Energy Efficiency trends and policies in Ireland

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EXECUTIVE SUMMARY

This report presents an analysis of energy efficiency trends in Ireland on the basis of indicators extracted from the ODYSSEE database[1]. The analysis focuses on the period 2000 to 2013. In addition, the report examines key polices and measures which are designed to promote energy efficiency, which are taken from the MURE[2] database.

The report also includes a review of recent trends in economic growth, energy consumption and related emissions in order to provide a context for energy efficiency.

OVERALL TRENDS

In Ireland the overall energy efficiency of the economy, as measured by ODEX[3] indicator, improved by 17.5% over the period 2000 to 2013 (1.5% per annum on average). Over the same period total primary energy consumption decreased by 3.5% (0.3% per annum); total final energy demand increased by 0.6% (0.05% per annum); GDP increased by 40.1% (2.6% per annum).

Ireland's third National Energy Efficiency Action Plan[4] outlines the proposals to meet the European Energy Services Directive target and the European target of a 20% improvement in energy efficiency by 2020. The estimated savings achieved to the end of 2012 were 12,337 GWh. Projected savings to 2016 in the plan are expected to be 20,410GWh and in 2020 are expected to be 31,955 GWh.

RESIDENTIAL

Over the period 2000 to 2013 the ODEX indicator of energy efficiency for the residential sector improved by 33.9% (3.1% per annum). Residential final energy use grew by 10.3% to 2,504 ktoe (0.8% per annum) over the period 2000 to 2013. Correcting for climate variation the overall increase was 6.0% (0.4% per annum).

During this time the number of households in Ireland increased by 36% from approx. 1.22 million to 1.66 million at the end of 2013. Energy usage per dwelling decreased by 18.9% during the period 2000 to 2013. When this is corrected for climate variations the decrease was 22.1%.

Over the same period, the average floor area per household of the housing stock is estimated to have increased by 10.3% (0.8% per annum) while the total floor area of the stock increased by 50.1%, (3.2% per annum). Energy usage per square metre fell by 26.5% (2.3% per annum), direct fuel usage per square metre decreased by 29.2% (2.6% per annum) while electricity usage per square metre decreased by 16.9% (1.4% per annum).

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1 http://www.indicators.odyssee-mure.eu/

2 http://www.measures-odyssee-mure.eu/

3 ODYSSEE Energy Efficiency IndeX

4
http://www.dcenr.gov.ie/Energy/Energy+Efficiency+and+Affordability+Division/National+Energy+Efficiency+Action+Plan.htm

Legislative measures are the most common type of policy measure targeting energy efficiency in the residential sector. Key energy efficiency measures in the residential sector are the various iterations of the building regulations and energy efficiency retrofitting of the residential building stock. Significant measures include changes to the building regulations were introduced in December 2011 and a Better Energy Homes Scheme for retrofitting energy efficiency measures into the housing stock.

COMMERCIAL AND PUBLIC SERVICES

Final energy use in the commercial and public services (or tertiary) sector (referred to here as the "services" sector) fell by 3.3% (0.3% per annum) between 2000 and 2013, to 1.297 Mtoe. During this period the value added generated by the sector grew by 50.9% (3.2% per annum). Energy intensity per unit of value added (kWh/$€_{2013}$) decreased by 35.9% (3.4% per annum). Energy intensity of electricity (kWh/$€_{2013}$) decreased by 24.5% (2.1% per annum) and the energy intensity of direct fuel use (kWh/$€_{2013}$) fell by 42.3% (4.1% per annum).

The numbers employed in services grew by 33.2% (2.2% per annum). Total final energy demand per employee reduced by 27.4% between 2000 and 2013 (2.4% per annum), with the electricity use per employee decreasing by 14.5% (2.1% per annum) and the direct fuel use per employee falling by 34.6% (3.2% per annum).

The measures for the services sector prior to 2005 were education-information-training (for example the public sector energy efficiency programme) and co-operative (voluntary standards and certification). Since 2005 there was a shift towards more legislative-normative (building regulations) and financial (grants for energy efficient boilers) measures.

The planned 2015 Building Regulations revision for Buildings other than dwellings will improve minimum standards set in previous 2005 regulations, with a minimum overall performance set at a 40% improvement on an equivalent building built to 2005 Regulations. The public sector programme is also a key energy efficiency measure in the services sector.

TRANSPORT

The transport ODEX improved by 18.5% over the period 2000 to 2013 (1.6% per annum) indicating an improvement in energy efficiency. The overall change in transport sector final energy demand between 2000 and 2013 was an increase of 6.0%. Between 2000 and 2007 final energy demand increased by 39.3% but between 2007 and 2013 it reduced by 23.9%.

Private car energy consumption increased by 29% between 2000 and 2013 and accounted for 42.8% of all transport energy demand in 2013. Heavy Goods Vehicle road freight energy demand increased 41% between 2000 and 2007 but decreased by 49% between 2007 and 2013 resulting in an overall drop of 29% over the time period 2000 to 2013. In 2013 it accounted for 14.3% of total transport energy demand.

The specific fuel consumption for new petrol cars in Ireland in 2013 was 5.19 litres/100km. This represented a decrease of 23% on the average fuel consumption in 2000 (or increase in fuel efficiency). Similarly the specific fuel consumption of new diesel cars reduced 26% between 2000 and

2013 to 4.64 litres/100km.

Infrastructural (investment in road, rail etc.) and fiscal (VRT and AMT tax changes etc.) measures are the most common type of measure in the transport sector. The key policy driving energy efficiency in road transport in Ireland since 2008 has been the overhaul of the vehicle registration tax (VRT) and the annual motor tax (AMT) systems to be graduated based on CO_2 emissions as opposed to engine size. More recent innovative measures include the UK-Ireland Functional Airspace Block and measures to encourage more efficient driver behaviour.

INDUSTRY

Between 2000 and 2007 the ODEX indicator of energy efficiency for industry improved by 25.2%. This trend was reversed between 2008 and 2011. The overall improvement in efficiency over the full period 2000 to 2013 was 23.0%, or 2.0% per annum. Final energy use in industry fell by 12.8% (1.0% per annum) between 2000 and 2013 to 2.22 Mtoe.

Electricity was the single largest fuel source for industry in 2013, accounting for 35.9% of industry final energy demand. Oil was the largest fuel source in 2000 accounting for 47.1% of energy demand but oil use in the sector declined by 54.6% over the time period, leading to a reduction in its overall share to 24.5%. This was largely as a result of fuel switching and structural changes.

While final energy demand decreased, the value added of industry increased by 10.0% over the full time period, resulting in a reduction in the economic energy intensity of industry of 20.7%.

In the industrial sector measures concerned with information/education/training are the most common. The key energy efficiency measure in the industrial sector is the Large Industry Energy Network (LIEN).

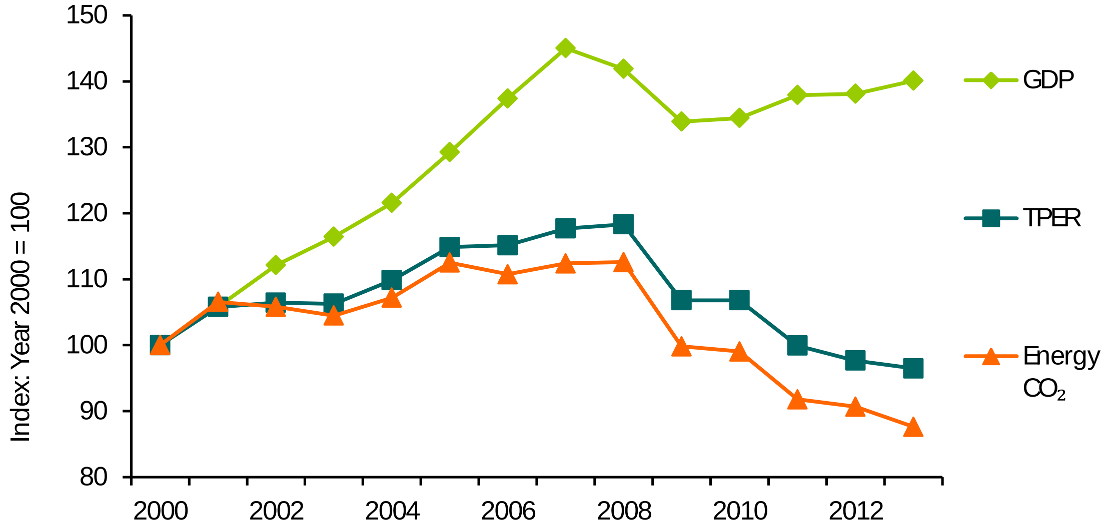
1 ECONOMIC AND ENERGY EFFICIENCY CONTEXT

1.1 ECONOMIC CONTEXT

This section gives a brief overview of economic growth and energy trends in Ireland over the period 2000 to 2010. This section draws upon the SEAI publication: *Energy in Ireland 1990 – 2013*[5].

Figure 1 and Table 1 present the trends in GDP, total primary energy requirement (TPER) and energy related CO_2 emissions for the period 2000 to 2013.

Figure 1: Macroeconomic indicators and Primary Energy Requirement



Source: SEAI and CSO

Table 1: Growth rates of Macroeconomic Indicators

	% Growth				% Average Annual Growth rates			
	2000-'13	00-'07	07-'10	10-'13	00-'13	00-'07	07-'10	10-'13
GDP	40.1%	45.0%	-7.3%	4.2%	2.6%	5.5%	-2.5%	1.4%
TPER	-3.5%	17.7%	-9.3%	-9.7%	-0.3%	2.4%	-3.2%	-3.3%
Energy CO_2	-13.4%	9.9%	-11.0%	-11.4%	-1.1%	1.4%	-3.8%	-4.0%
Energy CO_2 excl international aviation	-12.4%	12.4%	-11.9%	-11.5%	-1.0%	1.7%	-4.1%	-4.0%

Source: SEAI and CSO

There was strong economic growth in Ireland over the period 2000 to 2007 averaging at 5.5% per annum resulting in overall GDP growth of 45.0% in that time period. Following the economic crisis of 2008, the economy contracted in 2008 and 2009 before returning to modest growth in 2010 averaging 0.9% growth per annum between 2010 and 2013.

Primary energy consumption in Ireland in 2013 was 13.3 million tonnes of oil equivalent (Mtoe); a decrease of 3.2% on 2000, a decrease of 17.8% on 2007 and a decrease of 1.2% on 2012. Figure 1 shows the relative decoupling of total primary energy requirement (TPER) from economic growth

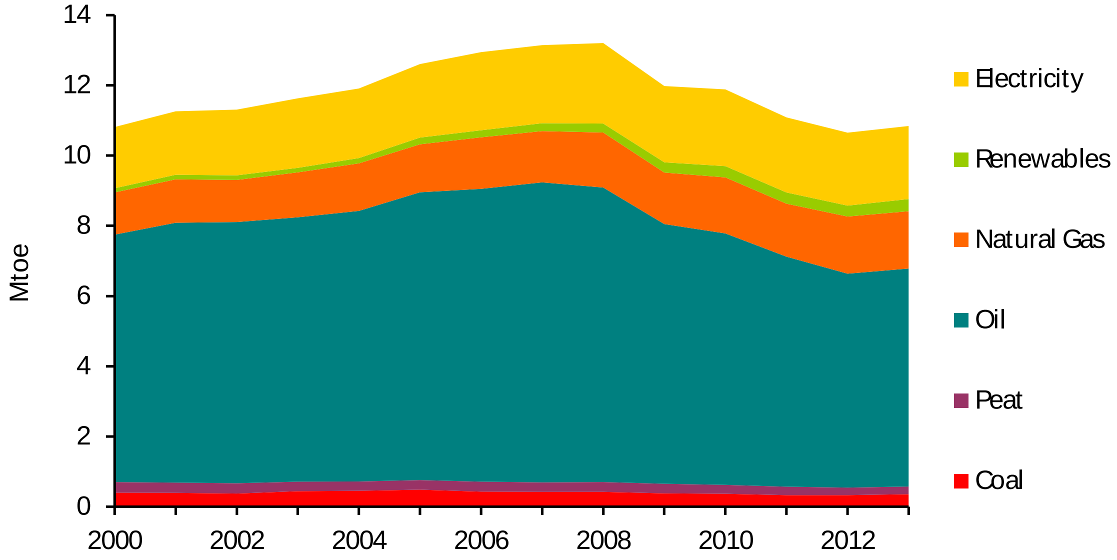
[5] Available from http://www.seai.ie/Publications/Statistics_Publications/

since 2000, in particular during 2002 and 2003[6] and also between 2010 and 2013, when the TPER declined by 3.3% per annum despite overall GDP growth pf 0.9% per annum. This is a result of changes in the structure of the economy and improvements in energy efficiency. To a lesser extent, the decoupling of CO_2 emissions[7] from energy use is also evident, particularly since 2001 and this is due to changes in the fuel mix.

1.2 TOTAL ENERGY CONSUMPTION AND INTENSITIES

Final energy demand is a measure of the energy that is delivered to energy end users in the economy to undertake activities as diverse as manufacturing, movement of people and goods, essential services and other day-to-day energy requirements of living. This is also known as Total Final Consumption (TFC) and is essentially total primary energy less the quantities of energy required to transform primary sources such as crude oil into forms suitable for end use consumers such as refined oils, electricity, patent fuels etc (Transformation, processing or other losses entailed in delivery to final consumers are known as "energy overhead"). The trend in TFC by fuel type for the period 2000 to 2013 is shown in Figure 2 and Table 2.

Figure 2: Total Final Consumption by fuel



Source: SEAI

[6] In 2002 and 2003 the reduction in the carbon intensity was due to the commissioning of two high efficiency gas fired electricity generating plant. There was also significant CCGT capacity added in 2006 and 2007 which contributed to the further decoupling in 2008. The growth in renewable energy in particular wind energy has also contributed to the decoupling of energy and CO_2 emissions.

[7] Energy-related CO_2 emissions shown here cover all energy related CO_2 emissions associated with TPER, including emissions associated with international air transport. These are usually excluded from the national GHG emissions inventory in accordance with the reporting procedures of the UN Framework Convention on Climate Change (UNFCCC) guidelines.

Ireland's TFC increased by 21.6% between 2000 and 2007 to 13,146 ktoe, before declining by 17.3% to 10,878 ktoe, just 0.1% above the consumption in 2000. In 2013 TFC increased by 1.1% on 2012, compared to a decrease of 1.2% in TPER, indicating an improvement in efficiency of supply. This is due mainly to efficiency gains in electricity generation and increased contributions from renewables and combined heat & power.

Table 2: Growth rate and shares of Total Final Consumption by fuel

TFC by Fuel	Quantity (ktoe)		Share		Growth	Annual average growth		
	2000	2013	2000	2013	2000-'13	2000-'13	2000-'07	2007-'13
Coal	398	355	3.7%	3.3%	-10.8%	-0.9%	0.8%	-2.8%
Peat	303	218	2.8%	2.0%	-27.9%	-2.5%	-1.5%	-3.6%
Oil	7,047	6,209	65.2%	57.1%	-11.9%	-1.0%	2.8%	-5.2%
Natural Gas	1,203	1,634	11.1%	15.0%	35.8%	2.4%	2.8%	1.9%
Renewables	118	345	1.1%	3.2%	193.6%	8.6%	9.7%	7.4%
Non-Renewable Wastes	0	35	0.0%	0.3%	-	-	-	-
Electricity	1,745	2,081	16.1%	19.1%	19.3%	1.4%	3.5%	-1.1%
Total Direct Fossil Fuel	8,952	8,416	82.8%	77.4%	-6.0%	-0.5%	2.6%	-3.9%
Total Final Consumption	10,814	10,878			0.6%	0.0%	2.8%	-3.1%
TFC climate corrected	10,773	10,656			-1.1%	-0.1%	3.1%	-3.7%

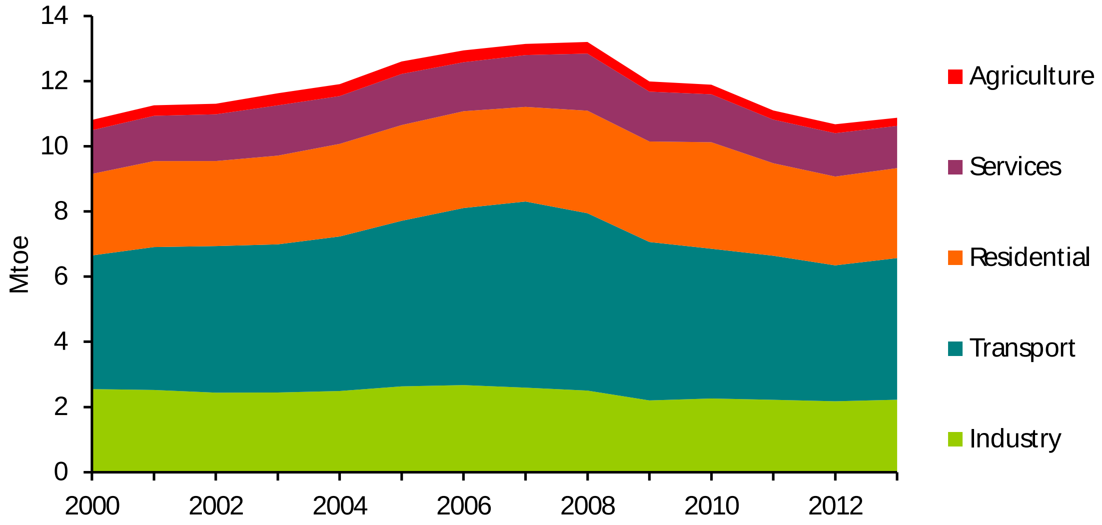
Source: SEAI

There have been a number of changes in the growth rates and respective shares of individual fuels in final consumption over the period 2000 to 2013, as shown in Table 2; the most significant changes can be summarised as follows:

- Final consumption of all fossil fuels decreased by 6.0% between 2000 and 2013. Oil, coal and peat all decreased while the use of natural gas increased over the period. The overall share of fossil fuels fell from 82.8% in 2000 to 77.4% in 2013, with the share of oil decreasing from 65.2% to 57.1% and the share of gas increasing from 11.1% to 15.0%.
- The largest percentage growth in consumption from 2000 to 2013 was in renewable energy which grew by 193.6%. The strongest growth was between2000 and 2010 during which time it was growing from a low base. The share of renewables increased from 1.1% to 3.2%.
- Final consumption of electricity grew by 19.3% between 2000 and 2013 and its share of TFC increased from 16.1% to 19.1%.

Figure 3 also shows the trend in TFC over the period, here allocated to each of the sectors of the economy. The effect of the economic downturn is evident from 2008 onwards. It is also evident from Figure 3 that transport continues to dominate as the largest energy consuming sector, in terms of final energy consumption, with a share of 40% in 2013.

Figure 3: Total Final Energy Consumption by sector



Source: SEAI

The changes in growth rates, quantities and shares are tabulated in Table 3 and summarised below.

Table 3: Growth rate and shares of Total Final Consumption by sector

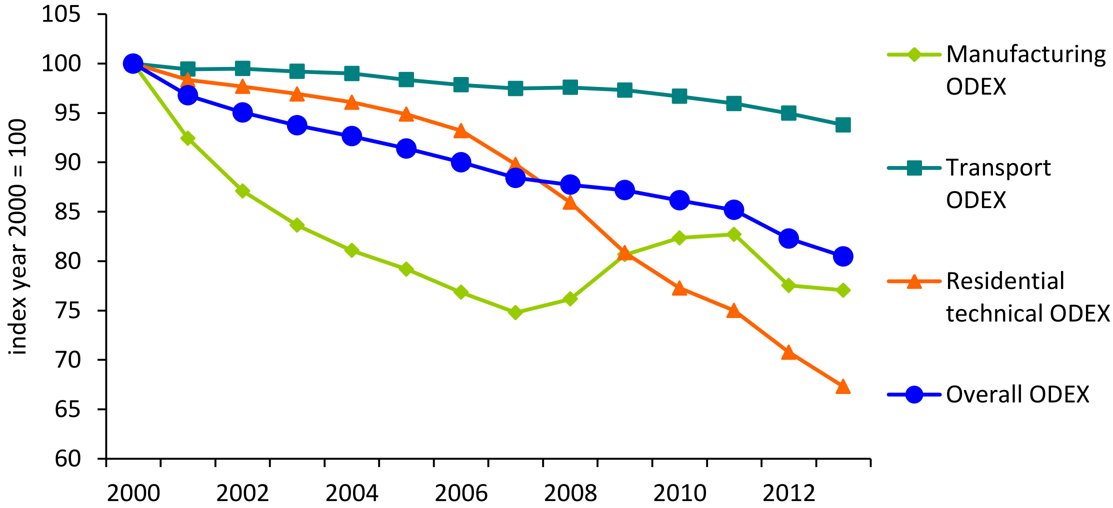
	Quantity		Share		Growth	Annual average growth		
TFC by Sector	2000	2013	2000	2013	2000-'13	2000-'13	2000-'07	2007-'13
Industry	2,549	2,223	23.6%	20.4%	-12.8%	-1.0%	0.2%	-2.5%
Transport	4,103	4,349	37.9%	40.0%	6.0%	0.4%	4.8%	-4.4%
Residential	2,504	2,762	23.2%	25.4%	10.3%	0.8%	2.1%	-0.8%
Commercial / Public	1,341	1,297	12.4%	11.9%	-3.3%	-0.3%	2.5%	-3.3%
Agriculture / Fisheries	317	249	2.9%	2.3%	-21.5%	-1.8%	1.1%	-5.2%
Total	10,814	10,879			0.6%	0.0%	2.8%	-3.1%

Source: SEAI

- Industry final energy consumption declined by 12.8% between 2000 and 2013, with its share of TFC falling from 23.6% to 20.4%.
- Transport final consumption grew strongly from the early 1990s until the onset of the economic recession in 2008 after which it reduced. In 2013 transport final energy consumption remained 6.0% above 2000 levels. Transport also increased its share of TFC, rising from 37.9% in 2000 to 40.0% in 2013.
- Final consumption in the residential sector declined by 0.8% per annum between 2007 and 2013. Despite this it experienced the highest overall growth between 2000 and 2013 of 10.3% and its share of TFC increased from 23.2% to 25.4%.
- Commercial and public sector final energy consumption declined by 3.3% between 2000 and 2013
- Agriculture and fisheries experienced the largest reduction in final energy falling 21.5% between 2000 and 2013. Its overall share of TFC is small however, going from 2.9% in 2000 to 2.3% in 2013.

The ODYSSEE project has developed a range of indicators for measuring energy efficiency at different levels and within different subsectors of the economy. ODEX is the index used to measure the energy efficiency progress by main sector (industry, transport, households) and for the whole economy (all final consumers). For each sector, the index is calculated as a weighted average of sub-sectoral indices of energy efficiency progress[8]. Figure 4 shows the ODEX indicators for the three main subsectors of the economy, industry/manufacturing, transport and residential, along with the combined overall ODEX. A fourth sector, services and commercial, does not have sufficient data available to construct on ODEX. The following sections of this report examine in detail each of the four main subsectors. The overall combined ODEX decreased by 19.5% over the period 2000 to 2013 (1.7% per annum), i.e. there was a 19.5% improvement in energy efficiency in the overall economy.

Figure 4: ODEX indices for manufacturing, transport, residential and overall economy.



Source: SEAI and ODYSSEE

1.3 ENERGY EFFICIENCY POLICY BACKGROUND

The EU has recognised energy efficiency as one of the most cost effective ways to enhance security of energy supply and to reduce emissions of green-house gases and other pollutants, playing a crucial role in achieving long term energy, environmental and climate goals. Accordingly the EU has placed energy efficiency at the heart of its Europe 2020 Strategy for sustainable growth and the transition to a resource efficient economy[9]. It has set an indicative target for 2020 of saving 20% of its primary energy consumption compared to projections. This target is supported by a range of EU measures including the Energy Efficiency Directive (EED), the Energy Performance of Buildings Directive (EPBD), the Ecodesign Directive, the Energy Labelling Directive, CO2 performance standards for cars and vans, the Emissions Trading Scheme, etc[10]. The Energy Efficiency Directive (EED) requires member states to set indicative national targets for energy efficiency and to report progress towards these targets in a series of National Energy Efficiency Action Plans (NEEAPs).

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[8] For more information see http://www.odyssee-mure.eu/publications/other/odex-indicators-database-definition.html

9 Energy Efficiency Plan 2011. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, COM(2011) 109 final.

10 Energy Efficiency and its contribution to energy security and the 2030 Framework for climate and energy policy. Communication from the Commission to the European Parliament and the Council, COM(2014) 520 final

The IEA report "Capturing the multiple benefits of energy efficiency" [11], seeks to "expand the perspective of energy efficiency beyond the traditional measures of reduced energy demand and lower greenhouse gas emissions by identifying and measuring its impacts across many different spheres." In it, the IEA promotes the concept of energy efficiency as being the "first fuel". Firstly in terms of the size of its contribution to meeting energy service demands as the IEA estimate that it contributed more than any individual fuel source amongst IEA member states in the period 1974-2010. Secondly, in that it is more cost effective, economically viable and secure than competing fuel sources.

Ireland issued its first NEEAP in 2009 as required by the Energy Services Directive (and subsequently by the EED) and this reaffirmed the target originally introduced in the 2007 White Paper of an energy efficiency saving equivalent to 20% of the average primary energy used over the period 2001 – 2005, to be achieved in 2020. The second NEEAP was released in 2013 and the most recent third NEEAP (NEEAP3) was launched in August 2014. The NEEAP3 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"[12]. It describes in detail the measures and associated savings achieved in 2012 and targeted for 2016 and 2020 for buildings, public sector bodies, industry, transport, supply side, as well as cross cutting measures.

1.4 ENERGY EFFICIENCY TARGETS

1.4.1 OVERALL NEEAP TARGETS AND TARGETS PER SECTOR

Table 4 shows the overall high level targets for energy savings to be achieved in each sector of the Irish economy in 2016 and 2020 as per the NEEAP3, as well as the estimated energy savings achieved in 2012.

Table 4: Sectoral energy savings targets and estimates contained in Irelands third NEEAP

Energy savings (GWh, PEE)	2012 (achieved)	2016 (expected)	2020 (expected)
Public	1,050	2358	3716
Business (Commercial/Industry)	3,257	5,114	7,594
Buildings	3,778	6,896	10,379
Transport	1,342	2746	4548
Energy supply	1,710	1,996	4,418
Cross sectoral (carbon tax)	1,200	1,300	1,300
Total	12,337	20,410	31,955

Source: Department of Communications, Energy and Natural Resources.

The buildings, transport and industry sectors will be discussed in detail in later sections of this report. In this section, a description is given of select recent policies that fall under the categories of "cross sectoral" and "energy supply" in the NEEAP3, which are broadly equivalent to the "General cross cutting" category in the MURE database.

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11 Available from www.iea.org/bookshop/475-Capturing_the_Multiple_Benefits_of_Energy_Efficiency

12 Copies of all three Irish NEEAPs are available for download from www.dcenr.gov.ie/energy/energy+efficiency+and+affordability+division/national+energy+efficiency+action+plan.htm

1.4.2 CROSS-SECTORAL ENERGY EFFICIENCY MEASURES

NEEAP3 was the first of the Irish NEEAPs to include specific energy savings targets for cross sectoral measures (including energy supply measures). The three measures included are listed in Table 5 below along with the estimated savings achieved in 2012 and the targeted savings for 2016 and 2020.

Table 5: Cross-sectoral measures included in Irelands third NEEAP

Energy savings, Primary Energy Equivalent (GWh)			
Title of the energy saving measure	2012 (achieved)	2016 (expected)	2020 (expected)
Carbon tax	1,200	1,300	1,300
Increased efficiency in power generation	1,431	1,675	4,056
Reduced transmission and distribution loses	279	321	362

Source: Department of Communications, Energy and Natural Resources.

A carbon tax of €15 per tonne of CO_2 (€/tCO_2) was introduced in the 2010 budget and came into effect in December of 2009, initially solely on liquid based fuels for transport. In May 2010 the tax was extended to liquid fuels for space and water heating in buildings. The rate was increased to 20 €/tCO_2 in December 2011 for transport fuels and also in May 2012 for liquid fuels for space and water heating. The carbon tax was extended to solid fuels (i.e. coal and peat) from May of 2013, at a lower rate of 10 €/tCO_2. This rate increased to 20 €/tCO_2 from May 2014.

As ETS installations already face a carbon price for their emissions, these installations were excluded from the impact of the new tax. Diesel use in the Agriculture sector is effectively exempt from any increases in the tax beyond €15 per tonne by way of tax reliefs available to farmers. Also, some of the impact of the carbon tax on freight vehicles was unwound by way of a diesel rebate scheme introduced in 2013 which allows some of the costs of excise tax on diesel to be reimbursed to freight operators if the tax inclusive cost of diesel exceeds €1.24.

Given the relatively limited time period since the introduction of the carbon tax, the fact that its introduction has been sequential rather than immediate, the proliferation of other sectoral policies and measures in the same sectors, and probably most significantly the fact that the introduction of the tax coincided with the onset a major economic recession, it is difficult at this stage to quantify its impact in isolation from other influencing factors.

With regard to increasing the efficiency of electricity generation, measures include:

- promoting and prioritising energy efficiency in investment decisions for new generation plant
- promoting competition in the All-Island Single Electricity Market
- providing incentives to encourage large energy users to reduce peak energy use

Measures to reduce transmission and distribution losses on the electricity grid are the responsibility the Transmission System Operator which is the state company Eirgrid. Eirgrid's role is to manage the power system as efficiently as possible and continue to investigate the scope for upgrades to the transmission and distribution networks to reduce energy transmission and operational losses.

2 ENERGY EFFICIENCY IN BUILDINGS

Buildings accounted for about 40% of total final energy consumption and around 55% of electricity consumption in the EU-28 in 2012, making it the largest energy end-use sector ahead of transport and industry. Furthermore the buildings sector has been consistently identified as a major potential source of cost effective energy efficiency improvements at international level by bodies such as the IEA[13][14], and at national level[15].

The following section 2.1.1 discusses the trends in energy consumption, energy intensity and energy efficiency of the Irish building stock, using data and analysis from SEAI and from the ODYSSEE[16] database. Section 2.2 discusses new and significant policy measures addressing energy efficiency in buildings for Ireland with reference to the NEEAP3 and to the MURE[17] database.

Energy in buildings generally encompasses two sectors, households and commercial. For Ireland, only limited data is currently available for energy consumption in the commercial sector building stock, although the situation will be improved in 2015/2016 with the publication of extensive new survey data from the Central Statistics Office. This report focuses on presenting data on the residential building stock.

2.1 ENERGY EFFICIENCY TRENDS

2.1.1 RESIDENTIAL ENERGY EFFICIENCY

2.1.1.1 RESIDENTIAL FINAL ENERGY DEMAND AND UNDERLYING DRIVERS

Figure 5 shows total final energy consumption in the Irish residential sector between 2000 and 2013. Final energy consumption peaked in 2010, due in part to the exceptionally cold weather experienced that year. Correcting for year to year climatic variations[18], the maximum climate corrected final consumption occurred in 2007. This declined year on year until 2012, with a return to growth in 2013. The increase in 2013 appears to be due to a certain amount of fuel switching towards solid fuels such as coal and solid biomass. Some of this increase is thought to be due to an extended cold spell during the first half of the year which continued until May. During this time, oil and gas prices were high and there may have been some fuel switching to coal and other solid fuels purchased on a week-to-week basis to supplement central heating systems. This increase may also have been in part due to a certain amount of stockpiling by householders ahead of the introduction of a carbon tax on solid fuels. Early indications from 2014 are that the downward trend has resumed.

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13 Transition to Sustainable Buildings; IEA, 2013

14 Energy Technology Perspectives 2015; IEA 2015

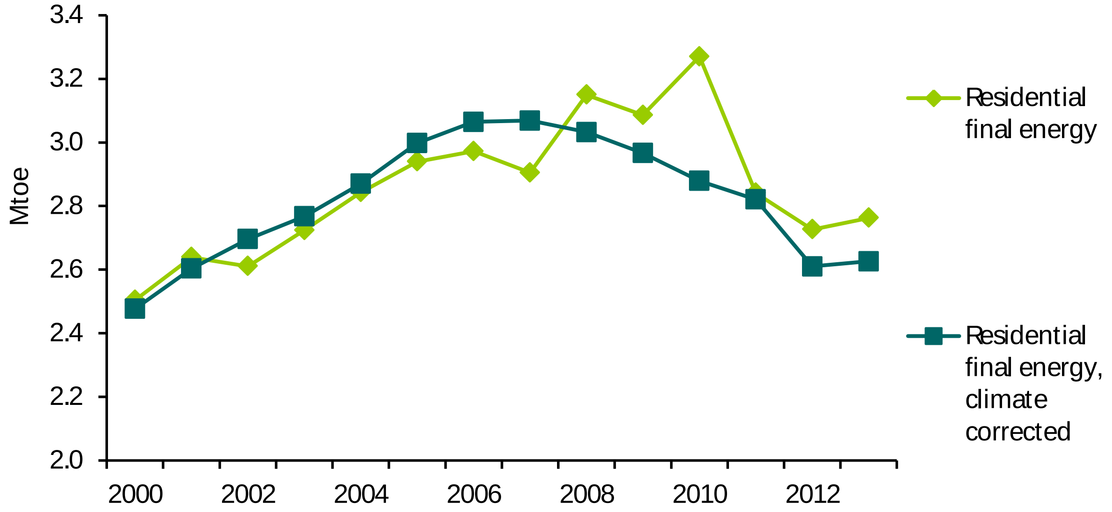
15 Towards a New National Climate Policy: Interim Report of the NESC Secretariat; NESC Secretariat 2012

16 http://www.indicators.odyssee-mure.eu/

17 http://www.measures-odyssee-mure.eu/

18 Climate correction involves adjusting the energy used for space heating by benchmarking the climate in a particular year with that of a long-term average measured in terms of number of degree days.

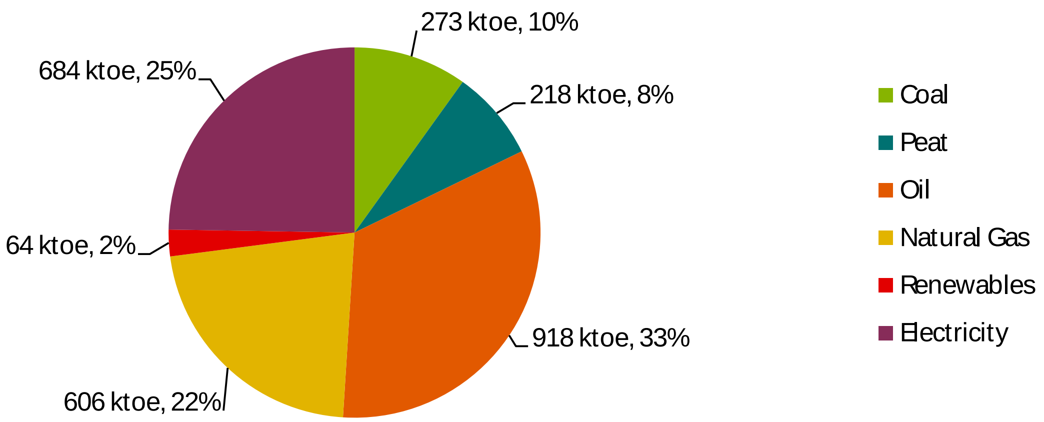
Figure 5: Residential final energy demand with climate correction



Source: SEAI

Ireland has an unusual residential fuel mix compared to many EU Member States (MS). The single largest fuel source is oil accounting for 33% of total residential fuel consumption in 2013, as shown in Figure 6. This is due to the fact that a large share of dwellings are in rural areas not connected to the gas grid and use oil fired boilers for space and water heating. Prior to the widespread adoption of oil fired central heating systems in rural areas single room heating with solid fuel open fires was the norm; in 1990 60% of residential final energy use was accounted for by coal and peat.

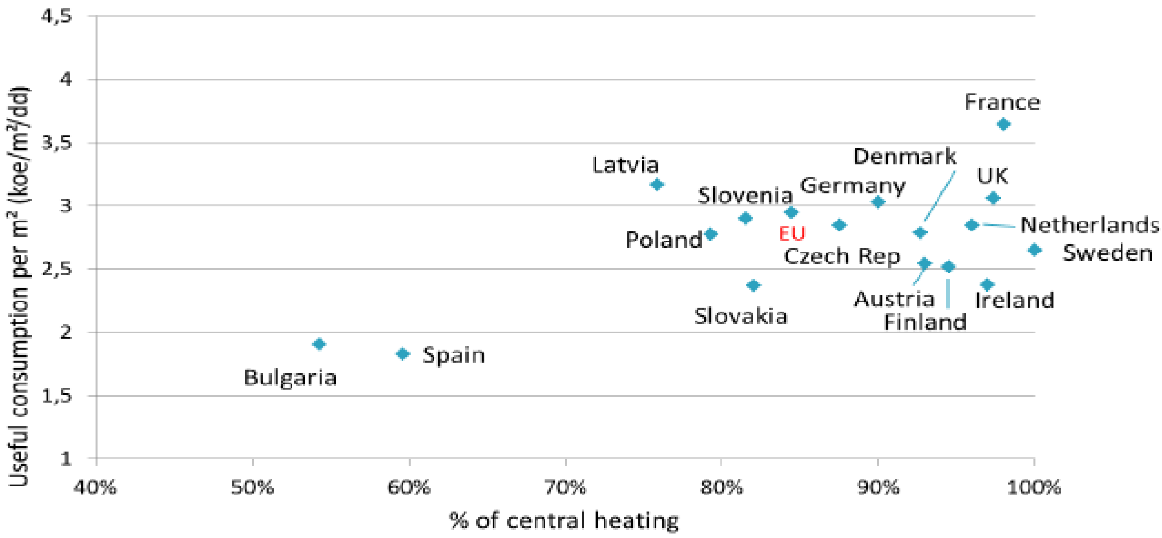
Figure 6: Residential final energy demand in 2013 by fuel type



Source: SEAI

The transition from open fire heating to boilers and central heating systems lead to more efficient energy conversion (open fire heating efficiency is approximately 30%, oil fired boiler efficiency in the range 70-85%) but also to greater thermal comfort and thus greater energy service demand. Figure 7 shows that when the share of dwellings with central heating is accounted for heating demand per m^2in Ireland compares favourably with similar EU MS.

Figure 7: Unit energy consumption and percentage share of central heating for EU member states.



Source: ODYSSEE

As oil is a relatively carbon intensive fuel source, dwellings with oil fired central heating systems may in future be targeted by policy measures to encourage fuel switching in order to meet onerous non-ETS carbon emissions reduction targets. While the primary aim would be carbon emissions reduction, fuel switching from oil fired boilers to increased use of renewables behind the meter or heat pump technologies may also significantly improve the primary energy efficiency of these dwellings.

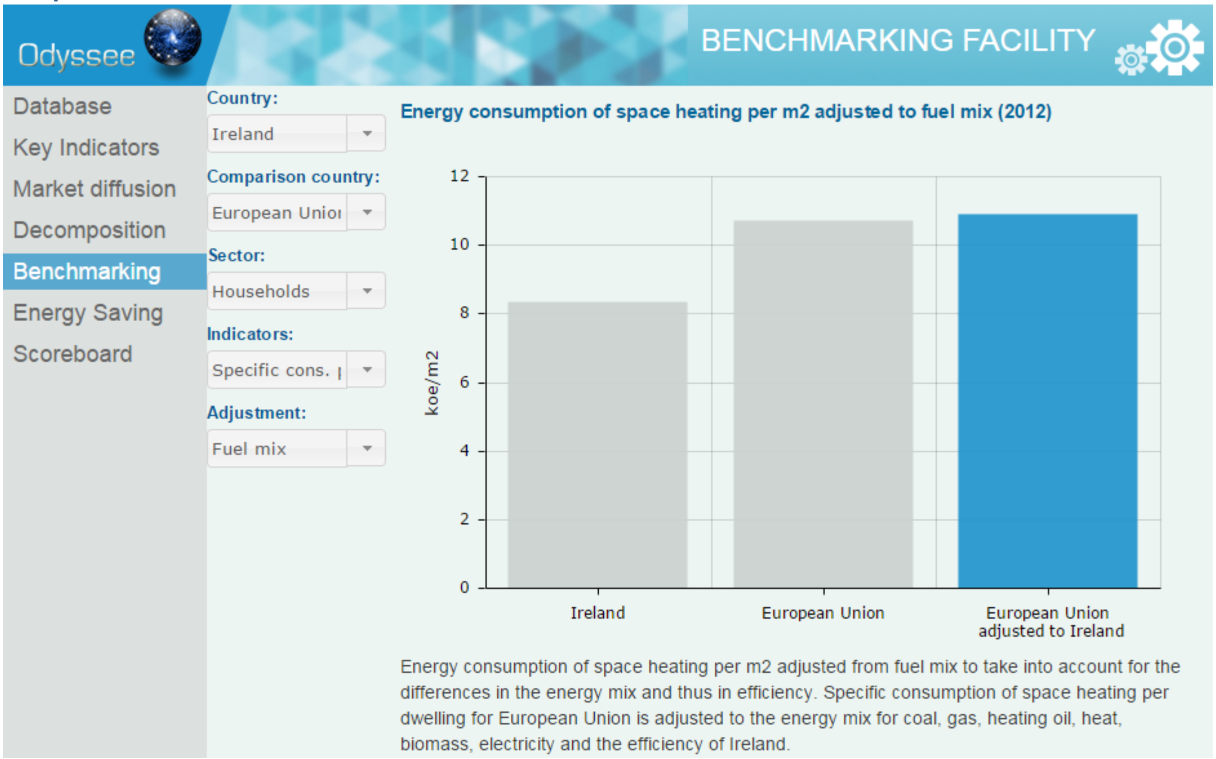
The ODYSSEE project has developed a number of online tools for examining the energy demand of EU MS for different sectors. One such tool is the benchmarking tool which enables a comparison to be made between different MS. For the residential sector the specific energy consumption per household or per m^2 of a given country ("reference country") can be compared to selected other countries by adjusting these comparison countries to the characteristics of the reference country in terms of climate or fuel mix, as shown in Figure 8.

The period 2000 to 2013 encompassed the building boom experienced in Ireland between 2002 and 2006 which saw a rapid increase in the number of dwellings constructed. The number of occupied dwellings[19] in the State is recorded by the CSO every five years during the national census, the last of which was held in 2011, and is estimated in other years by interpolation. The number of occupied dwellings increased by 36% between 2000 and 2013, from 1.22 million to 1.67 million (2.4% annual average growth). Floor area is not recorded in the census, but has been estimated by SEAI based on annual planning permission data[20]. The floor area of the average new house and new apartment granted planning permission also increased significantly in that time period, as shown in Table 6 and Figure 9

[19]Defined as the number of private households in permanent housing units.

[20] The methodology for estimating dwelling floor area is described in the SEAI report "Energy in the Residential Sector" available from http://www.seai.ie/Publications/Statistics_Publications/

Figure 8: ODYSSEE Benchmarking facility comparison of Ireland and EU average residential energy use per m^2 corrected for fuel mix.



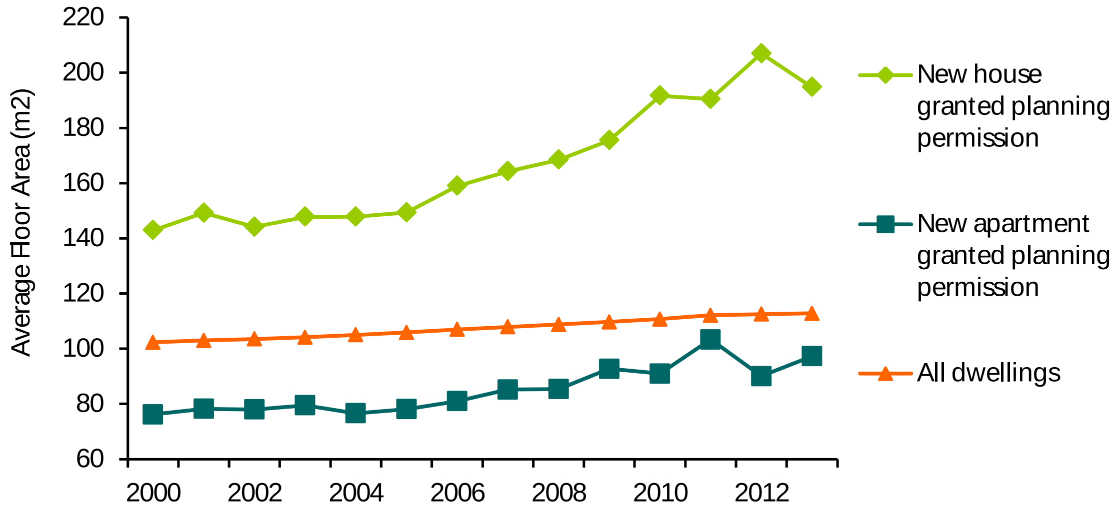
Source: ODYSSEE

Table 6: Percentage increase in floor area

	%Gross	%Annual Average			
Change in floor area of average:	2000-2013	2000-2013	2000-2005	2005-2010	2010-2013
New house	36%	2.4%	0.9%	5.1%	0.5%
New flat	28%	1.9%	0.5%	3.1%	2.2%
Stock dwelling	10%	0.8%	0.7%	0.9%	0.6%

Source: SEAI & Department of the Environment, Community and Local Government

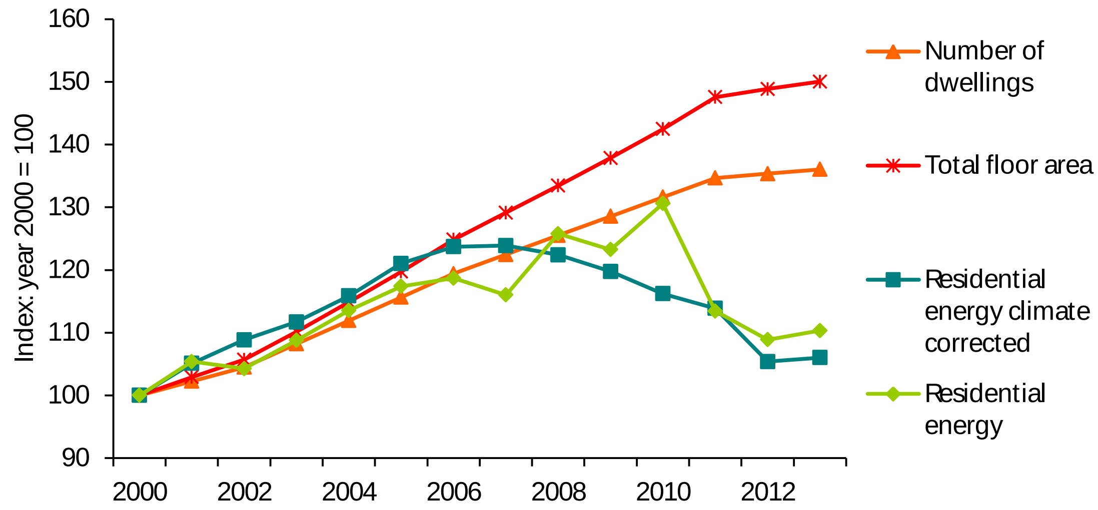
Figure 9: Increase in average floor area



Source: SEAI & Department of the Environment, Community and Local Government

Figure 10 shows the trend in residential final energy consumption, number of dwellings and total floor area between 2000 and 2013, expressed as an index relative to 2000. The growth in residential final energy use between 2000 and 2006 can be explained in part by the proportionate increase in total floor area and number of dwellings in that period. After 2006 there was a decoupling of the trend for energy demand from the continued growth in dwelling numbers and floor area. This suggests that there has been a significant improvement of the energy intensity of dwellings in the period 2006 to 2013.

Figure 10: Number of dwellings, floor area and residential final energy demand, indexed to 2000

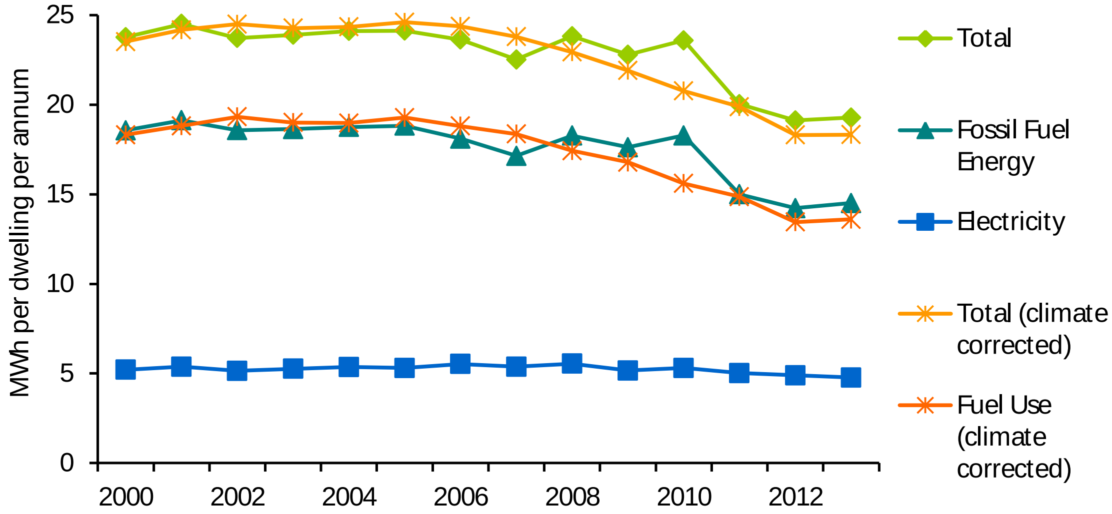


Source: SEAI

2.1.1.2 RESIDENTIAL ENERGY INTENSITY

Residential energy intensity can be expressed as energy per dwelling or energy per m^2 of heated floor area. Using the CSO data on number of dwellings, Figure 11 shows the trend for total final energy consumption per dwelling and onsite fossil fuel energy use (actual values and climate-corrected), as well as final electricity use per dwelling. In 2013 the 'average'[21] dwelling consumed a total of 18.7 MWh of energy, based on climate-corrected data. This comprised 13.9 MWh (75%) in the form of direct fossil fuels and the remaining 4.7 MWh as electricity.

Figure 11: Final energy demand per dwelling.

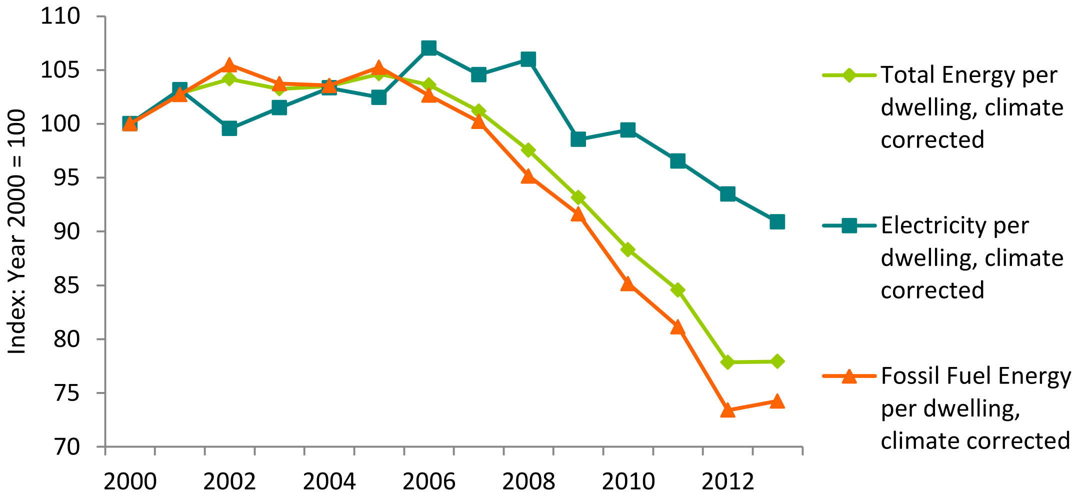


Source: SEAI

Energy intensity remained relatively constant between 2000 and 2006 at between 23 and 25 MWh per dwelling. From 2007 this trend changed with the average unit consumption declining year on year, falling to 18.3 MWh per dwelling in 2012, though rebounding slightly to 18.7 MWh per dwelling in 2013 (climate corrected). Electricity use (actual) fluctuated between 5.2 MWh/dwelling in 2000 and a maximum of 5.5 MWh in 2006 before declining to 4.7 MWh in 2013. Figure 12 shows the trends for energy per dwelling, climate corrected, split by fossil fuel and electricity use as an index with respect to the year 2000 values. While electricity use per dwelling has declined steadily since 2010 to 9% below the 2000 value, it is the decline in fossil fuel consumption to 76% of the 2000 value which is the main driver behind the overall reduction to 79% of the 2000 value.

[21] This average is calculated as the total energy consumption divided by the number of private households in permanent housing units.

Figure 12: Index of energy per dwelling climate corrected, total, fossil and electric



Source: SEAI

2.1.1.3 DECOMPOSITION OF RESIDENTIAL ENERGY TRENDS

The reduction in residential fossil fuel use post 2006 is likely due to a number of factors. One factor is likely to be the severe economic downturn experienced post 2008; another is the improvement in the technical energy efficiency of the housing stock due to new building regulations for new builds and energy efficiency retro-fitting of the existing stock. The ODYSSEE decomposition tool[22] offers a methodology for separating the overall trend in energy consumption for a particular sector into a number of underlying drivers. For the residential sector the factors considered are: climate; number of dwellings; size of dwellings; dwelling energy efficiency; other effects. Figure 13 shows the results of this analysis for the Irish residential sector for the periods 2000 to 2012, 2000 to 2007 and 2007 to 2012. Over the full period 2000 to 2012 the single strongest factor driving growth in residential sector energy use was the increase in the number of dwellings, followed by the increase in the average floor area of the dwellings. Countering this was the improvement in energy efficiency throughout the period and the behavioural effect between 2007 and 2012. The behavioural effect captures the effect of occupants reducing comfort levels and fuel expenditure due to economic or other reasons.

[22] http://www.indicators.odyssee-mure.eu/decomposition.html

Figure 13: ODYSSEE decomposition of Ireland's residential final energy demand

Source: ODYSSEE

2.1.1.4 RESIDENTIAL ODEX

The ODYSSEE project has developed a range of indicators for measuring energy efficiency at different levels and within different subsectors of the economy. For the residential sector the following indices are recorded where possible for EU MS:

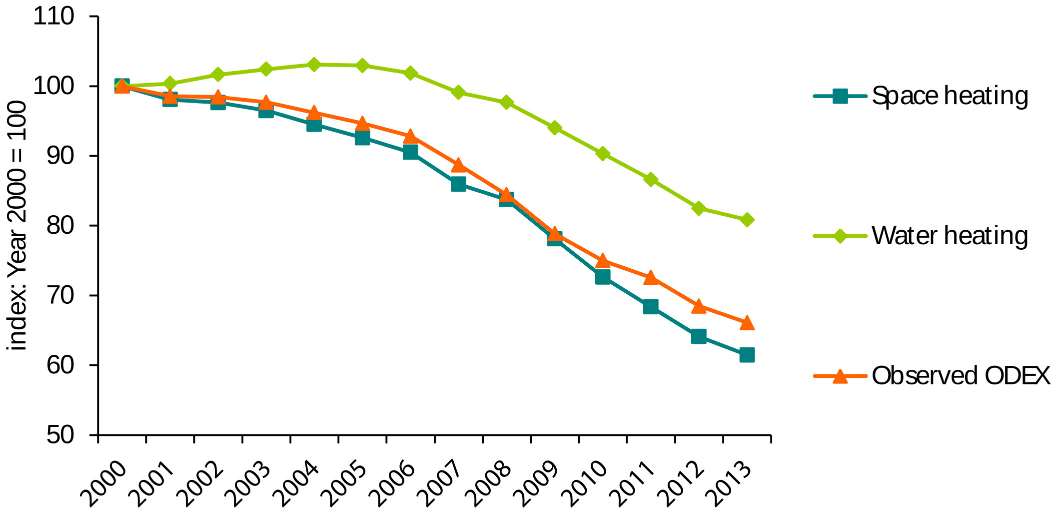
- space heating per m^2, corrected for climate and share of central heating (koe/m^2)[23]
- water heating (toe/dw)[24]
- cooking (toe/dw)
- large electric appliances (kWh/dw)

These sub-sectoral indices can be combined to form an overall index for the residential sector, known as the residential ODEX. For Ireland, there is currently insufficient data available to allow the calculation of the index for large electric appliances or cooking. Data in this area will be improved in coming years following the introduction of EU Regulation 431/2014 which places a mandatory requirement on EU MS to report data on energy end-use in households beginning in 2016 for 2015 data. End use is to be split by space heating space cooling, water heating, cooking, lighting and appliances. It is anticipated that this requirement will initially be met by the improved use of existing administrative data sources and modelling techniques. Figure 14 shows the trend for the space and water heating indices and the residential ODEX which is the weighted average of these two.

[23] Kilogram of oil equivalent, koe

[24] Tonne of oil equivalent, toe

Figure 14: ODYSSEE energy efficiency indicators for the Irish residential sector



Source: SEAI & ODYSSEE

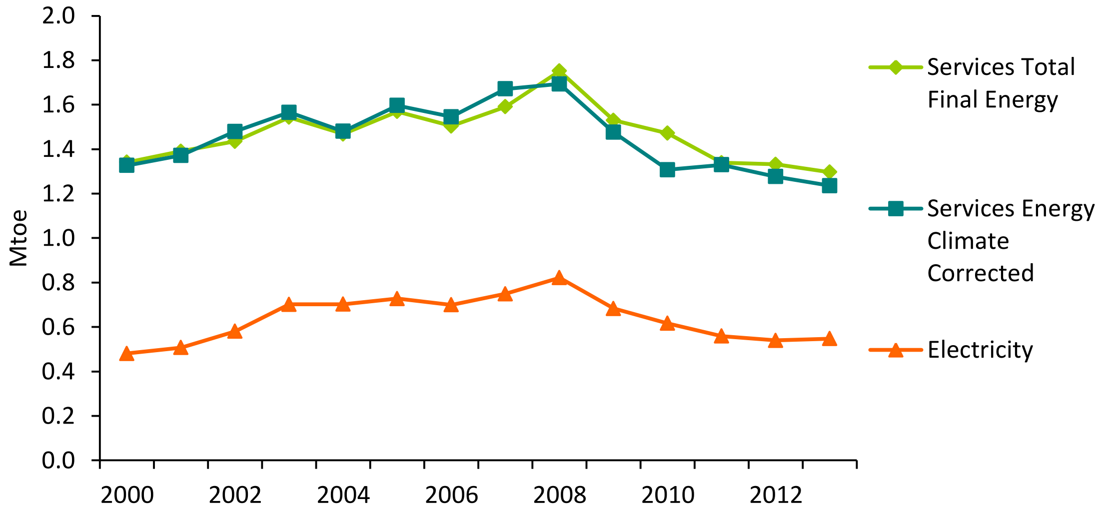
2.1.2 SERVICES ENERGY EFFICIENCY

2.1.2.1 SERVICES FINAL ENERGY DEMAND AND UNDERLYING DRIVERS

Figure 15 shows the actual final energy consumption of the commercial and services sector in terms of Mtoe, the climate corrected consumption, and the actual final electricity consumption. Figure 16 further shows this data indexed to 2000, as well as indices for Gross Value Added (GVA) in terms of 2012 euros, and for the numbers of persons employed in the sector.

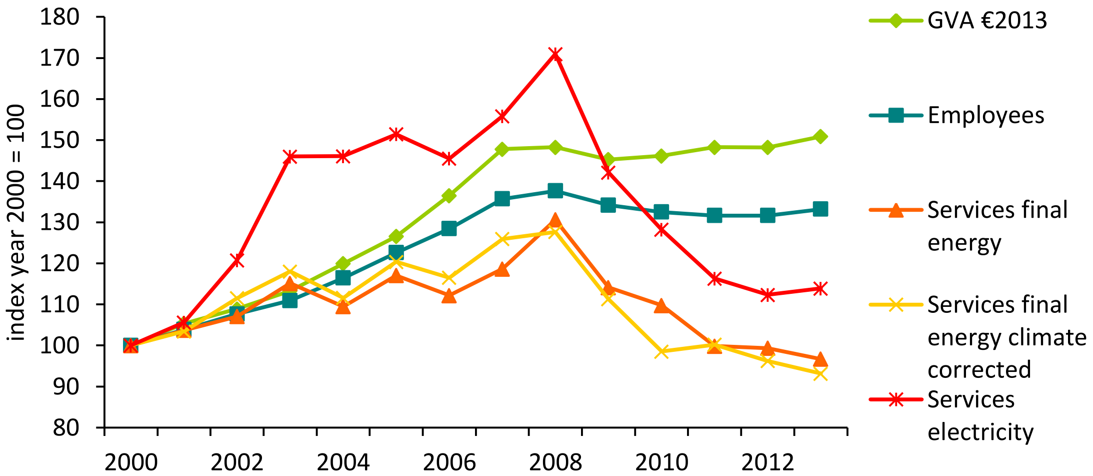
Final energy use in the commercial and public services sector increased by 30.6% between 2000 and 2008 (3.4% per annum). In 2013 it was 1,300 ktoe, 3.0% below 2000. Between 2000 and 2013 the value added generated by the sector grew by 50.9% (3.2% per annum) while the numbers employed increased by 33.2% (2.2% per annum). Between 2000 and 2008 electricity consumption in services increased by 71% (6.9% per annum). In 2013 it was 547 ktoe (6,366 GWh) and had a higher share than any other individual fuel in services at 42%, up from 36 %in 2000 and 24% in 1990. This growth is fuelled by the changing structure of this sector and the general increase in the use of information and communication technology (ICT) and air conditioning.

Figure 15: Services final energy demand



Source: SEAI

Figure 16: Services final energy demand, electricity, Gross Value Added and number of employees, indexed to 2000

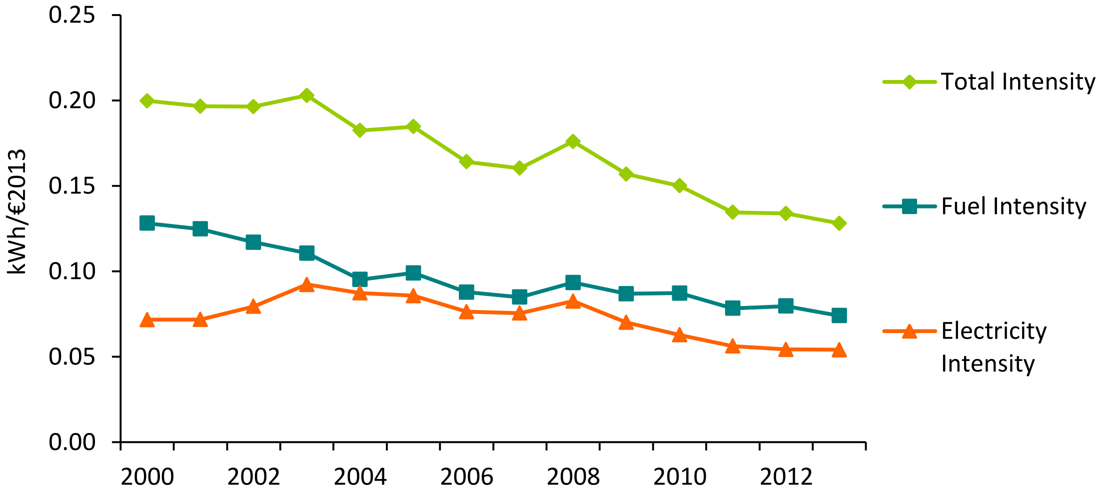


Source: SEAI

2.1.2.2 SERVICES ENERGY INTENSITY

The energy intensity of the services sector is generally measured with respect to the GVA generated by services activities. The overall energy intensity of the services sector in terms of kWh per euro GVA (chain linked to 2012) was 27.9% lower in 2013 than it was in 2000, as shown in Figure 17. This was due in part to the growth in the value added in the sector. Energy intensity in services fell by 1.8% in 2013. Electricity intensity increased up to 2003 and has been falling since with the exception of 2008. In 2013 electricity intensity increased by 2% compared with 2012 and is 37% below the peak in 2003.

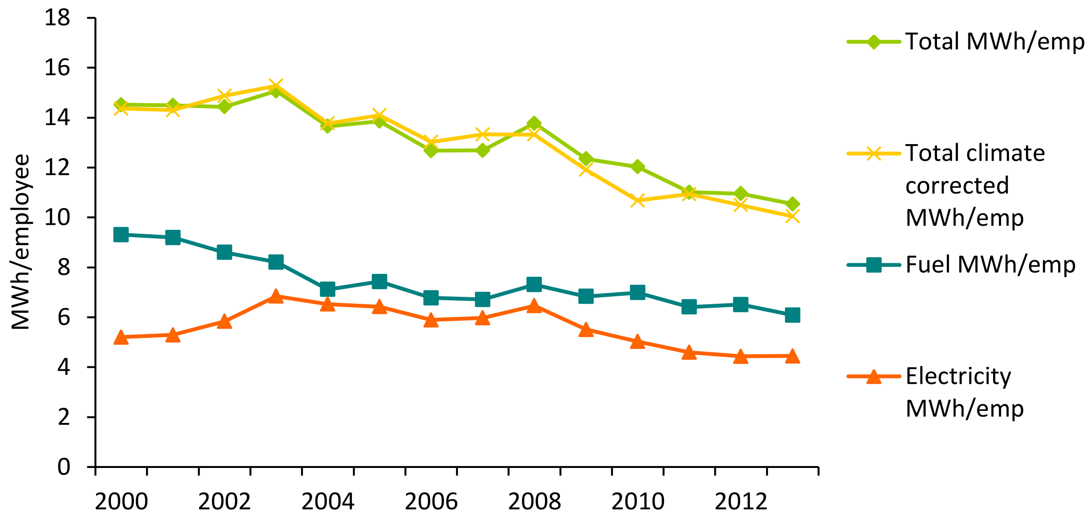
Figure 17: Services final energy demand per euro Gross Value Added



Source: SEAI

Two other measures in this sector are energy use per unit of floor area and per employee. The consumption of oil and gas is mainly for heating purposes and is related to the floor area heated, not directly related to the number of people occupying a building at a given time. Due to an absence of data on floor area in the services sector it is not currently possible to calculate the consumption per unit of floor area. Unit consumption of electricity per employee is used as an indicator of energy use in the services sector because in the main, there is a correlation between electricity use and the number of employees. With reference to Figure 18, the unit consumption of electricity per employee initially increased between 2000 and 2003 but declined between 2008 and 2013 by 31.2%, being 14.5% lower in 2013 than 2000, although 2013 saw an increase of 0.2%. Fuel consumption per employee in 2013 was 34.3% below 2000 levels, 36.3% below when climate corrected.

Figure 18: Services final energy demand per employee



Source: SEAI

2.1.2.3 SERVICES ODEX

As a result of the heterogeneous nature of the services sector it is difficult to assess the amount of energy that is consumed. Energy statistics relating to fuel consumption for the services sector in Ireland are calculated as a residual. This approach is unsatisfactory, not least because the energy use in the sector is affected by uncertainties in all other sectors. As a result, there is only limited information available to policy-makers with which to formulate and target energy efficiency policies and measures for the sector. The increasing number of energy suppliers in the liberalised market makes this task all the more difficult. Thus, the current data does not allow for ODEX indicators to be formulated.

Work is ongoing, however, to address this situation. In particular a survey of Business Energy Use has been carried out by the CSO in conjunction with SEAI on an annual basis since 2009, with approximately 4,500 businesses surveyed. The first results of this survey are not yet available but are expected to be released by the end of 2015 and will be updated annually thereafter. This rich, new dataset will enable analysis of commercial, public and industrial energy use at a level not possible previously.

2.2 ENERGY EFFICIENCY POLICIES

For a detailed review of policies targeting energy efficiency in buildings at EU level and a broad overview of some Member State policies refer to the latest ODYSSEE report on the buildings sector[25]. For a detailed description of policies relating to energy efficiency in buildings and other sectors, for each EU member state, refer to the MURE online database[26]. Provided here is a brief description of some recent policy measures implemented in Ireland targeting this area.

2.2.1 RESIDENTIAL SECTOR POLICY MEASURES

2.2.1.1 RESIDENTIAL SECTOR RETROFIT

The “Better Energy: Homes” scheme aims to stimulate energy-efficiency actions to reduce energy usage in existing dwellings. The scheme provides grant-aids for householders who want to make their homes more energy-efficient, providing incentives towards the implementation of energy efficiency measures including attic and wall insulation and heating controls with efficient boilers. An official Building Energy Rating (BER) is completed on each home which receives and energy upgrade detailing all energy efficiency measures carried out on the house. A follow on to the Home Energy Savings scheme, the Better Energy Homes Scheme has been in operation since 2011. In addition the “Better Energy: Communities” scheme provides grant aids with the aim to stimulate the delivery of innovative energy efficiency projects in communities and other areas including energy poor homes

These measures are included in Irelands third NEEAP collectively under the heading Residential Retrofit. The expected energy savings for these measures contained in the NEEAP are given in Table 7

[25] Available from http://www.odyssee-mure.eu/publications/br/

[26] Available at http://www.measures-odyssee-mure.eu/

below. These estimates are based on the stated Government commitment to achieve a total of 8,000 GWh from retrofit of domestic and non-domestic buildings and services.

Table 7: Achieved and predicted energy savings from selected residential sector policy measures.

	Energy savings (GWh, Primary Energy)			CO_2 savings ($ktCO_2$)		
	2012 (achieved)	2016 (expected)	2020 (expected)	2012 (achieved)	2016 (expected)	2020 (expected)
Residential Retrofit	507	1,500	3,000	126	370	738

Source: Department of Communications, Energy and Natural Resources

2.2.2 SERVICES SECTOR POLICY MEASURES

2.2.2.1 COMMERCIAL SECTOR RETROFIT

There are a number of measures targeting energy efficiency retrofit projects in the public and commercial sectors. The measures typically involve a combination of grants or subsidies, training and mentoring.

Through the Energy Efficiency Fund the Irish Government has committed €35 million as seed capital for investment in energy efficiency projects. This has been matched with investment from the private sector and a fund of €70 million has been established. The fund will enhance the level of finance available in the market to support the clear opportunity that exists in the public and commercial sectors for energy efficiency gains.

SEAI on behalf of the Department of Communications, Energy and Natural Resources (DCENR) has developed a National Energy Services Framework (NESF) to help develop the energy efficiency market in the non-domestic sector throughout Ireland. The NESF sets out the current roadmap through which energy efficiency projects and an Energy Performance Contracting process is being developed. The key aim of the NESF is to develop robust projects which are investment-ready for financing entities. This will stimulate the development of an Energy Services Company (ESCO) market, consisting of small, medium and large ESCOs, thereby supporting sustainable employment in construction and professional services.

In accordance with Article 7, Ireland will implement an Energy Supplier Obligation with an annual target currently set at 550GWh per annum and with a portion of these savings to be achieved in the commercial and industrial sectors.

The impact of these measures will be monitored on a project by project basis and saving initially estimated at the application stage with M&V to follow as the fund rolls out. In the latest NEEAP expected energy savings based on stated Government commitment to achieve a total of 8,000 GWh from retrofit of both domestic and non-domestic buildings and services, see Table 8

2.2.2.2 REGULATIONS FOR BUILDINGS OTHER THAN DWELLINGS

The planned 2015 Building Regulations revision for Buildings other than dwellings will improve minimum standards set in previous 2005 regulations addressing key areas such as: Insulation levels in building fabric; ventilation and air infiltration; avoidance of excessive solar gain; thermal bridging reduction; heating plant efficiency and control; air-conditioning plant efficiency; insulation of hot water storage vessels, pipes and ducts. In addition a minimum overall performance will be set on the Energy Performance Co-efficient (EPC) and Carbon Performance Coefficient (CPC). The maximum EPC will be set at a 40% improvement on an equivalent building built to 2005 Regulations.

Energy savings are predicted and evaluated based on a top down model of energy use in the tertiary sector based on projections of key economic indicators. Increases in projected energy use are then ascribed to new buildings and the savings predicted based on a 30% reduction in the specific energy consumption. This measure is also eligible for EPBD reporting. The predicted savings for this measure are shown in Table 8.

Table 8: Achieved and predicted energy savings from selected services sector policy measures

	Energy savings (GWh, Primary Energy)			CO_2 savings ($ktCO_2$)		
	2012 (achieved)	2016 (expected)	2020 (expected)	2012 (achieved)	2016 (expected)	2020 (expected)
Commercial & Indusrty Retrofit	0	1,000	25,000	0	256	633
2015 Building regulations - Buildings other than Dwellings	0	146	518	0	35	123

Source: Department of Communications, Energy and Natural Resources

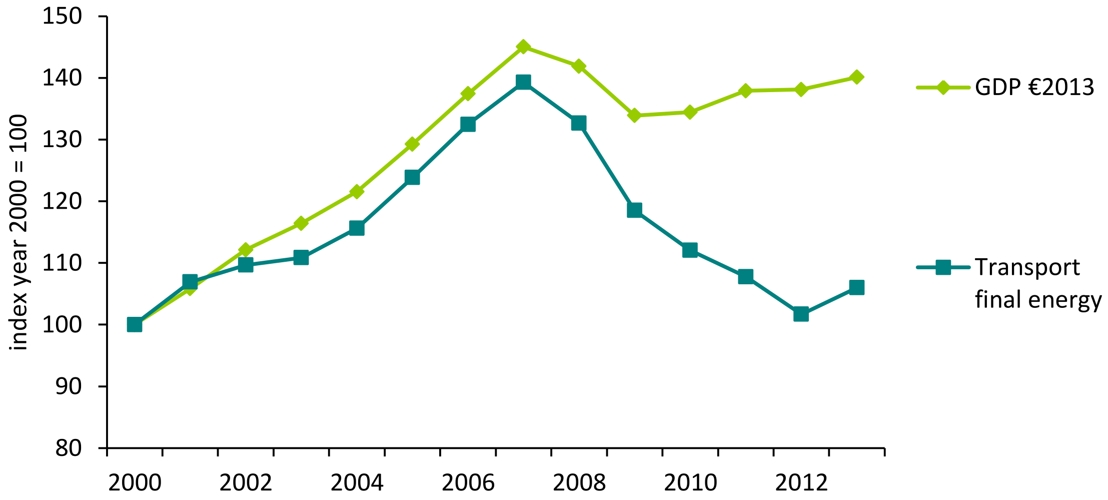
3 ENERGY EFFIENCY IN TRANSPORT

3.1 ENERGY EFFICIENCY TRENDS

3.1.1 TRANSPORT FINAL ENERGY DEMAND

Figure 19 shows the growth in transport final energy demand and GDP between 2000 and 2013, indexed to the year 2000. There was a strong correlation between the two trends between 2000 and 2008, and as far back as 1990. Both peaked in 2007 before declining in post 2008 recession period. It can be seen that in the initial years of 2008 and 2009 transport TFC declined more sharply than GDP. The two trends then fully decoupled from 2010 onwards with GDP returning to growth while transport TFC continued to decline until 2012, before finally returning to growth in 2013.

Figure 19: Transport final energy demand and GDP growth indexed to 2000



Source: SEAI & CSO

Figure 20 shows total final energy consumption in the Irish transport sector between 2000 and 2013, broken down by mode of transport[27]. Table 9 presents some of the key data behind this graph as well as percentage shares by mode, growth rates and annual average growth rates for selected years and time periods. Key features to note include:

- Private cars have had the highest energy demand in every year, accounting for 42.8% of transport final energy demand in 2013.
- Both Heavy Goods Vehicle freight (HGV) and aviation underwent strong growth in the period 2000 to 2007 and large declines between 2007 and 2013, with HGV in particular declining over 10% per annum between 2007 and 2013, or 49% over the time period. . The drop in road freight

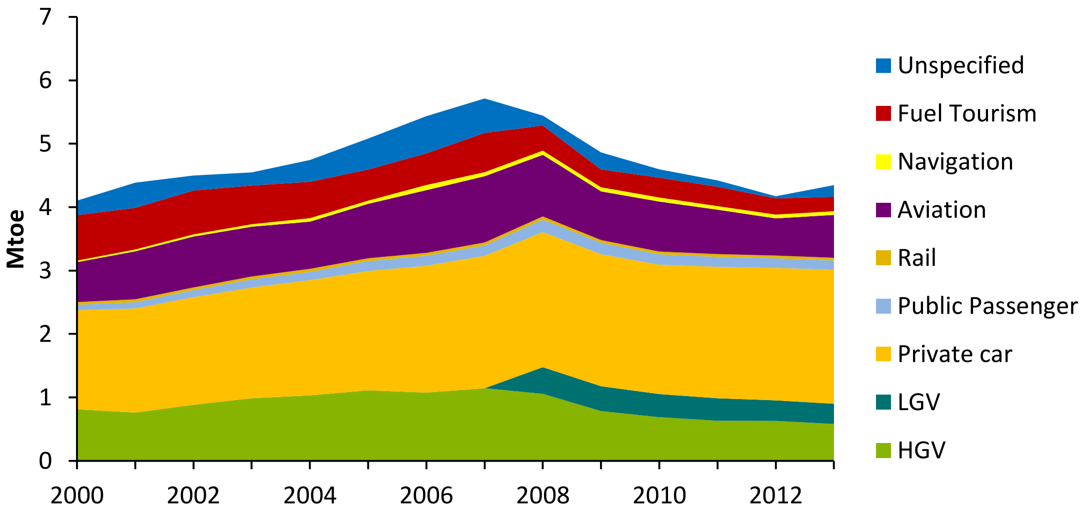
[27] Fuel tourism is defined as fuel that is bought within the State by private motorists and hauliers but consumed elsewhere. The category 'unspecified' in the figure refers to the difference between estimates of fuel consumption and data from the national energy balance. Included in 'unspecified' is fuel consumption by light goods vehicles, motorcycles, service vehicles (ambulances, etc), construction vehicles (excavators, loadalls, etc), lawnmowers.

demand was impacted by the end of the construction boom in Ireland in 2007 and the associated haulage of high weight, low value construction materials.

- Fuel tourism also declined significantly by 61% between 2007 and 2013, due to a narrowing of the gap between fuel prices between the Republic of Ireland and the UK.
- Public passenger services (buses and taxis) experienced a strong increase in energy demand of 94% over the period 2000 to 2013. The average annual growth rate was 9.6% between 2000 and 2007 but then contracted by on average 1.7% per annum between 2007 and 2013.
- Rail energy consumption decreased slightly between 2000 and 2013 but what is most notable is it's relatively low share, accounting for just 1.0% in 2000 and the same share in 2013
- Due to a lack of data it was not possible to estimate the contribution of Light Goods Vehicles (LGV) prior to 2008, therefore it can be seen from Figure 20 and Table 9 that this mode is only included after that date. Prior to 2008 LGV energy demand was included in the "Unspecified" band.
- Road transport (Private car, HGV, LGV, Public passenger, fuel tourism) accounted for 73% of transport final energy demand in 2013 (67% if fuel tourism is excluded).

Figure 20 and Table 9 also illustrate the relative weighting of private car transport compared to road passenger services and rail travel.

Figure 20: Transport final energy demand by mode



Source: SEAI

Table 9: Transport final energy demand by mode

Transport TFC by Mode	Quantity (ktoe)		Share		Growth	Annual average growth		
	2000	2013	2000	2013	2000-'13	2000-'13	2000-'07	2007-'13
HGV	813	581	19.8%	14.3%	-28.5%	-2.6%	5.0%	-10.7%
LGV	-	319	-	7.0%	-	-	-	-
Private car	1,562	2,113	38.1%	48.4%	35.3%	2.4%	4.2%	0.2%
Public Passenger	86	148	2.1%	3.5%	71.3%	4.2%	9.6%	-1.7%
Rail	42	42	1.0%	0.9%	-1.1%	-0.1%	1.6%	-2.1%
Aviation	630	676	15.4%	16.6%	7.3%	0.5%	7.5%	-7.0%
Fuel Tourism	718	229	17.5%	7.4%	-68.1%	-8.4%	-2.1%	-15.3%
Navigation	24	58	0.6%	1.6%	144.3%	7.1%	15.2%	-1.6%
Unspecified	228	183	5.6%	0.5%	-19.9%	-1.7%	13.2%	-16.6%
Total	4,103	4,348			6.0%	0.4%	4.8%	-4.5%

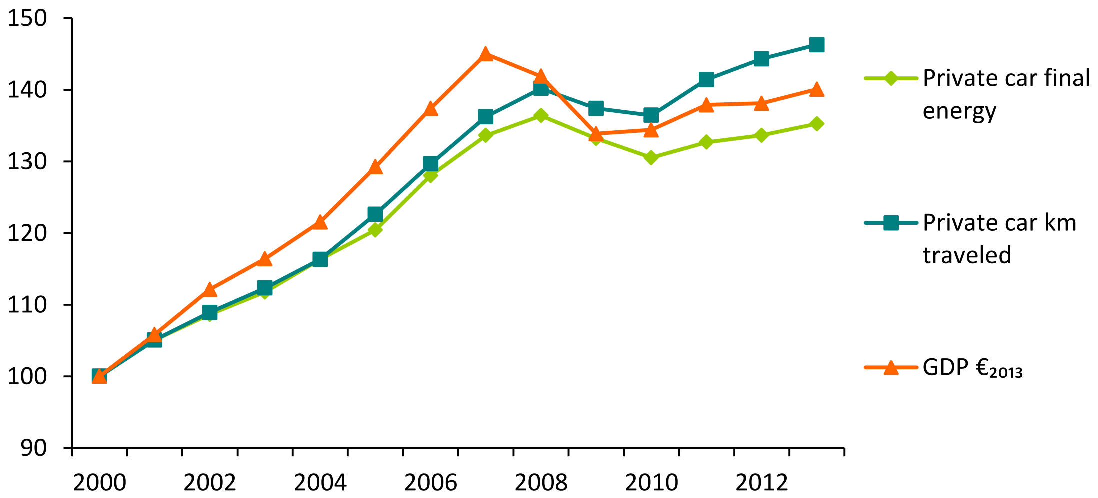
Source: SEAI

The following sections examine in more detail the trends for two key transport modes in Ireland: private car and HGVs.

3.1.1.1 PRIVATE CAR FINAL ENERGY DEMAND AND UNDERLYING DRIVERS

Figure 21 shows the trend for final energy consumption of private cars between 2000 and 2013, expressed as an index relative to the year 2000. Shown also are the indices for GDP and the annual number of vehicle km travelled. Between 2000 and 2004 growth in all indicators was strongly linked. From 2005 onwards an increase in the technical efficiency of private car transport can be seen as final energy grew by less than vehicle km travelled.

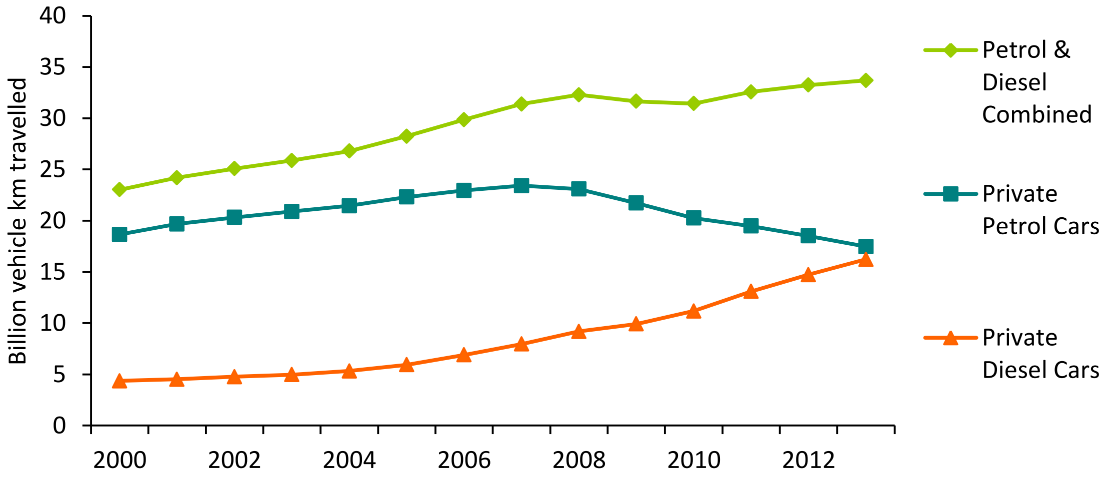
Figure 21: Private car final energy and underlying drivers, indexed to 2000



Source: CSO and SEAI

The total number of vehicle km decreased slightly in 2009 and 2010 at the height of the Ireland's economic recession but returned to growth between 2011 and 2013. Beneath this overall trend there was a significant switch from petrol to diesel, as can be seen from Figure 22.

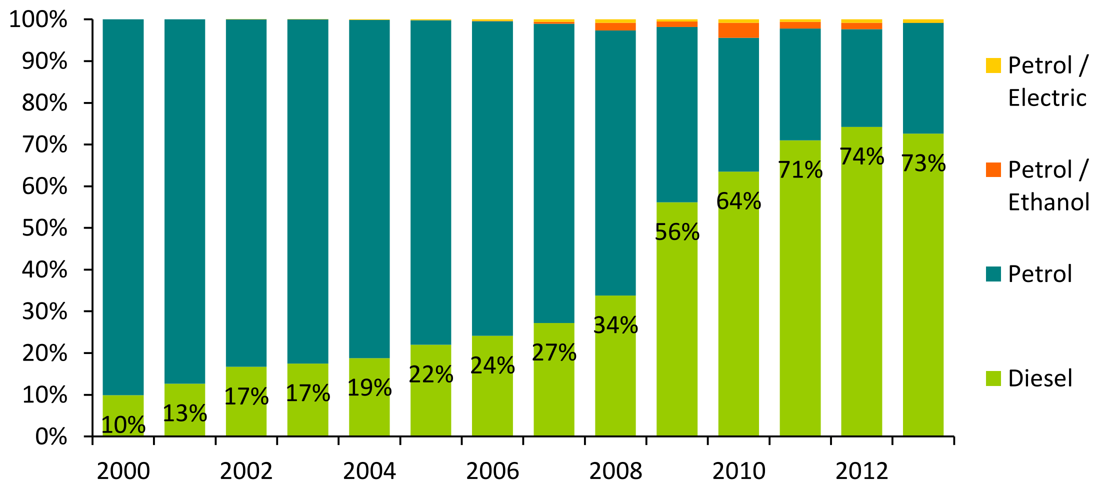
Figure 22: Private car stock total annual mileage



Source: SEAI

This switch in vehicle km was caused by a change in purchasing patterns from petrol to diesel vehicles. The share of new diesel vehicles increased right from the beginning of the time period but the rate accelerated after 2008 following changes to the annual motor tax system, as shown in Figure 23. Prior to 2008 annual motor tax was based on engine size; in July 2008 this system was changed to one based solely on the carbon dioxide emissions intensity of the vehicle, measured in gCO_2/km. This incentivised the switch from mid-sized petrol to mid-sized diesel cars as, in general, a diesel vehicle consumes less fuel and produces less gCO_2/km than a similarly sized petrol vehicle. This in turn suggests that the switch to diesel vehicles has contributed to the observed increase in efficiency of the private car stock.

Figure 23: Share of new vehicles registered in Ireland annually by fuel type



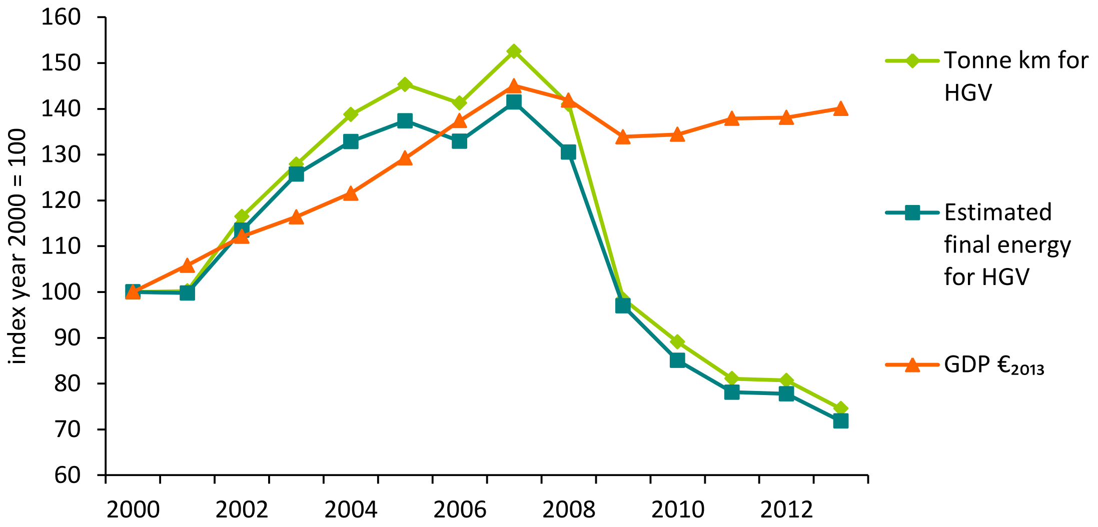
Source: Department of Transport, Tourism and Sport

3.1.1.2 HEAVY GOODS VEHICLES FINAL ENERGY DEMAND AND UNDERLYING DRIVERS

Figure 24 show the trend for the level of activity of HGV freight in Ireland measured in tonne km, expressed as an index relative to the year 2000. Shown also is the trend for GDP and the estimated final energy demand of HGV. Data on the specific fuel intensity of the Irish HGV fleet is unavailable. In the absence of Ireland specific data SEAI assume that the efficiency of the Irish HGV fleet in terms of energy per tonne-km matches that of the overall average EU fleet, as recorded by the ODYSSEE project. As this average efficiency has remained relatively flat over the time period so the trend for the estimated final energy demand of HGV follows closely the trend for HGV activity in tonne km.

The most notable aspect of this graph is the scale of the contraction in HGV activity following the onset of the economic crisis in 2008, relative to the contraction in GDP. Between 2007 and 2009 GDP fell by 7.7% whereas HGV tonne-km fell by 35.5%. In 2013 GDP recovered to 3.4% below 2007 levels (measured in 2013€) whereas HGV tonne-km remained 51.2% below the 2007 peak. This was in part due to the large influence on HGV activity of the building and road construction sector. The 2008 economic crisis in Ireland coincided with a collapse of a property bubble. Unlike overall GDP, the construction sector did not return to growth following 2009 and remained heavily subdued up to 2013.

Figure 24: HGV tonne km, GDP and estimated final HGV energy demand, indexed to 2000



Source: CSO and SEAI

3.1.2 TRANSPORT ENERGY INTENSITY

3.1.2.1 PRIVATE CARS

Figure 25 shows the specific fuel consumption in litres per 100km of new private cars licensed for the first time in Ireland between 2000 and 2013. The efficiency remained relatively flat in the initial period 2000 to 2007 but improved significantly thereafter.

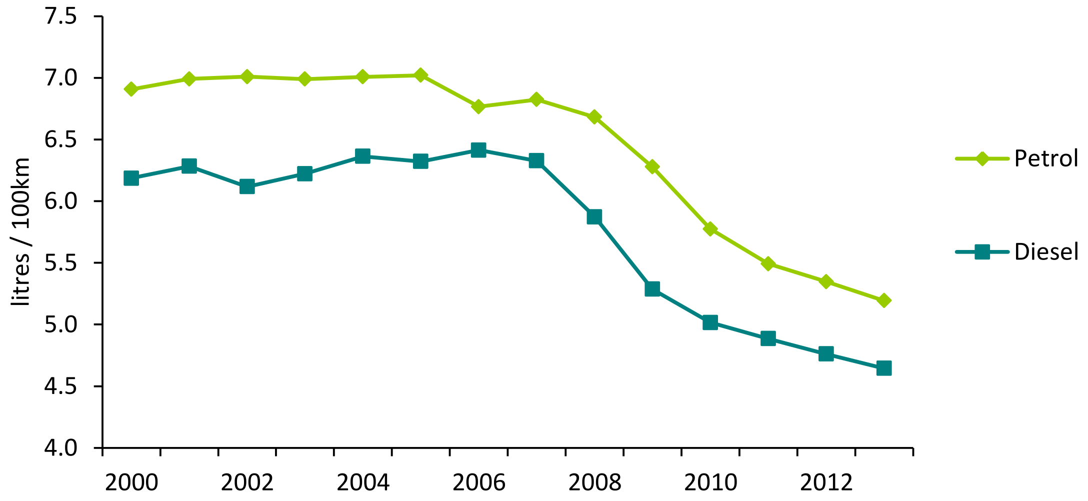
A number of factors coincided from 2008 onwards to drive this improvement, including:

- The change to the registration tax and annual motor tax system to be based on the carbon dioxide emissions intensity
- The coming into force of the obligation on car manufacturers to reduce overall average new car fleet emissions

- The onset of the economic crisis

The specific fuel consumption for new petrol cars in Ireland in 2013 was 5.19 litres/100km. This represented a decrease of 23% on the average fuel consumption in 2000 (or increase in fuel efficiency). Similarly the specific fuel consumption of new diesel cars reduced 26% between 2000 and 2013 to 4.64 litres/100km.

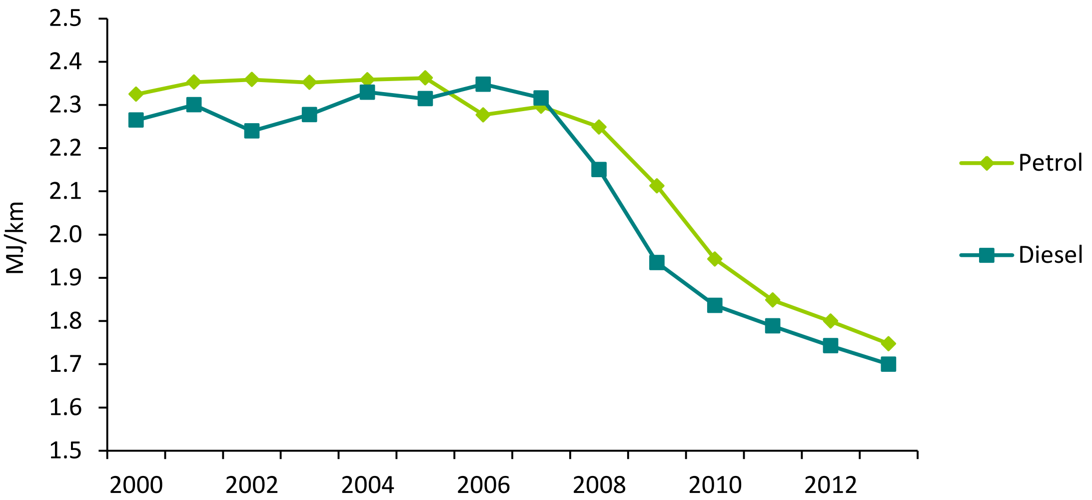
Figure 25: Private cars specific fuel consumption



Source: SEAI

A litre of diesel contains more energy than a litre of petrol so petrol and diesel cars are not comparable on Figure 25. This is relevant for Ireland where a large amount of fuel switching has taken place, as by switching from petrol to diesel it is possible to improve fuel efficiency in terms of litres/100km but at the same time reduce energy efficiency in terms of energy per km. Figure 26 shows the specific energy consumption of new petrol and diesel cars in Ireland in terms of MJ / km, in this way petrol and diesel cars are directly comparable.

Figure 26: Private cars specific energy consumption



Source: SEAI

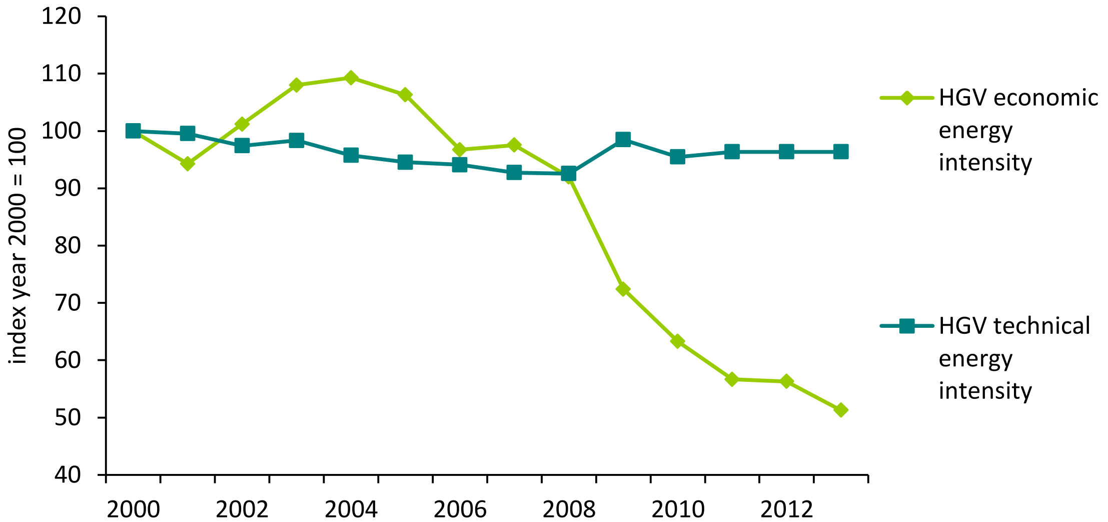
In almost all years the average diesel car is more energy efficient than the average petrol car, in spite of the fact that the average diesel car is typically larger and heavier than the average petrol car. Again the improvement in efficiency post 2007 is evident with the efficiency of the average petrol and diesel car improving by 24% and 27% respectively between 2007 and 2013.

3.1.2.2 FREIGHT

As discussed in section 3.1.1.2 there is no data specific to Ireland on the specific fuel consumption of HGVs, and therefore the average energy efficiency of the EU HGV fleet as per the ODYSSEE database is used to estimate HGV energy consumption. The trend from 2000 to 2013 for the average efficiency of the EU HGV fleet is shown in Figure 27 for reference (referred to here as technical energy efficiency). It can be seen that it has remained relatively constant over the time period.

The economic energy intensity of HGV freight can be defined as the ratio of the final energy demand of HGV to GDP. The separate trends for HGV final energy demand and GDP (in constant 2013 Euro) can be seen in Figure 24. Figure 27 shows economic energy intensity of HGVs, expressed as an index relative to 2000. The reducing trend evident after 2008 represents an improvement in the economic energy efficiency of HGV, i.e. using less energy per unit of GDP. This is due in part to the significant reduction in the activity of the road and building construction sector in that time period, as discussed in section 3.1.1.2. Activity in this sector involves the transport of large volumes of high weight, low value materials. The disproportionately large reduction in this sector has led to an increase in the average value of cargo being transported in the country as a whole, and thus an improvement in the economic energy intensity.

Figure 27: HGV technical energy intensity and economic energy intensity, indexed to 2000.



Source: CSO and SEAI

3.1.3 DECOMPOSITION OF TRANSPORT ENERGY TRENDS

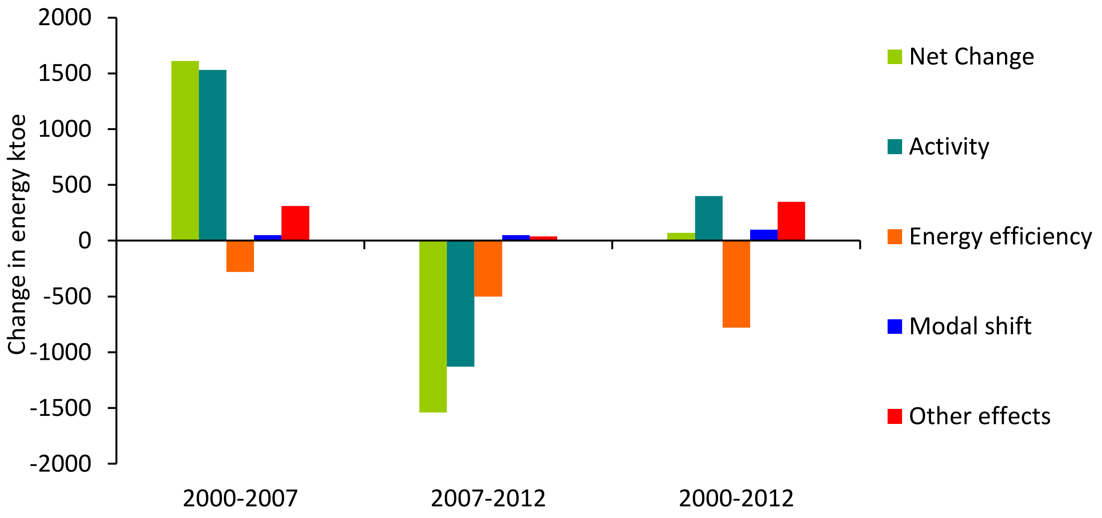
As discussed in section 2.1.1.3 the ODYSSEE decomposition tool[28] offers a methodology for separating the overall trend in energy consumption for a particular sector into a number of

[28] http://www.indicators.odyssee-mure.eu/decomposition.html

underlying drivers. For the transport sector the factors considered are: activity; energy efficiency savings, modal shift; other effects. Figure 28 shows the results of this analysis for the Irish transport sector for the periods 2000 to 2012, 2000 to 2007 and 2007 to 2012.

In each of the two time periods 2000 to 2007 and 2007 to 2012 changing activity was the primary driver for the observed change in overall transport energy consumption, acting to increase energy consumption in the earlier period and reduce it in the latter. Section 3.1.1 discusses the variation in activity by mode. Energy efficiency improvements acted to reduce overall energy consumption across both time periods, increasingly so post 2007. Over the full period 2000 to 2012 the overall increase in energy usage was just 70ktoe, a result of energy efficiency gains cancelling out the modest net activity increase that remained after the economic recession.

Figure 28: ODYSSEE decomposition of Irelands transport final energy demand



Source: ODYSSEE

3.1.4 TRANSPORT ODEX

The ODYSSEE project has developed a range of indicators for measuring energy efficiency at different levels and within different subsectors of the economy. For the transport sector the following indices are used for Ireland: private cars litres/100km; HGV koe/tonne km; rail koe/tkm, bus toe/vehicle. These sub-sectoral indicators are then expressed as indices relative to a base year and combined in a weighted average to form an overall index known as the transport ODEX. For Ireland private car and HGV dominate accounting for 95% by energy share of the four modes. Shown in Figure 29 are the trends for unit consumption of private cars and HGV together with the overall transport ODEX, expressed as indices relative to the year 2000. The overall ODEX tends to follow closely trend in private car fuel intensity over the time period due to the fact that private car is the largest end use.

Figure 29: ODYSSEE energy efficiency indicators for Irish transport sector

Source: SEAI and ODYSSEE

3.2 ENERGY EFFICIENCY POLICIES

For a detailed review of policies targeting energy efficiency in transport at EU level and a broad overview of some Member State policies refer to the latest ODYSSEE report on the transport sector[29]. For a detailed description of policies relating to energy efficiency for each EU member state, refer to the MURE online database[30]. Provided here is a brief description of some recent policy measures implemented in Ireland targeting this area.

3.2.1 UK-IRELAND FUNCTIONAL AIRSPACE BLOCK

The aim of the Functional Airspace Block (FAB) is to increase operational efficiency in aviation through international co-operation in airspace control. FABs are a key tool of the European Union's Single European Sky programme, aiming to help reduce the current fragmentation of air navigation service provision across Europe. The Irish and UK National Supervisory Authorities created the UK-Ireland FAB in 2008. The primary objective of the UK-Ireland FAB is to reduce costs to airspace users and increase the efficiency of FAB airspace. Through this objective EC performance targets regarding safety, cost efficiency, capacity/delay and the environment will be met. The method for monitoring and measuring fuel savings is as per the annual report on the UK-Ireland FAB issued by the Irish Aviation Authority and the UK National Air Traffic Services. The savings reported in NEEAP3 are shown in Table 10.

[29] Available from http://www.odyssee-mure.eu/publications/br/

[30] Available at http://www.measures-odyssee-mure.eu/

3.2.2 MORE EFFICIENT ROAD TRAFFIC MOVEMENTS

The promotion of eco-driving techniques has been demonstrated to achieve significant on-road energy savings and to be successful in reducing the gap between observed on-road energy use and emissions and standard test cycle emissions. It is planned to launch an awareness campaign and driver skills development programme to promote energy efficient driving behaviour. Energy savings are predicted by the Department of Communications, Energy and Natural Resources based on a bottom up model of the private vehicle stock, the savings reported in NEEAP3 are shown in Table 10.

Table 10: Achieved and predicted energy savings from selected transport sector policy measures

	Energy savings (GWh, Primary Energy)			CO_2 savings ($ktCO_2$)		
	2012 (achieved)	2016 (expected)	2020 (expected)	2012 (achieved)	2016 (expected)	2020 (expected)
Functional Airspace block	253	253	253	65	65	65
More efficienct road traffic movements	63	177	310	16	45	79

Source: Department of Communications, Energy and Natural Resources

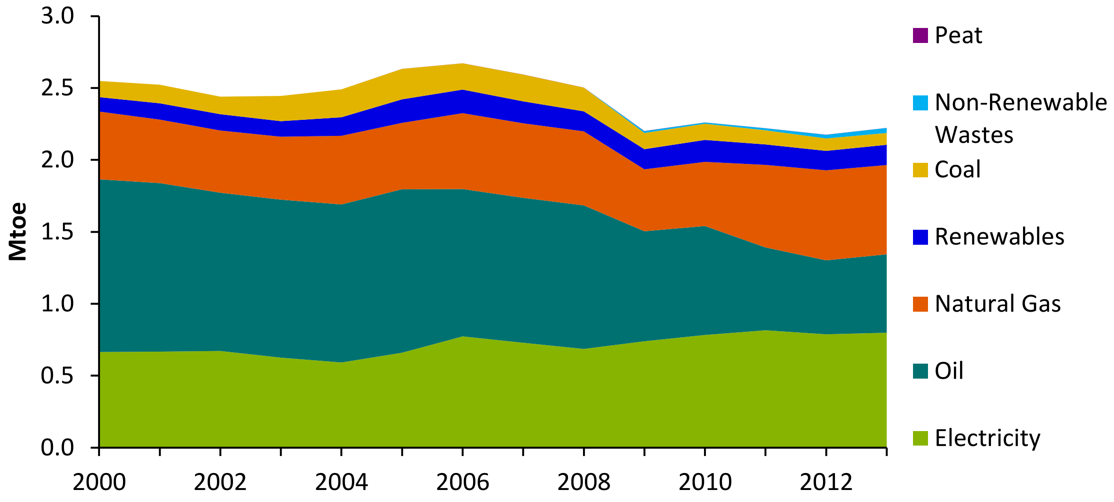
4 ENERGY EFFICIENCY IN INDUSTRY

4.1 ENERGY EFFICIENCY TRENDS

4.1.1 INDUSTRY FINAL ENERGY DEMAND

Figure 30 and Table 11 show industry final energy demand for the period 2000 to 2013 split by fuel type. Over that time period the overall industry energy usage has decreased and there has been fuel switching away from oil and coal and towards natural gas, electricity and renewables. The increase in renewables is mainly due to the use of biomass in the wood processing industry, the use of tallow in the rendering industry and the use of the renewable portion of wastes in cement manufacturing. Since 2009 non-renewable wastes have also been used as an energy source in industry. In the year 2000 oil was the largest fuel source on a final energy basis, by 2013 it was electricity.

Figure 30: Industry final energy demand by fuel type



Source: SEAI

Table 11: Industry final energy demand by fuel type

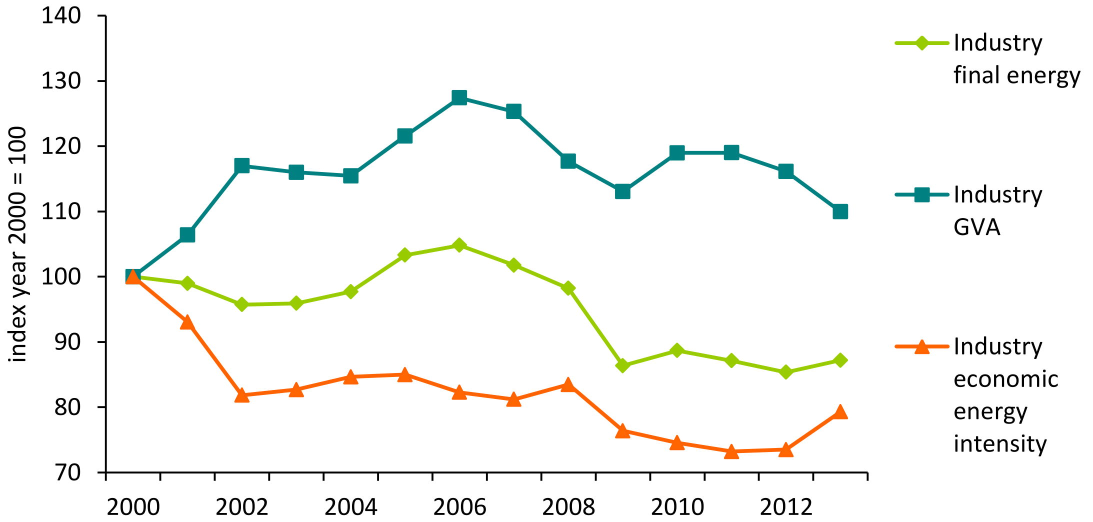
Industry TFC by Fuel	Quantity (ktoe)		Share		Growth	Annual average growth		
	2000	2013	2000	2013	2000-'13	2000-'13	2000-'07	2007-'13
Total Fossil Fuels	1,784	1,248	70.0%	56.2%	-30.0%	-2.7%	-0.6%	-5.1%
Coal	113	82	4.4%	3.7%	-27.0%	-2.4%	7.4%	-12.7%
Peat	-	1	-	0.0%	-	-	-	-5.4%
Oil	1,201	545	47.1%	24.5%	-54.6%	-5.9%	-2.5%	-9.7%
Gas	471	621	18.5%	27.9%	31.8%	2.1%	1.4%	3.1%
Renewables	100	141	3.9%	6.3%	40.2%	2.6%	6.2%	-1.3%
Non-Renewable Wastes	-	35	-	1.6%	-	-	-	-
Total Combustible Fuels	1,885	1,424	73.9%	64.1%	-24.4%	-2.1%	-0.2%	-4.4%
Electricity	665	799	26.1%	35.9%	20.2%	1.4%	1.3%	1.5%
Total	2,549	2,223			-12.8%	-1.0%	0.2%	-2.5%

Source: SEAI

4.1.2 INDUSTRY ENERGY INTENSITY

Industrial energy intensity is the amount of energy required to produce a unit of value added, measured in constant money values, i.e the ratio of industry final energy to industry GVA. Figure 31 shows the trends for industry final energy, GVA (in 2013 Euro) and energy intensity (ktoe/€2013) between 2000 and 2013, shown as indices relative to 2000. Over the period, industrial energy consumption decreased by 12.8% while value added increased by 10.0% resulting in a reduction in intensity of 20.7% (note that a downward trend in energy intensity signifies an improvement). In 2013 there was a reversal of trends for the previous three years with an increase in final energy of 2.2% and a decrease in GVA of 5.3% resulting in an increase in energy intensity of 7.9% for the year (or an equivalent decrease in energy efficiency).

Figure 31: Industry final energy demand, GVA and energy intensity, indexed to 2000



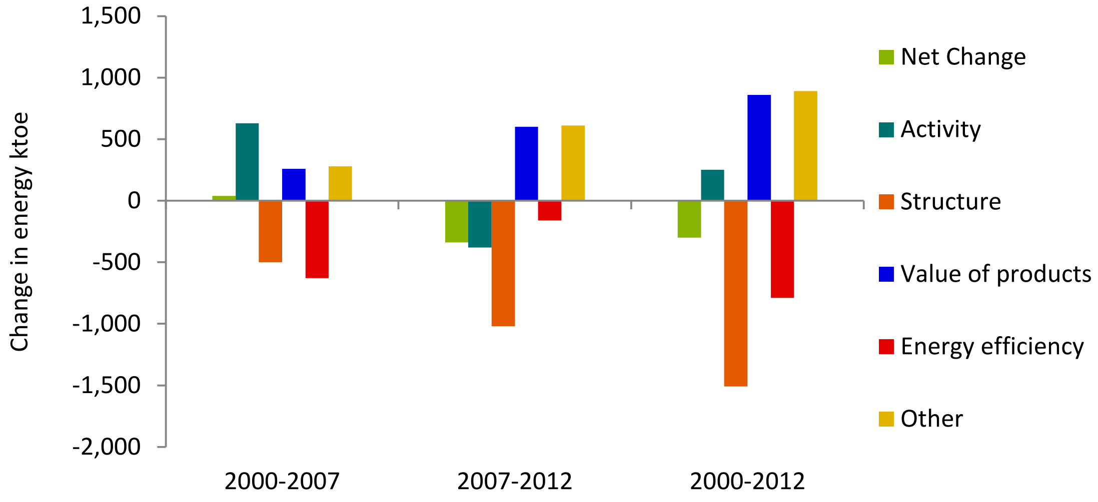
Source: CSO and SEAI

Measuring energy intensity and efficiency in this high level way captures many influencing factors, including changes in: technological efficiency; fuel mix, particularly in relation to electricity generation; economies of scale in manufacturing; and not least the structure of the economy. Economic structure in Ireland's case has changed considerably over the past twenty years. The structure of the economy has shifted in the direction of the high value-added sectors such as pharmaceuticals, electronics and services. Relative to traditional "heavier" industries, such as steel production, these growing sectors are not highly energy intensive. Examples of changes to the industry sector structure include the cessation of steel production in 2001, of fertiliser production in late 2002 and of sugar production in 2007. More recently there has been sharply reduced activity in cement production as a result of the economic downturn. Energy intensity will continue to show a decreasing trend if, as expected, the economy becomes increasingly dominated by high value-added low energy consuming sectors. This results in a more productive economy from an energy perspective but does not necessarily mean that the actual processes used are more energy efficient. There may therefore still be room for improvement.

4.1.3 DECOMPOSITION OF INDUSTRY ENERGY TRENDS

A decomposition methodology has been developed as part of the ODYSSEE project in order to separate out the relative contributions of the main influencing factors on overall industry energy usage, the results of which are shown in Figure 32 for the three time periods 2000 to 2012, 2000 to 2007 and 2007 to 2012. Over the time period 2000 to 2012 the single greatest factor reducing energy usage in the Irish industrial sector is shown to be structural changes.

Figure 32: ODYSSEE decomposition of Ireland's industry final energy demand



Source: ODYSSEE

4.1.4 INDUSTRY ODEX

The ODEX indicator is based on production indices for all of the industry sub-sectors relative to that in the base year (in this case 2000). It is important to note that, for some sub-sectors, the trends also include some non-technical changes, especially in the chemical industry as a result of the shift to light chemicals. Data for this sector are currently not available at a sufficiently disaggregated level.

Between 2000 and 2007 the ODEX indicator of energy efficiency for industry improved by 25.2%. This trend was reversed between 2008 and 2011. The overall improvement in efficiency over the full period 2000 to 2013 was 23.0%, or 2.0% per annum.

Figure 33: Industry ODEX

Source: SEAI and ODYSSEE

4.2 ENERGY EFFICIENCY POLICIES

4.2.1 LARGE INDUSTRY ENERGY NETWORK

The Large Industry Energy Network (LIEN) is a voluntary grouping, facilitated by SEAI, of companies that work together to develop and maintain robust energy management. They provide annual data reports to SEAI on their energy use and actions taken to reduce their consumption. 163 of Ireland's largest energy users are members of the LIEN.

The SEAI Energy Agreements Programme is a sub-set of 80 LIEN companies, who have agreed to work towards implementing ISO 50001. In return, they receive tailored support from SEAI in the form of assigning an Agreements Support Manager to provide both general and technical advice; assessing any gaps in order to achieve EN 16001; identifying special investigations to reveal opportunities for energy savings; organising tailored workshops, training and networking events; and providing EN 16001 implementation support.

The LIEN was included in Ireland's NEEAP3; the estimated savings achieved and predicted by 2020 are shown in Table 12.

4.2.2 ACCELERATED CAPITAL ALLOWANCE

The Accelerated Capital Allowance for Energy Efficiency Equipment (ACA) aims to improve the energy efficiency of Irish companies by encouraging them to purchase energy saving technologies. The scheme offers a tax incentive for companies who invest in highly efficient equipment to avail of tax breaks by allowing such businesses deduct the full cost of such equipment from taxable profits in the year of purchase rather than over the usual 'Wear and Tear' eight year period.

The scheme has expanded from 3 categories and 5 technologies in 2008 to 10 technologies and 52 technologies. The scheme currently has over 10,000 eligible products and it is estimated that up to 85% of a companies' equipment procurement needs can be sourced through the ACA. ACA eligible products are listed on SEAI's Triple E (Energy Efficient Equipment) Register which provides a benchmark register of best in class energy efficient products. Both the ACA and Triple E are managed by SEAI. Further information on the schemes, including a full list of categories, technologies and eligible products, can be found on SEAI's website.

A review and cost based analysis of the scheme was carried out in October 2014. The primary aim of this review was to set out the context and rationale for the scheme, evaluate its overall effectiveness and to make recommendations regarding continuance of the ACA. In the 2015 Budget speech it was announced that the scheme would continue for a further three years to 31 December 2017.

The ACA was included in Ireland's NEEAP3; the estimated savings achieved and predicted by 2020 are shown in Table 12.

Table 12: Achieved and predicted energy savings from selected industry sector policy measures

	Energy savings (GWh, Primary Energy)			CO_2 savings ($ktCO_2$)		
	2012 (achieved)	2016 (expected)	2020 (expected)	2012 (achieved)	2016 (expected)	2020 (expected)
Accelerated Capital Allowance	137	368	688	32	80	140
Large Industry Energy Network	1,802	2,235	2,728	449	539	642

Source: Department of Communications, Energy and Natural Resources