

# Towards a sustainable transport system

Comhar Briefing Paper<sup>1</sup>

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## Introduction

A transport system can be regarded as sustainable only if it is possible to imagine it being continued unchanged for several hundred years because it is not damaging society or the environment and is not dependent on a non-renewable, depleting resource to run. However, as this report shows, the Irish transport system has developed over the past few years in a way which has made it less sustainable by becoming, on a per capita basis, more heavily dependent on one increasingly scarce non-renewable resource - oil - than perhaps any other system in Europe. This dependency has arisen largely because of the recent under-priced, uncontrolled growth in the use of the private car. Many of the houses, shopping centres and industrial estates built recently will turn out to be very badly located if cars become too costly to use on anything like the present scale as a result of the increased cost of oil, whether the increase is a result of resource depletion or measures to protect the global climate.

This report begins by looking at the increased use of the Irish transport system in recent years and the extent to which the increases were necessitated by the country's economic growth. It shows that the increase in freight transport was largely unavoidable given the growth path followed but, if the pattern adopted in other EU countries had been followed, more of it could have been carried by rail. In Ireland, unlike most EU states, rail freight tonnage has declined in the past ten years.

However, where the country went more seriously wrong was in keeping the cost of driving a mile in a private car very low, with the result that demand for car use was higher than it would have been if the same tax burden had been imposed on motorists in a different way. Specifically, Ireland made the cost of owning a car high, but the cost of using one low, too low to cover the externalities imposed by a vehicle's use on the rest of the population. Removing this subsidy would have encouraged people to pay more attention to minimising the distance they travel to work and to lower energy transport modes. As aviation has also been subsidised by allowing it untaxed fuel and by the state paying a large proportion of the cost of flights from Dublin to regional airports, overall, the historically low cost of energy and the subsidies have encouraged people to use highly energy intensive transport modes and for less energy intensive ones to grow more slowly or to decline.

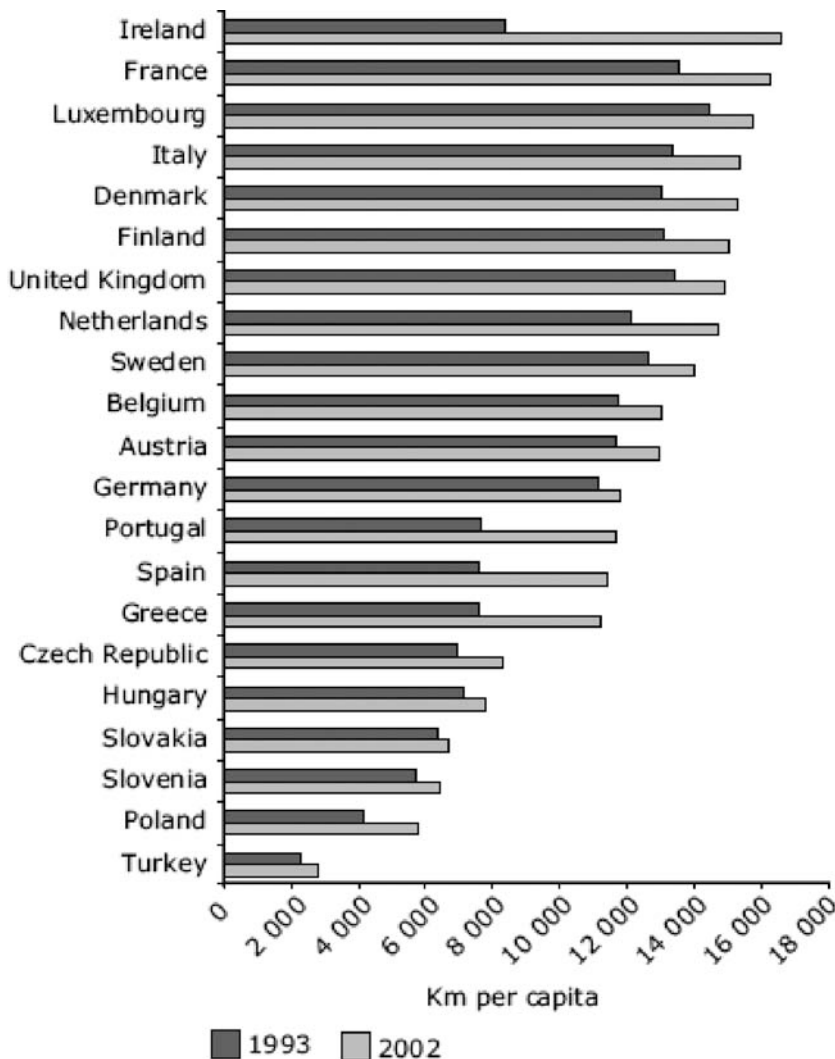
The report discusses the far-reaching environmental and social effects of allowing these changes to happen. It then turns to look at the policies and techniques that are available to rectify the situation.

## PART 1

### Recent performance - An overview of changes in transport volumes

The amount of transport activity in Ireland has increased more rapidly than in any other EU country since the early 1990s, according to the TERM report (EEA, 2006). As a result, Irish people now travel a greater distance in the course of a year than those in any other EU state.

Figure 1: Transport volumes 1993 and 2002



*Figure 1: In the ten-year period between 1993 and 2002, Ireland moved from being a middling country in terms of the distance its population travelled in the course of a year to the most travel intensive in the EU. The distances included above cover all forms of passenger travel including cars and air.*

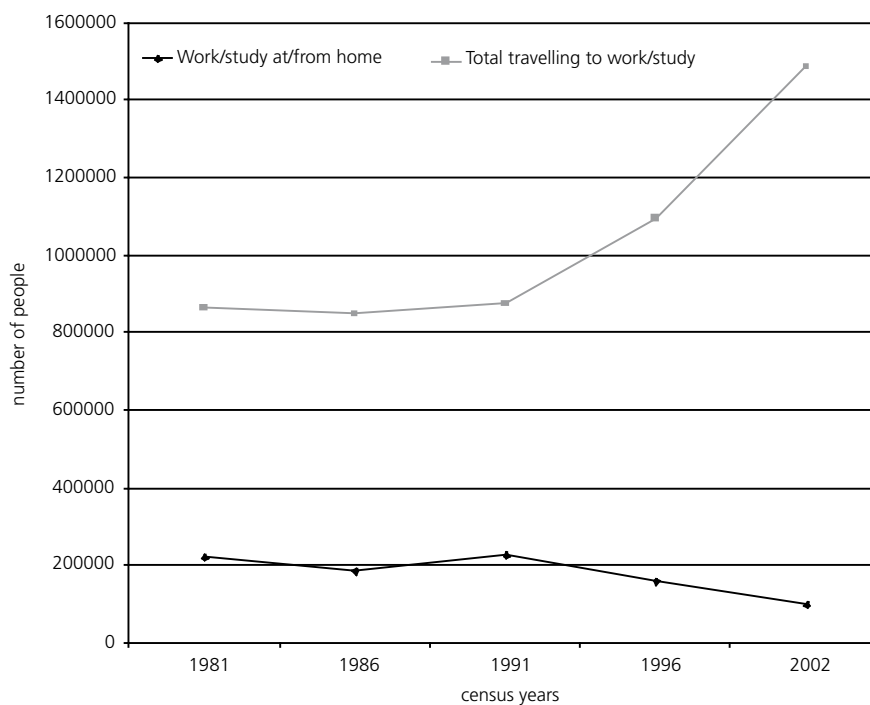
*Source: European Environment Agency, 2006.*

High transport growth, high levels of mobility, and resultant environmental problems are a Europe-wide phenomenon. The report comments:

*“Passenger transport per capita has grown particularly fast in Ireland. This can partly be explained by very strong growth in air transport by Irish-registered airlines, which also transport passengers from other countries. But even when air transport is excluded, Ireland still has the highest level of growth and would be at a level comparable to the United Kingdom.”*

The most solid data available for Ireland are the travel to work data collected by the CSO in the census (CSO, 2004). This data series shows a sharp increase in the number of people travelling to work and that, simultaneously, there was a sharp increase in the number of trips made by car.

**Figure 2: Total travelling to work and total working at home, censuses 1981 to 2002**



*Figure 2: As the numbers of people in employment grew, so, naturally did the number of those travelling to work.*

Figure 3: Modal split for travel to work 1981 to 2002 censuses

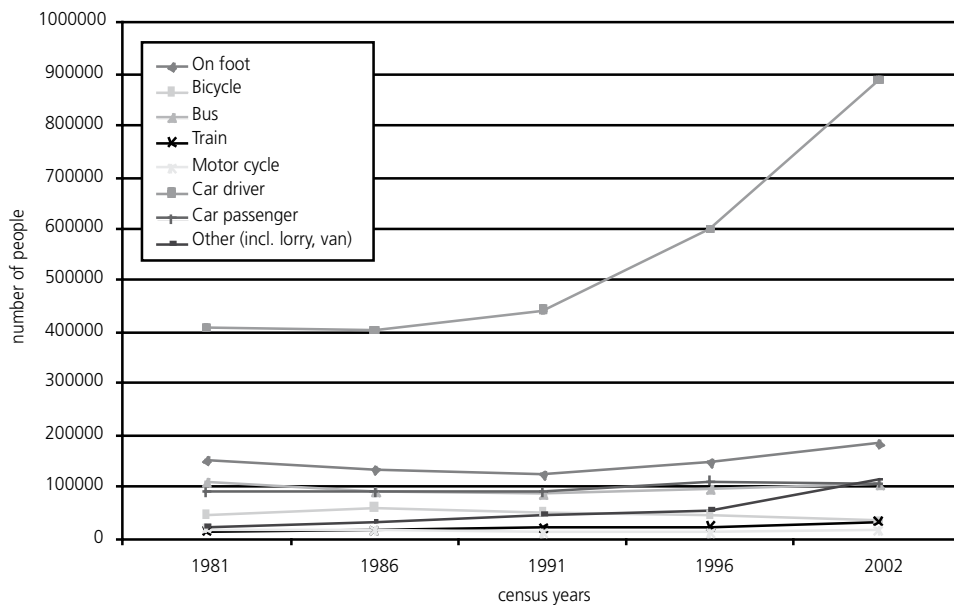


Figure 3: Many more journeys to work are now made by car.

The distances people travelled to work increased significantly (Walsh *et al.*, 2005) and a long-distance commuter zone developed around the major cities. A rough calculation from the CSO data suggests that between 1981 and 2002 total (one-way) mileage that people travelled to work each day increased from around 5 million miles to around 12 million miles. This increase was matched by a big increase in the number of motor vehicles registered annually. (DoEHLG, 2004)

Figure 4: Registered vehicles 1985-2004

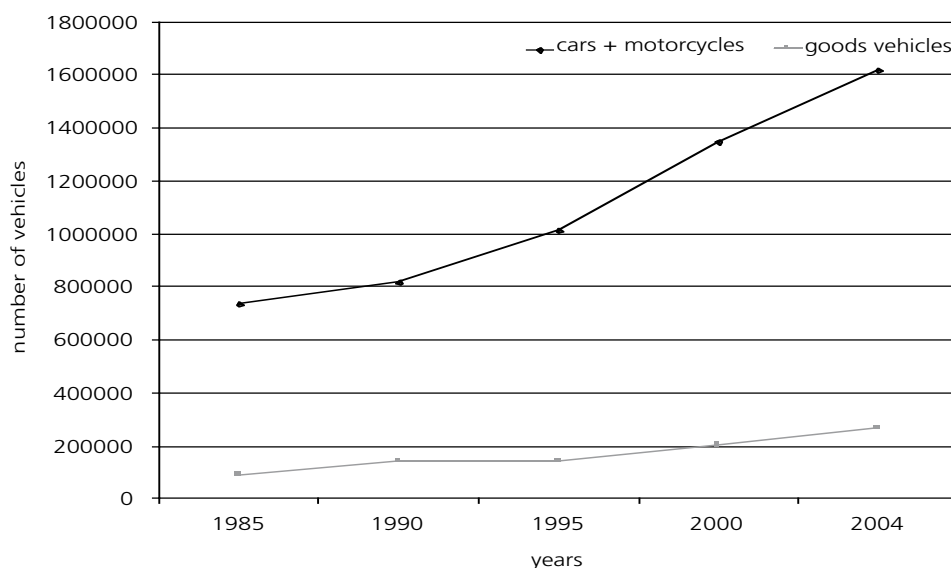


Figure 4: The number of new cars and motorcycles being put on to Irish roads each year doubled between 1986 and 2004. Source: DoELG 2004.

Growth in road freight has been even faster than in car travel, as shown in Figure 5. However, rail freight has declined sharply (Booz Allen Hamilton, 2003) and Irish Rail now carries 2% of the total freight (EEA, 2006), the second lowest percentage in Europe (excluding countries without a rail network).

Figure 5: Goods by Road, million tonne kilometres

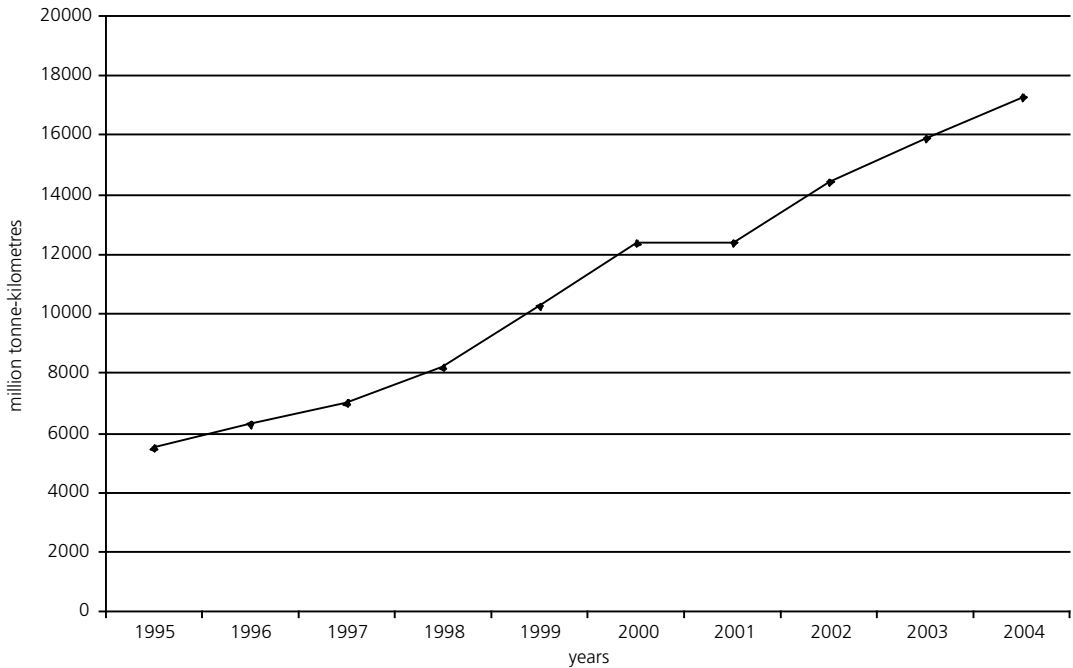
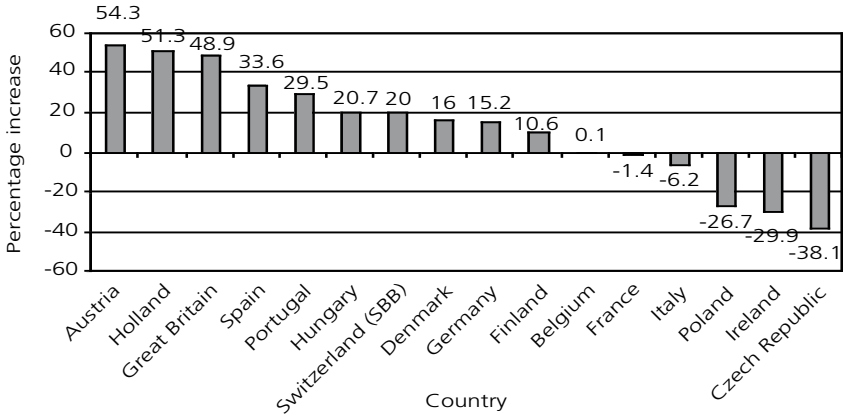


Figure 5: The amount of road freight carried tripled between 1994 and 2004. **Source:** CSO, 2005

Sea freight has shown an increase albeit more gradual and variable, from 30 million tonnes per year in 1993 to 43 million tonnes per year in 2000 to 52 million tonnes per year in 2005. Aviation has seen particularly sharp increases.

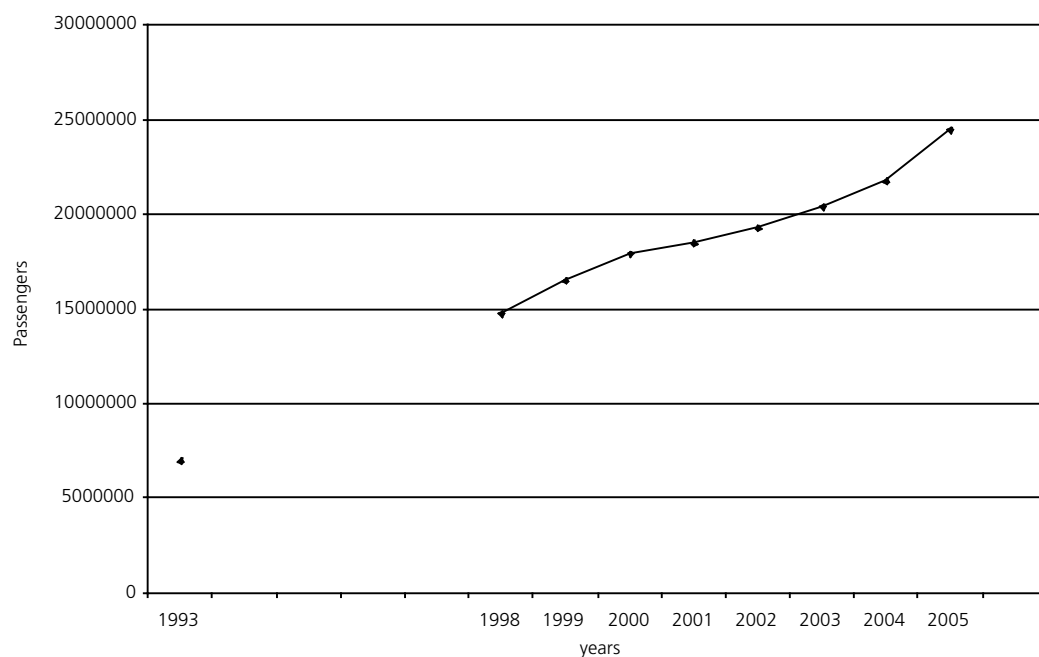
Figure 6: Freight Tonne Kilometres – 2004 against the Base Year



**Figure 6:** Other EU rail systems increased the amount of freight they carried between 2004 and the base year, the average of the 1993, 1994 and 1995 figures. In Ireland, however, rail freight declined.

**Source:** Ten-year European Rail Growth Trends, Association of Train Operating Companies, July 2005

**Figure 7: Number of Air Passengers**



**Figure 7:** There was a fourfold increase in the number of passengers going through Irish airports between 1993 and 2005. **Source:** EPA, 2004, Aer Rianta, 2003, Dublin Airport Authority, 2006.

This growth in transport was the result of a combination of the following factors, some of which are interdependent:

- Increased discretionary income available for transport.
- Increased income available for purchase of goods.
- Increased and substantial public capital investment in transport infrastructure and vehicles.
- Increased and substantial private capital investment in vehicles.
- Real fuel costs reducing as a proportion of income.
- Direct or indirect subsidies to all forms of motorised transport.
- Land use patterns generating increased transport demand.

### The reasons for the increase in transport

As Adam Smith's famous pin making example showed, societies raise their productivity and hence their incomes by organising themselves so that their workers and factories become increasingly specialised. This allows each worker to move up a single learning curve, becoming better and better at doing a very limited job, particularly as he or she can employ machinery and tools designed specifically for that job.

This trend has meant that mixed farms producing a wide range of foods and raw materials such as wool with few bought-in inputs have given way to very specialised "factory" farms which buy in all their feedstuffs and produce just a single product. Similarly, factories like the Foxford Woollen Mills, which took in the raw wool from the farms in the area and processed it right through to the finished blanket have been displaced by businesses in which almost every activity is out-sourced. Sales may still be done in house, perhaps, but manufacture and design are contracted out to specialist firms.

Specialisation has vastly increased the number of products we can use in a day. The Summer 2006 Argos catalogue lists over 30,000 different products, each of which is assembled from many components. Making each of these components cheaply enough to allow the products to be sold at affordable prices can only be done on a scale far beyond the capacity of a small country like Ireland to absorb. Hauliers move the components from the specialist factories which make them to the factories where the products are assembled, often in another country, and then to move the products to the dozens of countries in which they will be sold. The more products we use, therefore, the fewer can be made in Ireland at competitive cost and the more transport required to get them to us. The Argos range would be impossible without global trade.

International transport is therefore an essential part of the modern production process and its cost has fallen remarkably in the past 50 years thanks to containerisation. In 1956 loading loose cargo cost \$5.83 per ton. That same year, the first container ship cost less than 16 cents a ton to load<sup>2</sup>. Container ships have significantly reduced the difference in cost between shipping goods from a relatively close port on, say, the east coast of the US and one much further away in, say, Japan. They have also increased the speed with which exports can reach markets.

The cost of air freighting goods as a proportion of their value has also fallen, although more gradually than for sea freight. It fell by almost 3.5 per cent a year between 1973 and 1993<sup>3</sup>. As a result, volumes have grown hugely and, on a global level, more air cargo was carried on a single average day in 1999 than in the whole year fifty years earlier. As a result of these falls, it can quite easily cost more to get a container to or from a factory in Ireland to the port than it costs to ship it to the other side of the world.

As a result, Irish exporters have applied considerable pressure on successive governments to bring the cost of road haulage down and one effect of this has been that the sector has been allowed to externalise a lot of the costs it imposes. At a European level in 2000, the total external costs for all transport modes combined, excluding congestion, were estimated to be at least 7.3% of GDP. The fact that these costs were externalised constitutes a large subsidy to transport as an activity. Road transport

2 "Globalisation and International Locational Competition", lecture by Anne O. Krueger, First Deputy Managing Director, International Monetary Fund May 11, 2006, <http://www.imf.org/external/np/speeches/2006/051106.htm>

3 Ibid

alone accounts for 83.7% of external costs and thus gets that proportion of the subsidy, followed by air transport with 14%. Rail is responsible for only 1.9% of the externalities and waterways, 0.4%.

Two-thirds of the overall external costs stem from passenger transport and one third from freight transport. For passenger transport, railways have external costs 3.3 times lower than those of road transport, and 4 times lower than road freight. Since road transport contributes 22% to the European economy<sup>4</sup>, and the externalities attributable to it are equivalent to 6.1% of European GDP, it is getting a subsidy equal to roughly a quarter of its total operating costs. The external costs making up this figure arise from accidents, noise, air pollution, climate change, damage to nature and landscapes, the loss of time to people needing to cross a road, the use of scarce space in urban areas, and the upstream and downstream effects of transport activity such as the environmental costs of producing the fuels and the vehicles etc.

According to a European Environment Agency report<sup>5</sup>, less than half the full external cost of running a freight vehicle on Irish roads is covered by the fuel tax paid. UK hauliers pay almost twice the tax rate.

Figure 8: External costs and fuel tax

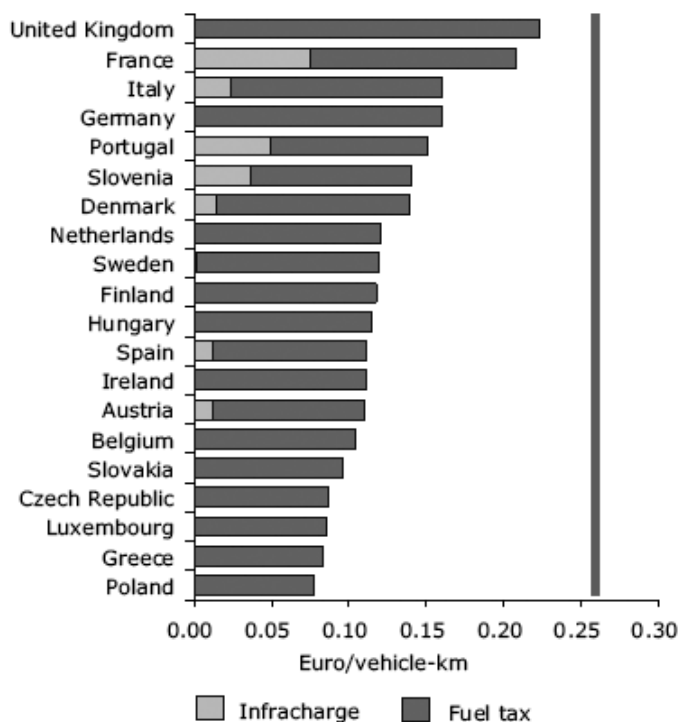


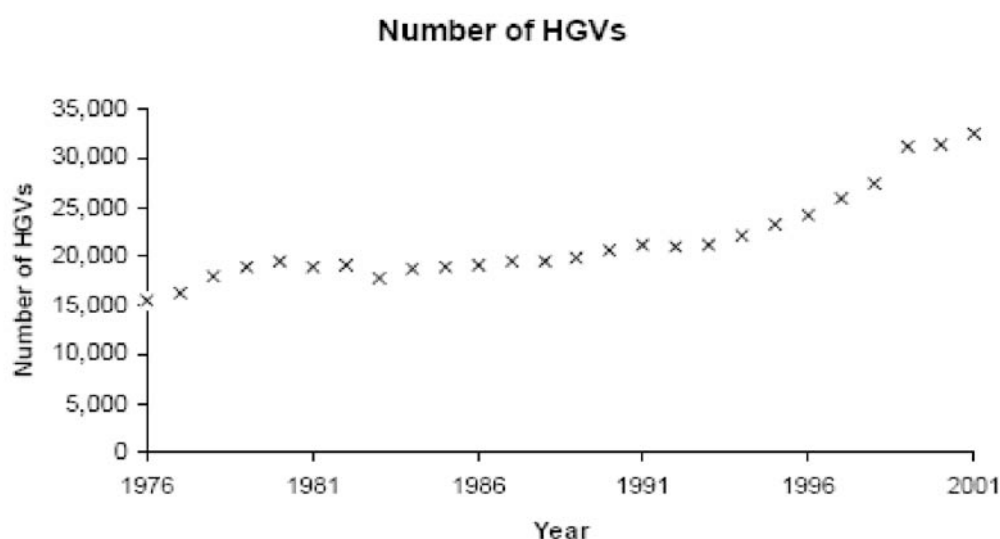
Figure 8: In Britain, road haulage companies almost cover the damage they do to the environment through their fuel tax payments. Their counterparts in Ireland pay less than half the cost. This constitutes a subsidy from the planet and the public. **Source:** EEA, 2006.

4 [http://www.erf.be/images/stat/2006\\_chap1.pdf](http://www.erf.be/images/stat/2006_chap1.pdf)

5 European Environment Agency, 2006, *Transport and the Environment: Facing a Dilemma* [http://reports.eea.europa.eu/eea\\_report\\_2006\\_3/en/term\\_2005.pdf](http://reports.eea.europa.eu/eea_report_2006_3/en/term_2005.pdf)

This road-use pricing policy did nothing to inhibit a doubling<sup>6</sup> in the number of heavy goods vehicles on Irish roads in the 25 years between 1976 and 2001 although given that national income more than doubled in that period and that rail freight was not promoted as an alternative, this increase was unavoidable in view of the strategy for growth adopted.

Figure 9: Number of HGVs

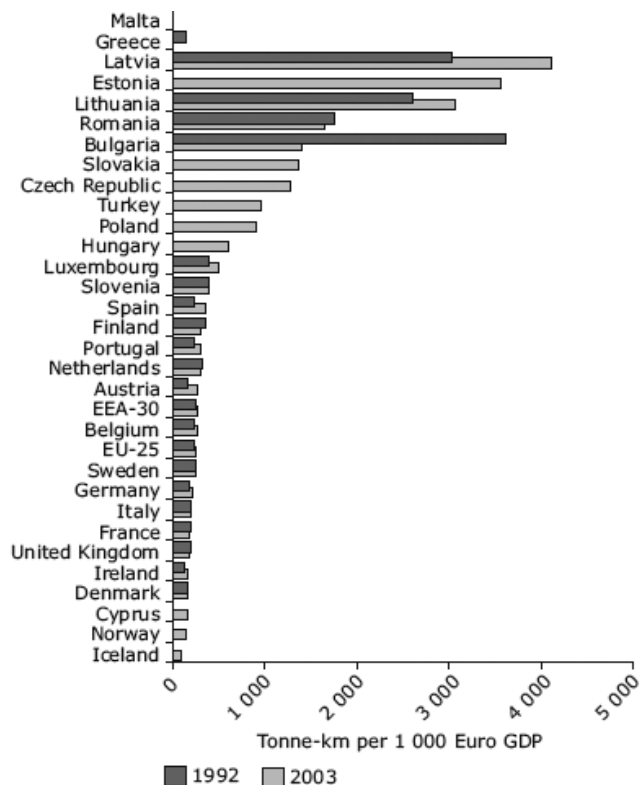


*Figure 9: The number of heavy goods vehicles using Irish roads more than doubled between 1976 and 2001. However the carrying capacity increased by more because the average size of the vehicles increased.*

Ireland does, in fact, have a low freight transport propensity for the size of its national income. It rates as a relatively efficient economy in this respect, as shown in Figure 10 below.

6 National Roads Authority, Future Traffic Forecasts 2002-2040, August 2003, downloadable from <http://www.n4.ie/PublicationsResources/DownloadableDocumentation/Transportation/file,863,en.PDF>

Figure 10: EU Freight Movements

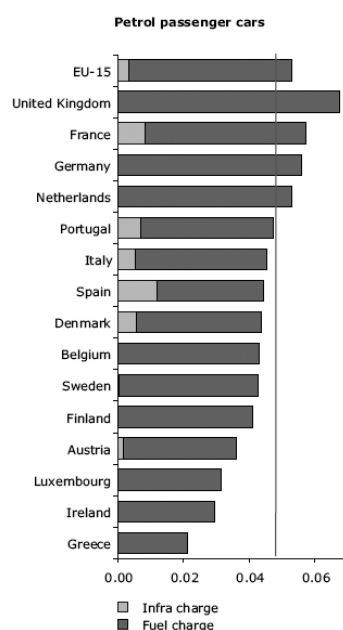


**Figure 10:** Although Ireland moved freight less than most EU countries in relation to its national income, it became less efficient in this respect between 1992 and 2003. **Source:** EEA, 2006.

There was, however, an alternative to allowing the uncontrolled expansion of motor car use. As workers have become more specialised, there has been an explosion in the number of occupational roles. Hunter-gatherer societies are said<sup>7</sup> to contain no more than a few dozen distinct social personalities, while modern European censuses recognise 10,000 to 20,000 unique occupational roles, and industrial societies may contain more than a million different kinds of social personalities overall. People with one occupational role cannot readily substitute for those with another, so the more occupational roles a society has, the more travelling has to be done to get people with different specialities to where they are needed. Fewer of us can live as close to our work as less specialised workers did a century ago because many jobs now involve visits to several customers or locations in the course of a week, so some expansion of car use was necessary. However, the price of car ownership and use has been falling in real terms for many years and, by failing to limit or prevent this fall, successive governments have distorted the way that this country has developed spatially. As the chart below shows, Ireland has become the EU's most car dependent country and therefore its least efficient and most unsustainable economy in this respect.

7 J.A. Tainter, *The Collapse of Complex Societies*. Cambridge: Cambridge University Press, 1988. See also R. H. McGuire, 'Breaking down cultural complexity: inequality and heterogeneity' in *Advances in Archaeological Method and Theory*, Volume 6, ed. Michael B. Schiffer, pp. 91-142. New York: Academic Press, 1983.

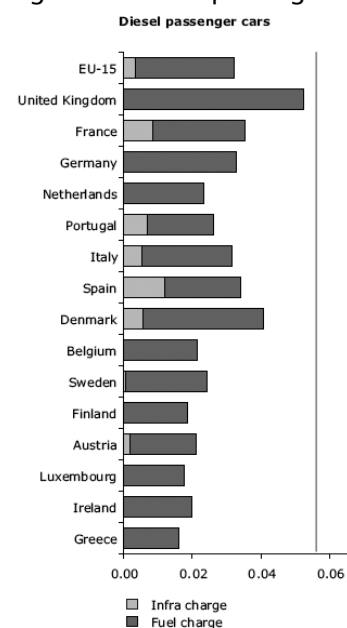
Figure 11: Petrol passenger cars



*Figure 11: The red line gives an indication of the cost in euro cents that driving a typical petrol car a kilometre imposes on society and the environment. In Ireland, the level of fuel tax is too little to cover this damage.*

*Source: EEA, 2006*

Figure 12: Diesel passenger cars

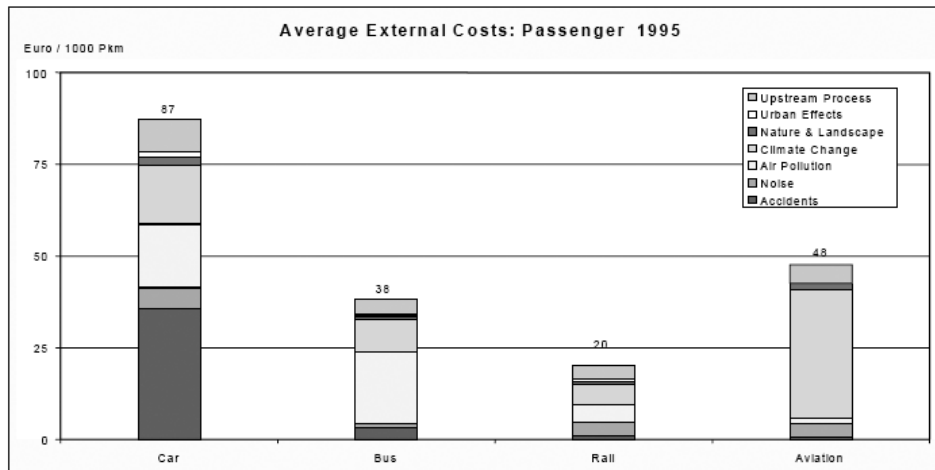


*Figure 12: Diesel cars do more damage to the environment and to people than petrol cars but they pay a smaller proportion of that cost in Ireland and in the rest of the EU. They are therefore getting a greater subsidy.*

*Source: EEA, 2006.*

As with road freight, Ireland has not been charging motorists for the full cost of the burden they are placing on the environment and on other people. As a result, the transport mode with the greatest environmental impact has been encouraged, as shown in Figure 13.

Figure 13: Average External Costs: Passenger 1995



**Figure 13:** In terms of the external cost imposed per passenger per kilometre travelled, car travel is twice as bad for society and the environment as bus travel and four times as bad as train travel. This is largely because of the number of road accidents cars cause. Surprisingly, this chart shows car travel to be worse than air travel but we suspect that the damage the latter does to the global climate might be underestimated. Current thinking is that an aircraft's con trail and  $\text{NO}_x$  emissions double its warming effect. This might not have been taken into account here. See the IPCC's Aviation and the Global Atmosphere <http://www.grida.no/climate/ipcc/aviation/index.htm> **Source:** INFRAS, 2000.

The cost of congestion has been omitted from the externalised cost figures we have quoted so far, possibly because this is a cost that road users impose on each other rather than the public or the environment as a whole. Congestion simply increases the effective price of using the road system. However, another reason for its exclusion is that its cost is difficult to measure and most of the figures given for it are little more than guesstimates. In 1999, the EU estimated<sup>8</sup> that the cost of congestion in the EU-15 in 1996 was 2% of its GDP. If that proportion applied in Ireland at present it would mean that the cost of congestion here is about €3.2 billion a year, or €800 per person. The Dublin Chamber of Commerce told an Oireachtas committee in December 2003 that the cost in Dublin alone was €3bn, a figure they said was based on an EU White Paper published the previous year<sup>9</sup>. In August 2005 the DCC cut its figure back to €2.5 billion<sup>10</sup>. The managing director of Dublin Bus Joe Meagher told<sup>11</sup> the Oireachtas Committee on Transport in May 2006 that congestion was currently costing the company €60 million a year and that the average speed of buses across the network had fallen to just 12km/h. This cost amounted to a third of its ticket revenue in 2005, or the equivalent of its state grant. The €60 million figure excludes the value of the bus passengers' time, which would have been a much larger figure.

8 European Commission, European Transport in Figures, Statistical Pocketbook, 1999

9 "Businesses call for Dublin metro as gridlock costs €3bn a year" by Chris Dooley, *Irish Times*, 3 December, 2003

10 Ireland's Strategic Infrastructure Investment 2020, Goodbody Consulting, September 2005.

11 Dublin Bus wants roads deal with Luas, by Tim O'Brien, *Irish Times*, 18 May, 2006.

The question has to be asked: "Who benefits from the consistent underpricing of road access?" It could be argued that, as far as road freight is concerned, everyone does. This is because the lower freight costs make Ireland more attractive as a production-for-export location and, in the absence of the subsidy, there would either be less direct and indirect employment in the sector or that the wages it paid would have to be lower to compensate. On the other hand, the lower freight costs make imports cheaper and lower distribution costs within the country for firms producing for the local market. Overall, then, lower freight costs are likely to favour bigger firms, whether at home or abroad, and more centralised production.

As far as car use is concerned, the only winners appear to be landowners who were able to sell sites in places that, but for the car, would not have been readily accessible, and their gains have been at the expense of other landowners in places either closer to where people shop, work, go to school and seek entertainment, or where such services could have been developed. Country dwellers may appear to have gained because, under past policies, the cost of running a car has been kept down, but, as incomes rose, bus services and better local shops would have developed, and other rural services would have been improved or maintained. The clear losers are those unable to afford a car, or unable to drive one - the young, the old and the ill - whose needs are badly served. And all of society has lost, too, because a system has been created that takes a lot of resources to run and not only costs a lot to use in money terms but also, thanks to congestion, in terms of its users' time. Car owners in Ireland pay less tax per mile travelled than any other EU-15 country apart from Greece and Luxembourg, while they pay more each year to own their vehicles than anywhere else besides the Netherlands. (Burnham, 2001) The high cost of ownership here is largely due to Vehicle Registration Tax. Thus, although motorists in Britain and Ireland paid about the same amount of tax in total to run their cars for a year, the lower costs per mile here encouraged car use while the higher ones in Britain discouraged it. Vehicle registration tax is levied on the "Open Market Selling Price" of a vehicle, as calculated by the Vehicle Registration Office. Cars and minibuses with less than 12 permanently fitted passenger seats, are charged at 22.5% up to 1400cc, 25% between 1401cc - 1900cc and 30% above that. Only half of the normal VRT is payable on hybrid vehicles that derive their power from a combination of an electric motor and an internal combustion engine.

Figure 14: Annual Ownership Taxation for a 1600cc car

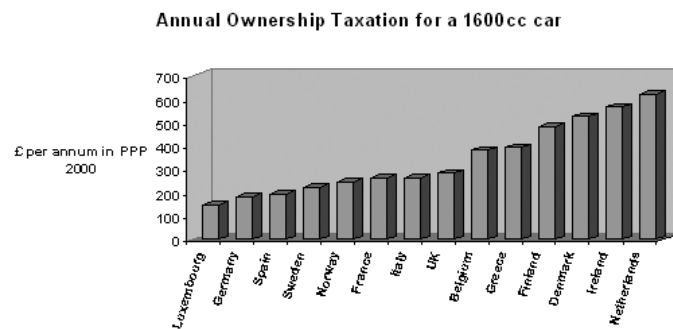


Figure 14: The annual cost of owning a car in Ireland is amongst the lowest in the EU.

Source: UK Commission on Integrated Transport, 2001

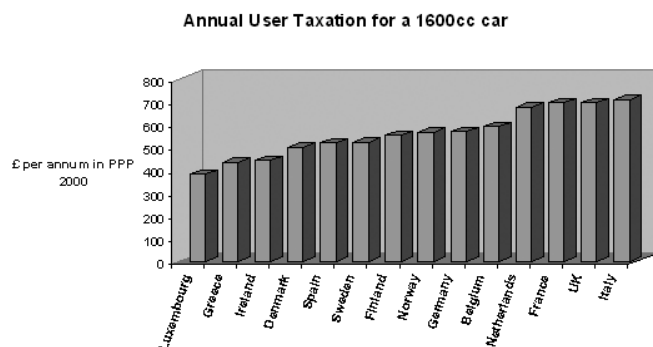


Figure 15: By contrast, the cost of using a car in Ireland is amongst the lowest in the EU.

Source: CFIT, 2001

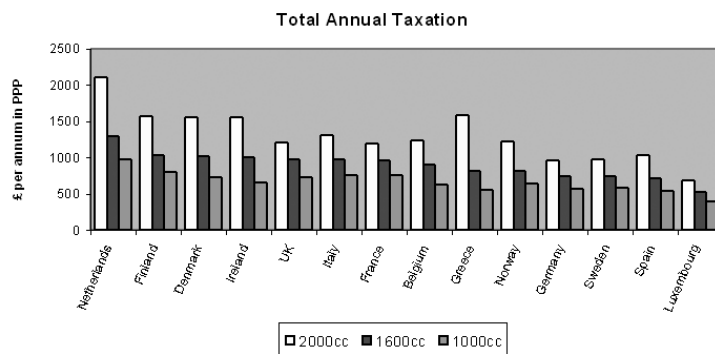


Figure 16: As a result, the total cost of running a car doing 14,000 km a year is much the same in Britain and Ireland. However, the Irish tax system is more encouraging of greater car use.

Source: CFIT, 2001

VAT is payable on the VRT. So its effect is to increase the cost of purchasing a vehicle in Ireland by Ireland perhaps a third in comparison with countries in which only VAT is charged. This has a significant effect on the annual cost of owning a vehicle - the figures in the barcharts amortised the purchase price over 14 years. Another component of the annual cost of ownership is Road Tax which is levied on a vehicle's engine size. It runs from €151 a year for a vehicle under 1000cc to €1,343 on vehicles above 3000cc.

Ireland may not be able to maintain Vehicle Registration Tax much longer. In July 2005 the European Commission proposed (COM(2005)261 final) that registration taxes for passenger cars be gradually abolished over a period of five to ten years and that the annual tax paid on a car should be based on its CO<sub>2</sub> performance. Most economists would probably support treating the purchase of a car in the same way as any other purchase - that is, levying VAT at the standard rate but nothing else - while ensuring that its owners pay the true cost of every journey they make in some form of user charge. We will return to this in a later section.

While Irish petrol is cheaper than average, Irish truck operators pay roughly the same in excise duty and VAT combined on their fuel as their average EU counterpart. The EU-15 average excise duty is €374 per 1,000 litres.

	Excise Duty/1000 litres in 2005
UK	€693
Germany	€470
France	€417
Italy	€413
Denmark	€404
Sweden	€394
Ireland	€368
Netherlands	€365
Belgium	€341
Finland	€319
Portugal	€314
Austria	€297
Spain	€294
Luxembourg	€278

Source: European Road Federation.

Aviation companies pay no tax at all on their fuel, despite the fact that they are in competition with other modes of transport. Even in Ireland, airlines are in competition with trains. Moreover, they get other subsidies to compete with surface transport. Last year, Aer Arann and Loganair were awarded contracts<sup>12</sup> valued at €45.8 million for the latest round of State-subsidised air links to six regional airports. It is arguable that this sum could have benefited far more travellers if it had been used if it had been used to provide earlier and later or more frequent train services instead.

### **The interrelationship between transport and land use**

Most people do not readily recognise the important linkages between transport, and land-use factors. Yet the two are deeply interconnected. The type of transport system chosen profoundly affects the type and character of land-use decisions that follow and the way in which residents end up commuting and attaining their daily needs.

A decision to build a motorway, for example, creates pressures to convert (or re-zone) farm land into housing estates or retail outlets. Recent evidence suggests that when this development occurs in Ireland it tends to follow a car-oriented form of land development similar to what is currently found in suburbs in the U.S. Much of Ireland's new growth around motorways is largely designed using American style Euclidean Zoning. Euclidean zoning's main characteristic is the segregation or separation of uses. Shops, schools, and other amenities tend to be separated from residential zones and often best accessed by car. Car use is typically a requirement due to distances and the lack of connectivity between housing estates. Zoning regulations or planning guidelines "often favour disconnected cul-de-sac street designs over more connected grid networks." (Frank *et al.*, 2006) In such places children are typically driven to school and all shopping or the enjoyment of amenities is car-dependent.

Transport planning efforts that emphasised public modes of transport typically have a very different impact on land-use planning and the built environment. Transit-oriented development of village-oriented development uses public transport to deliver commuters to community, neighbourhood, or village centres where residents can walk or cycle to their homes and to attain their daily needs in neighbourhood shops, thus seriously reducing the need for a car. Land-use densities are also affected in part because residential density is needed to enhance the viability and efficiency of public transport.

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12 "€45m in State air contracts goes to two airlines", Lorna Siggins, *Irish Times*, 27 May 2005.

## PART 2

### Overview of the environmental and social impact of transport

#### *Environmental impact*

The environmental impact of transport in Ireland is set out effectively in *Ireland's Environment 2004* (EPA).

#### **Greenhouse gases and acid precursors**

The latest figures in relation to GHG emissions (EPA, 2006) indicate that Ireland's emissions in 2004 were 23.5% above than the 1990 baseline. Transport related emissions were and are the fastest growing sector of greenhouse gas emissions, growing by 143% between 1990 and 2004. In 1990 transport emissions were 9.3% of the total; this had grown to 18.3% by 2004.

The EPA, in *Ireland's Environment 2004*, comments as follows in relation to both CO<sub>2</sub> and NO<sub>x</sub>:

*"The need to curb the massive growth in energy consumption and associated emissions of CO<sub>2</sub> and NO<sub>x</sub> from road traffic is a daunting challenge at the present time. The problem is exacerbated by the incompatibility between public transport services and the scale of housing development throughout the country. This challenge can only be met by breaking the link between the growth in road transport and growth in the economy, which requires a radical shift to bus, rail and cycle use. The State cannot expect to comply with its emissions ceilings for NO<sub>x</sub> and GHGs if their contributions from road traffic are not soon brought under control."*

Many of the emissions considered under the heading of long-range transboundary pollutants are also considered under the heading of ambient air quality. (Additionally, a significant percentage of the ambient air pollutant load, even in the vicinity of roads, derives from long-distance transport of primary pollutants and their secondary products.) These pollutants are responsible for both this contribution to ambient air pollution, and also to problems of acidification and eutrophication. (They also contribute to haze although this is an aspect which for some reason receives more attention in North America than in Europe.)

A Strategy to Reduce Emissions of Transboundary Air Pollution by 2010 was adopted in 2005. All the projections in the Strategy envisage a substantial overshoot of the emissions ceiling for NO<sub>x</sub>. Emission levels of NO<sub>x</sub> in 2010 are predicted at between 94 kilotonnes and 82.2 kt depending on which of the identified measures are implemented. Both of these are substantially above the ceiling of 65 kt. Road transport contributes 31.5 kt to both of these estimates. In essence, as the EPA indicates in the quotation above, it will be impossible to meet the ceiling without substantial additional reductions in predicted emissions from transport.

#### **Ambient air quality**

Ambient air quality is the main air pollution/emissions issue considered in EIA of road schemes. This is because of the serious human health impacts of air pollution originating from fossil fuel combustion, especially in motor vehicles.

The WHO Regional Office for Europe's (1999), study entitled "*Health costs due to road traffic-related air pollution*", estimated that long term exposure to air pollution from cars causes twice as many deaths as road traffic accidents in the countries studied.

The EPA (2004) identifies  $PM_{10}$  and  $NO_x$  as the pollutants of greatest concern:

*"Emissions from road traffic are now the primary threat to the quality of air in Ireland. The pollutants of most concern in this regard are nitrogen dioxide ( $NO_2$ ) and fine particulate matter, expressed as  $PM_{10}$ . Results of monitoring indicate that compliance with the stringent new  $PM_{10}$  and  $NO_2$  standards may present problems in some urban areas subject to heavy traffic. The EPA will advise local authorities on measures needed to ensure compliance with the standards. The introduction of such measures, in the form of air quality management plans or short-term traffic restrictions, would be a major new challenge for local authorities."*

### **Habitat loss and fragmentation**

Road construction and operation has significant effects in fragmentation of habitat and loss of agricultural and undeveloped land.

### **Noise**

Roads and aircraft cause significant noise nuisance for nearby residents with resultant negative health and social impacts. This factor also has biodiversity implications.

### **Built Environment**

Roads construction and road traffic have significant negative impacts on the built heritage and have been the subject of major controversy as a result.

### **Water**

One significant element missing from *Ireland's Environment 2004* is the impact on water quality including streams and groundwater (ref from Paul Johnston report?). Drainage from roads carries significant quantities of hydrocarbon and heavy metal pollutants, which are liable to contaminate groundwater and surface water. Additionally, the paving of ground and diversion of drainage systems will change the hydrological regime.

### **Social Impact of Transport**

Most people do not readily recognise the important linkages between transport, community planning, and social well-being. Yet all three of these areas are deeply interconnected. The type of transport system chosen profoundly affects the type and character of land-use decisions that follow and the way in which residents end up commuting and attaining their daily needs.

A decision to build a motorway, for example, creates pressures to convert (or re-zone) farm land into housing estates or retail outlets. Recent evidence suggests that when this development occurs in Ireland

it tends to follow a car-oriented form of land development similar to what is currently found in suburbs in the U.S. Much of Ireland's new growth around motorways is largely designed using American style Euclidean Zoning. Euclidean zoning's main characteristic is the segregation or separation of uses. Shops, schools, and other amenities tend to be separated from residential zones and often best accessed by car. Car use is typically a requirement due to distances and the lack of connectivity between housing estates. Zoning regulations or planning guidelines "often favour disconnected cul-de-sac street designs over more connected grid networks." (Frank *et al.*, 2006) In such places children are typically driven to school and all shopping or the enjoyment of amenities is car-dependent.

Car-oriented development that encourages or enables one-off housing or suburban estates that require long commutes to work and to shop have been found to create many unintended consequences.

Examples include:

### Health Effects

The way authorities decide to design and build transport systems and communities affects human health. Car-dependent designs not only produce greenhouse gases and other pollutants but affect human health in other ways, such as reducing opportunities to be physically active or engaged with others in their communities. Obesity, Depression, Social Isolation, and Car-crashes are common effects of car-oriented transport systems.

### Obesity and Air Pollution

Car-dependent development negatively effects health because people walk or cycle less and thus are more likely to be overweight. "A survey of 10,898 people in Atlanta, Georgia (Frank, Anderson & Schmid, 2004) showed that each additional hour spent in a car was associated with a 6% increase in the odds of being obese, while each additional kilometre walked per day was associated with a 4.8% reduction in the odds of being obese" (Frank *et al.*, 2006). A recent article published in the *Journal of the American Planning Association* made the following conclusions based on empirical examination of communities in Washington State in the US:

"The literature shows single-use, low density land development and disconnected street networks to be positively associated with auto dependence and negatively associated with walking and transit use. These factors in turn appear to affect health by influencing physical activity, obesity, and emissions of air pollutants. We evaluated the association between a single index of walkability that incorporated land use mix, street connectivity, net residential density, and retail floor area ratios, with health-related outcomes in King County, Washington. We found a 5% increase in walkability to be associated with a per capita 32.1% increase in time spent in physical active travel, a 0.23-point reduction in body mass index, 6.5% fewer vehicle miles travelled, 5.6% fewer grams of oxides of nitrogen (NO<sub>x</sub>) emitted, and 5.5% fewer grams of volatile organic compounds (VOC) emitted. These results connect development patterns with factors that affect prevalent chronic diseases. (Frank *et al.*, 2006)." (Emphasis added.)

### Depression and social isolation

There are also empirical linkages between walking, social engagement, and depression. The elderly are particularly susceptible to the corrosive effects of social isolation. Social isolation among the elderly tends to occur in car-dependent housing conditions (where they must rely upon others to get around) or in crime-ridden urban places where the fear of crime acts as a deterrent to walking and community involvement. In addition, healthy communities contain residents of all ages and ideally different economic means. Car-dependent housing estates may very well force the elderly to leave their communities once they find it difficult to drive; families with limited means (or whose economic lot changes) may find they are also forced to move due to the added cost-burdens of car-ownership and maintenance.

### Car-Crashes

Ireland has the third highest pedestrian death rate in the EU and the highest level of child pedestrian deaths in Western Europe & the EU. Car crashes are the number one killers of young men (16 - 25) in Ireland according to the National Safety Council. (<http://www.nsc.ie/RoadSafety/RoadSafetyIssues/>) Building communities that are oriented around the motor vehicle cause significant costs in terms of life, injury and property damage. They also place children at significant risk of death or injury. Many road schemes directly encourage more driving by car and thus place residents at greater risk of injury or death.

### Sectoral Policy measures

#### Policy in relation to climate change

In pursuance of its existing and anticipated obligations, the government published a National Climate Change Strategy in 2000. The Strategy sought to address both the 2008-2012 Kyoto Protocol commitment and the longer-term commitments implicit in the UNFCCC.

The National Climate Change Strategy (2000) says in relation to road-building:

*"Roads Investment*

*... a total of £4.7bn is planned in investment in National Roads in the NDP. In the delivery of the investment programme, the assessment of environmental protection will include the assessment of the impact of individual projects on greenhouse gas emissions. The growth in these emissions will be managed through maximising the efficient use of road transport, removing delays in inter-urban journeys, (which, inter alia, will have the effect of increasing efficiencies in fuel use due to improved journey times and reduced congestion), road pricing, an integrated approach to land use planning and transport, including through the achievement of balanced regional development and the proposed National Spatial Strategy."*

It is striking that the role of road-building in facilitating and stimulating road use is not referred to even in the National Climate Change Strategy itself.

In relation to transport, this strategy predicted that business as usual predictions of a 180% increase over 1990 levels by 2010. It included indicative targets for 2010 for transport of 2.67 Mt CO<sub>2</sub> below business as usual emissions, to be achieved by a range of measures as set out below.

#### Transport measures in National Climate Change Strategy, 2000

Vehicle Efficiency Improvements	0.77 Mt CO <sub>2</sub>
Fuel Measures (displace bunkering)	0.9 Mt CO <sub>2</sub>
VRT, Taxes	0.5 Mt CO <sub>2</sub>
Labelling	0.1 Mt CO <sub>2</sub>
Public Transport Measures	0.15 Mt CO <sub>2</sub>
Traffic Management	0.2 Mt CO <sub>2</sub>
Freight	0.05 Mt CO <sub>2</sub>
<b>Total</b>	<b>2.67 Mt CO<sub>2</sub> per annum</b>

These measures have variously not been implemented or not been successful. In 2002, the Progress Report on the National Climate Change Strategy claimed that the implementation of the DTO's Platform for Change would "reduce emissions by over 1 Mt of CO<sub>2</sub> per annum by 2016, a 41% reduction on projected emissions." The report contains no further explanation of this figure. The assumptions behind such a calculation relate to inelasticity of demand and the issues of induced and suppressed demand, which are discussed below.

Work by Sustainable Energy Ireland (2003) has quantified potential emissions reductions from a) a shift in car purchasing to more efficient cars and b) from reduced mileage. Its conclusion is that substantial reductions can only be achieved by reduced mileage.

Subsequently SEI (2004) examined greenhouse gases from transport and concluded:

*"This chapter has presented the current and potential Irish response to greenhouse gas emissions from transport. The transport policy measures currently in place such as vehicle and fuel taxes, public transport measures and road charges have not been designed with the reduction of greenhouse gas emissions as their primary function. Many of the measures described in the National Climate Change Strategy to reduce greenhouse gas emissions from transport have yet to be implemented and the latest projections of CO<sub>2</sub> emissions per year from transport in 2010 are at 14.2 Mt per year. This is significantly higher than the target set in the National Climate Change strategy at 11.4 Mt CO<sub>2</sub> emissions per year from transport."*

### **Policy in relation to emissions of long-range transboundary air pollutants**

The National Emissions Ceilings Directive is implemented into Irish law by the European Communities (National Emissions Ceilings) Regulations 2004, S.I. No. 010 of 2004.

Unlike the Kyoto allocations, there is no provision or allowance in the NEC Directive for trading of emission rights. A breach of the emissions ceilings is a breach of the Directive. This puts the NEC Directive in unavoidable conflict with national transport policy which is facilitating ongoing increases in NO<sub>x</sub> emissions and certainly not providing for sharp cuts in such emissions.

The "National Programme for Ireland under Article 6 of Directive 2001/81/EC for the progressive reduction of national emissions of transboundary pollutants by 2010" which the Department of the Environment released in April 2005, deals with this conflict as follows.

*"The legislative proposal to revise the national emission ceilings and other aspects of the directive by mid-2006 will, as before, be based on integrated assessment modelling and consultations to update the model are due to commence with Member States in April 2005. It seems clear, based on available updated data sets, that the current ceilings for Ireland do not represent the most cost effective route for Ireland to make its contribution to meeting the directive's interim environmental objectives. It is anticipated that this will become evident during the analytical preparations for the new legislative proposal.*

*This National Programme will be updated and revised as necessary in 2006 to take account fully of all relevant policy and legislative developments particularly the proposal to revise the national emission ceilings and other aspects of the directive."*

Demand reduction does not appear to have been considered as a policy measure in this regard nor assessed for cost-effectiveness (for which see below).

### **Policy in relation to ambient air quality**

No specific national policy in relation to ambient air quality has been articulated as such. The EU Air Quality Framework Directive and Daughter Directives apply. Ambient air quality impacts of road construction are intended to be picked up and controlled at the EIA stage. However, this does not happen effectively. Exceedences of EU limits under Directives are required to lead to the adoption of Air Quality Management Plans. One plan has been adopted but the mechanism in the Directive has not been implemented in full.

### **Direct investment and subsidy**

#### **National Development Plan investments (road, rail and regional airports)**

##### **Road infrastructure**

Emissions and air issues are referred to in the transport-related documents associated with the National Development Plan.

The National Roads Needs Study addresses air pollution as follows:

*“Air pollution from transport is most effectively addressed by measures to reduce emissions from vehicles at EU and National level. A range of options may also have to be considered, as detailed in the Environmental Resources Management (ERM) Report, to ensure improved efficiency for new vehicles including the use of alternative fuels, improved maintenance of vehicles, etc.”*

The concept of limits referred to above is not relied on. Improved vehicle efficiencies are stated to be the most effective means to reduce emissions. No evidence is adduced to support this statement.

In fact, it is clear that improved vehicle efficiencies will not be sufficient to reduce emissions in a situation of high growth in traffic such as in Ireland. Work by SEI shows definitively they will not meet greenhouse gas targets and research on ambient air quality shows increased total traffic levels can easily make up for reduced emission levels from individual vehicles. (SACTRA, 1994, Newman, Kenworthy and Lyons, 1988, Newman and Kenworthy 1989, SEI, 2003)

The entire thrust of the EU Ambient Air Quality legislation made up of the Framework Directive and Daughter Directives is based on a recognition that action in relation to the emission rates of individual vehicles is not sufficient to achieve the targets in the Directives and that therefore Member States need to carry out local air quality management.

### **National Development Plan (NDP) 1999**

The NDP (Chapter 13) contains an excellent analysis of the environmental policy framework of the plan.

Unfortunately, in the sections of the NDP where the detail in relation to the Roads programme and its environmental impact would be expected, the analysis in Chapter 13 is not worked out in a manner to inform or influence the plan itself.

In the Roads section, all reference to both the environmental policy objectives and the framework described in 13.21 for integrating them into the plan is dropped in favour of a discursive and vague approach.

Even more surprisingly, the Pilot Eco-audit of the plan also fails to refer specifically to the key changes identified in Chapter 13. The “Pilot Eco-audit” lacks any detail in relation to the likely impact of the plan or how it measures up against existing environmental policy objectives. The only area where it goes into any level of useful detail is in relation to the mechanisms for ensuring integration of environment/sustainable development policy in the relevant sections of the NDP. This process of integration set out in the Eco-audit appears not to have happened.

### **Ports and Airports**

The NDP provides for comparatively small levels of investment in ports and regional airports. For some reason the significant investment in Dublin Airport is not included in the NDP. There is no analysis of

environmental factors in relation to these investments in the NDP. We have not found any reports dealing with the environmental impacts of these investments.

### **Transport 21 investments (road and rail, national level)**

The Transport 21 investment programme does not seem to have come from a structured analysis separate from work already done in the Strategic Rail Review and the National Roads Needs Study.

### **Local road infrastructure and land use decisions**

These decisions are made at local authority level. The lack of any local authority control or input into public transport decisions means a predominant focus on roads-based solutions to local transport needs. Similarly, land use designations are generally based on road access. This leads to a failure to avail of significant opportunities to provide public transport-oriented developments. Decisions at plan or programme level since July 2004 have to be subjected to Strategic Environmental Assessment. How effective this will be in practice in integrating environmental considerations remains to be seen.

### **Road safety information (primarily national level)**

Road safety information and enforcement is primarily carried out at a national level, although there are road safety officers in local authorities. Ireland has a poor road safety record, widely ascribed to low levels of enforcement.

### **Social Capital/Sense of Community/Quality of Life**

#### **Social Capital**

Harvard Professor Robert Putnam and others have repeatedly demonstrated the importance of social interactions and engagement for community well-being. Social and community ties are key components of a more encompassing concept called social capital. Social capital is defined as the social networks and interactions that inspire trust and reciprocity among citizens (Putnam, 2000). Individuals with high levels of social capital tend to be involved politically, to volunteer in their communities, and to get together more frequently with friends and neighbours. They are also more likely to trust or to think kindly of others and attempt to help solve community problems (Putnam, 2000; Coleman, 1990; and Fukuyama, 1995). Social capital has been found to be linked to the proper functioning of democracy, the prevention of crime, the creation of well-adjusted young people, and enhanced economic development. (See Putnam, 2000 for discussion). Higher levels of individual-level or community-level social capital is also affiliated with better health.

In a survey of the neighbourhoods of Galway, Leyden (2003) investigated the relationship between neighbourhood land-use design and individual levels of social capital. Data were obtained from a household survey that measured the social capital of citizens living in neighbourhoods that ranged from traditional, mixed-use, pedestrian-oriented designs to modern, car-dependent suburban housing estates. Statistically controlling for host of factors, the analyses indicate that persons living in walkable, mixed-use neighbourhoods have higher levels of social capital compared with those living in car-oriented suburbs. Respondents living in walkable neighbourhoods were more likely to know their neighbours, participate politically, trust others, and be socially engaged.

Leyden's study concluded with an appeal to avoid the planning and construction of car-dependent communities. Mixed-use, pedestrian-oriented designs that encouraged access to amenities on foot were recommended as being important for the proper functioning and well-being of a community.

### **Commuting**

According to Robert Putnam (2000) and several other scholars, commuting (especially by private car) has a negative affect on social and community involvement. Long, tiring commutes, tend to take away from the time and energy commuters would otherwise spend volunteering in their communities or with their families.

### **Culture and Civic Society**

Social interaction and conversations between adults, teenagers, and children are an important component of cultural transfer and the teaching of social norms. Car-dependent communities tend to offer less opportunities for the sort of social interactions that are important for culture transfer, and the creation of well-adjusted young people. In the absence of conversation and other forms of guidance and role-modelling many young people are forced to learn cultural values from television or other artificial mediums. Those portrayed via these mediums are often distorted and alien to reality.

### **Sense of Place and Pride in Community**

Most human beings develop a connection with their communities and a sense of pride in the place they are from. It is an empirical question as to the degree this is occurring in car-dependent, cookie cutter, housing estates. Poor connectivity, severance and the inability to walk to anything that resembles a real village or urban place may have a dysfunctional affect on children. At a minimum the inability to walk or cycle to shops, school, or other amenities probably affects their sense of independence and adds to the time burden of parents who must serve as continual family-chauffeurs.

### **Social Exclusion/Disadvantage/Marginalisation**

Transportation systems that rely upon motor vehicles clearly advantage some in society and disadvantage others. Cars are expensive. The Automobile Association estimates that the annual cost of owning a small (under one litre car) worth €12,581 is €2,850. This cost includes depreciation (€1,572), finance and insurance but not the cost of parking or the use of a garage. Maintenance and fuel costs mean that the cost of driving a kilometre is 15.5 cents if petrol is 117 cents per litre. Unlike houses, cars depreciate in value. This makes then a bad use of limited family resources. Motorway-oriented transportation clearly discriminates against those with limited economic means.

### **Key Issues and Challenges faced for the future, globally and locally**

Transport designs must consider a broader range of issues and concerns than they do currently. The way authorities decide to design and build transport systems and communities affects human health and human social interaction. The next National Development Plan should give much more weight to effective public transport designs coupled with the creation of walkable, mixed-use neighbourhoods or pedestrian-oriented villages. Citizens should be provided with a range of transport options and be expected to attain most of their daily needs on foot at nearby shops and amenities. Suburban estates that require the use of a car should not be given planning permission.

There is a growing literature that concludes that active travel modes (walking and cycling) along with safe, efficient, public transportation are vastly more healthy for individuals, their families and their communities than suburban estates that are zoned only for houses and car-dependent. The current car-oriented style growth is a model that became popular in the United States in the 1970s and has wrought serious unintended consequences. Almost every major organisation in the US involved with planning, architecture, town-building, the environment, or health has called for a move away from Euclidean zoning, preferring more mixed-use, pedestrian-oriented planning models with public transport options instead. Examples of organisations calling for more enlightened, time-tested land-use and transport practices include:

- The Centres for Disease and Prevention Control (CDC)
- The Robert Wood Johnson Foundation
- American Planners' Association
- National Trust for Historic Preservation
- US Environmental Protection Agency (EPA)
- American Institute of Architects (AIA)
- Congress for New Urbanism

An example of the sort of planning being promoted can be found on the American Institute of Architects' webpage. It reads in part:

#### **AIA's 10 Principles for Liveable Communities**

##### **1. Design on a Human Scale**

Compact, pedestrian-friendly communities allow residents to walk to shops, services, cultural resources, and jobs and can reduce traffic congestion and benefit people's health.

##### **2. Provide Choices**

People want variety in housing, shopping, recreation, transportation, and employment. Variety creates lively neighbourhoods and accommodates residents in different stages of their lives.

##### **3. Encourage Mixed-Use Development**

Integrating different land uses and varied building types creates vibrant, pedestrian-friendly and diverse communities.

##### **4. Preserve Urban Centres**

Restoring, revitalizing, and infilling urban centres takes advantage of existing streets, services and buildings and avoids the need for new infrastructure. This helps to curb sprawl and promote stability for city neighbourhoods.

**5. Vary Transportation Options**

Giving people the option of walking, biking and using public transit, in addition to driving, reduces traffic congestion, protects the environment and encourages physical activity.

**6. Build Vibrant Public Spaces**

Citizens need welcoming, well-defined public places to stimulate face-to-face interaction, collectively celebrate and mourn, encourage civic participation, admire public art, and gather for public events.

**7. Create a Neighbourhood Identity**

A “sense of place” gives neighbourhoods a unique character, enhances the walking environment, and creates pride in the community.

**8. Protect Environmental Resources**

A well-designed balance of nature and development preserves natural systems, protects waterways from pollution, reduces air pollution, and protects property values.

**9. Conserve Landscapes**

Open space, farms, and wildlife habitat are essential for environmental, recreational, and cultural reasons.

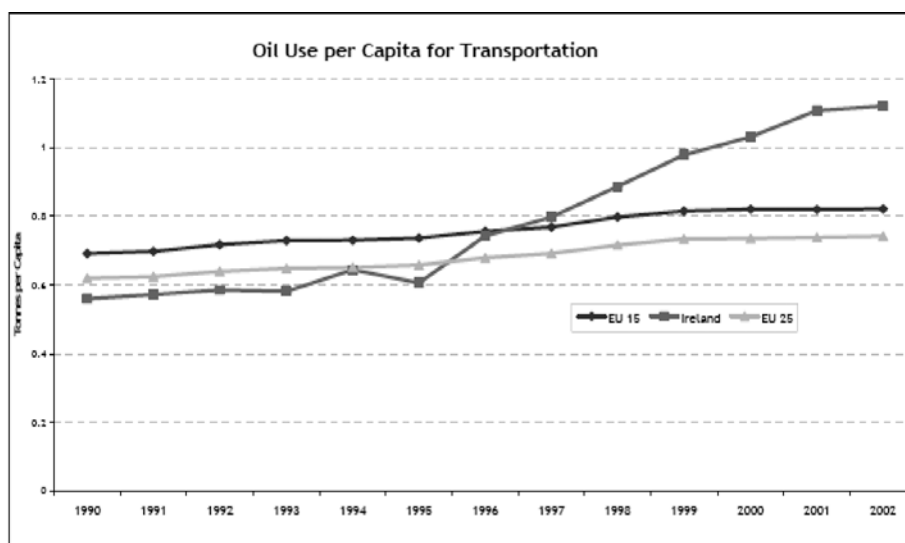
**10. Design Matters**

Design excellence is the foundation of successful and healthy communities.

## PART 3

### Oil depletion, emissions permits and climate change

Figure 17: Oil Use per Capita for Transportation



Source: Amárach Consulting, EU Energy & Transport Figures 2004

**Figure 17:** Ireland's transport system uses more oil per person each year than most others in the EU. This makes the country very vulnerable to oil price increases and shortages. **Source:** Forfás

### Oil dependency

Ireland's transport system is almost completely oil dependent, although coal and natural gas are used for trams and some trains via conversion into electricity. As Figure 17 shows, it is appreciably more oil dependent on a per capita basis than its counterparts in other EU countries. Although there are still differences of opinion, there is a growing consensus<sup>13</sup> among oil experts and consulting companies that world oil production will peak within the next fifteen years and that this will lead to massive price increases. Even organisations like the International Energy Agency which believe that the oil peak is at least a generation away accept that the price of oil will rise in real terms because of the increasing amounts of capital investment required to meet the world's expanding oil demand now that the easiest sources of oil to extract have become exhausted. We can conclude from this that, unless there is a global recession, the price of liquid motor fuels will be considerably higher than they have been in the past.

One of the factors which could push energy prices very high is the fact that the demand for energy is not very price sensitive in the short-term. People need time to adapt, perhaps by insulating their houses better and living nearer their work, while firms need time to adjust their production and distribution

13 A Baseline Assessment of Ireland's Oil Dependence, Forfás, Dublin, April 2006. [http://www.forfas.ie/publications/Forfás060404/webopt/Forfás060404\\_irelands\\_oil\\_dependence\\_report.pdf](http://www.forfas.ie/publications/Forfás060404/webopt/Forfás060404_irelands_oil_dependence_report.pdf)

methods. Indeed, this adaptation process can increase energy demand as the type of investment it involves is more energy-intensive than most consumption spending. As a result, higher energy prices can have the perverse effect of increasing energy demand. Only the availability of other energy sources will control prices and developing these needs a long lead time. It is unlikely that it will be possible to develop them enough rapidly enough not only to meet world oil demand, which is increasing at 2-3% a year, but also to replace the amount of oil lost as world production begins to shrink at a rate of, it is estimated, 4-6% a year.

The result of any failure to meet the world's growing energy demand will be to slow or check global economic growth. This will have a severe effect on the demand for transport, particularly in the freight sector. The potential oil substitutes for transport are: biodiesel, bioethanol and electricity from the wind.

## **Biofuels**

### ***(a) Biodiesel as a diesel substitute***

Most attention in Ireland so far has been given to the production of biodiesel from rapeseed oil. A hectare of land can produce 1,100 kg of rape oil which is roughly equivalent to a tonne of mineral diesel fuel. Since the Irish transport system burns over 2 million tonnes of mineral diesel annually, 2 million hectares would be needed to produce enough rape oil to replace it. This is five times more land than the country currently has under arable cultivation. But rape, a member of the cabbage family, cannot be grown continuously in the same place without pests and diseases building up. If a four-year rotation was used, Ireland would have to have twenty times more land under arable crops than it does at present to produce the oil for its diesel-powered vehicle fleet. Even if that amount of land was available, even more land would be needed to grow extra rape oil to power the machinery used to till the rape fields and process the crop. Also, because natural gas is used to make fertilizer for rape, we would still be using a lot of fossil energy to produce the bio-energy version.

The fundamental problem with rape and all the other plants that could be grown in Ireland to produce oil is that they are annuals or biennials and thus take a lot of energy to grow. The Energy Return On Energy Invested (EROEI) is therefore poor. Tropical and sub-tropical trees and shrubs which produce fruits containing oil such as *Jatropha* and *Moringa* offer a much better energy return and Ireland will have to consider importing their oil for its diesel engines.

### ***(b) Ethanol (ethyl alcohol) as a petrol substitute***

The production of ethanol from maize, wheat, and sugar beet gives a poor return on the energy invested in the process. However, processes have been developed recently for breaking down the lignocellulose found in all plants into sugars which can then be fermented into ethanol. A demonstration plant was opened in Canada in 2004 which it is hoped will produce 100 million litres of ethanol this year and Sweden has ambitious plans for this technology using wood waste. It opened a plant using sawdust in 2005. These processes are said to have an EROEI of six at present with the prospect of increasing to ten. This would mean that the energy return was better than that for coal mining which, when used to produce electricity, is said to have an energy return of about eight. Ireland could almost certainly meet its petrol needs using this cellulose technology but it has to be remembered that there will be competition

for the biomass from people who wish to use it for Combined Heat and Power systems in large buildings and for domestic heating using wood pellet stoves etc. There will also be a demand for the ethanol itself from other countries seeking a liquid fuel for their transport fleets. The fuel will therefore not be cheap.

### Wind electricity

Ireland has the potential to produce much more electricity from the wind than it is currently using. The main problem with this source of energy is its variability but its energy could be stored in batteries, as compressed air or as hydrogen, when the wind was blowing. However batteries are heavy. This effectively limits the vehicle's range since installing a bigger, heavier battery would require more power to move the vehicle, which would in turn quickly exhaust the additional battery capacity. Battery power is therefore likely to be restricted to small, light cars for short journeys and vans for urban use. Compressed air vehicles will have similar limitations because of the limited amount of energy that can be stored in a pressure vessel of reasonable size. Hydrogen, whether from biomass or wind electricity, seems to be required for trucks, tractors and longer-distance cars but its cost will be considerably greater than current petrol and diesel prices. If produced electrically, it takes 4kWh to produce 3kWh-worth of hydrogen. The hydrogen must then be liquefied or compressed. Liquid hydrogen is likely to be required for road vehicles because it requires less space than the compressed form but it takes about 14kWh of electricity to liquefy a kilo of hydrogen, an amount which can deliver about 33.7 kWh when burned. In other words, it takes about 16.24kWh to produce 280 grammes of liquid hydrogen, the energy equivalent of a litre of petrol. In 2003, a German expert, Werner Zittel, prepared the following estimates of cost of providing hydrogen to fuel an Irish fleet of 1.2 million passenger cars and close to 200,000 trucks. He wrote<sup>14</sup>:

*"A rough calculation indicates that at least 300 fuelling stations should offer hydrogen to achieve public acceptance of the fuel. This corresponds to 10 per cent of all fuelling stations countrywide. If this hydrogen were to be entirely supplied by wind power produced electricity, the total system cost would be of the order of 50 billion Euros or, spread over 30 years, about 2 billion Euro per year. In total about 20 GW offshore wind converters are needed for the power production.*

*"If this hydrogen was completely supplied from biomass via gasification, the total system cost would be in the order of 20 billion Euros, or spread over 20 years, about 1 billion Euro per year. Annually, about 13 million tons of dry biomass would be needed for hydrogen production, or a cultivated area of about 0.7 million hectare. Costs would be similar to those at present but with the difference that a large fraction of the money is now transferred to foreign countries, while domestic fuel production in the countryside would channel the money instead to a domestic labour force."*

So, while Ireland has the potential to get enough energy from the wind and biomass to keep a transport fleet of the present size on the road if it chooses to do so, the cost of the energy would be high and its use would be at the expense of other uses.

Higher energy, food and consumer goods prices will leave the average family with less discretionary expenditure. In Ireland, the first effect of this will be on the housing market, which has been absorbing

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14 Before the Wells Run Dry, Feasta, Dublin, 2003, p137.

most of the income many families have had left after meeting their living expenses. If this market collapses, as many seem to anticipate, the demand for transport will drop both as a result of less materials being moved and fewer people travelling to work. All other sectors will be affected and joblessness will soar. Two income households hit by unemployment will probably sell one car.

More generally, and as the years pass, people will react to the higher costs of owning and operating vehicles in the following ways:

- Families will try to avoid the cost of operating a second car and, later, if incomes fall or prices rise steeply, the first one. They will wish to live near their work, shops and schools so that they can walk, cycle or use an electric moped. The demand for public transport will increase and services will become more frequent. Badly located houses, particularly those which are costly to heat, will become unsaleable.
- More shops will offer home deliveries of goods ordered via the internet. They will minimise the costs of this in rural areas by using contractors who will combine deliveries from several businesses and only deliver in a particular area once or twice a week. In urban areas, a surcharge will be introduced for deliveries not on the regular day.
- Road freight will become particularly costly. Fresh fruit and vegetables coming from elsewhere in Europe will arrive by sea rather than by truck and a variety of ports around the country will be used to minimise the distances the goods have to travel once landed. Irish Rail will start overnight container trains between the major centres and the ports, offering road haulage firms the option of just handling collections and deliveries. Companies like IKEA, which manufacture in bulk and then truck all over the world to a few depots which the public have to visit by car, will have to change their business model or disappear. Global brands will tend to licence their manufacturing to small, flexible factories in each country to minimise freight costs. Farmers will increasingly supply their local markets, local breweries using returnable bottles will develop and there will be significantly more local production for local use.
- Less construction work will be carried on because the country will be experiencing problems maintaining the stock of buildings it has. What buildings do go up will be made of lighter, lower embodied-energy materials such as timber, field stone from the site itself, hemp and lime. A proportion of any blocks required will be made on site using the soil found there. Lighter buildings will mean that strip and raft foundations give way to piles linked by a ring-beam. As a result, far less cement, aggregate, and steel reinforcement will be needed and the energy used for excavation and site levelling will be reduced. Overall, much less transport will be required.

## **B. The availability of emissions permits**

The European Commission intends<sup>15</sup> to bring aviation into the Emissions Trading System by 2009 or 2010 and other areas of transport will follow fairly quickly. Indeed, they might all be introduced together in 2009-10 or from January 2013 when the post-Kyoto arrangements come into effect as the argument can - and doubtless will - be made that it is unfair to place tight emissions limits on one type of transport and not on the others.

If aviation is brought into the ETS by itself, it will be as part of the present ETS which began in January 2005. However, if it is part of a set of arrangements for the transport sector as a whole, a standalone system as supported by the European Parliament in its vote on 4 July, 2006 would be possible as there would be a big enough pool of emissions permits available to make trading relatively stable. In general, however, more permits would be available for transport, and their cost might therefore be lower, if the sector was part of the present ETS. In the very short-term, it might even be possible for emissions from transport to grow, thanks to emissions savings in other sectors of the European economy. However, as the number of emissions permits was reduced over the years, emissions from the sector would have to fall too. This would mean, almost certainly, that road use fell some time in the next 10-15 years.

### **Further traffic growth?**

The overall conclusion to be drawn from looking at the prospects for the Irish and global economies and the way emissions limits might be imposed has to be that the government should shape its roads policy on the basis that

- emissions restrictions are likely to prevent further growth in road traffic within 15 years, and possibly rather sooner
- the world economy's growth is likely to be restricted and may well contract, even collapse, in the next 25 years as a result of energy shortages
- energy prices and the cost of vehicles are likely to rise significantly in relation to people's earnings, reducing road traffic volumes, and
- in view of the need to act to slow the rate of climate change, the use of fossil fuels for road transport should be phased out over the next 25 years.

If incorporated into the cost-benefit analyses carried out for new roads, these considerations would almost certainly mean that very few projects showed an acceptable rate of return because an increase in traffic volumes could no longer be assumed and that a reduction in volumes was more likely.

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15 Peter Zapfel, Environment DG, European Commission, speaking at the EU Emissions Trading 2006 conference, Brussels, July 11, 2006.

### Climate impacts and long-range pollution

There can be no effective climate policy without tackling emissions from transport. This requires addressing the growth in transport. The EEA advises:

*"In spite of the initiatives mentioned above, transport emissions of greenhouse gases are presently growing. The main offender is the growth in transport demand, which is not being offset by the energy efficiency of vehicles. Policy development therefore needs to address transport growth if absolute reductions in greenhouse gas emissions are to be achieved."*

Unfortunately, current policies aim at facilitating and even encouraging growth in transport.

### Future trajectory under 'business as usual'

Current transport policy is based on a 'predict and provide' model and consists effectively of the following policy elements:

- Growth in surface transport is a desirable or at least inevitable aspect of economic growth.
- The primary means of surface transport is the private car and will remain so.
- Predict and provide is the basis for road planning except in major urban centres. It is applied in suburban areas, on inter-urban routes and in rural areas.
- Public transport has a significant contribution to make in urban areas. Its contribution is measured primarily by its contribution to reducing congestion on the roads.
- Growth in aviation is entirely desirable and must be facilitated. Policy goes beyond predict and provide in directly subsidising and encouraging aviation.
- Use of non-motorised modes and avoidance of transport are not significant elements of policy.

The emphasis on predict and provide has led to and will continue to lead to significant ongoing increases in road traffic volumes. This has been particularly clearly seen in the Dublin area. This experience is entirely consistent with international experience (SACTRA, 1994, European Conference of Ministers for Transport, 1996, Noland, 1999).

If the scenario envisaged by predict and provide planners is realised, most environmental, social and economic impacts of high levels of road traffic will increase accordingly. Technical improvements will have minor mitigating effects on these impacts. However, as we point out above, there is good reason to consider that the future may not be simply a continuation of current trends.

## PART 4

### Policy options

#### A. Promoting greater sustainability

There are two ways in which the resource-cost of the Irish transport system can be cut in order to make it more sustainable. One is to reduce the amount of transport required at any given national income level. This is largely a spatial planning issue for families (where should we live?), companies (where should our next shop be opened?) and the state. The other is to make the transport activities that cannot be eliminated by these locational changes more energy-efficient. We will deal with each way in turn. However, we want to stress that, in a market economy such as Ireland's, the signals to families and firms are given by prices. If the state keeps transport costs deliberately low to "help the hard-pressed motorist" or to "enable companies to compete" there may be short-term advantages but the wrong locational decisions will be made and Ireland will become more energy intensive than it need and thus less sustainable.

We therefore recommend that the government should warn the public that energy prices are going to be very much higher in future in real terms because of the combined effects of measures to slow climate change and oil and gas depletion. Moreover, it should develop its own programmes on the basis that a business-as-has-been-usual-for-the-past-50-years path will not be possible in the near future because energy will be scarce and expensive. We understand, however, that the reality of oil and gas depletion has not been taken on board in the preparation of the next National Plan.

The elements of the price-adjustment programme we would propose are as follows:

- a) A statement by the Taoiseach on the future of world oil and gas supplies and on the effects that the drastic measures that will be required to slow climate change will have on the availability and price of fossil fuels, and hence on their non-fossil replacements.
- b) The government's acceptance in its public statements that real incomes will inevitably fall as a result of the higher energy prices and that the Irish economy might shrink, although some sectors, especially those to do with energy saving and renewable energy production, will be highly profitable.
- c) An announcement by the Minister for Finance that, over a period of years, Vehicle Registration Tax is to be scrapped and that the excise duty on motor fuels is to be increased so that the motorist is paying the full marginal cost of his or her road use. The announcement would make it clear that, as the government expects motor fuels to be brought within the EU Emissions Trading System by 2013 at the latest, the anticipated cost of the emissions permits will be incorporated in the excise duty until the EU system is in operation, in order to give the public the right signals now.

- d) The removal of all subsidies on air travel, the introduction of VAT on air tickets and the scrapping of plans to extend publicly-owned airports.
- e) The introduction of congestion charging where necessary. (See below).
- f) That the annual road tax is to be levied in future according to the maximum load a vehicle is likely to impose on the road surface and hence the damage it is likely to do.
- g) That cars will be energy rated in the way they are already are in Britain, as shown in Figure 18.  
The EU Labelling Directive 1999/94 stipulates provision of CO<sub>2</sub> information in car showrooms and car advertisements but leaves a wide scope for national implementation and only a few countries operate colour-code schemes such as those for fridges and washing machines, and only very few provide information on annual fuel costs.

Figure 18: Fuel Economy

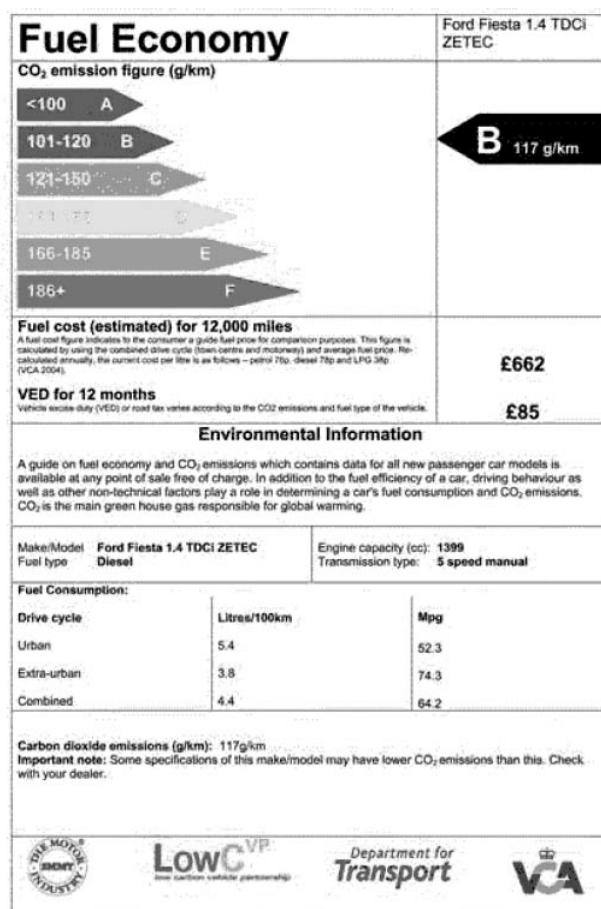


Figure 18: A fuel economy label as used on cars in Britain.

## 1. Reducing the requirement for transport

The widespread public acceptance that energy, and particularly motor fuels, will be much more costly in future will encourage people to look for houses in places where they can manage without a car, or at least without a second vehicle. Similarly, companies are likely to place their shops, factories and offices where the transport costs are least. There will be a greater tendency for, say, an office to be located near to where people live rather than in a city centre and, rather than having one large office which requires a lot of people to come together each day, an organisation could have several smaller ones with good video and data links between them. Similarly, the average size of shops is likely to fall as they move closer to their customers. Global companies will seek to change their business model, making a much greater range of products in each country and having more local showrooms.

We expect higher energy prices to have another effect on industrial location and thus on transport demand. Most renewable energy sources are located outside the major cities and can only be developed on a small scale. A pattern could emerge similar to that seen in the early years of the Industrial Revolution when textile companies sought out and developed water power sources and built their mills to use them. In the new model, we see communities developing, say, a biomass-fired CHP plant in conjunction with a company seeking a source of electricity and heat at a guaranteed price, rather than one subject to the vagaries of the international market. This distributed production may increase transport use getting the raw materials to the energy source and then the product away, but total energy costs and emissions would fall, and some rural people should have shorter distances to travel to work.

Changing the way our cities are designed could help reduce energy use. People living in dense urban areas use less energy for travel on a daily basis than someone living in a rural or suburban location but they tend to compensate for this by using more energy in their leisure time, particularly on air travel. However, a Norwegian study (Holden and Norland, 2004) has shown that if people in dense urban areas have access to a garden, which need not be attached to their flat or house, they spend more of their leisure there and take fewer flights. There will also be energy and transport savings because they will grow some of the more energy-intensive foods, such as fresh vegetables and salads. So the large areas of small plots with fruit trees and chalets on them within cycling or walking distance of many European cities make energy sense.

## 2. Making transport more energy efficient

We noted earlier that cheap energy had encouraged the use of energy-intensive transport modes even though less energy-intensive modes can be just as effective. To a large extent, the higher prices produced by the market and by government changing its tax policies will reverse the trend to move to higher energy modes. However, there are things that the state can do to speed the retreat along.

One is the introduction of congestion charging. The government's attitude on this has been that it should not begin until bus services have been improved. Yet we saw that although Quality Bus Corridors are in use in some places, Dublin Bus cannot give a good service because of the congestion, which costs it as much as its government grant. If it puts on more buses, it will worsen the congestion itself. In short,

we have a classic Catch-22 situation from which the government can only escape when it realises that buses and the Luas are not the only transport options and there are even less energy-intensive transport modes. Dublin used to be noted for the number of cyclists and could be again. According to Dublin City Council, 5% of commuters already cycle, which is not surprising since a bike is much the fastest way to move around the city. "It is our objective to double that [percentage] over the next seven years" it says on its website. "In order to achieve this we are constructing 160km of cycleways and significantly increasing cycle parking facilities. We are also promoting cycling awareness and identifying safe routes to school." The Port Tunnel will shortly reduce the number of trucks passing through Dublin and using a congestion charge to reduce the number of cars could make the city much safer and attractive for cyclists. It would also improve bus speeds and thus improve the service. The politicians should not wait, particularly if they follow London's policy and use the revenue from the congestion charge to improve facilities for cyclists and for public transport.

The perceived level of risk seems to be a major deterrent to cycling. In the Netherlands, as the number of cycling fatalities was brought down by two-thirds, the distance cycled went up by 30%. In Denmark between 1990 and 2000, the number of seriously injured cyclists fell by 30% while the distance travelled by cyclist went up by about the same percentage.

Figure 19: Oil Use per Capita for Transportation

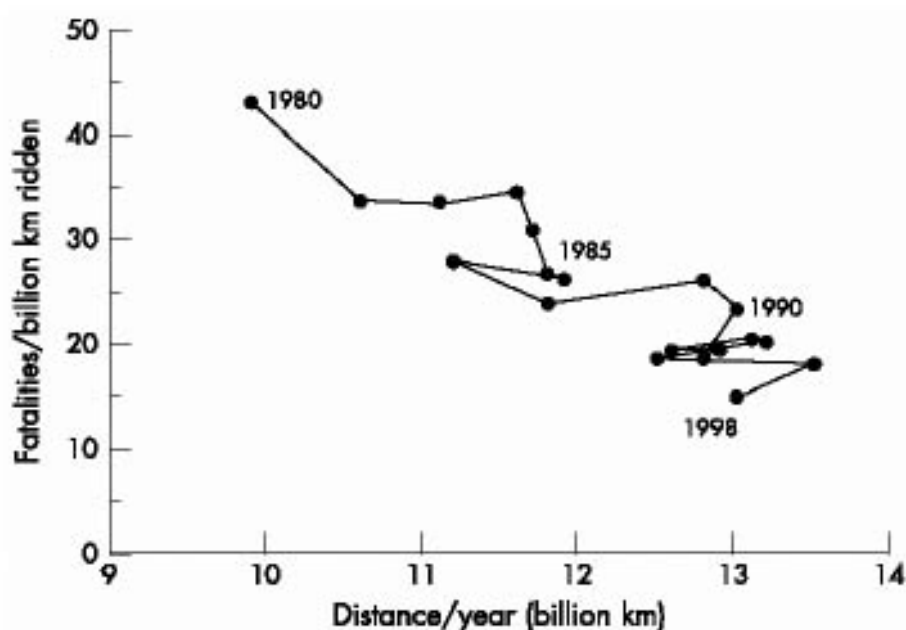


Figure 19: As cycling got safer in the Netherlands, the distance cycled increased steadily. Other countries have had the same experience. Source: Ege & Krag, undated

Two complementary methods of reducing this risk and perception of risk are:

- significant changes in road design practice, discussed below, and
- a presumption that the motor vehicle operator is liable when in collision with a more vulnerable road user, as in Denmark, Belgium, the Netherlands, and France.

In Copenhagen, where 34% of the population cycle to work, speed, exercise and convenience seems to be the main motives.

Figure 20: Oil Use per Capita for Transportation

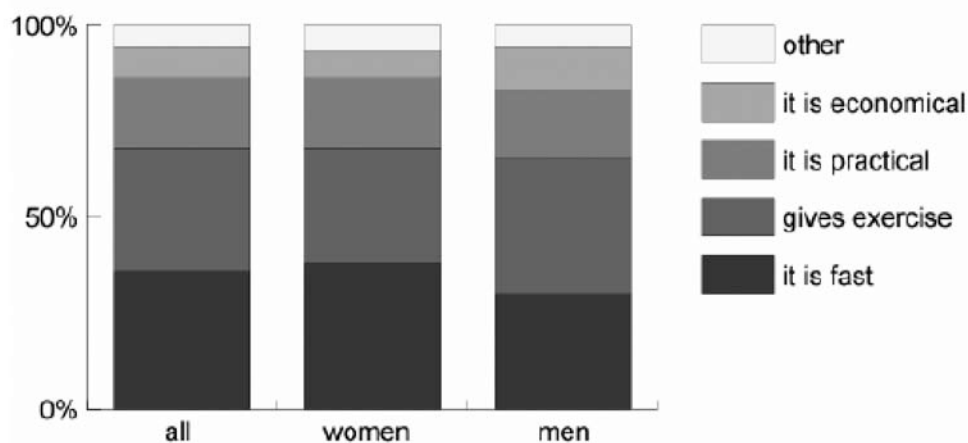
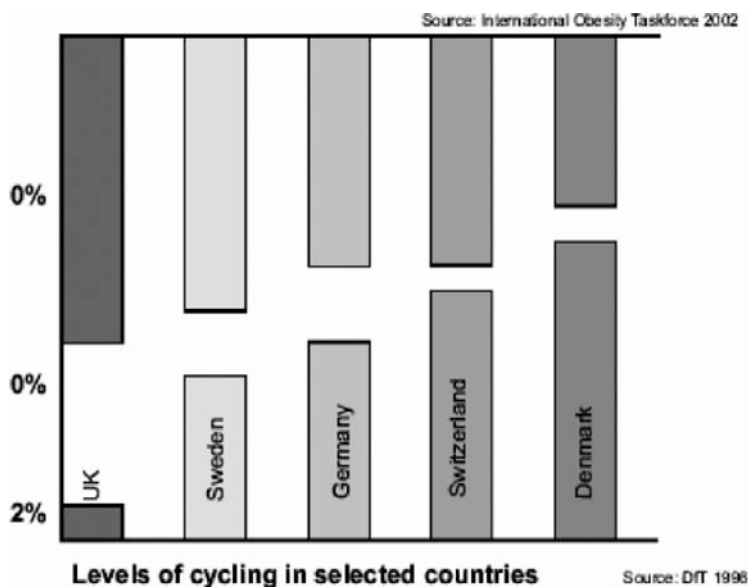


Figure 20: The reasons given by Copenhagen residents in a survey on why they cycled to work.

Source: Ege & Krag.

There would certainly be health benefits to any increase in cycling. Figure 21 below shows that in societies where more cycling is done there is less childhood obesity. In addition, hypertension, cardiovascular disorders, diabetes, osteoporosis, breast cancer, colon cancer, gallstone, depression and back pain are all reduced by the mild exercise which cycling gives.

Figure 21: Levels of cycling in selected countries



Other areas in which the state could act to speed a modal switch are in meeting Irish Rail's need for capital investment if it is to carry more freight and also in encouraging the ferry companies to provide a better alternative to air travel. For example, it seems to be impossible to use the internet to buy a combined rail and ferry ticket to take one from anywhere in Ireland to a British station. The ferries concentrate their marketing efforts to the needs of passengers with cars.

## B. Developing transport infrastructure

### *Induced traffic*

The most important policy change in this area would be a recognition of the operation of induced traffic and demand elasticity in transport planning. An increase in road capacity can lead to an increase in traffic volumes using the routes in relation to which potential time savings have been enabled. This is particularly prevalent in situations of urban congestion.

This phenomenon has been empirically verified in a number of studies and accepted as real by official working groups and review bodies. As a result of the Standing Advisory Committee on Trunk Road Assessment's (SACTRA) report entitled *Trunk Roads and the Generation of Traffic* (1994), all analyses of road proposals in the UK are required to assess the impact of induced traffic which would result from the proposal.

The reason for this is clear from the SACTRA report itself. Among its conclusions (see pp. i to iv) are the following:

*"Induced traffic can and does occur, probably quite extensively, though its size and significance is likely to vary widely in different circumstances"*

*"Studies demonstrate convincingly that the economic value of a scheme can be overestimated by the omission of even a small amount of induced traffic. We consider that this matter is of profound importance to the value of money assessment of the Road Programme"*

*"Induced traffic is of greatest importance in the following circumstances:*

- where the network is operating or is expected to operate close to capacity;*
- where traveller responsiveness to changes in travel times or costs is high, as may occur where trips are suppressed by congestion and then released when the network is improved;*
- where the implementation of a scheme causes large changes in travel costs."*

*"Routes should be assessed in their entirety for environmental reasons - decisions on schemes in one part of a corridor should not pre-commit environmentally sensitive decisions elsewhere in the corridor without a thorough economic and environmental appraisal of the overall strategy."*

*"We recommend that variable demand methods should now become the normal basis of trunk road traffic forecasts, and that these forecasts must be carried through into operational, economic and environmental evaluation of schemes in a systematic way. In particular, where networks are operating close to capacity, suitable procedures must be used to represent the constraint of traffic in the base case and the release of traffic growth in the do-something case as additional capacity is provided."*

The European Conference of Ministers of Transport, report on *Infrastructure-induced Mobility* (1996) contains the following conclusions:

*"In the case of new road infrastructure, we can expect to see an average increase in mobility of 10 per cent in the short term and 20 per cent in the longer term, although induced traffic can range anywhere from zero to 40 per cent, depending on circumstances."*

*"It is nonetheless true that even where the additional traffic has the advantage of better conditions (an obvious benefit to the community), it also contributes to congestion and environmental nuisances. This can erode the perceived benefits, sometimes substantially. The net effect depends on the existing levels of congestion - in areas that are heavily congested, the net benefit will be very much less, if not negative, since the new scheme will only add traffic to an area that is already saturated, with consequence that are all too familiar. In urban areas, new road construction to alleviate congestion is unlikely to be successful, although it will improve accessibility."*

Noland (1996) of the U.S. Environmental Protection Agency analysed induced traffic within the framework of transport economics, concluding that "these results strongly suggest that induced demand effects are real and need to be considered both by planners for specific projects and by policy makers at both the regional and national level."

Induced traffic results from one or more of the following:

- trips which otherwise would not have been made (or where the demand was previously suppressed by congestion),
- trips now made by private motor vehicle which would otherwise have been made by public transport, foot or bicycle,
- trips now being made at peak times which would otherwise have been made off peak,
- in the longer term, trips resulting from changed land use patterns induced by the road.

The phenomenon of induced traffic means that it is generally impossible to reduce congestion or improve air quality by providing more road space. This conclusion has been extensively demonstrated (Newman and Kenworthy, 1989). Furthermore any improvement in the emission rates of individual vehicles resulting from reduced congestion is less than the increase in emissions resulting from increased numbers of vehicle-miles which are induced by the reduction in congestion. (Newman, *et al.*, 1988)

Induced traffic has implicitly been acknowledged in the shift in transport and traffic policy represented by the Dublin Transportation Initiative Final Report (1995). Unfortunately it has not been incorporated into national road planning and the standard assumption underlying transport planning in Ireland remains that demand for mobility is independent of capacity.

A significant correlation of induced traffic is the fact that providing extra public transport capacity on a corridor will lead to an increase in total travel along that corridor, and that the increase in public transport ridership will not necessarily be matched by a reduction in travel by car or other modes.

### **C. Integration of transport planning with land-use planning**

Although the inseparability of land-use planning and transportation has long been recognised both academically (Newman and Kenworthy, 1989) and in official policy, there is an ongoing lack of integration of land-use planning and transportation. This can be seen both at national level - National Spatial Strategy (2002), National Development Plan (2000), Strategic Rail Review (Booz Allen Hamilton, 2002), - and at local level with some significant exceptions (Cork LUTS, 1978).

Similarly, transport decisions are typically taken on a mode-by-mode basis. The local authorities who are responsible for both land use planning and road planning and provision have no functions in relation to public transport. The Dublin Transport Initiative (1995) represented a significant shift from the division between road planning and public transport planning. However, the Dublin Transportation Office established as a result is primarily advisory. The institutional arrangements for multi-modal transport planning are still not in place in Dublin, although they are planned with the proposed Dublin Transport Authority. There are no similar plans for the rest of the country.

Additionally, walking and cycling as modes are often ignored and their potential disregarded. This is despite the fact that over a 40% of the trips to work of less than 4 miles are made by car and 44% of schoolchildren aged between 5 and 12 again travelling less than 4 miles to school go by car (CSO, 2004).

Integration of land use planning and multi-modal transport planning would be a major shift from the current approach which is a combination of *laissez-faire* and predict-and-provide, wherein transport policy consists primarily of providing roads in an attempt to alleviate congestion.

### ***Design approaches***

Road designs which disadvantage any road users (by increasing risk or perception of risk, reducing comfort, directness or speed) act to deter them. (Hillman, 1990) This is particularly the case with cyclists and pedestrians who are more exposed to the outside environment than those in motor vehicles. This is a common problem with walking and cycling in Ireland. Design for walking and cycling is carried out as an add-on to road design, if at all, and some design features which cause particularly severe problems for pedestrians and cyclists are still common. (Galway Cycling Campaign, 2006) Poor designs can also disrupt access to public transport.

Additionally, the creation of a pleasant environment along a route will encourage its use by pedestrians and cyclists, especially if it involves a reduction in the speeds of motor vehicles on the route.

Important information on the priorities and desires of users can be gained by surveying them, which has not traditionally been part of transport planning or road design. (Kipke, 1993)

### **D. Provision of information, raising of awareness and changing of attitudes**

Lack of information about transport options has been identified as a significant barrier to use of public transport in particular. Measures such as journey planning websites can assist significantly. (Transport for London) Such websites can also assist in planning pedestrian and cycle trips. (DTO, TFL) Unfortunately the maps do not always show all possible routes. Significant impediments exist to walking where street signs, maps etc. only show vehicular routes and do not indicate pedestrian-only routes and short-cuts (as is effectively universal in Ireland.) Correct signage can help significantly. (Kraugerud, 1997)

Additionally, advertising to promote walking, cycling and public transport is widely used in other countries. Note that advertising is considered by car marketers to be highly effective in promoting their mode.

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