



## Appendix 2: Transport

### A 2.1 Transport Energy Trends

Transport now accounts for 40% of Total Final energy Consumption in Ireland. Energy demand in transport has increased by 131% between 1990 and 2004. It now accounts for 32.7% of Energy related CO<sub>2</sub> in Ireland. From Table 2 below it can be seen that the car is the dominant mode of transport for travel with 55% of people traveling to work by car. Public Transport only accounts for 8.6% of commuters with 6.6% by Bus and 2% by Train.

Table 2: Modes of Transport used by commuters to get to Work

Source: CSO (2003)

On Foot	Bicycle	Bus	Train or Dart	Motorcycle / Scooter	Motor Car	Car Passenger	Lorry	Other	Work at home	Not Stated
176,060	33,154	102,497	31,878	16,826	860,664	105,556	107,120	5,774	95,905	25,615
11.3%	2.1%	6.6%	2.0%	1.1%	55.1%	6.8%	6.9%	0.4%	6.1%	1.6%

### A 2.2 Transport Emissions

The main fuels used in Transport are Petrol and Diesel. Kerosene is consumed in the aviation industry but as aviation is currently outside the remit of the Kyoto Protocol it will not be included in this analysis. Table 3 shows CO<sub>2</sub> emission levels for different modes of transport in gCO<sub>2</sub>/passenger km.

Table 3: CO<sub>2</sub> Emission figures for Different modes of Travel

Source: Tyndall (2001)

Mode of Travel	gCO <sub>2</sub> / passenger km
<b>Petrol</b>	185.2
<b>Diesel</b>	139.8
<b>Hybrid</b>	124.3
<b>Rail</b>	72.1
<b>Air</b>	211.3
<b>Bus</b>	55.9

These figures are approximate and are based on averages across the different modes of transport. They highlight the significant difference in emissions between public transport to Petrol and Diesel Vehicles. This highlights the need to increase the utilisation of public transport, to develop alternative cleaner fuels and to support initiatives to promote walking and cycling for short journeys.

### A 2.3 Strategies & Plans

#### Transport 21

Transport 21 -- the government's 10 year plan for transport -- was announced in November 2005. The plan proposes an investment of €34.4 billion, €26 billion of which will come from government funds, and the rest as PPP (Public Private Partnership). The public transport element of the plan is worth a total of €16 billion. It includes massive investment in the rail network, an Interconnector tunnel under the city centre connecting Heuston Station with Spencer Dock, several new Luas lines, a metro line from the centre of Dublin to Dublin Airport, expansion of the DART network, reopening of a rail link to Navan, completion of the motorway system, and better integration of all transport systems.



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**Rail:** The Western railway Corridor is part of the plan. The immediate section of the Western Railway Corridor which is due to be reopened is from Ennis to Athenry, allowing Limerick–Galway intercity services. A commuter service is intended for Galway to Athenry, serving Oranmore.

**Road:** An "Atlantic Corridor" from Donegal to Limerick and Waterford is intended, although much of it will only be upgraded two-lane or 2+1 road. Limerick to Ennis is already dual carriageway.

### **Clare County Development Plan**

An integrated transport strategy is included in the Clare County Development Plan. It says that "the Planning Authority will seek to minimize daily routine travel, maximize the proximity of people to employment and the services they require and encourage the use of alternative transport modes in the settlements of through the adaptation of an integrated transport strategy."

The strategy deals with: pedestrian links and cyclists; coaches, buses and taxis; air transport; rail transport, water-borne transport; and road transport (which is a big part of this transport strategy).

### **Limerick County Development Plan**

Chapter 8 of the Limerick County Development Plan is dedicated to Transport and Infrastructure. The Limerick Planning, Land Use and Transportation Study (PLUTS) was commissioned by Limerick County Council and Limerick City with the objective of producing short, medium and long term strategies for planning, land use development and transport systems for the whole Limerick region. Although Limerick County Council has not formally adopted the PLUTS, these strategies have been taken into account in developing policy objectives for the promotion of integrated transportation strategies in the Development Plan.

### **Limerick City Cycle Network Strategy**

Limerick City Council has identified and included in its Development Plan and Corporate Plan, the issue of sustainable transport modes for Limerick City and environs. The development of a cycle network is an important step toward this objective. A key focus is to link centres of education and work places with residential areas.



## A 2.4 What Moves Us

### The Car

In Ireland the number of cars on Irish Roads has doubled from 1990-2004. This growth has driven by the growth in the economy and the increase in the number of people working in Ireland. The density of new cars per head of population has increased from 1990 levels of 227 cars per thousand to 391 per thousand in 2004 which is just below the EU-15 average of 491 per thousand (SEI, 2006). This has created significant problems with congestion in the towns and cities around the country.

This increase in car ownership is also one of the reasons why CO<sub>2</sub> emissions have increased substantially since 1990. It is estimated that 40% of CO<sub>2</sub> emissions from the Transport sector are generated by passenger cars (SEI, 2004). Chart 1 below provides a breakdown of CO<sub>2</sub> emissions from the different transport types.

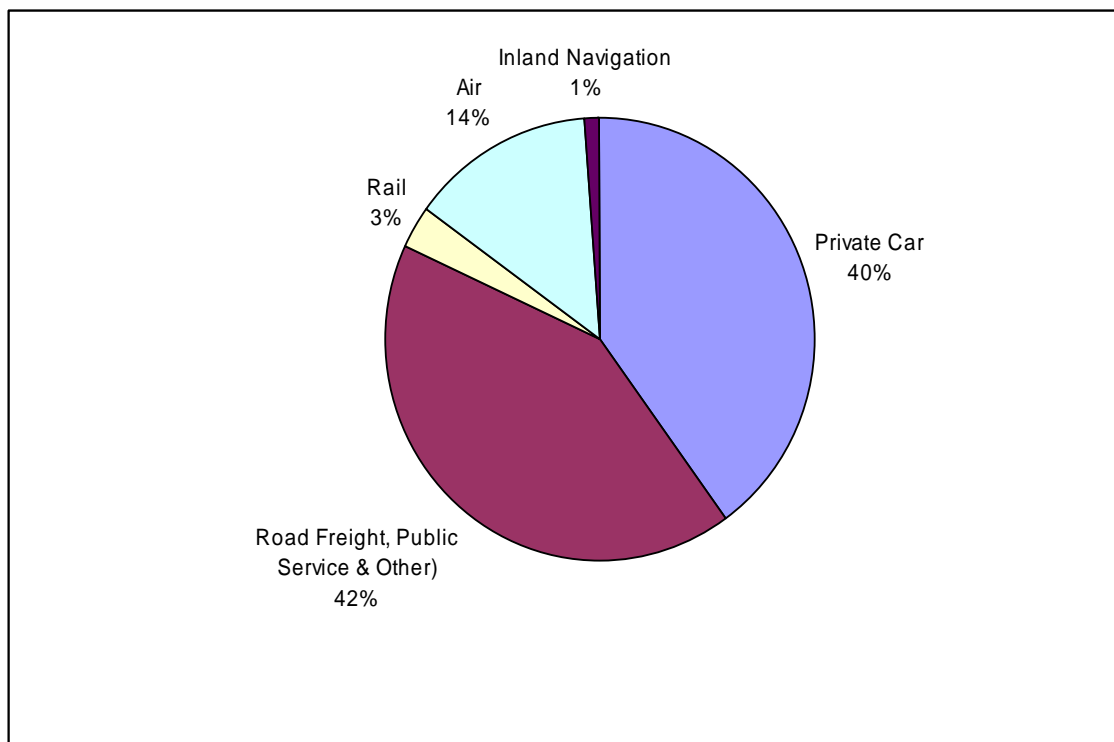


Chart1: Breakdown of CO<sub>2</sub> Emissions for the different modes of Transport in Ireland.

Source: SEI, (2004)

The average emission for petrol engine cars purchased between 2000 and 2004 was 167.6g of CO<sub>2</sub>/km and for diesel cars 169.6g of CO<sub>2</sub>/km (SEI, 2006). This compares with average emissions of 164g CO<sub>2</sub> /km in 2003 (EEA, 2005) for the total car fleet in the EU in 2003. The main reason for the Irish figures being higher than the EU figures, are due to the increasing purchasing trends in Ireland towards larger cars.

The EU emission figures represents a significant reduction of 12% compared to the 1995 figure of 185g/CO<sub>2</sub> but there is still significant progress to be made if the EU target of 140g of CO<sub>2</sub>/km is to be achieved by 2008/2009. This target has been set out through a voluntary agreement between the EU and the European, American, Japanese and Korean automobile manufacturers and this would represent a 25% reduction in emissions since 1995. These reductions will have significant impact on reducing emissions from passenger cars but the level of these reductions will depend on the age of the car fleet. With the high rate of new cars being purchased in Ireland the total car fleet



is being significantly renewed. At the end of 2002 the average age of cars was 5.2 years with (SEI 2004). 45% of cars were 5 years or under and 71% were 7 years or younger.

In 2001 it has been made mandatory under EU and Irish Law to provide the CO<sub>2</sub> emissions for any new vehicle sold. The Society of Irish Motoring Industry (SIMI) publishes an emissions guide annually which gives data on CO<sub>2</sub> emissions for all vehicles sold in Ireland (SIMI, 2004). There have been many advanced technological improvements in terms of fuel efficiencies in new cars utilising more efficient engine technology, better control over the combustion cycle in engines, and reduction of energy losses. However many of these improvements have been offset by the increased number of extras now offered in new vehicles particularly air conditioning which can increase the energy load of a vehicle by up to 25%.

## **A 2.5 Alternative Fuel Technologies**

Hybrid Vehicles have been developed to increase fuel efficiency and reduce CO<sub>2</sub> emissions. They normally consist of two engines: an electric engine and an internal combustion engine. In Stop Start Driving and Urban driving the electric engine kicks in, allowing the vehicle to run on the clean electric engine without burning any fuel. Toyota introduced the first Hybrid vehicle the Prius in 1997 which has an average fuel consumption of 4.3liters per 100km. A number of other companies have also launched Hybrid vehicles since then including: Honda, Ford, GM, Lexus and Peugeot-Citroen (e-atomium, 2006).

Many other clean technologies are being which have been explored including electric cars which are run on batteries which are charged up. However the life of the batteries is short and these vehicles are only suited for urban driving covering small distances. Other clean technologies being looked at are cars run on fuel cells and hydrogen fuel cars but to date have not been commercially developed.

Biofuels are fuels produced from a variety of biomass sources. They are classed as being carbon neutral as the CO<sub>2</sub> released by when burning these fuels is absorbed by the plants grown to replace them.

- Biodiesel which is a direct alternative to diesel is produced from plants such as Rapeseed, Sunflower Oil, and Recycled vegetable oils. It provides similar performance to diesel and can be blended to run on conventional diesel engines up to mixtures of 5% Biodiesel, 95% Diesel or diesel engines can be converted to run on 100% Biodiesel by making modifications to the engines.
- Bioethanol can be used instead of petrol. It is produced from plants such as sugar beet, cereals and forest residues. It can be used a 5% blend with Petrol with no engine modifications required. For blends greater than 5% modifications need to be made to the engine to ensure complete combustion of the mix. It is widely used in Brazil where the Bioethanol is produced from sugar cane. In Ireland it is still only being developed and is not as developed as Biodiesel.

Other options include running a vehicle on pure plant oil and not refining it into Biodiesel. There are a number of companies supplying pure plant biofuels but these can only be run on modified diesel engines. The oil is produced by pressing oil from plants such as Rapeseed or Sunflower, or from recycled filtered Vegetable oil.



## A 2.6 The bicycle and Cycle Lanes

The Bicycle is one of the most eco friendly mean of transport. A person cycling 5,000 kilometers a year will avoid 1 ton of CO<sub>2</sub> emissions by comparison to a person using a petrol family car for the same distance. But it is limited to short travel distance. Bicycles are the preferred mode of transport for those in full time education and some people who work within 2 miles of their home.



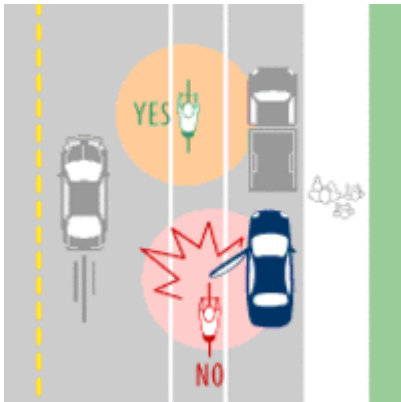
Electric bike arrived on the Irish market and you can now buy one easily. Electric bikes are close to being maintenance-free, are usually on bicycle lanes, cruise up to 30 kmph, and cost no more than a good mountain bike. They have an energy consumption of 0.05 kWh /passenger-km and emissions of 0.04 kg CO<sub>2</sub>/passenger-km.

However, the use of bicycle in Ireland is obviously decreasing, even among children and young people. There is a modal shift towards car.

Increased use of bicycles would have a personal health benefit for the individuals involved as well as the reduction in CO<sub>2</sub> emissions. The number of cyclists could increase if the following points were improved:

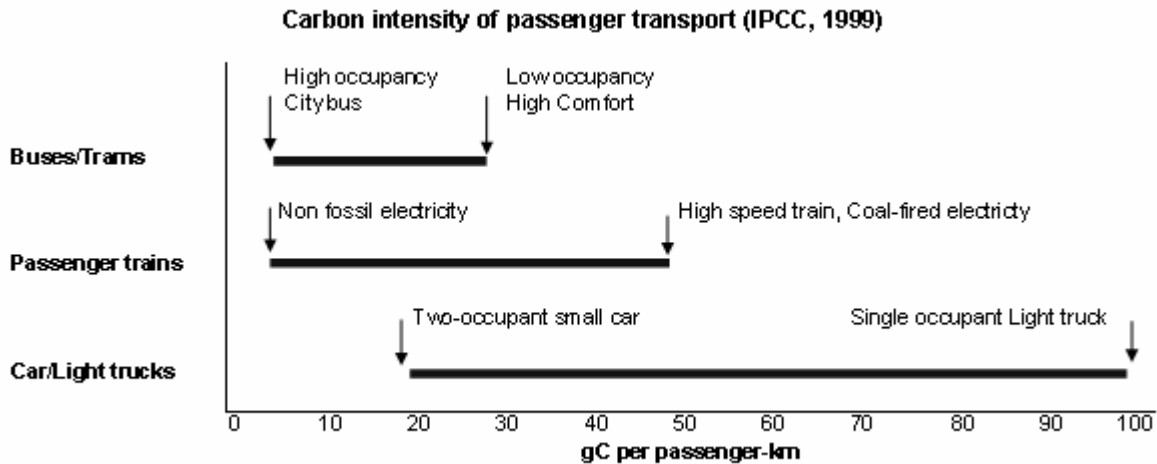
- Cycle lanes - number and design.
- Bicycle parking racks.
- Changing & showering facilities at work.
- Motorist lack of care and courtesy

Number and design of cycle lanes are an important issue because it plays a role in security of cyclists. For example, the “door zone” bike lanes which are being developed are very dangerous (as shown on the picture below)





## A 2.7 Public Transport - General



Source: IPCC (1999)

## A 2.8 Public Transport - Buses

Emissions of CO<sub>2</sub> per passenger-km from bus or coach transport are less than 20 gC. This is at least three times less than private cars. There are two key factors which can be used to reduce emissions from bus transport:

- increase the number of passengers (by improving service frequency and number of routes)
- use less polluting fuels

### ➤ Increase the number of passengers

There are different actors in the bus transport network:

- the national company (Bus Eireann)
- private companies
- non profit making organisations

And the network is made of different types of services:

- intercity services
- local services
- urban services
- airport services

### ➤ Use less polluting fuels

Buses can be converted to work with biofuels. Several countries are already using biofuels in their public transport fleets: Sweden, Germany, Austria, France...

There are two main types of **biofuels** :

- Bioethanol: Basically alcohol, bioethanol is made from starch plants (grain, mostly corn, and tubers like cassava); sugar plants (sugar beet or sugar cane); and - although largely still in the preliminary stages - from cellulose plants. Bioethanol is obtained using biological production technology, which is fermentation and subsequent enrichment by distillation/rectification and dehydration.

Bioethanol is a readily available, clean fuel that can be utilized in combustion engines in different ways:



- Hydrous ethanol (95 percent by volume) contains some water. It is used directly as a gasoline substitute in cars with modified engines.
- Anhydrous (or dehydrated) ethanol is free of water and at least 99 percent pure. This ethanol can be blended with conventional fuel in proportions of between 5 and 85 percent (E85). As a 5 percent additive it can be used in modern engines without modification. Higher blends require modified engines as run on so-called flexible fuel vehicles.
- Finally, bioethanol is also used to manufacture ETBE (ethyl-tertiary-butyl-ether), a fuel additive for conventional petrol.

- Diester : The word Diester is the contraction of "diesel" and "ester methyl of vegetable oil". In France, the people and media use this term to speak about biodiesel. Diester is a variety of ester-based oxygenated fuels from renewable biological sources. It can be used in compression- ignition (diesel) engines without any modifications. Pure Diester is biodegradable, nontoxic and essentially free of sulfur and aromatics. The « Diester », used as a blend up to 30%, is a relevant solution to reduce urban pollution: direct substitution to diesel fuel, reversible solution, no extra financial investment required. This rate is considered as an « environmental and technical » optimum to be used for urban fleet vehicles. The Club des Villes Diester was created to inform and promote this optimum rate. Although biodiesel can be used in any diesel engine, among the first to switch to biodiesel include centrally fueled fleets such as urban buses.

### Hybrid diesel-electric buses



A "hybrid drive" means there is a combination of more than one type of motive power on the bus. Hybrid electric buses utilize two power sources: a smaller than normal internal combustion engine and an energy storage unit (the battery). The engine-generator combination works in parallel with the battery, providing electrical power to keep the battery charged. As a result, the engine operates only in its most efficient ranges. For example when accelerating from a stop, the electric transmission accelerates the vehicle to a speed of about 12 kmph. Once the vehicle is underway, the parallel hybrid system blends both the diesel engine and electric motor power to maintain speed. At highway speeds, the vehicle is powered solely by the diesel engine. During this time, the engine also charges the energy storage system (battery).

Significant fuel economy is achieved when the vehicle runs at its optimal speed, offering top engine performance and low exhaust emissions. The vehicle also uses regenerative braking to charge the batteries.

Operating costs for hybrid vehicles have been shown to be lower, both in fuel savings and in maintenance costs, particularly with plug-in hybrids.

**Eco-driving** – or energy efficient driving behaviour – is an other factor of energy efficient transport. Eco-driving can be trained among bus-drivers to raise their awareness of energy efficiency.

[http://europa.eu.int/comm/agriculture/biomass/biofuel/index\\_en.htm](http://europa.eu.int/comm/agriculture/biomass/biofuel/index_en.htm)

<http://www.partenaires-diester.com>

[http://www.biofuelregion.se/dokument/44\\_88.pdf](http://www.biofuelregion.se/dokument/44_88.pdf)

[http://www.advancedenergy.org/corporate/initiatives/hybrid\\_electric\\_bus.html](http://www.advancedenergy.org/corporate/initiatives/hybrid_electric_bus.html)



## A 2.9 Public Transport - Rail

Passenger rail has increased by more than 20% in Ireland between 1995 and 2002. However, the railway lines density (length of lines/area) is still far less than the average railway lines density in Europe. In 2004, the density was 27 m/km<sup>2</sup> in Ireland, and 50 m/km<sup>2</sup> in Europe.



*Irish Rail Network*

*(Source: [www. http://www.irishrail.ie](http://www.irishrail.ie))*

Rail transport represents 3.8% of CO<sub>2</sub> emissions from transport. However, it is the mode with highest growth in CO<sub>2</sub> emissions between 1990 and 2002: 185% of growth, but on a much smaller scale of magnitude compared with road transport.

For rail travel, carbon emissions per passenger-km depend on several factors, such as source of primary energy, type of locomotive (i.e. diesel or electric) and load factor. In general, emissions vary between below 5 and 50 gC per passenger-km.

Although the energy efficiency of rail is very favorable, advances are still sought to improve competitiveness and relative costs with other modes. One way is to increase the capacity in order to increase the energy efficiency per ton or passenger traveling. To this end, double deck trains have been developed and are widely used, particularly in the United States. Other examples are



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Japan Rail East and SNCF in France, which increased the number of passenger seats by 40% without any increase in vehicle weight.

The energy form used is a second controllable aspect of energy efficiency. Worldwide, approximately 60% of passenger transport by rail uses non-renewable diesel fuel (UIC, 2004). Electricity is an option, and this electricity can be supplied from renewable energy sources. Some rail companies have begun to set criteria for the type of electricity purchased for use of trains. For example, Swedish rail only uses “green electricity”. The other option is the use of renewable raw material for combustion.

In Ireland, 3% of the lines are electrified (in Europe, the average of electrified railway lines is 50%).

Diesel used by rail transport represents 0.94% of transport fuel consumption in Ireland.

Source: Strategy to reduce Greenhouse Gases from Irish Transportation, 2004, SEI