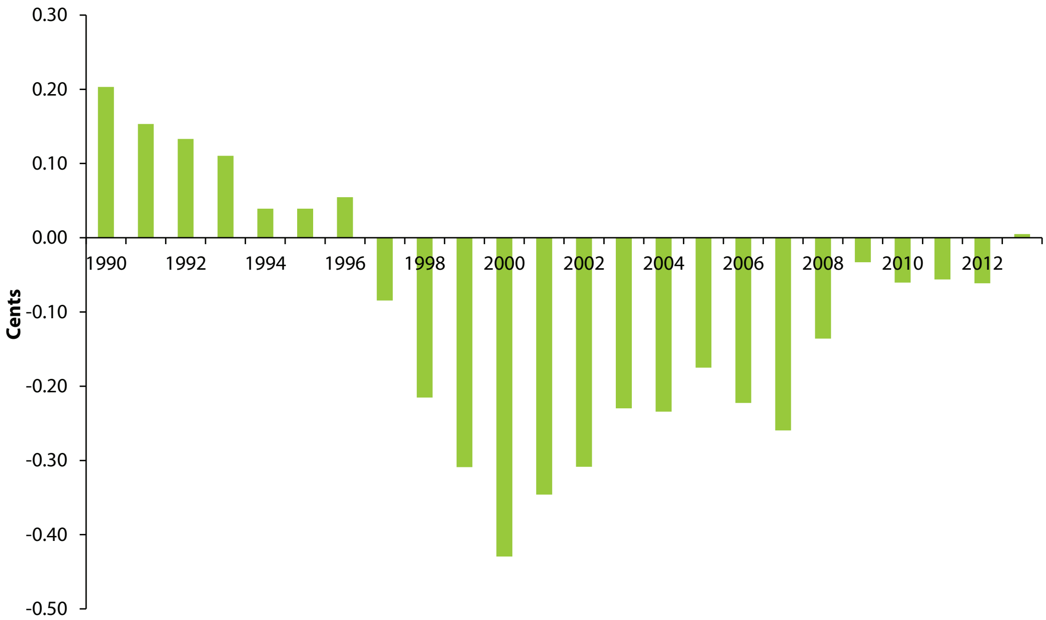
The key determinant of fuel tourism is the relative price of fuel between countries. *Table 32* and *Figure 56* present 'at the pump' Irish and UK unleaded petrol prices for the period 1990 to 2013. 1997 was the first year in which the price of petrol became more expensive in the UK than in ROI. The differential increased quickly to 43 cent in 2000, which was the maximum recorded differential over the time period. In 2013 the price of petrol in the ROI was marginally more expensive (0.5 cent) than that in the UK for the first time since 1996.

Table 32 *Petrol prices for the Republic of Ireland and the UK 1990 – 2013*

Unleaded petrol (€)	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012	2013
Ireland	0.76	0.69	0.89	1.09	1.12	1.12	1.24	1.12	1.30	1.48	1.62	1.59
UK	0.56	0.65	1.32	1.27	1.34	1.38	1.37	1.15	1.36	1.54	1.68	1.58
Difference	0.20	0.04	-0.43	-0.18	-0.22	-0.26	-0.14	-0.03	-0.06	-0.06	-0.06	0.00

Source: Eurostat

Figure 56 *Difference in petrol prices for the Republic of Ireland and the UK 1990 – 2013*



Source: Eurostat

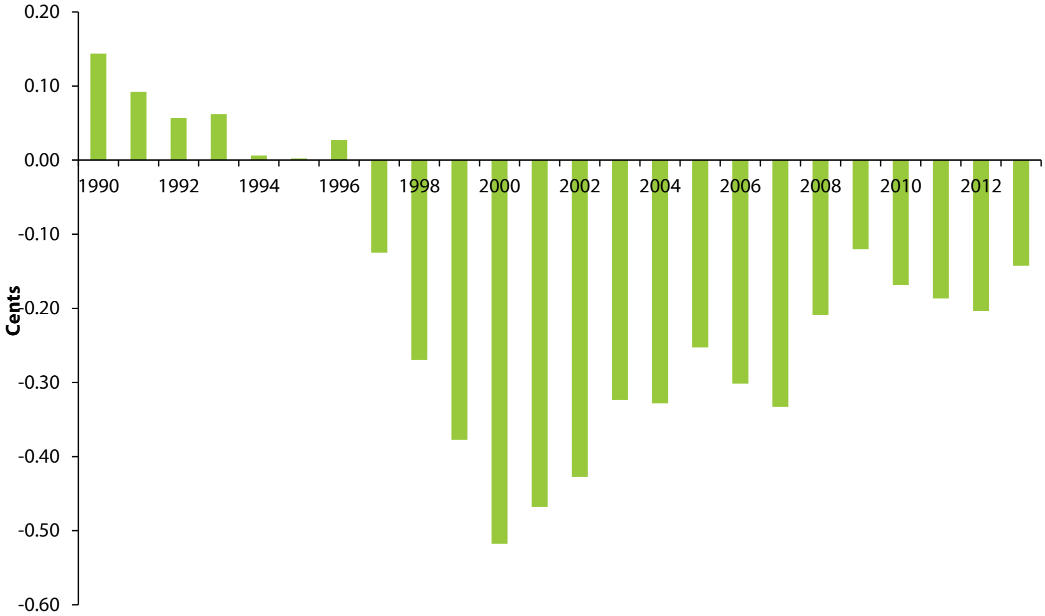
Table 33 and *Figure 57* show diesel prices for the same period. Diesel prices were more expensive in the UK from 1997 onwards. The largest differential in the price of diesel between Ireland and the UK occurred in 2000 when diesel was 52 cent cheaper in Ireland than in the UK. In 2013 diesel was 14 cent cheaper per litre in Ireland than in the UK.

Table 33 *Diesel prices for the Republic of Ireland and the UK 1990 – 2013*

Auto Diesel (€)	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012	2013
Ireland	0.68	0.66	0.82	1.07	1.10	1.08	1.29	1.05	1.22	1.41	1.55	1.51
UK	0.54	0.65	1.34	1.33	1.40	1.42	1.50	1.17	1.39	1.60	1.76	1.66
Difference	0.14	0.00	-0.52	-0.25	-0.30	-0.33	-0.21	-0.12	-0.17	-0.19	-0.20	-0.14

Source: Eurostat

Figure 57 *Difference in diesel prices for the Republic of Ireland and the UK 1990 – 2013*



Source: Eurostat

4.8.2 Estimated Energy Consumption due to Fuel Tourism

The Department of the Environment, Community and Local Government produces estimates of petrol and diesel sold in Ireland but consumed outside the State.[60] These estimates are used by SEAI and are shown in the form of final energy demand for the period 1990 to 2013 in *Figure 58* below.

Figure 58 *Estimated final energy demand due to fuel tourism*

Source: Department of the Environment, Community and Local Government

60 DEHLG, 2006, *Ireland's Pathway to Kyoto: Compliance Review of the National Climate Change Strategy*, http://www.environ.ie.

5 Analysis of National Car Test and Commercial Vehicle Roadworthiness Test Data

As discussed in section *4*, SEAI uses data from the National Car Test (NCT) and the Commercial Vehicle Roadworthiness Test (CVRT) to estimate the annual energy demand of a number of modes of transport, namely private cars, taxi/hackneys and, more recently, light goods vehicles. SEAI calculates the average annual mileage[61] of these vehicles based on the odometer readings from the NCT and CVRT databases. Anonymized NCT data was first made available to SEAI in 2006 by Applus, the company responsible for the operation of the NCT scheme in Ireland. Updated NCT data has been made available annually since then and in 2013 data from the CVRT was made available by the Road Safety Authority. Use of these rich, low level data sets enables more in-depth analysis of trends within individual modes of transport than would otherwise be possible through the use of more high level, aggregate data, for instance on overall fuel sales.

5.1 National Car Test Data

The NCT was introduced in Ireland in January 2000. Private cars are first tested under the NCT after four years, then every two years and annually after ten years. Taxi/hackneys are first tested in the year in which they are first registered as a taxi/hackney and annually thereafter.

NCT testing was introduced on a phased basis as follows:

- Year 2000: Cars first registered before 1st January 1992
- Year 2001: Cars first registered between 1992 and 1996
- Year 2002 onwards: All four-year-old cars and eligible older cars
- From June 2011 cars over ten years old are required to be tested annually.

One of the variables recorded as part of the test is the odometer reading (in most cases representing current vehicle mileage). Due to the testing schedule data for private cars, vehicles currently less than four years old are not included in the database. This means that the figures for average mileage in this analysis refer to the sample of NCT-tested cars rather than the population of all cars. As additional years of data become available, these cars will be included as they are tested but the lag of four years will remain. The sample, however, is large enough to ensure that the results provide a reasonable proxy of the population.

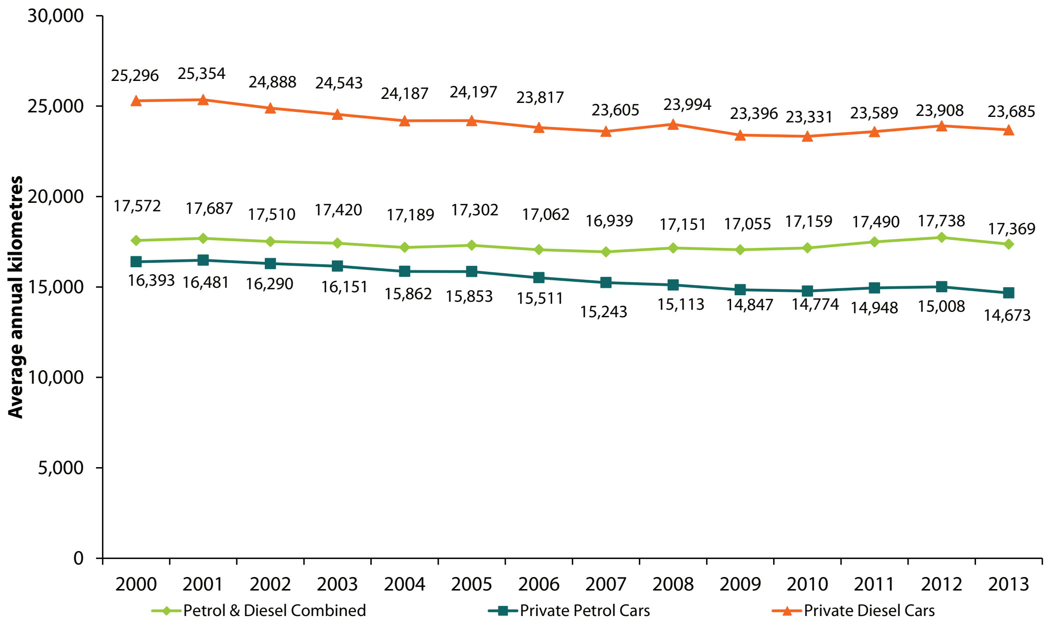
5.1.1 Private Car Average Annual Mileage

Figure 59 presents the results of the NCT analysis for 2000 to 2013. The combined average mileage for petrol and diesel cars in 2013 was 17,369 kilometres (10,793 miles). Diesel cars had an average mileage of 23,685 km (14,718 miles). The average for petrol cars was 14,673 km (9,117 miles). Overall average annual mileage per private car fell by 2.1% in 2013, compared to 2012. The decrease for petrol cars was 2.2%, and for diesel cars 0.9%. Over the period 2000 to 2013 the average mileage for all private cars fell by 1.2% (0.1% per annum on average). Over this period petrol car annual mileage fell by 10.5% (0.8% per annum) while diesel car average mileage fell by 6.4% (0.5% per annum).

The data suggests that average annual mileage is decreasing in Ireland, while section *4.2.1.1* showed that ownership rates are increasing. Many households now own two cars. This will, typically, increase the transport energy usage per household but will also reduce the per car average mileage.

61 Mileage in this report is used as a generic term to describe distance travelled in either miles or kilometres.

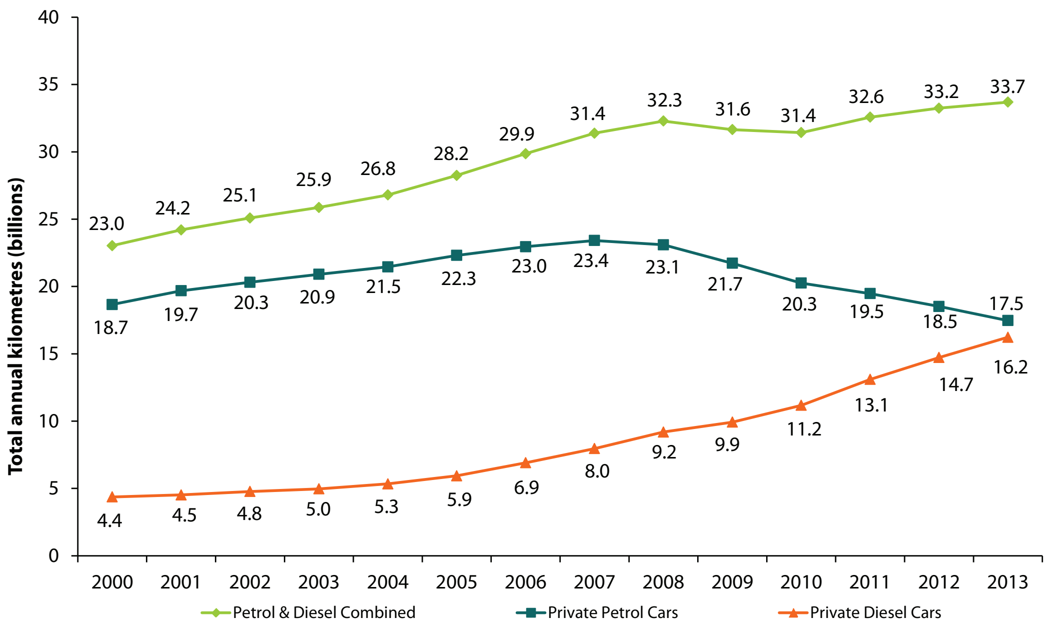
Figure 59 *Private car average annual mileage 2000 – 2013*



Source: Based on NCT data

As shown in *Figure 60*, the overall total vehicle kilometres travelled by all private cars increased by 46% over the period 2000 to 2013. This in turn has led to increased private car fuel consumption (as detailed in section *4.2.2.3*). Total mileage for petrol cars fell by 6.4% and that for diesel cars increased by 271%.

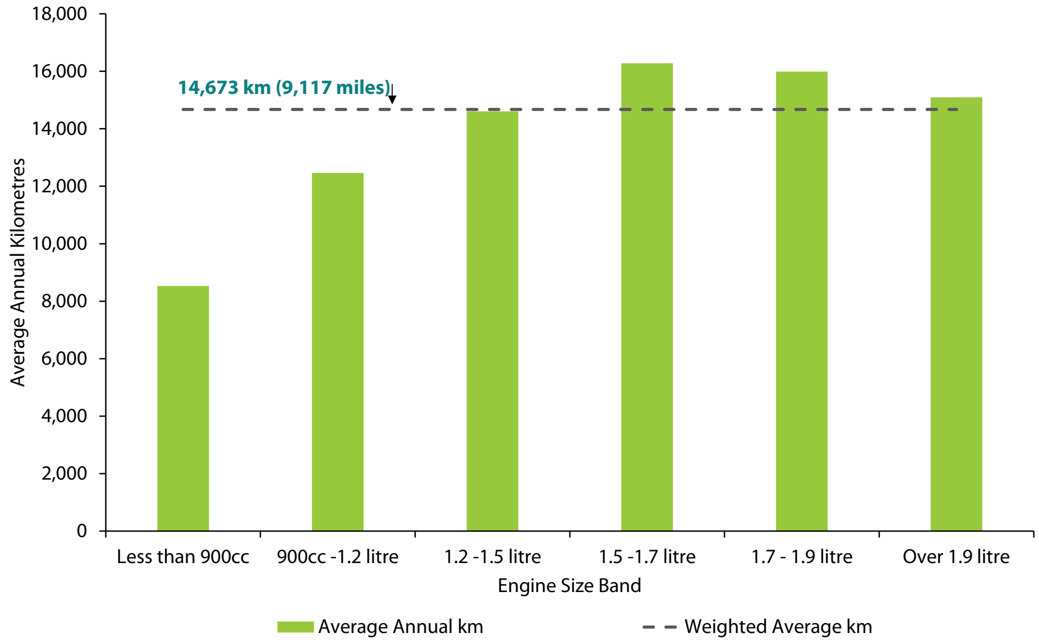
Figure 60 *Private car total annual mileage 2000 – 2013*



Source: Based on NCT data

Figure 61 presents the average annual mileage for different categories of petrol engine size band in 2013. It can be seen that smaller cars tend to have a lower annual mileage than the larger bands, though the greatest mileages are recorded in the 1.5 to 1.7 litre band. The band with the greatest number of vehicles is the 1.2 to 1.5 litre while the band with the least number of vehicles is the less than 900cc, leading to a weighted average of 14,673 km (9,177 miles).

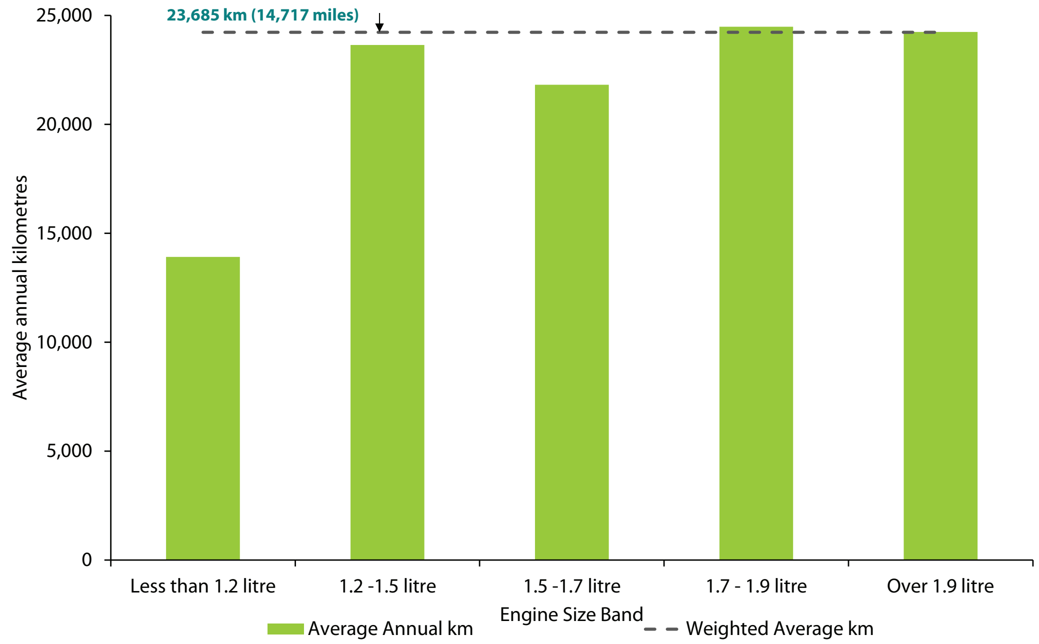
Figure 61 *Petrol car average annual mileage by engine size band 2013*



Source: Based on NCT data

Figure 62 presents data for diesel engine size bands in 2013. Again, vehicles in the lowest engine size band cover lower mileages, however there are only a small number of diesel cars in the lowest three bands, so the weighted average is dominated by the two highest bands.

Figure 62 *Diesel car average annual mileage by engine size band 2013*



Source: Based on NCT data

Using the new mileage data and the specific fuel consumption data from section *4.2.2*, it is possible to estimate expenditure on petrol and diesel for a selection of engine size bands. The fuel consumption values given for new cars are measured under set test conditions. It has been found that average real world fuel consumption values are typically 20% higher than the results of these tests. Therefore the standard values were increased by 20% to arrive at on-road fuel consumption For the purposes of comparison, an overall mileage estimate of 20,000 km per annum is used. A petrol price of €1.59/litre and a diesel price of €1.51/litre is assumed.

Table 34 presents estimates of the different emissions categories of petrol vehicle examined in section *4.2.2*. For the same annual mileage, vehicles in the highest emissions band use more than double the petrol and cost over three times more to run per annum (petrol costs and annual road tax only).

Table 34 *Estimates of annual cost (fuel & road tax) of petrol cars by emissions category*

Vehicle category petrol	Average test consumption (litres/100km)	Estimated fuel consumption per annum (litres)	Estimated fuel cost per annum (€)	Annual Road Tax (2012)	Total Cost
A (<=120 gCO_2/km)	4.9	1,177	€1,558	€172	€1,730
B (121 – 140 gCO_2/km)	5.6	1,341	€1,775	€275	€2,050
C (141 – 155 gCO_2/km)	6.4	1,541	€2,039	€390	€2,429
D (156 – 170 gCO_2/km)	7.0	1,674	€2,216	€570	€2,786
E (171 – 190 gCO_2/km)	7.7	1,849	€2,447	€750	€3,197
F (191 – 255 gCO_2/km)	8.8	2,102	€2,782	€1,200	€3,982
G (> 255 gCO_2/km)	11.3	2,723	€3,604	€2,350	€5,954

Source: Based on Department of Transport, Tourism & Sport and NCT data

Table 35 presents estimates of the different emissions categories of diesel vehicle examined in section *4.2.2*. Again for the same annual mileage, vehicles in the highest emissions band use approximately 2.2 times the diesel and again costs almost 3.5 times more to run per annum (diesel costs and annual road tax only).

Table 35 *Estimates of annual cost (fuel & road tax) of diesel cars by emissions category*

Vehicle category diesel	Average test consumption (litres/100km)	Estimated fuel consumption per annum (litres)	Estimated fuel cost per annum (€)	Annual Road Tax (2012)	Total Cost
A (<=120 gCO_2/km)	4.3	1,042	€1,315	€172	€1,487
B (121 – 140 gCO_2/km)	5.1	1,221	€1,540	€275	€1,815
C (141 – 155 gCO_2/km)	5.7	1,365	€1,721	€390	€2,111
D (156 – 170 gCO_2/km)	6.1	1,474	€1,860	€570	€2,430
E (171 – 190 gCO_2/km)	6.8	1,634	€2,061	€750	€2,811
F (191 – 255 gCO_2/km)	8.2	1,973	€2,489	€1,200	€3,689
G (> 255 gCO_2/km)	9.6	2,308	€2,912	€2,350	€5,262

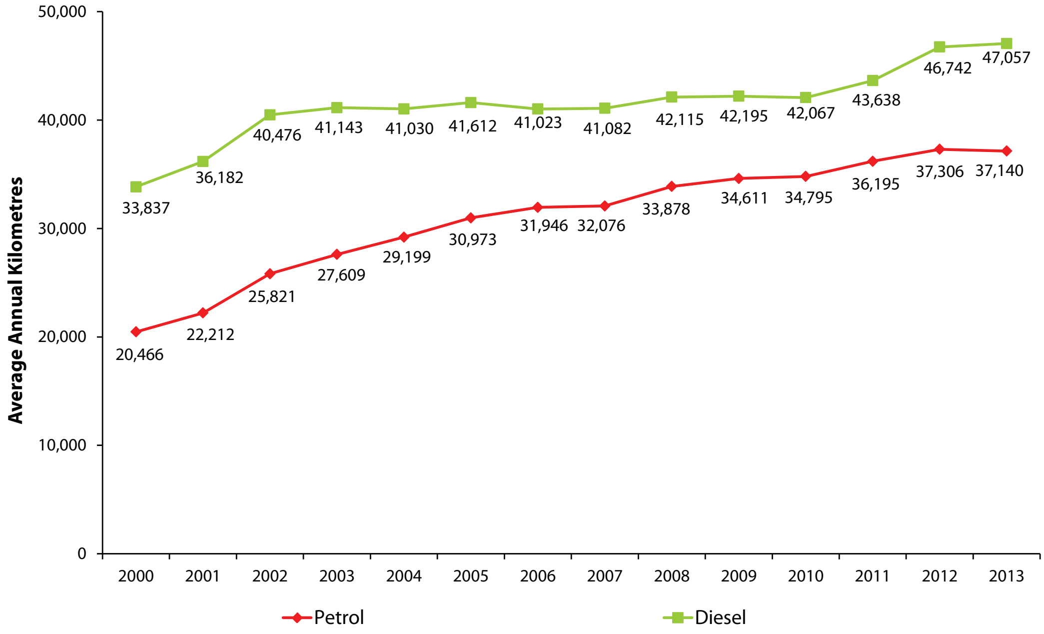
Source: Based on DEHLG and NCT data

Interestingly, comparing *Table 34* and *Table 35*, the difference in running costs between petrol and diesel varies by between €243 in band A to €691 in band G. But there is a more significant difference in costs between adjacent bands of the same fuel type. For instance the estimated annual cost difference for petrol cars in band A over band B is €320 (€103 of which is road tax) while that for band F over band G is €1,971 (€1,150 of which is road tax). Similarly for diesel cars the estimated annual cost difference of band A over band B is €328 and band F over band G is €1,574.

5.1.2 Taxi/Hackney Average Annual Mileage

As mentioned in section *5.1*, all taxi/hackney vehicles are also required to undergo an NCT test annually. *Figure 63* presents the annual average mileage data for petrol and diesel taxi/hackney vehicles for 2000 to 2013.

Figure 63 *Taxi /hackney average annual mileage 2000 – 2013*



Source: Based on NCT data

Over the period, the average mileage increased by 82% (4.7% per annum) for petrol taxi/hackney vehicles and by 39% (2.6% per annum) for diesel vehicles. A breakdown by engine size category is not available but it can reasonably be assumed that most vehicles will be at the larger end of the engine size range.

The levels of mileage for taxis are approximately double those of private cars, which is to be expected as they are working vehicles. The trend in average mileage per vehicle for taxis is rising, whereas the trend for private cars is falling gradually.

5.2 Commercial Vehicle Roadworthiness Test Data

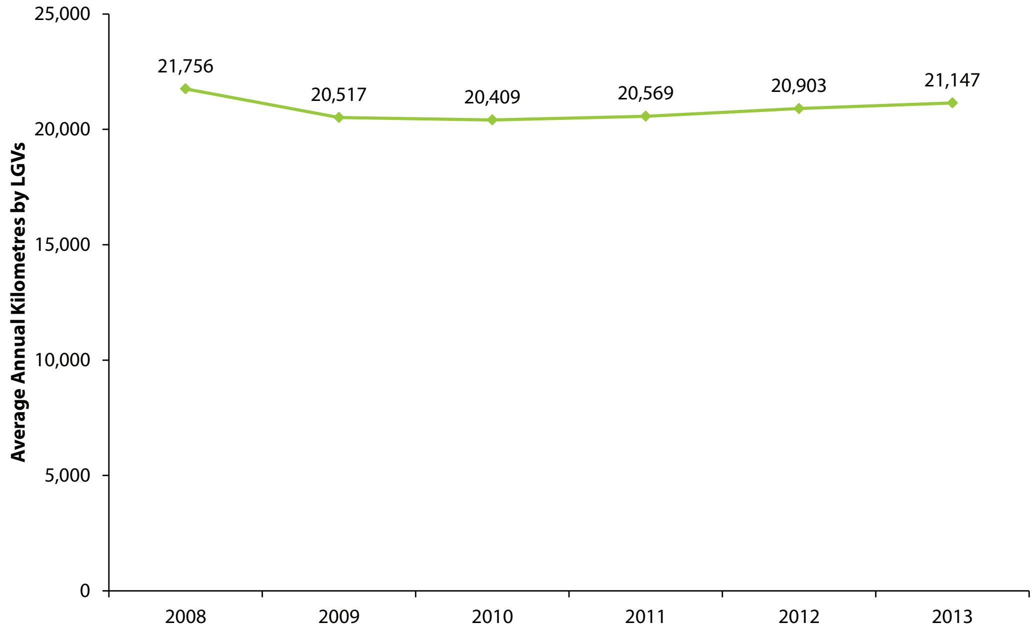
In accordance with EU Directive 2009/40/EC, all EU Member States are required to test for roadworthiness of motor vehicles and trailers. In Ireland the Road Safety Authority Commercial Vehicle Roadworthiness Act of 2012 reformed the system of testing commercial vehicles and transferred the responsibility for the management and operation of the commercial vehicle testing system from local authorities to the Road Safety Authority (RSA)[62]. One outcome of this reform was the centralisation of the data from commercial vehicle testing to a single IT system. Data from this new CVRT database was made available to SEAI in 2013 and contains mileage data from odometer readings back to 2007.

5.2.1 Light Goods Vehicles

All commercial vehicles are required to be tested annually. This data allows us to calculate the average mileage of the entire stock of LGVs back to 2008. The results of this analysis are shown in *Figure 64*. Between 2008 and 2010 the average annual mileage fell by 6% from 21,756 km to 20,409 km. It increased to 21,147 in 2013, 3% below 2008.

62 For further information see www.cvrt.ie and www.rsa.ie/en/RSA/Your-Vehicle/Your-Vehicle-/Commercial-Vehicle-Testing-/

Figure 64 *LGV average annual mileage 2008 – 2013*



Source: SEAI

6 Transport Sector Energy Demand, Carbon Emissions and Targets

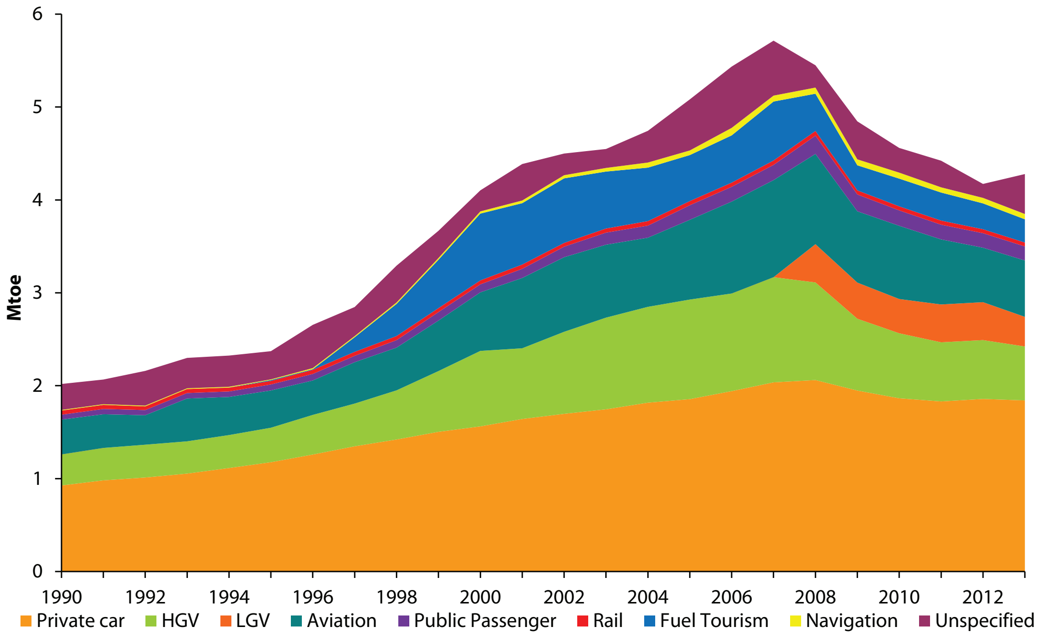
6.1 Transport Energy Consumption and Carbon Dioxide Emissions by Mode

As discussed in section *4*, for the purposes of this report the transport sector in Ireland is split into the following modes:

- Private cars, as discussed in section *4.2*
- Heavy goods vehicles, as discussed in section *4.3.2*
- Light goods vehicles, as discussed in section *4.3.3*
- Public-passenger vehicles, as discussed in section *4.4*
- Rail, as discussed in section *4.5*
- Aviation, as discussed in section *4.6*
- Coastal marine and inland waterway navigation, as discussed in section *4.7*
- Fuel tourism, as discussed in section *4.8*
- Unspecified

Figure 65 and *Table 36* show the transport sector's energy usage over the period 1990 to 2013 split by mode of transport.

Figure 65 *Transport final energy consumption by mode 1990 – 2013*



Source: SEAI

Table 36 *Growth rates and shares of transport final energy consumption by mode 1990 – 2013*

	Growth %	Average annual growth rates %					Quantity (ktoe)		Shares %	
Mode	1990 – '13	'90 – '13	'00 – '05	'05 – '10	'10 – '13	2013	1990	2013	1990	2013
HGV Road Freight	74	2.5	5.7	-8.2	-6.0	-8.4	334	581	16.6	13.6
LGV Road Freight	-	-	-	-	-4.7	-21.8	-	319	-	7.5
Private Car	99	3.2	3.5	0.1	-0.4	-0.9	926	1,842	45.9	43.0
Public Passenger	189	4.9	12.7	1.2	-3.0	-3.1	52	151	2.6	3.5
Rail	-6	-0.3	1.2	-0.6	-1.3	-1.0	45	42	2.2	1.0
Aviation	62	2.2	6.4	-1.7	-8.4	3.4	375	607	18.6	14.2
Fuel Tourism	-	-	-7.2	-9.6	-5.7	-10.2	0	250	0.0	5.8
Navigation	690	9.9	16.0	5.4	-3.9	-3.5	7	57	0.4	1.3
Unspecified	54	2.0	19.4	-13.5	17.4	186.3	279	430	14	10.1
Total	**112**	**3.5**	**4.4**	**-2.1**	**-2.1**	**2.5**	**2,019**	**4,279**	**100**	**100**

Source: SEAI

In the period 1990 to 2013 the total final energy consumption (TFC) of the transport sector increased 112% from 2,019 to 4,280 ktoe. There is a clear divide to be seen in consumption trends pre and post 2007, due in large part to the economic downturn that began in 2008. Between 1990 and 2007 final energy consumption increased 186% to 5,772 ktoe while between 2007 and 2013 consumption fell by 26%.

Road transport, consisting of private car, HGV and LGV road freight and public-passenger vehicles accounted for 69% of the total final consumption in the transport sector in 2013, and thus for 27% of economy-wide total final consumption. In 2013 the largest category, private car consumed 1.8 Mtoe[63] and was responsible for 63% of road transport consumption and 43% of total transport final consumption.

HGV road freight in particular has been affected by the both the economic boom and the recession, experiencing both the greatest increase in the period 1990 to 2007 (239% from 334 to 1,132 ktoe) and the greatest contraction in the period 2007 to 2013 (44% from 1,132 to 633 ktoe).

Aviation, including domestic and international, was second only to road freight in its volatility over the period. It grew 179% from 375 ktoe to 1,045 ktoe between 1990 and 2007 (6.2% per annum). This was followed by a decline to 587 ktoe in 2012, a fall of 44%. 2013 saw an increase of 3.4% to 607 ktoe.

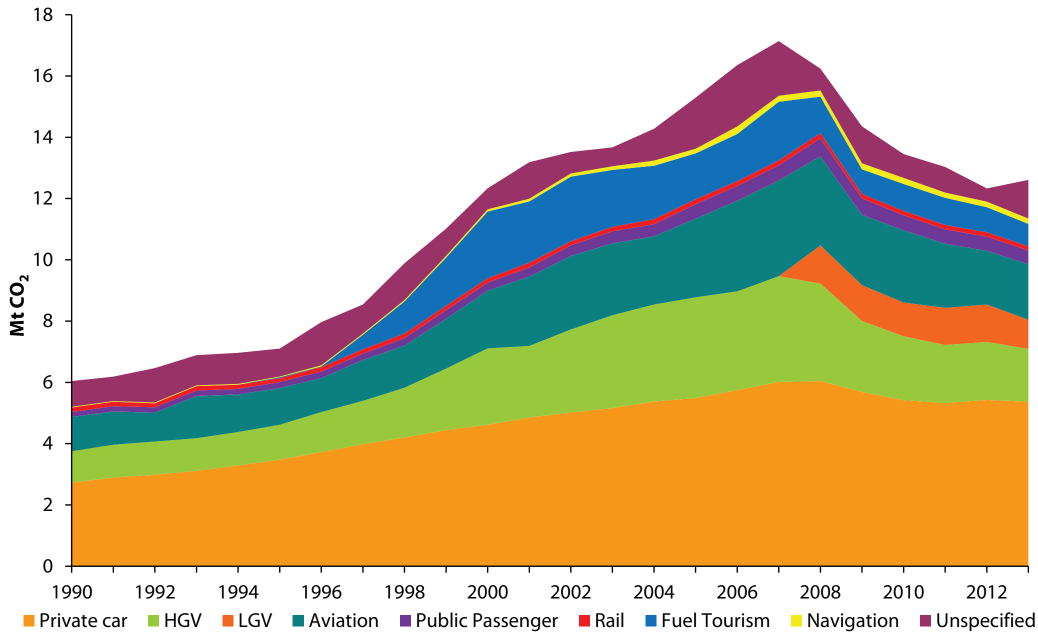
Between 1990 and 2013 public-passenger vehicles TFC grew by 189% (4.9% per annum) from 52 to 151 ktoe.

Combined petrol and diesel fuel tourism is also included in *Figure 65*. Only fuel tourism out of the Republic of Ireland (ROI) is included in this report i.e. fuel which is purchased in ROI but consumed elsewhere. Before 1997, the trend was negative – that is, fuel was purchased outside and consumed within the State.

Figure 66 and *Figure 67* show the energy-related CO_2 emissions resulting from the transport sector. The 2007 peak is again evident. Total emissions in 2007 were 17,141 kt CO_2, an increase of 184% on 1990. Between 2007 and 2013 CO_2 emissions fell by 26% to 12,618 kt CO_2, 109% above 1990 levels, or equivalent to the level of emissions in the year 2000. Road private car, the largest category throughout the time period, was responsible for 43% (5,372 kt CO_2) of the total in 2013, followed by HGV road freight on 15% (1,882 kt CO_2) and international aviation for 14% (1,813 kt CO_2).

63 Million tonnes of oil equivalent.

Figure 66 *Transport CO_2 emissions by mode 1990 – 2013*



Source: SEAI

Figure 67 *Growth rates and shares of transport CO_2 emissions by mode 1990 – 2013*

	Growth %	Average annual growth rates %					Quantity (kt CO_2)		Shares %	
Mode	**1990 – '13**	**'90 – '13**	**'00 – '05**	**'05 – '10**	**'10 – '13**	**2013**	**1990**	**2013**	**1990**	**2013**
HGV Road Freight	68	2.4	5.7	-8.7	-6.1	-8.9	1,025	1,726	17.0	13.7
LGV Road Freight	-	-	-	-	-4.8	-22.3	-	949	-	7.5
Private Car	97	3.1	3.5	-0.3	-0.3	-1.1	2,728	5,369	45.1	42.6
Public Passenger	180	4.8	12.6	0.6	-3.0	-3.5	160	448	2.7	3.6
Rail	-7	-0.3	2.2	-1.8	-2.1	-3.3	148	137	2.4	1.1
Aviation	62	2.2	6.4	-1.7	-8.4	3.4	1,121	1,813	18.5	14.4
Fuel Tourism	-	-	-7.2	-10.1	-5.9	-10.6	0	731	0.0	5.8
Navigation	718	10.0	16.0	5.4	-2.8	0.0	22	176	0.4	1.4
Unspecified	32	1.3	19.5	-14.2	12.4	156.2	839	1,261	13.9	10.0
Total	**109**	**3.4**	**4.4**	**-2.5**	**-2.1**	**2.3**	**6,043**	**12,609**	**100**	**100**

Source: SEAI

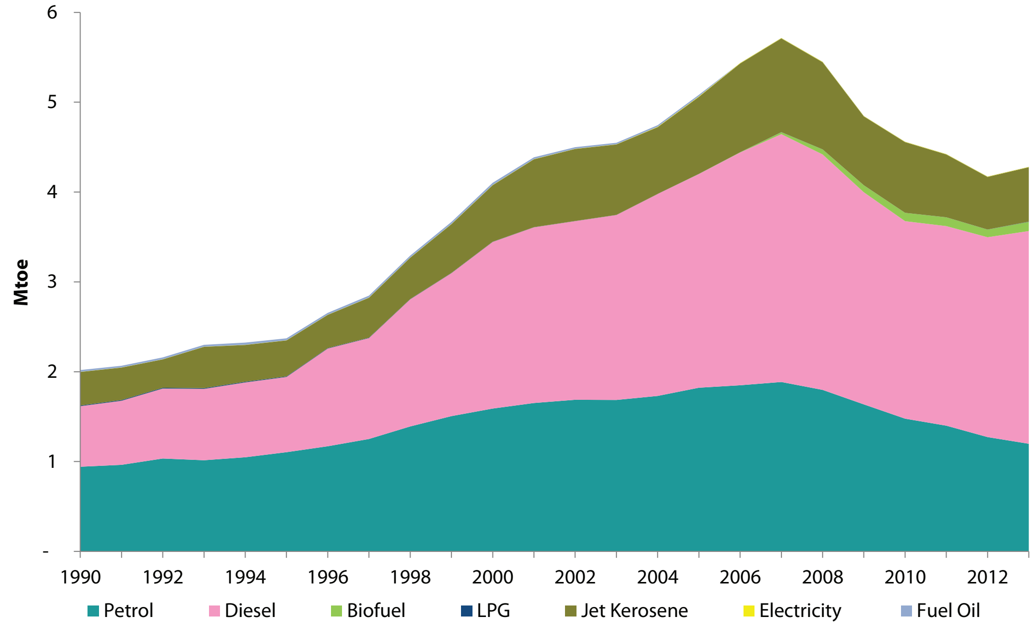
6.2 Total Final Energy Consumption by Fuel Type

Figure 68 and *Table 37* detail the trends in final energy consumption in transport by fuel type over the period. Diesel had a share of Total Final Energy Consumption (TFC) of transport in 2013 of 55%, followed by petrol at 28% and kerosene at 14%. There were also small quantities of electricity, liquid petroleum gas (LPG) and renewables. Note that in *Figure 68* and *Table 37* "Renewables" in this case is comprised only of liquid biofuels, as no other form of renewable energy is utilised apart from renewable electricity, which is counted for under electricity.

Between 2007 and 2013 the use of biofuels grew by 374%; however, quantities were small in comparison to overall transport energy consumption – usage of biofuels rose from 3 ktoe in 2006 to 22 ktoe in 2007 and subsequently to 102 ktoe in 2013.

The largest increase among oil products over the time period was in diesel consumption which increased more than threefold (251% growth or 5.6% per annum). Kerosene consumption was 62% higher in 2013 than in 1990 and petrol was 27% higher. It is interesting to note from *Table 37* the switch in shares of petrol and diesel between 1990 and 2013. Petrol had a 47% share of transport fuels in 1990, falling to 28% in 2012, while diesel share rose from 33% in 1990 to 55% in 2013.

Figure 68 *Transport sector total final consumption 1990 – 2013*



Source: SEAI

Table 37 *Growth rates and shares of final energy consumption in transport*

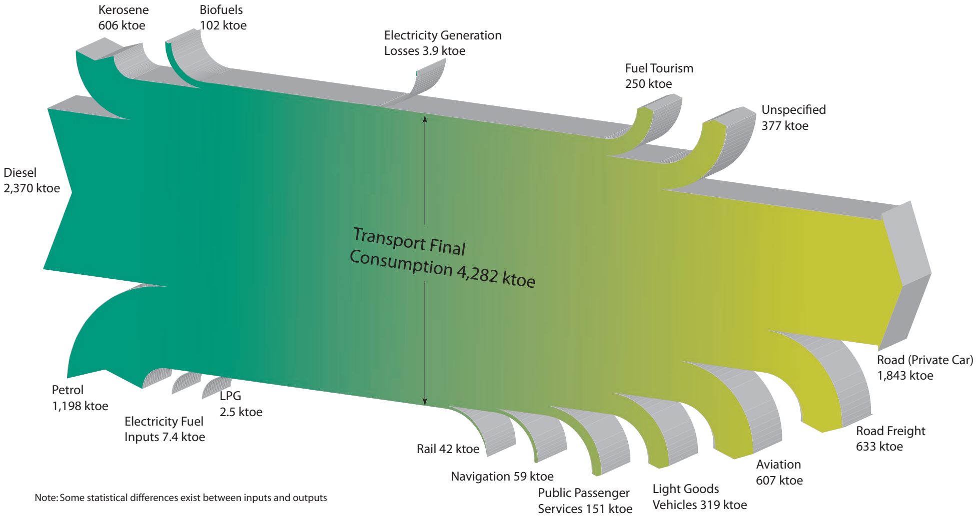
	Growth %	Average annual growth rates %					Quantity (ktoe)		Shares %	
	1990 – 2013	'90 – '13	'00 – '05	'05 – '10	'10 – '13	2013	1990	2013	1990	2013
Fossil Fuels	107	3.2	4.4	-2.5	-2.2	2.3	2,017	4,173	99.9	97.5
Petrol	27	1.0	2.8	-4.1	-6.8	-5.8	942	1,198	46.7	28.0
Diesel	251	5.6	5.1	-1.6	2.5	6.5	674	2,368	33.4	55.3
Kerosene	62	2.1	6.4	-1.7	-8.4	3.4	374	606	18.5	14.1
LPG	-81	-7.0	-14.1	-12.8	36.3	30.4	7	1	0.3	0.0
Renewables	-	-	-	142.8	3.4	20.5	-	102	0.0	2.4
Combustible Fuels (Total)	112	3.3	4.4	-2.1	-2.1	2.6	2,017	4,275	99.9	99.9
Electricity	161	4.3	17.8	-5.0	-2.8	-7.0	1	4	0.1	0.1
Total	**112**	**3.3**	**4.4**	**-2.1**	**-2.1**	**2.6**	**2,019**	**4,279**	**100**	**100**

Source: SEAI

6.3 Energy Flow in the Transport Sector

Figure 69 presents Ireland's transport sector energy balance for 2013 as an energy flow diagram. Total primary energy requirement by fuel type is shown as inputs on the left and total fuel consumption by mode is shown as outputs on the right. The assumptions for road freight, private car and taxi/hackney vehicles are detailed in Appendix A.1. Fuel tourism data comes from an analysis conducted by DEHLG. Electricity generation losses associated with electricity consumption for DART and Luas services are also included. The key features discussed previously can again be seen, for instance the dominance of oil based products on the supply side, the relative weighting of private car transport compared to road freight, bus and rail on the demand side, as well as the sizeable contribution to demand of fuel tourism.

Figure 69 *Energy flow in transport sector 2013*



Source: SEAI

6.4 Targets and Indicators

The latest *Energy in Ireland* report[64] describes in detail the policies and targets relating to both greenhouse gas (GHG) emissions and renewable energy in Ireland and presents the latest data on Ireland's progress towards these targets. This section discusses the targets relevant to the transport sector.

6.4.1 Carbon Dioxide (CO_2) Emissions Targets

There are a number of policies that set GHG emissions targets for Ireland. None of these set specific targets for the transport sector, but two of them consider emissions from the transport sector as part of the overall targets; these are the Kyoto Protocol and the non-emissions trading scheme target.

The Kyoto Protocol is an international legally binding agreement to reduce GHG emissions. Ireland's target was that the average annual emissions in the years 2008 to 2012 should not exceed a level of 13% above the emissions in 1990. This target was applied across the entire economy, with no sector specific targets.

In 2008, the EU agreed a climate energy package that included a target to reduce GHG emissions across the EU by 20% below 1990 levels by the year 2020. This resulted in two specific pieces of GHG emissions legislation affecting Ireland, one relating to the emissions from companies within the Emissions Trading Scheme (ETS) and one relating to all activities in the economy not covered by the ETS, referred to as non-ETS emissions. Non-ETS emissions include those from areas such as housing, agriculture, industrial processes not covered under the ETS and also transport. Under an effort sharing agreement Ireland is required to reduce its non-ETS emissions by 20% below 2005 levels by 2020. Again, this target applies only at the aggregate level across all non-ETS emissions, and no targets are specified for particular subsectors such as transport.

Although neither the Kyoto nor the non-ETS targets consider transport sector emissions in isolation, it is useful to examine how the transport sector fared in contributing towards the broader effort of meeting the overall targets. At the national level Ireland's emissions reached a peak in 2001 at 12% above the Kyoto target before falling slightly to 8% above the target in 2008 and declining in 2009 to 1% below the target and further to 8% below the target in 2012, meaning that Ireland achieved the overall Kyoto target.

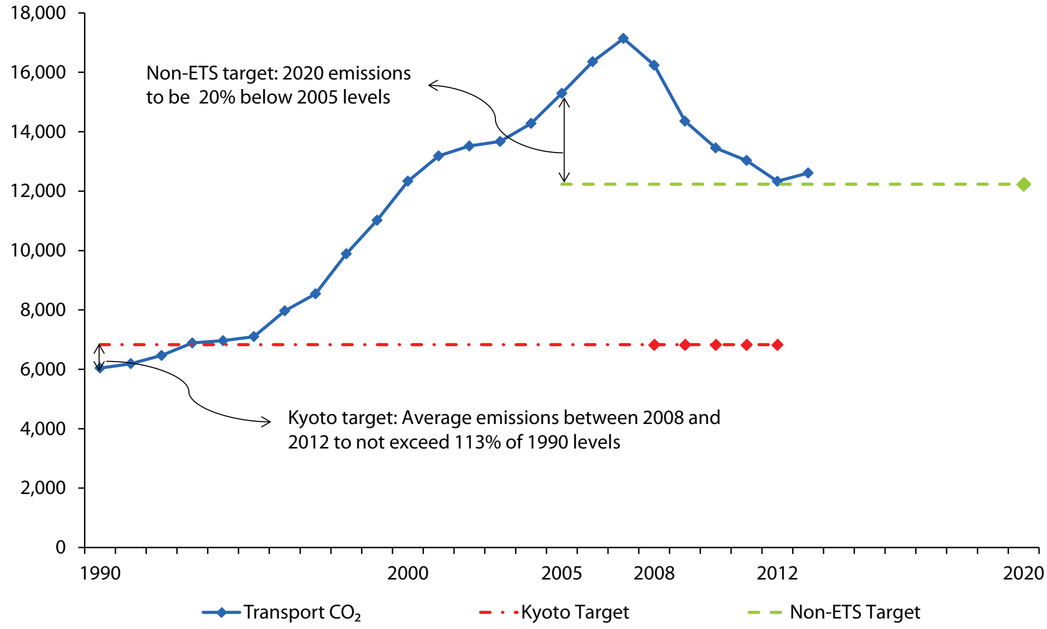
Figure 70 shows CO_2 emissions from the transport sector for the period 1990 to 2013 along with both the Kyoto and non-ETS targets. Note that although shown here is CO_2 emissions, the targets are specified in terms of GHG emissions, and so also include emissions such as NO_2 and CH_4. Looking at the contribution of transport sector CO_2 emissions towards the Kyoto target, it can be seen from *Figure 70* that taken in isolation the transport sector failed dramatically to limit emissions growth to within the Kyoto level of 13% above 1990 levels. Transport sector CO_2 emissions reached a peak of 184% above 1990 levels in 2007 before reducing to 169% above 1990 levels in 2008 and falling further to 109% above 1990 levels in 2012. The average annual CO_2 emissions between 2008 and 2012 were 130% above 1990 levels. This meant that other sectors of the economy had to overachieve GHG emissions reductions in order to compensate for the excess in the transport sector.

64 Most recent edition at time of writing *Energy in Ireland 1990 – 2012; 2013 report*, www.seai.ie.

Shown also in *Figure 70* is the non-ETS target of a 20% reduction in overall GHG emissions below 2005 levels by 2020 applied to transport CO_2 emissions. The first thing to note is that in the context of the transport sector this target allows considerably more emissions than Kyoto, due to the use of 2005 as the base year rather than 1990. Transport CO_2 emissions in 2005 were 153% higher than in 1990, with the result that the non-ETS target is 79% higher than that of the Kyoto agreement, when applied specifically to the transport sector. Peak transport sector CO_2 emissions occurred in 2007 and reached 12% above 2005 levels, or 40% above the non-ETS target. CO_2 emissions declined every year between 2007 and 2012 reaching 19.4% below 2005 levels in 2012, before increasing again in 2013 to 17.5% below 2005 levels.

If Ireland returns to significant economic growth in the period to 2020 and if the historical trend for transport carbon emissions to be strongly coupled with economic growth continues then the transport sector will once again contribute negatively to the overall effort of GHG emissions abatement and will require extra measures in other areas of the economy to compensate.

Figure 70 *Transport sector CO_2 emissions and equivalent reduction targets 1990 – 2020*



Source: SEAI

6.4.2 Renewable Energy Targets

The most recent *Renewable Energy in Ireland*[65] report discusses renewable energy in more detail examining the relevant national and international policy context and the contribution of renewable energy sources to the electricity, thermal and transport energy markets. Presented here is a summary of the data relating to the transport sector, updated where possible with new data.

6.4.2.1 Overall RES-T targets

Transportation is the energy consuming sector that is most difficult to decarbonise; it is also the sector most exposed to volatile oil prices due to its reliance on imported oil. The Renewable Energy Directive 2009/28/EC established a mandatory minimum 10% target for the contribution of renewable energy as a share of all petrol, diesel, biofuels and electricity consumed in road and rail transport energy by 2020. According to the Directive for this target a weighting of 2.5 is applied to the electricity from renewable energy sources consumed by electric road vehicles, where the contribution is calculated as the energy content of the input of electricity from renewable energy sources, measured two years before the year in question. Also supported through a weighting factor of 2 are advanced biofuels, and biofuels from waste; that is, biofuels that diversify the range of feedstocks used to become commercially viable receive an extra weighting compared to first generation biofuels. In Ireland the vast majority of renewable energy in transport, over 99% in unweighted energy terms in 2013, is in the form of biofuels, with renewable electricity accounting for less than 1%, the majority of this being supplied to electric rail services.

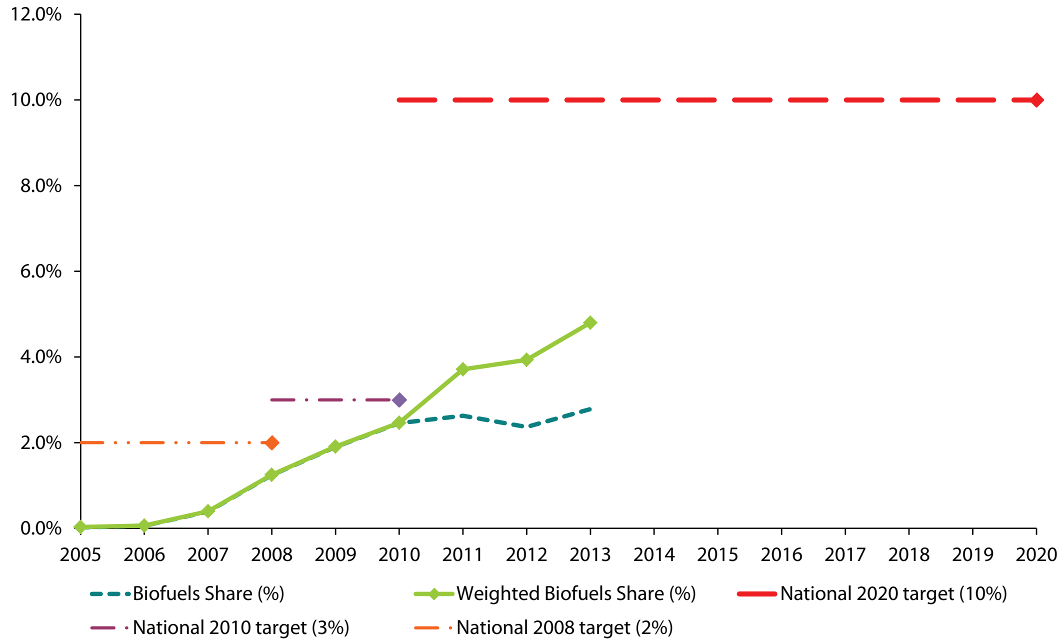
65 SEAI, 2014, *Renewable Energy in Ireland 2012*, www.seai.ie

6.4.2.2 Biofuels

Under the Biofuels Obligation Act 2010 suppliers of fuel for road transport were required to include an average of 4% biofuels by volume (approximately 3% in energy terms) in their sales between 1st July 2010 and the end of 2012. As of the start of 2013 the requirement is 6.383%[66] by volume.

Figure 71 presents data on the percentage penetration of biofuels, as a share of road transport energy, in accordance with the definition in the EU Biofuels Directive (2003/30/EC), both with and without the weighting specified in the Renewable Energy Directive 2009/28/EC. It illustrates the dramatic recent growth in biofuels used for transport, albeit from a low base. Note that the RES-T targets cover all forms of renewable energy, including renewable electricity, but as discussed previously the amount of renewable electricity used to date is almost negligible. It is evident from *Figure 71* that the growth coincided with the introduction of tax relief support for biofuels, with slow growth to 0.06% in 2006 followed by an increase to 1.2% in 2008 and 2.6% in 2010. The Mineral Oil Tax Relief scheme (MOTR II) ended in 2010 with the introduction of the Biofuels Obligation Scheme. The weighted share of biofuels in transport energy (RES-T) in 2013 is 4.8%. It can also be seen from *Figure 71* that the EU Directive 2003/30/EC target for RES-T of 2% by 2008 was not met. In addition, the Government target of 3% RES-T by 2010 was not met but was surpassed in 2011.

Figure 71 *Biofuels as a proportion of road and rail transport energy (RES-T) 2005 – 2013*



Source: SEAI

Table 38 shows the data behind *Figure 71* in absolute terms. The top section of *Table 38* shows, in energy terms, the amounts of petrol, diesel and biofuel used in transport for the purposes of calculating the RES-T percentage. Beneath these, in bold, is the biofuel penetration rate calculated without reference to double counting of second generation biofuels and biofuels produced from waste. The bottom section of the table shows the energy value of the biofuels taking into account the weighting allowed for the double counting and below this, in bold, the subsequent calculation of the RES-T percentage arising from this.

66 Office of the Attorney General, (Dec. 2012), *S.I. No. 562/2012 - National Oil Reserves Agency Act 2007 (Biofuel Obligation Rate) Order 2012*, http://www.irishstatutebook.ie/2012/en/si/0562.html

Table 38 *Biofuels growth in ktoe and as a proportion of road and rail transport energy 2005 – 2013*

ktoe	2005	2006	2007	2008	2009	2010	2011	2012	2013
Petrol	1,822	1,883	1,920	1,830	1,666	1,505	1,425	1,296	1,198
Diesel	2,378	2,590	2,758	2,615	2,378	2,236	2,221	2,225	2,370
Biofuels (ktoe)	1	3	22	56	77	93	98	85	102.2
Biofuel Penetration	***0.0%***	***0.1%***	***0.5%***	***1.2%***	***1.9%***	***2.4%***	***2.6%***	***2.4%***	***2.8%***
Weighted biofuels (ktoe)	1	3	19	56	78	93	138	141	176
Weighted biofuels share	***0.0%***	***0.1%***	***0.5%***	***1.2%***	***1.9%***	***2.7%***	***3.7%***	***3.9%***	***4.8%***

Source: SEAI

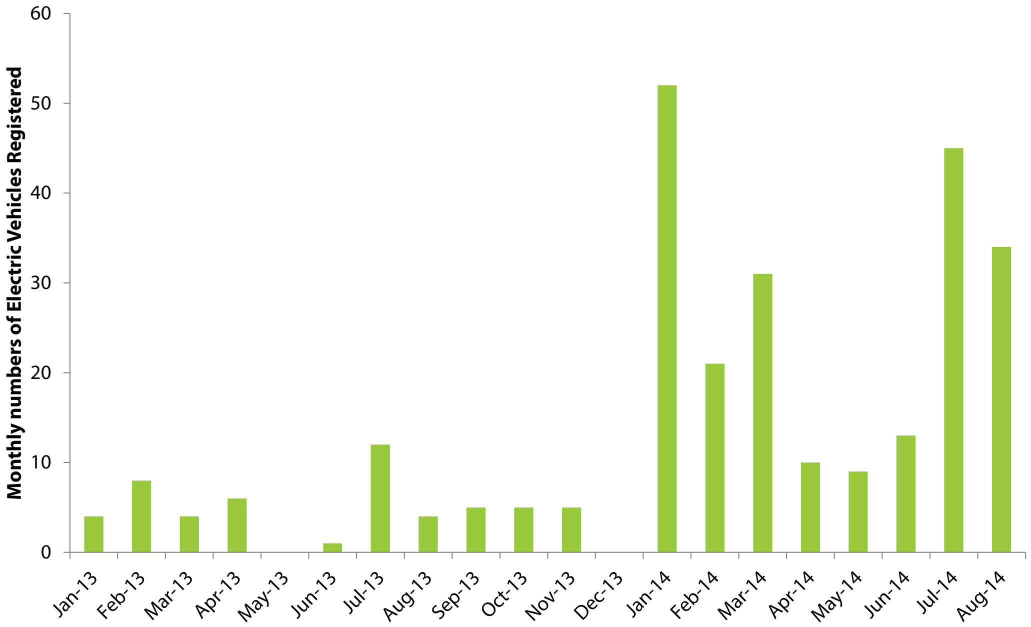
6.4.3 Electric Vehicles Targets

Electric vehicles (EVs) have been identified as having an important role in achieving both energy efficiency and renewable energy targets[67]. In April 2011 a grant programme was launched together with VRT relief of up to €5,000 per vehicle to support EVs in order to generate the critical mass necessary to assist in the development of an EV market in Ireland. In parallel a nationwide programme to roll-out EV charging points was begun and at the end of January 2014, 819 public charge points had been installed, including 48 DC fast chargers, with 95% of all major towns and cities having EV recharging infrastructure in place.

Ireland set an initial target of converting 10% of its passenger and light commercial vehicle stock to electric vehicles by 2020 (roughly equivalent to 230,000 vehicles). According to the Vehicle Registration Unit of the Department of Transport, Tourism & Sport , at the end of 2013 there were a total of 420 EVs licensed in Ireland, including 251 passenger vehicles, 63 goods vehicles, 53 motorcycles and 53 other EVs (taxi, forklift etc). This number represents less than 0.2% of the initial target for 2020. This lower than anticipated uptake of EVs has led to a downward revision of the estimated number of EVs in the fleet by 2020. It is now projected that the adoption rate of EVs will rise steadily from 0.5% of new vehicles in 2014 to 15% in 2020, resulting in 50,000 EVs in 2020.

Data for 2014 show that there has been a significant increase in the uptake of EVs in the year to date. *Figure 72* shows data on the number of EVs registered by month from January 2013 to August 2014. There were 215 vehicles registered up to the end of August 2014, compared to just 54 in the whole of 2013. The upswing in demand for EVs is due in part to the general increase in motor sales and also likely due to the entrance of new manufactures and car models to the EV market.

Figure 72 *Monthly registrations of electric vehicles January 2013 – August 2014*



Source: SEAI

67 Department of Communications Energy and Natural Resources, 2014, *National Energy Efficiency Action Plan 2014*, http://www.dcenr.gov.ie/NR/rdonlyres/20F27340-A720-492C-8340-6E3E4B7DE85D/0/DCENRNEEAP2014publishedversion.pdf

6.4.4 Transport Energy Efficiency

6.4.4.1 National Energy Efficiency Action Plan

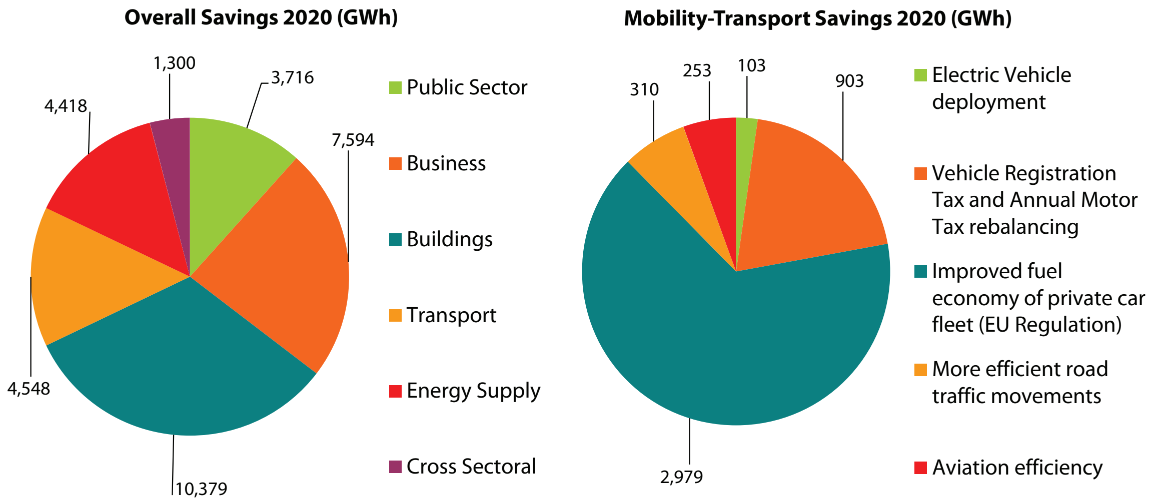
In response to the requirements of the Energy Services Directive[68] (ESD) the Department of Communications Energy and Natural Resources published Ireland's first National Energy Efficiency Action Plan[69] (NEEAP) in May 2009. Ireland's second NEEAP[70] was launched in February 2013 and the third and final NEEAP was released in August 2014[71].

The NEEAP sets out a suite of policies and measures to deliver energy efficiency savings with three specific targets. Rather than specifying absolute limits to total energy consumption as was done for GHG emissions in the Kyoto protocol, under the ESD targets are framed in terms of savings with respect to a counter factual baseline which estimates the theoretical energy consumption that would have resulted had particular measures not been implemented. The quantities of savings required are specified as percentages of the average energy consumption over the period 2001 – 2005. The targets set out in the NEEAP are as follows:

- Total savings of 9%, equivalent to 17,130 GWh or 1,473 ktoe in all sectors by 2016, as required by the ESD
- Total savings of 20% equivalent to 34,060 GWh or 2,929 ktoe in all sectors by 2020
- Savings of 33% equivalent to 3,240 GWh or 279 ktoe in the public service by 2020.

The details of the policies and measures implemented as part of the NEEAP, the methodologies for calculating the savings attributed to each and the savings achieved to date are provided most recently in the third NEEAP. Shown in *Figure 73* is the overall energy savings target for 2020 broken down by sector. The transport sector accounts for 14% of the total energy efficiency savings identified. Shown also are the energy savings targeted for the transport sector according to each individual measure. It can be seen that the majority of the energy savings (66%) are expected to come from the EU regulations on improved fuel economy of new private cars.

Figure 73 *National Energy Efficiency Action Plan 2020 energy savings targets*



Source: Department of Communications, Energy & Natural Resources

6.4.4.2 ODEX

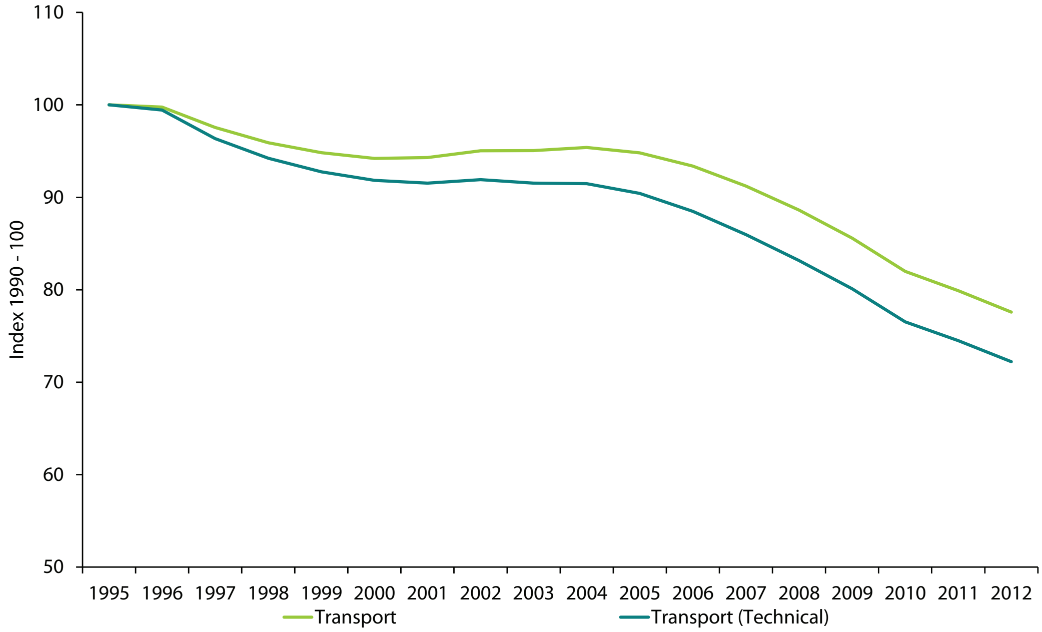
Energy efficiency is covered in detail in the report *Energy Efficiency in Ireland (2009)*[72] published by SEAI. This section draws from aspects of that report on transport energy efficiency.

Analysis of energy efficiency trends across the EU has been carried out since 1993 through the Odyssee[73] project, which includes Irish involvement through SEAI. Through this project a set of indicators have been developed

68 Directive 2006/32/EC; Full details are available at http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2006:114:0064:0064:en:pdf
69 Full details are available at http://www.dcenr.gov.ie/NR/rdonlyres/FC3D76AF-7FF1-483F-81CD-52DCB0C73097/0/NEEAP_full_launch_report.pdf
70 Full details are available at http://www.dcenr.gov.ie/NR/rdonlyres/B18E125F-66B1-4715-9B72-70F0284AEE42/0/2013_0206_NEEAP_PublishedversionforWeb.pdf
71 http://www.dcenr.gov.ie/NR/rdonlyres/20F27340-A720-492C-8340-6E3E4B7DE85D/0/DCENRNEEAP2014publishedversion.pdf
72 SEAI, 2009, *Energy Efficiency in Ireland*, www.seai.ie.
73 For full details of the project go to www.odyssee-indicators.org.

which measure achievements in energy efficiency at the level of the main energy end-uses in the economy. A key development in the Odyssee project has been the formulation of a new set of energy efficiency indicators, known as ODEX. These provide an alternative to the usual energy intensities used to assess energy efficiency changes at the sectoral or economy level. They include factors only related to energy efficiency and exclude changes in energy use due to other effects such as climate fluctuations, changes in economic and industry structures, lifestyle changes, etc. The overall ODEX indicators for the transport sector are shown in *Figure 74*.

Figure 74 *Transport ODEX 1995 – 2012*



Source: SEAI

A decrease in the ODEX is equivalent to an increase in energy efficiency. The transport-observed ODEX fell by 9% over the period 1995 to 2007 (0.8% per annum) and fell a further 15% in the period 2007 – 2012 (3.2% per annum), with the result that in 2012 the observed ODEX was 22% below that in 1995; that is to say the energy efficiency of the transport sector increased 22% between 1995 and 2012, as measured using the ODEX.

The technical ODEX is an estimate of the technical progress in energy efficiency of vehicles that would have occurred had the average engine size of the fleet remained the same as 1995. The technical ODEX decreased by 14% between 1995 and 2007 (1.3% per annum) and a further 16% between 2007 and 2012 (3.4% per annum), with the 2012 index being 28% below that in 1995.

The principle driver of this reduction was the increase in technical efficiency of the private car stock, where the unit consumption of the overall car stock was down 31% relative to 1995.

7 Conclusions

The transport sector in Ireland is the largest fuel consumer in the economy and the sector with the largest share of energy-related CO_2 emissions:

- It accounted for 33% (4,326 ktoe) of Ireland's primary energy demand in 2013 and 40% (4,279 ktoe) of final energy consumption.
- Final energy use in the transport sector remained 112% above 1990 levels in 2013, having increased to 183% above 1990 levels in 2007, before declining by 26% in the period 2007 to 2013.
- In 2013, energy use in transport was over 97.5% dependent on oil products, all of which are imported. This has clear implications for Ireland's security of energy supply.
- The sector was responsible for 35% (12.6 Mt CO_2) of Ireland's energy-related CO_2 emissions, higher than any of the other sectors.

The sector is therefore key to a number of energy and climate policy issues for Ireland. This is why it is a focus for policy makers to implement programmes that will mitigate demand for transport energy.

Timely and comprehensive data on energy trends is needed in order to inform policy development. This report aims to provide such data.

The 2007 report identified a number of key data gaps which needed to be filled in order to have a comprehensive understanding of energy and CO_2 trends in the transport sector. Some progress has been made in this respect, notably with the analysis of LGV road freight transport.

There remains scope for improvement, for example:

- the development of improved estimations of fuel consumption in air transport
- further research into HGV energy demand so as to develop an improved estimate the technical energy intensity (toe/tkm value) of the Irish HGV stock
- improved data on the energy demand of private buses
- data on private car passenger kilometres either by means of a transport survey or possibly by assessing occupancy rates from roadside surveys.

Glossary of Terms

Carbon Dioxide (CO_2): A compound of carbon and oxygen formed when carbon is burned. Carbon dioxide is one of the main greenhouse gases. Units used in this report are t CO_2 – tonnes of CO_2, kt CO_2 – kilo-tonnes of CO_2 (103 tonnes) and Mt CO_2 – mega-tonnes of CO_2 (106 tonnes).

Carbon Intensity (kg CO_2/kWh): This is the amount of carbon dioxide that will be released per kWh of energy of a given fuel. For most fossil fuels the value of this is almost constant, but in the case of electricity it will depend on the fuel mix used to generate the electricity and also on the efficiency of the technology employed. Renewable sources of electricity generation, such as hydro and wind, have zero carbon intensity.

Energy Intensity: The amount of energy used per unit of activity. Examples of activity used in this report are gross domestic product (GDP), tonne-kilometres, vehicle kilometres. Where possible, the monetary values used are in constant prices.

Gross Domestic Product: The gross domestic product represents the total output of the economy over a period.

Gross Final Consumption (GFC): The Renewable Energy Directive (2008/28/EC) defines gross final consumption of energy as the energy commodities delivered for energy purposes to manufacturing industry, transport, households, services, agriculture, forestry and fisheries, including the consumption of electricity and heat by the energy branch for electricity and heat production and including losses of electricity and heat in distribution.

Heavy Goods Vehicle (HGV): Goods vehicles with an unladen weight greater than or equal to 2,033 kg

Light Goods Vehicle (LGV) Goods vehicle with an unladen weight of less than 2,033kg

Total Final Consumption (TFC): This is the energy used by the final consuming sectors of industry, transport, residential, agriculture and services. It excludes the energy sector such as electricity generation and oil refining etc.

Total Primary Energy Requirement (TPER): This is the total requirement for all uses of energy, including energy used to transform one energy form to another (eg burning fossil fuel to generate electricity) and energy used by the final consumer.

Energy Units & Conversion Factors

Energy Units

joule (J): Joule is the international (S.I.) unit of energy.

kilowatt hour (kWh): The conventional unit of energy that electricity is measured by and charged for commercially.

tonne of oil equivalent (toe): This is a conventional standardised unit of energy and is defined on the basis of a tonne of oil having a net calorific value of 41686 kJ/kg. A related unit is the kilogram of oil equivalent (kgoe), where 1 kgoe = 10–3 toe.

Energy Conversion Factors

To:	**toe**	**MWh**	**GJ**
From:	*Multiply by*		
toe	1	**11.63**	**41.868**
MWh	0.086	**1**	**3.6**
GJ	0.02388	**0.2778**	**1**

Fuel Energy Content and CO_2 Emissions Factors

Fuel Energy Content

Fuel	Net Calorific Value toe/t	Net Calorific Value MJ/t
Crude Oil	1.0226	42,814
Gasoline (petrol)	1.0650	44,589
Kerosene	1.0556	44,196
Jet Kerosene	1.0533	44,100
Gasoil / Diesel	1.0344	43,308
Residual Fuel Oil (heavy oil)	0.9849	41,236
Milled Peat	0.1860	7,787
Sod Peat	0.3130	13,105
Peat Briquettes	0.4430	18,548
Coal	0.6650	27,842
Liquefied Petroleum Gas (LPG)	1.1263	47,156
Petroleum Coke	0.7663	32,084
	Conversion Factor	**Conversion Factor**
Electricity	86 toe/GWh	3.6 TJ/GWh

Fuel Emission Factors

	t CO_2/TJ (NCV)	g CO_2/kWh (NCV)
Liquid Fuels		
Motor Spirit (Gasoline)	70.0	251.9
Jet Kerosene	71.4	257.0
Other Kerosene	71.4	257.0
Gas/Diesel Oil	73.3	263.9
Residual Oil	76.0	273.6
LPG	63.7	229.3
Naptha	73.3	264.0
Petroleum Coke	92.9	334.5
Solid Fuels and Derivatives		
Coal	94.6	340. 6
Milled Peat	116.7	420.0
Sod Peat	104.0	374.4
Peat Briquettes	98.9	355.9
Gas		
Natural Gas	56.9	204.7
Electricity		
(2013)	135.7	466.9

Data Sources

- Central Statistics Office, Skehard Road, Cork, www.cso.ie
- Department of the Environment, Community and Local Government, Custom House, Dublin 1, www.environ.ie
- (UK) Department of Trade and Industry, 1 Victoria Street, London SW1H 0ET www.dti.gov.uk
- The Directorate-General for Energy and Transport, Brussels, http://ec.europa.eu/dgs/energy_transport/index_en.html
- Dublin Airport Authority, Dublin Airport, www.daa.ie
- EU-funded SAVE II Odyssee Project, http://www.odyssee-indicators.org/
- Eurostat, Luxembourg http://epp.eurostat.cec.eu.int/portal/page?_pageid=1090,30070682,1090_33076576&_dad=portal&_schema=PORTAL
- Iarnród Éireann, Inchicore, Dublin 8, www.irishrail.ie
- National Car Test Service, Lakedrive 3026, Citywest Business Campus, Naas Road, Dublin 24, www.ncts.ie
- Road Safety Authority, Moy Business Park, Primrose Hill, Ballina, Co Mayo, www.rsa.ie
- Revenue Commissioners, Dublin Castle, Dublin 2, http://www.revenue.ie
- (UK) Vehicle Certification Agency, 1 The Eastgate Office Centre, Eastgate Road, Bristol, BS5 6XX, http://www.vca.gov.uk/fcb/new-car-fuel-consump.asp

References

Bosseboeuf, D, 2006, *Personal communication between SEI and Mr Didier Bosseboeuf*, ADEME

Central Statistics Office, 2013, *CSO Statistical Yearbook 2013,* CSO, Skehard Road, Cork or www.cso.ie

Central Statistics Office, 2013, *Transport Omnibus 2012,* CSO, Skehard Road, Cork or www.cso.ie

Central Statistics Office, various years, *Road Freight Surveys,* CSO, Skehard Road, Cork or www.cso.ie

Commission of the European Communities, 2007, *An Energy Policy for Europe*, COM (2007) 1 FINAL

Commission of the European Communities 2007, *Results of the review of the Community Strategy to reduce CO_2 emissions from passenger cars and light-commercial vehicles*, COM(2007) 19 final

Department of Communications, Energy and Natural Resources, 2007, *Delivering a Sustainable Energy Future for Ireland*, www.dcenr.gov.ie/NR/rdonlyres/54C78A1E-4E96-4E28-A77A-3226220DF2FC/30374/EnergyWhitePaper12March2007.pdf

Department of Communications, Energy and Natural Resources, 2009, *Maximising Ireland's Energy Efficiency; The National Energy Efficiency Action Plan 2009 – 2020*, http://www.dcenr.gov.ie/NR/rdonlyres/FC3D76AF-7FF1-483F-81CD-52DCB0C73097/0/NEEAP_full_launch_report.pdf

Department of Communications, Energy and Natural Resources, 2010, *National Renewable Energy Action Plan*, http://www.dcenr.gov.ie/NR/rdonlyres/C71495BB-DB3C-4FE9-A725-0C094FE19BCA/0/2010NREAP.pdf

Department of Communications, Energy and Natural Resource, 2013, *Ireland's Second National Energy Efficiency Action Plan to 2020*, http://www.dcenr.gov.ie/NR/rdonlyres/B18E125F-66B1-4715-9B72-70F0284AEE42/0/2013_0206_NEEAP_PublishedversionforWeb.pdf

Department of Communications, Energy and Natural Resources, 2014, *Green Paper on Energy Policy in Ireland*, http://www.dcenr.gov.ie/NR/rdonlyres/DD9FFC79-E1A0-41AB-BB6D-27FAEEB4D643/0/DCENRGreenPaperonEnergyPolicyinIreland.pdf

Department of Public Expenditure and Reform, 2011, *Infrastructure and Capital Investment 2012 -16: Medium Term Exchequer Framework*

Department of the Environment, Community and Local Government, 2014, *National Climate Policy Position*, http://www.environ.ie/en/Environment/Atmosphere/ClimateChange/NationalClimatePolicy/News/MainBody,37848,en.htm

Department of the Environment, Heritage and Local Government, 2006, *Ireland's Pathway to Kyoto: Compliance Review of the National Climate Change Strategy*, http://www.environ.ie

Department of the Environment, Heritage and Local Government, 2007, N*ational Climate Change Strategy 2007 – 2012,* http://www.environ.ie

Department of Transport, Tourism and Sport, 2013, *Climate Change Mitigation - Preparation of Low-Carbon Roadmap for Transport - Issues Paper for Consultation*, http://www.dttas.ie/sites/default/files/publications/corporate/english/low-carbon-roadmap-transport-sector-issues-paper-december-2013/issues-paper-consultation-preparation-low-carbon-roadmap-transport.pdf

Department of Transport, Tourism and Sport, *Smarter Travel - A Sustainable Transport Future; A New transport Policy for Ireland 2009 – 2020*, http://www.smartertravel.ie/

Environmental Protection Agency, 2014, *Ireland's Greenhouse Gas Emission Projections; 2013 – 2030*, www.epa.ie

European Union, 2003, *Directive 2003/30/EC of the European Parliament and of the Council on the promotion of the use of biofuels or other renewable fuels for transport*, http://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1407423057793&uri=CELEX:02003L0030-20100401

European Union, 2003, *Directive 2003/96/EC on restructuring the Community framework for the taxation of energy products and electricity*, http://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1407423134237&uri=CELEX:02003L0096-20040501

European Union, 2006, *Directive 2006/32/EC of the European Parliament and of the Council on energy end-use efficiency and energy services*, http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32006L0032&from=EN

European Union, 2009, *Directive 2009/28/EC of the European Parliament and of the Council on the promotion of the use of energy from renewable sources*, available from http://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1401881317196&uri=CELEX:02009L0028-20130701

European Union, 2009: *Decision No 406/2009/EC of the European Parliament and of the Council of 23rd April 2009 on the effort of Member States to reduce their greenhouse gas emissions to meet the Community's greenhouse gas emission reduction commitments up to 2020.* Official Journal of the European Union 5.6.2009 L 140/136-148

European Union, 2009: *Directive 2009/29/EC of the European Parliament and of the Council of 23rd April 2009 amending Directive 2003/87/EC so as to improve and extend the greenhouse gas emission allowance trading scheme of the Community.* Official Journal of the European Union 5.6.2009 L 140/63-87

European Union, 2012, *Directive 2012/27/EU of the European Parliament and of the Council on energy efficiency*, http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2012:315:0001:0056:EN:PDF

Howley M and Ó Gallachóir BP, 2009, *Data Gaps and Barriers – Experience from Ireland, Proceedings of IEA Workshop on Data, Analysis and Policy: The three Faces of Energy Efficiency Indicators, January 21–22nd 2009,* http://www.iea.org/Textbase/work/2009/indicators/Howley.pdf

Howley M, Ó Gallachóir BP and Dennehy E, 2009, *The greening of the vehicle registration tax (VRT) and the annual motor tax system in Ireland, Proc Workshop, Monitoring of Energy Demand Trends and Energy Efficiency in the EU (ODYSSEE-MURE)*, May 18–19th 2009, http://www.ucc.ie/serg/pub/ODYSSEE-May09.pdf

International Energy Agency, 2006, *Energy Technology Perspectives, Scenarios & Strategies to 2050,* www.iea.org

Ó Gallachóir BP and Howley M, 2004, *Changing Fleet Structure versus Improved Engine Performance – Energy and CO_2 Efficiency of New Cars Entering the Irish Fleet*, http://www.ucc.ie/serg/pub/VAFSEP.pdf

Office of the Attorney General, 2012, *S.I. No. 562/2012 - National Oil Reserves Agency Act 2007 (Biofuel Obligation Rate) Order 2012*, http://www.irishstatutebook.ie/2012/en/si/0562.html

Polaski K. and Ó Gallachóir BP, 2009, *Driving the Sustainable Energy Agenda, Proceedings of Energy Ireland Conference*, 10th – 11th June 2009, Dublin

Sustainable Energy Authority Ireland, 2003, *Energy and CO_2 Efficiency in Transport – analysis of new car registrations in year 2000*, www.seai.ie

Sustainable Energy Authority Ireland, 2004, *Liquid biofuels strategy study for Ireland,* www.seai.ie

Sustainable Energy Authority Ireland, 2006, *Policy incentive options for liquid biofuels,* www.seai.ie

Sustainable Energy Authority Ireland, 2006, *Security of Supply Metrics – First Report,* www.seai.ie

Sustainable Energy Authority Ireland, 2007, *Response to Department of Finance VRT Consultation,* http://www.finance.gov.ie/documents/publications/vrt/vrtseai.pdf

Sustainable Energy Authority Ireland, 2008, *Energy in Ireland 1990 – 2007,* www.seai.ie

Sustainable Energy Authority Ireland, 2009, *Energy Efficiency in Ireland – 2009 Report*, www.seai.ie

Sustainable Energy Authority Ireland, 2011, *Energy Security in Ireland: A Statistical Overview – 2011 Report*, www.seai.ie

Sustainable Energy Authority Ireland, 2014, *Renewable Energy in Ireland – 2012 Report*, www.seai.ie

Sustainable Energy Authority of Ireland, 2013, *Energy in Ireland 1990–2012*, www.seai.ie

Vehicle Certification Agency, fuel consumption and CO_2 emissions data, http://www.dft.gov.uk/vca/fcb/new-car-fuel-consump.asp

Vehicle Registration Unit, various years, *Irish Bulletin of Vehicle and Driver Statistics,* http://www.dttas.ie/publications?field_sector_tid=4

Appendix: Fuel Consumption Methodology

This report, in section 4, referred to new estimates of fuel consumption for private cars, taxi/hackney vehicles and goods vehicles. This section details the methodology for each of these estimates.

A.1 Private Car and Taxi/Hackney Energy Demand

This section explains the estimation of the energy demand of private cars, as well as taxi/hackneys, as referred to in section *4.2.3* and *4.4.2.2.*

For private cars, the methodology was as follows:

Fuel specific consumption data (combined cycle) for each engine size band was multiplied by the corresponding per car mileage estimate from the analysis of NCT data and then by the number of cars to get the total number of litres of petrol and diesel consumed.

This was then multiplied by a factor of 1.2 to get on-road consumption as opposed to data from the test cycle. Data was converted to ktoe. As data are only available for the period 2000 to 2007, estimates were extrapolated back to 1990 by assuming that the average per car fuel consumption for this period remained constant over the period 1990 to 2000. While this may not be the case, it is currently considered to be the best available method of estimating fuel consumption back to 1990. The estimate of per car fuel consumption was multiplied by the total number of cars per year.

For taxis/hackneys, fuel specific consumption data for each engine size band was not available. Instead, an average of the four largest private car petrol and diesel engine size bands was used. It is believed that this is a reasonable assumption as taxis/hackneys will most likely have larger engine sizes. Another difference from the private car method was that the urban test cycle was used for taxis/hackneys.

The fuel specific consumption average was multiplied by the corresponding per taxi/hackney mileage estimate from the analysis of NCT data and then by the number of cars, to get the total number of litres of petrol and diesel consumed.

Estimates were extrapolated back to 1990 by assuming that the average per taxi/hackney fuel consumption for the period 2000 to 2006 remained constant over the period 1990 to 2000. The estimate of per car fuel consumption was multiplied by the total number of taxis/hackneys per year.

A.2 Light Goods Vehicles Road Freight Energy Demand

As for private cars and taxis, the annual mileage of LGVs was calculated from analysis of the CVRT database. For LGVs, data was not previously available on the specific fuel consumption (l/100km). This was estimated for each unladen weight band by combining data from the CVRT database on the profile of vehicle models in the stock with data from the UK Vehicle Certification Agency (VCA) on the fuel consumption of particular models. The data required for this methodology is fully available back to 2011. In order to estimate over a longer time series we assume that the average fuel consumption of each unladen weight band remained constant from 2008 to 2010, which allows us to extend the estimation back to 2008.

A.3 Heavy Goods Vehicles Road Freight Energy Demand

Data on the technical energy intensity of HGV road freight for the EU27, i.e. the toe/tkm, is available from the Odyssee[1] project. Data are available for the period 1990 to 2011. In the absence of further data it has been assumed that the intensity remained constant from 2011 to 2013, this will be updated as new data becomes available. Previously SEAI had used data for the EU-15, but this has is no longer available and has effectively been superseded by data for the EU-27, therefore, this is the data that will be used going forward.

Multiplying these energy intensity values by the total number of road freight tkm from various iterations of CSO's *Road Freight Survey*[2] gives yearly estimates for the total amount of energy consumed by the mode. As there is likely to be differences between the efficiency of freight transport in Ireland and that on mainland Europe, there is scope to improve the estimation of Ireland's HGV energy demand through improved data and analysis of the energy intensity in toe/tkm of HGV freight in Ireland.

1 Odyssee is a cross-European project which develops and maintains a database of energy-efficiency indicators. More information can be found at http://www.odyssee-indicators.org/.

2 Full details are available from www.cso.ie.

SUSTAINABLE ENERGY AUTHORITY OF IRELAND

Sustainable Energy Authority of Ireland
Energy Policy Statistical Support Unit
Building 2100
Cork Airport Business Park
Co. Cork
Ireland

t +353 1 808 2100
f +353 21 240 7987
e epssu@seai.ie
w www.seai.ie

Sustainable Energy Authority of Ireland
Wilton Park House
Wilton Place
Dublin 2
Ireland

t +353 1 808 2100
f +353 1 808 2002
e info@seai.ie
w www.seai.ie

Ireland's EU Structural Funds Programmes 2007 - 2013
Co-funded by the Irish Government and the European Union

EUROPEAN REGIONAL DEVELOPMENT FUND

The Sustainable Energy Authority of Ireland is partly financed by Ireland's EU Structural Funds Programme co-funded by the Irish Government and the European Union