

# 2

## AIR\*

### Features

- Emission trends
- Ambient air quality
- Air pollution control and reduction measures
- Emissions from transport

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\* The Chapter reviews progress in the last ten years, and particularly since the 2000 OECD Environmental Performance Review. It also reviews progress with respect to the objectives of the 2001 OECD Environmental Strategy.

## Recommendations:

- implement additional measures to *reduce NO<sub>x</sub> emissions* in order to achieve current and forthcoming NEC Directive requirements; consider how these requirements could be achieved most cost-effectively among the relevant sectors;
- complete *retrofitting of the coal-fired Moneypoint power plant* to reduce SO<sub>2</sub> emissions; carry out *further investment in combined heat and power installations* in the industrial, commercial and service sectors; and ensure compliance of large combustion plants with requirements of the National Emissions Reduction Plan;
- ratify the *Stockholm Convention on POPs and the Aarhus Convention protocols on POPs and heavy metals*; ;
- implement the 2009 *Sustainable Travel and Transport Action Plan*, particularly measures to improve public transport in urban areas; assess how road pricing/ congestion charges could contribute to achievement of the plan's objectives; and reinforce programmes to support public transport options in rural areas;
- *develop measures to better link land use and transport planning* with a view to controlling urban sprawl.

## Conclusions

Following major reductions since 2000 in emissions of SO<sub>2</sub> (–61%) and *non-methane VOCs* (–17%), Ireland is on track to meet the relevant 2010 EU targets. The National Emission Ceilings (NEC) Directive target for *ammonia* emissions was achieved in 2001. Emissions of particulate matter (PM) have been substantially reduced in urban areas, and emissions of *CO and toxic contaminants* have decreased. *In all major sectors generating air pollutants, reductions have been made* as a result of *i) a substantial shift from heavy fuel oil to natural gas in electricity generation and industry, ii) reductions in the sulphur content of fuel oil and gas oil, iii) decreased use of coal and peat in the residential sector and iv) application of catalytic controls and other technology in cars. Voluntary agreements* between central authorities and the private sector significantly reduced the sulphur content in coal and petroleum coke for heating. *Urban air quality* complies with all standards for SO<sub>2</sub>, NO<sub>x</sub>, lead, PM<sub>10</sub>, CO, ozone and benzene. EU requirements for levels of cadmium, lead, arsenic, nickel and polycyclic aromatic hydrocarbons (PAHs) in ambient air have been met. *Air quality monitoring* has improved, including recent requirements for small particulates, heavy metals (arsenic, cadmium, mercury, nickel) and PAHs. *Pressure on air quality from*

*transport* has been reduced, especially in Dublin, through investment in light rail (tram and train networks), tunnels and bypasses. *Vehicle standards* have gone into effect: the share of inspected vehicles violating emission standards remains low and the availability of cleaner fuels has increased. A *long-term Transport 21 strategy and an ambitious Sustainable Travel and Transport Action Plan* have been adopted to promote sustainable mobility and access.

However, the decrease in  $NO_x$  emissions is very slow and Ireland, along with many other EU member states, will face considerable difficulty in meeting the  $NO_x$  emission target of the NEC Directive. The installation of flue gas desulphurisation at the Moneypoint coal-fired electricity station, which is expected to bring national emissions of  $SO_2$  below the 42 000 tonne 2010 ceiling, has yet to be completed. Ireland has not yet ratified the Stockholm Convention on persistent organic pollutants (POPs) or the Aarhus Convention protocols on POPs and heavy metals. To facilitate ratification, revised emission inventories of POPs and heavy metals have been finalised and reported in 2009. Some policy recommendations of the *2000 public transport strategy for Dublin* have not been implemented, most notably improvement of the bus service, integrated ticketing and facilities for cycling and walking. Property and land taxation, combined with land use planning procedures that are not integrated with investment in public transport infrastructure, have led to considerable *urban sprawl* and growing reliance on cars in urban and, increasingly, rural areas. Most *freight* is now carried by road, which increases air pollution pressures.



## 1. Policy Objectives

The goal of improving ambient air quality to minimise health risks, particularly in urban areas, is included in the 1997 National Sustainable Development Strategy and the 2000-06 and 2007-13 National Development Plans. Ireland's commitments to reducing transboundary air pollution were translated into the *2005 National Programme on Transboundary Pollutants*, revised in 2007. The programme's priorities include reducing emissions in *i*) road transport, by improving infrastructure, fuel quality and the effectiveness of pollution abatement technologies, and *ii*) power generation and industry, through integrated pollution and prevention control (IPPC) licensing, fuel switching and technology change (DoEHLG, 2007).

*Air emission targets* for sulphur dioxide ( $SO_2$ ), nitrogen oxides ( $NO_x$ ), non-methane volatile organic compounds (NMVOCs) and ammonia ( $NH_3$ ) were

established by the 2004 National Emission Ceilings (NEC) regulations, in line with the European Union's NEC Directive (2001/81/EC) and the Gothenburg Protocol to the Geneva Convention on Long-range Transboundary Air Pollution (CLRTAP) (Table 2.1).<sup>1</sup> Ireland has not set national emission ceilings for heavy metals or persistent organic pollutants (POPs), nor has it ratified related protocols to the CLRTAP.<sup>2</sup>

Table 2.1 Performance on EU and international targets<sup>a</sup>

Pollutants	2010 targets		Reductions in 2007		2007-10 reduction required (%)
	2010 level required/ 1990 emission baseline (‘000 tonnes)	Reduction required on baseline (%)	2007 emissions (‘000 tonnes)	1990-2007 reduction (%)	
SO <sub>2</sub>	42/178	-76	54.2	-70	-23
NO <sub>x</sub>	65/115	-43	117	+2	-44
NMVOCS	55/110	-50	57	-48	-4
NH <sub>3</sub>	116/126	-8	105.6	-16	0

a) The 1999 Gothenburg Protocol of the UNECE Convention on Long-range Transboundary Air Pollution and the EU National Emission Ceilings Directive (2001/81/EC), which have the same targets for Ireland.

Source: EPA.

Irish *air quality objectives* have been harmonised with the EU air quality framework directive (96/62/EC) and its four “daughter” directives. Binding air quality standards were set in 1999 and 2002 for SO<sub>x</sub>, NO<sub>x</sub>, lead, PM<sub>10</sub>, carbon monoxide (CO) and benzene in line with provisions of the first two “daughter” directives (1999/30/EC and 2000/69/EC).<sup>3</sup> The 2004 Ozone in Ambient Air Regulations transposed the third “daughter” directive (2002/3/EC). The final “daughter” directive (2004/107/EC), which established target values in ambient air for arsenic, cadmium, nickel and polycyclic aromatic hydrocarbons (PAHs) as well as a requirement to monitor mercury in ambient air, was transposed into Irish law in 2009. A more recent EU directive, introducing a limit value for fine particulate matter (PM<sub>2.5</sub>), is due to be transposed before June 2010.<sup>4</sup>

*Recent policies on energy and transport*, including the 2007 white paper on energy, the 2007 Bioenergy Action Plan and the 2009 Sustainable Travel and Transport Action Plan, specify measures to reduce greenhouse gas emissions from

energy generation and consumption, such as switching to renewables, producing combined heat and power (CHP), tightening building standards and reducing fuel use in transport, in addition to addressing conventional air pollutants.

Irish performance in implementing air pollution reduction policies can also be assessed against the relevant recommendations of the *2000 OECD Environmental Performance Review* (Table 2.2).

## 2. Emissions and Pollution Concentration Trends

### 2.1 Atmospheric emissions

During the review period Ireland made *important progress in reducing emissions of key air pollutants* and meeting related targets. The NEC targets for  $\text{NH}_3$  were achieved in 2001 and progress towards meeting the  $\text{SO}_2$  and NMVOC targets is on track (Table 2.1). The emission intensity (per unit of GDP) is below the OECD Europe average for these pollutants (Figure 2.1). Emissions of PM and toxic pollutants have been reduced. However, Ireland has encountered considerable difficulty in reducing  $\text{NO}_x$  emissions: emissions per capita are above the OECD Europe average (EPA, 2008a, 2008b).

$\text{SO}_2$  emissions have decreased significantly (–61%) since 2000, dropping below the OECD Europe average per capita. The reduction was especially strong in the power generation sector (–62%), heading towards the 2010 target of the NEC Directive (Figure 2.2). The most significant reduction in industry came from the non-ferrous metals subsector as a result of conversion from conventional oil-fired boilers to gas-fired CHP generation. The pending installation of flue gas desulphurisation at the largest Irish coal-fired electricity station, Moneypoint, which generated up to 30 000 tonnes of  $\text{SO}_2$  annually, is expected to bring national emissions of  $\text{SO}_2$  below the 2010 target.

In the 1990s, Ireland's  $\text{NH}_3$  emissions increased because substantial quantities of animal manure and chemical fertiliser were applied to farmland. The trend reversed in 1999 and the emissions decreased following a decline in the numbers of cattle and sheep, as well as a decrease in fertiliser use (Figure 2.2).<sup>5</sup> The NEC ceiling for ammonia was achieved in 2001 and the emission reduction is expected to continue, mostly through further reductions of cattle and sheep numbers.

NMVOC emissions decreased by nearly 17% in the review period, coming close to the 2010 target (Figure 2.2) and are down by nearly 30% since 1990. Catalytic converters and evaporative control technologies in petrol cars as well as higher vapour recovery standards in petrol storage and distribution systems have yielded large

Table 2.2 Progress in environmental performance

Recommendations from the 2000 OECD Environmental Performance Review	Action taken since 2000
<ul style="list-style-type: none"> <li>• Develop and implement a <i>national plan to reduce air pollutant emissions</i>, to be co-ordinated with development plans for key sectors (<i>e.g.</i> transport, energy), and, <i>inter alia</i>, to identify cost-effective measures to reduce emissions of SO<sub>x</sub>, NO<sub>x</sub>, VOCs and GHGs;</li> <li>• retrofit <i>power plants</i> with flue gas desulphurisation or denitrification equipment, to the extent that this is more cost-effective than creating incentives to use low-sulphur oil and coal; confirm a timetable for progressive phase-out of existing peat-fired power plants, especially those over ten years old;</li> <li>• continue to implement the <i>IPC licensing</i> scheme and explore means to strengthen local authorities' monitoring and inspection capabilities, to ensure that facilities not licensed under the IPC scheme are adequately regulated;</li> <li>• further develop <i>monitoring</i> of ambient concentrations of PM<sub>10</sub>, NO<sub>x</sub>, VOCs and O<sub>3</sub>, particularly in major cities;</li> <li>• examine the environmental effectiveness and economic efficiency of <i>variable transport costs</i>, giving consideration to the introduction of road-use pricing systems (<i>e.g.</i> use of tolls);</li> <li>• accelerate and expand application of <i>in-use vehicle emissions testing</i> (including for second-hand imports);</li> <li>• continue to implement intermodal <i>demand management measures</i> (<i>e.g.</i> environmental traffic cells, parking management, dedicated bus corridors) in Dublin and other major cities, in order to stimulate demand for public transport and limit demand for private vehicles;</li> </ul>	<ul style="list-style-type: none"> <li>• A <i>National Programme on Transboundary Pollutants</i> developed in 2005 (revised in 2007), focusing on <i>i)</i> road transport, by improving infrastructure, fuel quality and the effectiveness of pollution abatement technologies, and <i>ii)</i> power generation and industry, through IPPC licensing, fuel switching and technology change. A <i>National Emissions Reduction Plan</i> developed in 2005 to address emissions from existing power plants.</li> <li>• <i>Retrofitting of the Moneypoint power plant</i> planned, to reduce SO<sub>2</sub> emissions (imminent); two modern, higher-efficiency <i>peat-fired power stations</i> commissioned and all the old stations closed.</li> <li>• <i>National integrated permitting</i> amended in 2003, in line with provisions of the EU IPPC Directive, requiring industry to innovate to decouple production from pollution. Certain activities that do not require an IPPC licence (<i>e.g.</i> solvent using installations) may be required to register with their local authority and obtain a certificate of compliance.</li> <li>• As envisaged in the 2000 <i>National Air Quality Monitoring Programme</i>, new monitoring sites established, extending the capacity for background air quality and PM<sub>10</sub> monitoring.</li> <li>• <i>Road pricing</i> implemented for the motorway around Dublin; comprehensive <i>Sustainable Travel and Transport Action Plan</i> adopted in 2009.</li> <li>• <i>National Car Testing</i> introduced in 2000. Testing is compulsory for cars over four years old, with test certificates valid for two years.</li> <li>• Extensive <i>public transport infrastructure projects</i> completed in Dublin, including upgrading rail lines and services, such as Dublin Area Rapid Transit (DART); introducing a light rail system (Luas) and renewing the fleet of Bus Átha Cliath, the Dublin bus operator; introducing dedicated bus corridors and park and ride facilities; and launching traffic management programmes.</li> </ul>

Table 2.2 Progress in environmental performance (cont.)

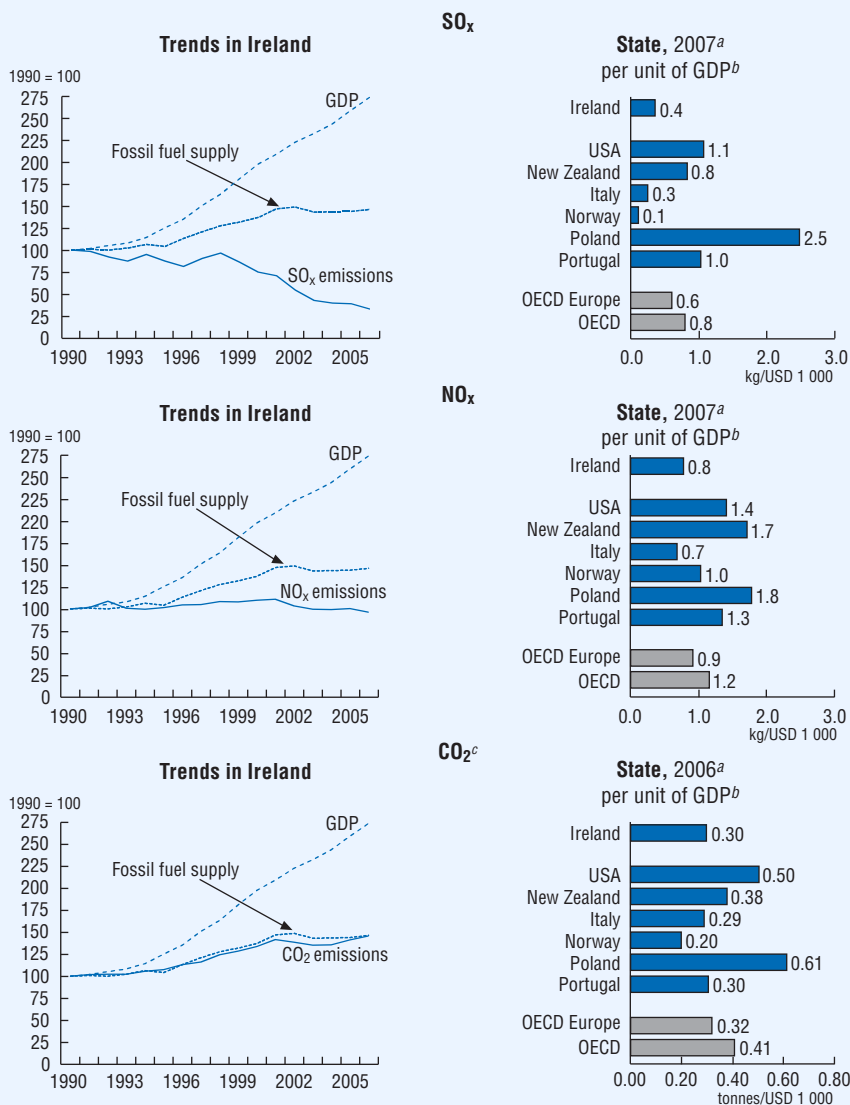
Recommendations from the 2000 OECD Environmental Performance Review	Action taken since 2000
<ul style="list-style-type: none"> <li>• accelerate completion of <i>congestion-alleviating road infrastructure</i> (e.g. bypasses, ring roads, tunnels); implement measures (e.g. planning, economic incentives) to <i>shift freight and passenger traffic</i> out of Dublin to the extent feasible;</li> <li>• seek better application of the <i>user-pays principle</i> to road transport, giving special consideration to an increase in vehicle use taxation (e.g. fuel taxation) relative to ownership taxation (e.g. vehicle registration, sales tax), and to other economic instruments.</li> </ul>	<ul style="list-style-type: none"> <li>• Ten <i>major transport infrastructure projects</i> completed by 2006, including the Dublin Port Tunnel, which helps address major traffic bottlenecks in the capital.</li> <li>• <i>Vehicle registration tax and annual motor vehicle tax</i> for passenger cars revised in 2008 to reflect CO<sub>2</sub> emission ratings; tax reductions applied to hybrid-electric cars and tax exemptions to electric cars and cycles.</li> </ul>

Source: OECD, Environment Directorate.

reductions in transport, which accounted for some 22% of NMVOC emissions in 2007 (down from 38% in 2000). The contribution from solvent use, the other major source of NMVOCs, has remained relatively constant in absolute terms even though emission sources such as paint use, dry cleaning and pharmaceutical and chemical industrial activity have increased. This stabilisation reflects reductions in the NMVOC content of paint and regulatory enforcement of solvent-emitting activities.<sup>6</sup>

*NO<sub>x</sub> emissions* decreased by 13% during the review period, remaining close to the NEC 1990 baseline level and, unlike the three principal air pollutants, at nearly twice the 2010 NEC ceiling (Figure 2.2). While reductions took place in the power generation subsector (–32% over 2000–07) and will continue as further controls are applied, emissions from industry increased by 33% compared with 2000, accounting for 16% of the total in 2007. Between 2001 and 2007, *NO<sub>x</sub> emissions* from cement production increased by 95%; in 2007 the cement industry accounted for 60% of total industrial *NO<sub>x</sub> emissions* and 9.5% of total national emissions. The pace of emission reduction in road transport, a major source of *NO<sub>x</sub>* at 45% of the total in 2007, reached 19% in 1999–07 (from a peak of 67 600 tonnes in 1999 to 54 900 tonnes in 2007) benefitting from catalytic converter technology.<sup>7</sup> Expected faster reductions were offset, however, by increases in vehicle numbers and average engine size. As Ireland is in recession, with GDP dropping 3% in 2008 and an estimated 10% in 2009, the rate of *NO<sub>x</sub>*

Figure 2.1 Air pollutant emissions



a) Or latest available year.

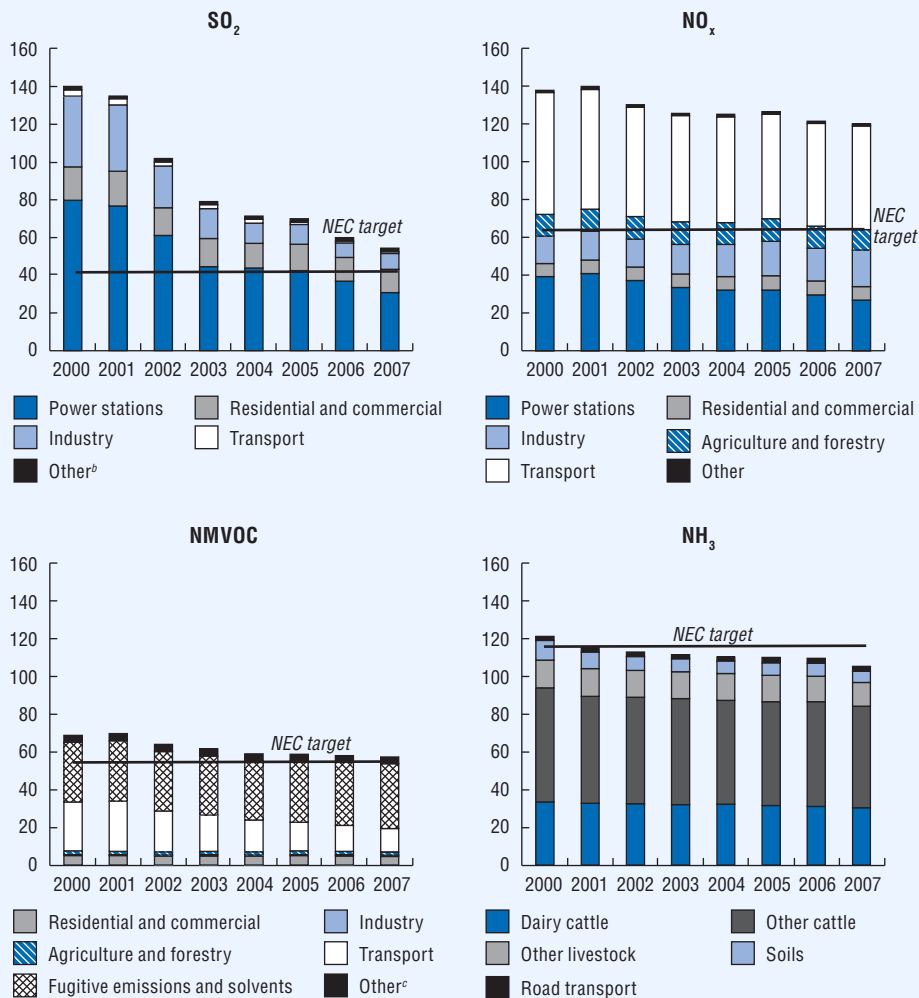
b) GDP at 2000 prices and purchasing power parities.

c) Emissions from energy use only; excludes international marine and aviation bunkers; sectoral approach.

Source: OECD-IEA (2008), *CO<sub>2</sub> Emissions from Fuel Combustion*; OECD (2008), *OECD Economic Outlook No. 84*; OECD-IEA (2008), *Energy Balances of OECD Countries*.



Figure 2.2 Trends in air pollutant emissions under the EU NEC Directive,<sup>a</sup> 2000-07 (1 000 tonnes)



a) Directive 2001/81/EC of the European Parliament and of the Council on national emission ceilings for certain atmospheric pollutants.

b) Includes agriculture and forestry.

c) Includes power stations.

Source: EPA.

emission reduction will increase, especially in transport and industry, but the remaining gap still represents a serious challenge to efforts to realise the required emission cuts.

*CO emissions* have decreased by about 33% since 2000 (–59% since 1990) (Table 2.3). Progress has been due to the success of technological controls in petrol cars and major reductions in residential combustion of solid fuel. The decreasing trend is expected to continue with improvements in motor engines and non-road applications.

Bans on bituminous coal in large cities and towns have contributed to emission reductions for *primary PM* (Table 2.3). As emissions of sulphur and nitrogen, the principal constituents of secondary PM, have fallen considerably, concentrations of NPM in the atmosphere have been decreasing. However, efforts will be needed to meet requirements of EU directive 2008/50/EC, which introduced a limit value for PM<sub>2.5</sub>.

Reductions in emissions of *heavy metals and other toxic air contaminants* (Table 2.3) can be attributed to regulatory measures and technological advances, including the almost total ban on leaded petrol in 1999 and the closing of hospital incinerators that could not meet the high EPA standards required for IPPC licensing.<sup>8</sup> The closing of an iron smelting facility in Cork also had an important effect. Increased emissions of total mercury (by 15%) are a result of increased use of petroleum coke and coal as fuel in the cement industry after the entry of a number of additional cement producers into the Irish market after 2000. In 2007 manufacturing industries and construction accounted for 70% of total national mercury emissions having increased by 140% since 1990 (McGettigan, 2009). Nearly 70% of dioxin emissions are generated by uncontrolled combustion, with domestic burning of waste accounting for 58% and accidental building fires for 11%. However, the combined range for dioxins and PCB levels in milk fat, reported in a survey carried out in 2007, was 0.141 to 0.611 pg WHO-TEQ, with a mean of 0.225 pg WHO-TEQ per gram.<sup>9</sup> This was well below the EU limit for milk and milk products of 6 pg for dioxins and PCBs combined (EPA, 2007).

## 2.2 Ambient air quality

Due to Ireland's location, weather patterns that supply predominantly clean air, the relative lack of heavy industry and the bans on coal burning in many urban areas since the early 1990s, *no exceedances of ambient air quality limit values* were observed during the review period (Box 2.1). A well-developed measurement system for SO<sub>2</sub>, NO<sub>2</sub>, O<sub>3</sub> and PM<sub>10</sub> concentrations in Irish cities has shown decreasing trends since 2000, except for NO<sub>2</sub>, benzene and CO levels in Dublin (Figure 2.3). Risks of

Table 2.3 **Atmospheric emissions of CO, PM and heavy metals, 2000 and 2007**

	CO	TSP <sup>a</sup>	PM <sub>10</sub>	PM <sub>2.5</sub>	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
	'000 tonnes	tonnes											
2007	170 715	23 315	14 025	9 531	14.8	0.63	0.86	3.04	3.98	12.41	64.02	3.99	14.52
2000	254 374	27 960	16 868	11 300	28.81	1.07	0.75	3.17	6.34	11.16	69.39	4.2	45.24
Change (%) 2000-07	-33	-17	-17	-15	-48	-41	15	-4	-37	11	-7	-5	-68

a) Total suspended particulates.

Source: EMEP, 2009.

exceeding the limit values for PM<sub>10</sub>, O<sub>3</sub> and NO<sub>x</sub> remain in urban areas affected by emissions from solid fuel burning and traffic, especially in combination with warm, sunny weather.

### 3. Measures to Prevent and Control Air Pollution

In line with a recommendation of the 2000 Environmental Performance Review, Ireland further developed monitoring for ambient concentrations of key air pollutants. As envisaged in the 2000 *National Air Quality Monitoring Programme*, new monitoring sites were established, extending the capacity for background air quality and PM<sub>10</sub> monitoring (EPA, 2000, 2009).<sup>10</sup> Further efforts are needed to measure mercury and PM<sub>2.5</sub> in ambient air, building on the first mercury measurement site at Mace Head (which fulfils the minimum requirements of the fourth “daughter” directive, 2004/107/EC) and new PM<sub>2.5</sub> measurement sites set up in 2008 and 2009 (which will meet the requirements of the Clean Air for Europe Directive by 1 January 2010). Revised emission inventories for POPs and heavy metals prepared in 2009 should facilitate ratification of the Stockholm Convention and the Aarhus protocols.

Annual *air quality reports*, produced since 1996, provide time series for pollutant concentrations that are presented in a set of indicators, which compare measured concentrations with current and future air quality standards. Industrial emissions were reported for 2001 and 2004 through the European Pollutant Emission Register (EPER), which covered 50 pollutants from 183 EPA-licensed facilities.

### Box 2.1 Ambient air quality

As required by the EU air quality framework directive, the territory of Ireland is divided into *four zones for the assessment and management of air quality*. Zone A is the Dublin conurbation, zone B the Cork conurbation, zone C other cities and large towns (Galway, Limerick, Waterford, Clonmel, Kilkenny, Sligo, Drogheda, Wexford, Athlone, Ennis, Bray, Naas, Carlow, Tralee, Dundalk, Navan, Newbridge, Celbridge, Mullingar, Letterkenny and Balbriggan) and zone D remaining areas. Local authorities operate monitoring networks in zones A and B while the EPA monitors the rest of the country, using fixed and mobile stations. Up-to-date information on air quality is made available through media such as newspapers and the Internet, with sensitive population groups such as asthmatics, represented by the Asthma Society, given more specific information.

*Concentrations of SO<sub>2</sub> and black smoke* have declined significantly since the early 1990s, a trend that continued over the review period. In 2008, there were no SO<sub>2</sub> exceedances of either the daily limit value of 125 µg/m<sup>3</sup> or the hourly limit value of 350 µg/m<sup>3</sup> at any of the monitoring stations while black smoke concentrations were one-tenth of the 98-percentile standard of 250 µg/m<sup>3</sup> (EPA, 2009a). These reductions underline the effectiveness of emission control legislation introduced in the greater Dublin area starting in 1990, which banned the marketing, sale and distribution of bituminous coal. Other important measures included lowering the sulphur content of fuel and switching from solid fossil fuel to natural gas.

All 18 stations across the country where PM<sub>10</sub> was monitored in 2008 complied with the 2005 limit value, which permits no more than 35 exceedances greater than 50 µg/m<sup>3</sup> in a calendar year. PM<sub>2.5</sub> levels measured at one station in 2008 were below an annual mean limit value of 25 µg/m<sup>3</sup> established by the 2008 EU Clean Air for Europe Directive. Average levels of PM<sub>10</sub> are higher in towns, such as Ennis, Waterford and Navan, than in big cities because of higher use of solid fuel for domestic heating. In Dublin and Cork, levels of PM<sub>10</sub> are higher at traffic-influenced sites than at background locations. Levels have been little changed in recent years as increased traffic levels have offset reductions in emissions from modern vehicles.

Reporting for emissions from 2007 (the first reporting year) was completed in June 2009 through EPER's successor, the European Pollutant Release and Transfer Register (E-PRTR).<sup>11</sup> The list of substances to be reported on the E-PRTR has increased to 91, and reporting will be done annually rather than every three years. Ireland's efforts to establish a national PRTR should enable ratification of the Aarhus Convention's Protocol on Pollutant Release and Transfer Registers.

Ireland's air management regulatory framework has been kept up to date with the EU requirements. In particular, *integrated permitting*, introduced in 1992 by the

### Box 2.1 Ambient air quality (cont.)

All 13 stations where  $NO_2$  was measured in 2008 complied with the limit values and there was no discernible change in levels in recent years. Annual  $NO_2$  concentrations measured at suburban and rural sites are significantly lower than those measured at urban stations, indicating that compliance with the new limits should not be problematic in areas that are not subject to heavy traffic.

*Ozone* levels are lower than in most OECD countries. Average concentrations are generally well below the thresholds for effects on human health and vegetation set down in the 2004 Ozone in Ambient Air Regulations. The hourly information threshold of  $180 \mu\text{g}/\text{m}^3$  has been breached occasionally, for example in 2003 and 2006, during a combination of transboundary pollution and warm, sunny weather. The public is informed of such incidents via Met Éireann weather bulletins.

The *CO* air quality limit of  $10 \text{ mg}/\text{m}^3$  was not exceeded in 2008 at any of the seven stations across the country. The highest maximum eight-hour CO level measured in 2008 was  $6.2 \text{ mg}/\text{m}^3$  at Coleraine Street in Dublin. The levels vary year on year, with no discernible trend, and are well within the limit value in force since 2005.

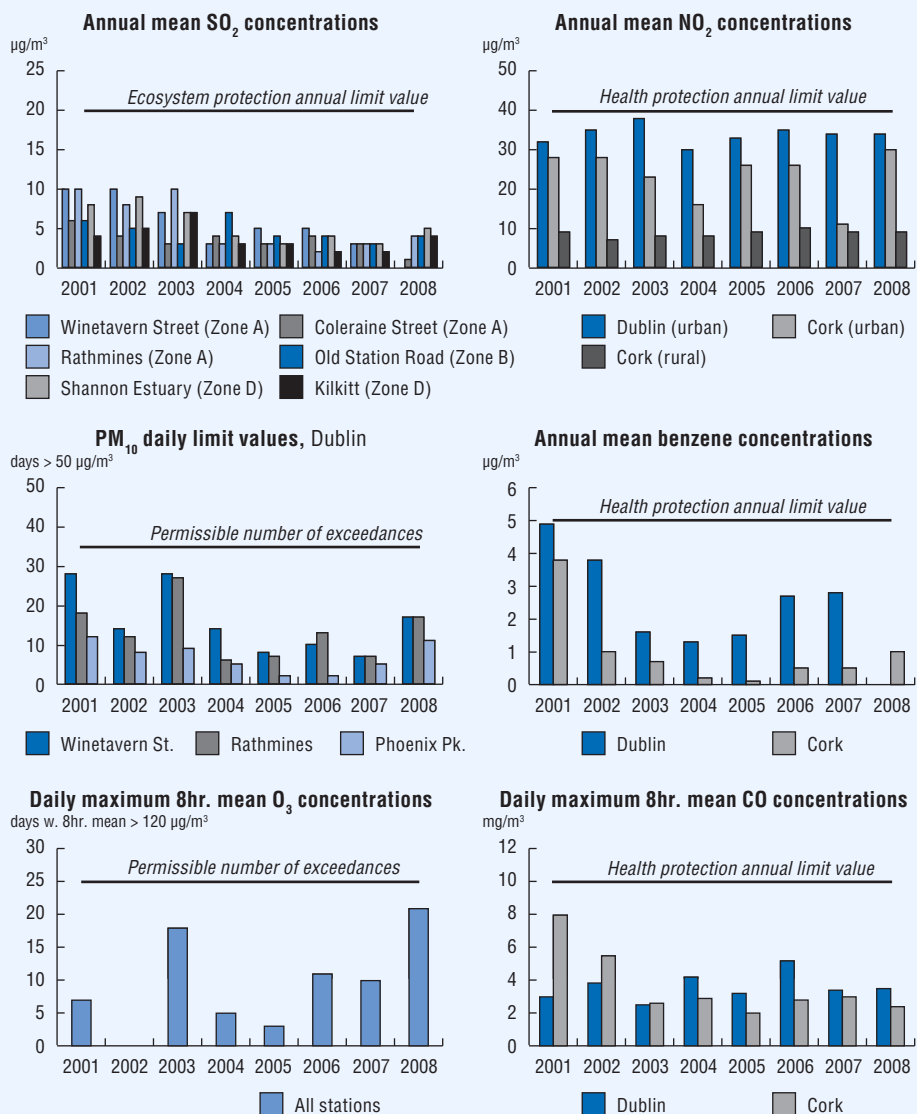
*Benzene* concentrations have decreased significantly since 2001, when the mean level recorded at Winetavern Street, Dublin, was close to the  $5 \mu\text{g}/\text{m}^3$  limit value. The levels recorded at measurement stations in recent years have been much lower, well within the limit value of  $5 \mu\text{g}/\text{m}^3$ , which must be met by 2010. In Ireland, as in most European countries, benzene concentrations in petrol have been reduced to the average concentration of about 0.7%, below the EU limit of 1%.

Annual mean *lead* levels measured at all ten monitoring stations were less than  $0.05 \mu\text{g}/\text{m}^3$ , one-tenth of the annual limit value of  $0.5 \mu\text{g}/\text{m}^3$  set out in the 2002 Air Quality Standards Regulations. Levels have been consistently low since leaded petrol was phased out in 1999.

Environmental Protection Act, was amended in 2003 through the Protection of the Environment Act, in line with provisions of the IPPC Directive (96/61/EC). IPPC licences, granted by the EPA to around 760 industrial and power generation activities, provide the framework for enforcement of legislation on all environmental media, including emissions to air.<sup>12</sup> They require industry to innovate to decouple production from pollution. Activities that do not require an IPPC licence must be registered with their local authority and obtain a certificate of compliance.

Assessment of *compliance with permits* is carried out by the EPA's Office of Environmental Enforcement, established in 2003, with support from the Environmental Enforcement Network (Chapter 6). Enforcement officers target facilities presenting a

Figure 2.3 Air quality, 2001-08



Source: EPA (2008).

potentially high risk to the environment and/or continually showing significant non-compliance. Sectors requiring particular attention include mining, iron processing, recovery of non-ferrous metal, and production of energy, aluminium, chemicals and cement. Most installations in these subsectors are large and many are operated by major multinational firms capable of meeting high environmental standards. Small and medium-sized facilities, in areas such as surface coating, boiler making and sheet metal fabrication, have less capacity for environmental management systems. As they have been a source of some incidents of public concern, recently, there has been a substantial increase in the number of warning letters relating to air incidents issued by local authorities (EPA, 2009b). This is a result of the approach taken by a number of local authorities in dealing with air pollution issues. Steps have also been taken to further reduce air pollutants emissions from uncontrolled combustion of waste, so-called “backyard burning”. The steps include regulations introduced in 2009 that increase the fine for illegal waste burning to EUR 3 000.

To promote a *shift from polluting fuels to cleaner alternatives*, a ban on the use of bituminous coal for heating, initially introduced in Dublin in 1990, has been extended to Cork (since 1995), Arklow, Drogheda, Dundalk, Limerick and Wexford (since 1998), Celbridge, Galway, Leixlip, Naas and Waterford (since 2000) and Bray, Kilkenny, Sligo and Tralee (since 2003). In 2002, a study estimated that the ban had saved around 360 lives annually in Dublin and reduced health costs by between EUR 71 million and EUR 142 million (Clancy, 2002). In 2002, the ban was complemented by a voluntary agreement by importers and distributors of solid fuel to reduce the sulphur content in coal and petroleum coke (Box 2.2). Other regulations, restricting the sulphur content of heavy fuel oil, gas oil and marine fuels, came into force in 2008.

*Investment to replace solid fuel and heavy fuel oil with natural gas in power and heating generation* has significantly contributed to air emission reductions. The use of gas in the power sector increased by over 60% between 1990 and 2006: on average 55% of Ireland’s electricity is now generated from gas, accounting for 65% of total gas demand. The share is expected to increase with the scheduled commissioning of new gas-fired plants at Aghada (420 MW) in late 2009 and Whitegate (440 MW) in 2010. In addition, EUR 11 million was allocated over the review period to a programme providing grants to install small-scale CHP units (up to 1 MW) in hotels, leisure centres, small hospitals, offices and commercial buildings.<sup>13</sup>

To address emissions from existing power plants, Ireland adopted a *National Emissions Reduction Plan (NERP)* in 2005.<sup>14</sup> Its ceilings for SO<sub>2</sub> and NO<sub>x</sub> emissions over 2008-16 are more ambitious than the minimum requirements in the LCP Directive (by 27% for SO<sub>2</sub> and 46% for NO<sub>x</sub>). The NERP gives plant operators the flexibility to identify the most cost-effective abatement options available to achieve

### Box 2.2 Voluntary agreements on reducing air pollution from domestic use of solid fuel

In 2002, the Department of the Environment, Heritage and Local Government (DoEHLG) and the Solid Fuel Trade Group Ltd. (SFTG) signed a *negotiated agreement* to improve air quality by introducing voluntary sulphur content limits in petroleum coke (petcoke) and bituminous coal used for domestic purposes, in addition to extending the ban on the marketing, sale and distribution of bituminous coal to smaller urban areas. The SFTG represents the importers and principal distributors of solid fuel in Ireland.

The agreement envisaged a *phased approach* to assure maximum sulphur contents of 2% for all imports of petcoke by 2005 (down from 2.9% in 2002) and 0.7% for all imports of bituminous coal, with total annual imports of bituminous coal having an average sulphur content of 0.6%. The agreement also specified a phased approach to introducing the use of smokeless fuel in specific cities. For example, the SFTG agreed to ensure that smokeless fuel comprised at least 25% of overall solid fuel sales during the 2002-03 heating season in Bray, Kilkenny, Sligo and Tralee and to ban the marketing, sale and distribution of bituminous coal in these towns from October 2003. The agreement also envisaged a phased increase of the penetration by smokeless fuel as a percentage of overall solid fuel sales, from 25% in 2002 to 75% in 2004, in Athlone, Carlow, Clonmel and Ennis. For its part, the DoEHLG agreed not to extend the ban on the marketing, sale and distribution of fuel to other urban areas in advance of the review unless such action was required to assure adherence to air quality standards. The agreement was the result of a consultation process that began in 2001 with the paper "Potential National Ban on Bituminous Coal and Petcoke".

In 2006, the DoEHLG and SFTG signed a *second agreement* that consolidated the environmental gains achieved under the 2002 agreement and reduced further the sulphur contents in bituminous coal and petcoke. The agreement was further extended in 2008 until 2011. Over the life of the new agreement the SFTG pledges to continue its efforts to keep the average sulphur content of imported bituminous coal as low as possible, striving to achieve an average sulphur content of 0.55%.

Recognising that emissions of PAHs are associated with the burning of solid fuel, the SFTG agreed to engage with the DoEHLG in *research on the domestic solid fuel sector's contribution to overall PAH emissions*, and other measures necessary to assure compliance with the EU directive (2004/107/EC) related to levels of arsenic, cadmium, mercury, nickel and PAHs in ambient air.

the environmental objective of the directive. Under the plan, flue gas desulphurisation at the Moneypoint coal-fired plant, which will bring national emissions of SO<sub>x</sub> below the 2010 NEC target, will offset emissions at other plants (DoEHLG, 2007).



Following the decision of the Irish Government to further liberalise the electricity market, the Electricity Supply Board closed 1 300 MW of older oil-fuelled power generating capacity at Tarbert and Great Island which will significantly contribute to the reduction of emissions from the power sector.<sup>15</sup> Progress has also been made on reducing emissions from peat-fuelled plants with the commissioning of two modern, higher-efficiency peat-fired power stations and the closure of all the old stations. Meeting the national target to convert 30% of the capacity to biomass co-firing would further enable Ireland to increase fuel diversity in electricity generation and reduce emissions (IEA, 2007).

## 4. Transport and Environment

### 4.1 Transport trends

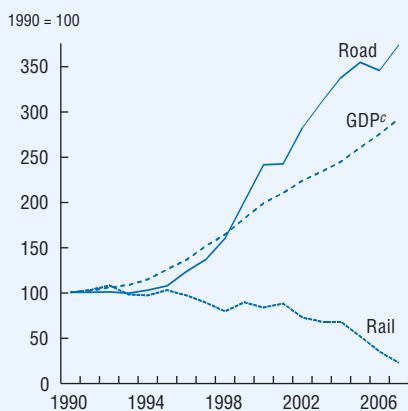
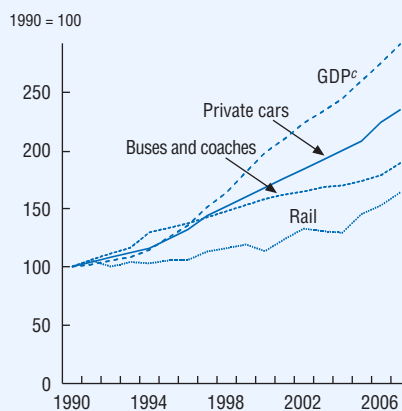
Prolonged economic, population and labour force growth stimulated a *significant increase in freight and passenger traffic* (Figure 2.4). Energy use in transport has grown by 180% since 1990, reaching 5.7 million toe in 2007. Transport now accounts for over 40% of total final consumption, more than twice as much as industry. Demand has been met mainly by roads, whose traffic volume increased from 32 billion vehicle-km in 2000 to 44 billion in 2007. Over that period the number of registered motor vehicles rose by nearly 70% to 2.5 million (CSO, 2008). Road traffic uses more than 80% of the total final energy consumed in the transport sector.

The number of *private cars* increased by 43% between 2000 and 2007 and now accounts for 83% of the total vehicle fleet. Nevertheless, private car ownership remains lower than the OECD Europe average (Figure 2.4). Private cars use 46% of road transport energy and 38% of all transport energy.

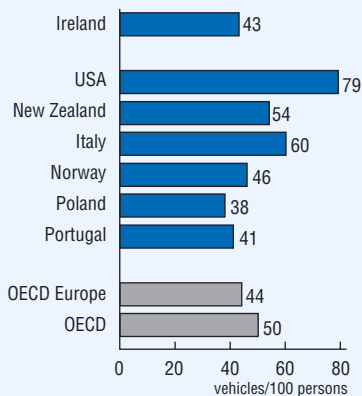
As the distances for *freight transport* in Ireland are short, the increase in road freight traffic from 12 billion tonne-km in 2000 to 19 billion in 2007 represented significant growth.<sup>16</sup> The number of road freight vehicles nearly doubled. The increase in road freight was accompanied by a notable decrease in rail freight traffic, from 500 million tonne-km in 2000 to 130 million in 2007 (Figure 2.4).

Despite the increases in transport activities, most *emissions from transport* showed important decreasing trends in 2000-07: SO<sub>2</sub> emissions fell by 71%, NMVOCs by 49%, CO by 43%. This reflects improvements in fuel quality and vehicle performance, and to a lesser extent, increased investment in transport infrastructure and public transport. However, NO<sub>x</sub> emissions decreased at a notably slower pace (-15%), and CO<sub>2</sub> emissions increased by 36% between 2000 and 2007.<sup>17</sup>

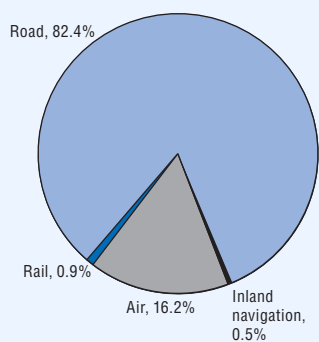
Figure 2.4 Transport sector

Freight traffic,<sup>a</sup> 1990-2007Passenger traffic,<sup>b</sup> 1990-2007

## Private car ownership, 2007



## Total final energy consumption by the transport sector, 2006



a) Index of relative change since 1990 based on values expressed in tonne-kilometres.

b) Index of relative change since 1990 based on values expressed in passenger-kilometres.

c) GDP at 2000 prices and purchasing power parities.

Source: OECD, Environment Directorate; OECD-IEA (2008), *Energy Balances of OECD Countries*.

Out of total emissions in 2007, mobile sources accounted for 66% of CO, 53% of NO<sub>x</sub> and 24% of NMVOCs.

## 4.2 Transport policy implementation

Improvement of *road infrastructure and transport services* to support rapid economic development was among the top priorities of the 2000-06 National Development Plan (NDP), which allocated over EUR 8 billion to upgrade five main intercity routes to motorway or high-quality dual carriageway standard and significantly improve other key routes (GoI, 2007b). Ten major projects had been completed by the end of 2006, including the Dublin Port Tunnel, the largest urban motorway tunnel in Europe, which helps address major traffic bottlenecks in the capital.<sup>18</sup> The NDP emphasis on transport infrastructure development led to the creation in 2002 of the Department of Transport, which took over responsibilities on road investment from the DoEHLG. It also covers aviation and public transport.<sup>19</sup>

Efforts have been made to address *environmental issues in transport planning*. The 2000 Planning and Development Act transferred responsibility for approval of motorways, bus routes and other road projects from the National Road Authority to the Irish Planning Board, together with consideration of environmental impact statements. The National Roads Project Management Guidelines, issued in 2000, aim at identifying negative environmental impacts in the early stages of planning, before the project goes through statutory procedures such as the impact statements. Even though the guidelines make extensive provision for public consultation, public participation in environmental impact assessment procedures is not always assured, especially for large infrastructure projects (Chapter 7).

Infrastructure development continued with *Transport 21*, a capital investment framework for 2006-15 totalling EUR 34 billion, of which 54% is allocated for roads and 46% for public transport and regional airports (DoT, 2005). Transport 21 aims to facilitate a switch to more sustainable modes, such as public transport, cycling and walking, and improve planning for transport infrastructure development within greater Dublin and other dynamic conurbations. Modelling of the impact of Transport 21 in the greater Dublin area has projected a 20% fuel consumption reduction by 2015.

## 4.3 Fuels

Of the 180 000 new private cars licensed in 2007, 71% were petrol-fuelled and 28% diesel-fuelled. The remaining 1% used alternative fuels, including petrol

with electricity or ethanol. The market share of *newly registered diesel cars* doubled in the review period and consumption of diesel rose from 1.7 million tonnes to 2.4 million tonnes in 2000-06 while that of petrol increased from 1.5 million tonnes to 1.9 million tonnes (UNSD, 2008). The rapid increase in diesel use was principally due to the fact that the excise rate on diesel was lower than that on unleaded petrol (Figure 2.5). Over time, this differential created strong incentives to buy diesel cars and to drive longer distances over their lifetime. Current diesel-powered vehicles produce more NO<sub>x</sub> and PM per kilometre than those burning unleaded petrol though the recent introduction of Euro 5 and 6 standards should reduce this differential.

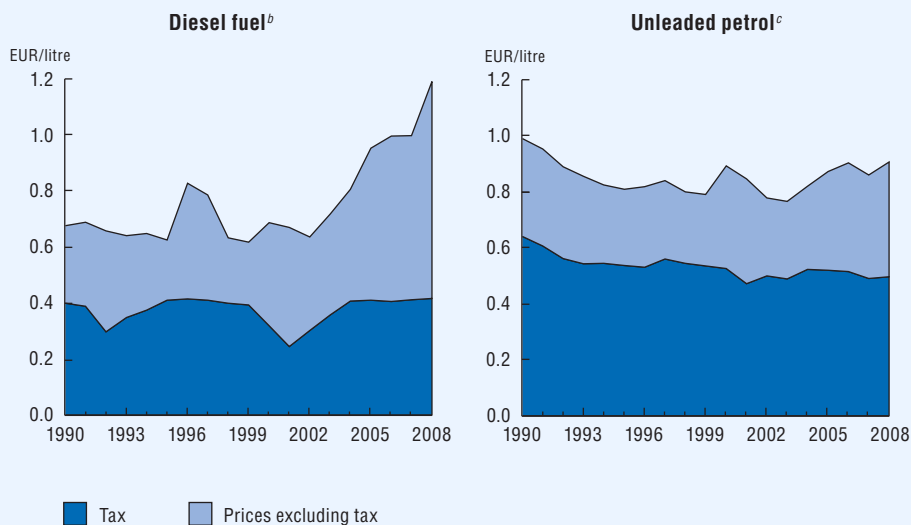
During the review period a significant tax differential between Ireland and its neighbours in the retail prices of petrol and diesel resulted in considerable “*fuel traffic*”, also called “*tank tourism*”, where fuel is sold in one country but consumed in another. Tax adjustments for commercial diesel have since narrowed the price difference between Ireland and the UK by over 60 %, thus reducing the “*fuel traffic*” and its impact on emissions.

Progress was made in widening the use of *cleaner fuel*. All fuel for road transport has been unleaded since 1999. Petrol and diesel fuel with a maximum sulphur content of 350 mg/kg were introduced in 2000 and the sulphur levels were further reduced to 50 mg/kg in 2005. Fuel with a maximum sulphur content of 10 mg/kg (“*sulphur free*”) has been sold in some areas since 2005, with the coverage extended throughout the country from 2009. Fuel quality is regularly measured and monitored, and offences are prosecuted by the Revenue Commissioners.<sup>20</sup>

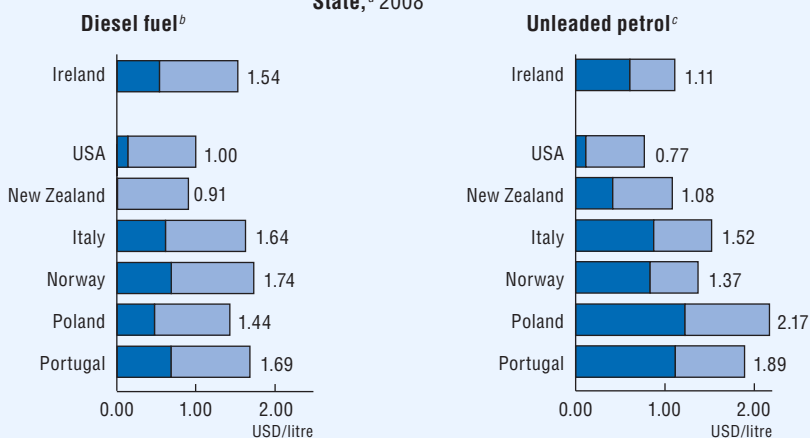
To meet requirements of the EU directive on promotion of *biofuels* and other renewable fuels in transport (2003/30/EC), a transport biofuel market was created in 2005 with the Biofuels Mineral Oil Tax Relief Schemes I and II. These tax incentives, which are scheduled to be replaced in 2010 by a biofuel obligation, provide relief from excise duty for pilot projects putting biofuel on the market. They involve competitive calls for proposals; biofuels produced outside the programme are taxed the same as petrol or diesel. A further support programme, involving grants for capital requirements, was initiated in 2006. The aim is to enhance security of the transport fuel supply (now all imported) by encouraging development of a domestic biofuel sector. These programmes led to a significant rise in the uptake of biofuels, whose share of road fuel consumption reached 0.6% in 2007 and 1.6% in 2008, compared to the intermediate target of 2.2% by 2008 (DCENR, 2008).<sup>21</sup> A revised biofuel obligation is expected to come into effect in 2010 with a penetration rate of 4%. However, the extent of biofuel use in transport is under discussion: recent analyses suggest that government support of biofuel production in

Figure 2.5 Road fuel prices and taxes

Trends in Ireland, <sup>a</sup> 1990-2008



State, <sup>d</sup> 2008



a) At constant 2000 prices.

b) Automotive diesel for commercial use.

c) Unleaded premium (RON 95).

d) Diesel fuel: at current prices and exchange rates; Unleaded petrol: in USD at current prices and purchasing power parities.

Source: OECD-IEA (2009), Database of End-Use Prices.

OECD countries is costly, has a limited impact in terms of reducing greenhouse gases and improving energy security, and has a significant impact on world crop prices (OECD, 2008a).

#### 4.4 Vehicles

Ireland implemented the *EU vehicle emissions standards (Euro 4)* for cars, trucks and vans in 2005-06. The Euro 5 and 6 standards, agreed in 2006 and in force from 2009, should have a positive effect on air quality, especially as regards NO<sub>x</sub> emissions.

Until 2008, the *vehicle registration tax (VRT)*, for first-time registration of a vehicle in Ireland, and an *annual motor vehicle tax* were calculated according to engine size, with higher rates imposed on large engines. As disposable income increased, Irish citizens bought more and larger cars, so the rising number of cars with engine capacity over 1 400 cc offset fuel efficiency improvements between 2000 and 2007.<sup>22</sup> In 2008, the basis for calculating the VRT and annual motor vehicle tax for passenger cars was revised to reflect CO<sub>2</sub> emission ratings, providing incentives to buy more CO<sub>2</sub>-efficient cars and putting Ireland among the front-runners in Europe in linking car emissions with climate effects.<sup>23</sup> However, recent analyses suggest that the CO<sub>2</sub> tax rate differentiation for vehicles with large engines may be too strong, as the resulting emission reductions come at a higher cost than elsewhere in the economy (Chapter 8). A 50% reduction in VRT applied to hybrid-electric cars until the end of 2006 resulted in an increase in their numbers from eight in 2002 to 248 in 2004. The relief was extended to flexible fuel cars; since 2008, registration of such cars has entailed VRT relief of up to EUR 2 500, in addition to VRT benefits related to their lower CO<sub>2</sub> emissions. For 2008-10, electric cars and cycles are entirely exempt from VRT. On the other hand, heavy-duty vehicles pay a fixed registration tax of EUR 50, much below that for private cars.

The introduction of the *National Car Test* in 2000 has made an important contribution to the reduction of emissions from individual cars. Testing is compulsory for cars over four years old, with test certificates valid for two years. A review in 2005 showed that while in 2000 only 4% of cars fully passed the test the first time, the pass rate rose steadily to over 50% in 2004 for petrol cars, with a significant drop of emissions as a key factor of test failures.

#### 4.5 Public transport

The priority in the 2000-06 NDP on improving *public transport in Dublin* was translated into “A Platform for Change”, the Dublin Transportation Office strategy

to 2016 (DTO, 2001). Implementation has included upgrading of rail lines and services, such as DART; development of the Luas light rail system; fleet renewal for Bus Átha Cliath, the Dublin bus operator; dedicated bus corridors; park and ride facilities; and traffic management programmes.

Significant investment has helped modernise *rail and bus services*. A railway safety investment programme from 1999 to 2003 allocated over EUR 600 million (including EU funds) to expand the rail network and improve safety management at Iarnród Éireann (Irish Rail). The entire intercity fleet had been renewed by the end of 2007, with the introduction of new carriages and modern diesel rail cars. Bus Éireann, the national bus operator, has bought 421 new buses since 2000, of which 65 are additional and 356 replacements. The purchase programme aims at improving the quality and reliability of the fleet as well as enabling increased services and reducing individual bus emissions.

The *TaxSaver Commuter Ticket Scheme* was established in 1999 as an incentive for employees to use public transport to commute to work. Passes for travel by bus, rail and commuter ferry, provided by employers as part of employees' salary, are exempt from benefit-in-kind taxation and pay-related social insurance. Participating employees can save up to 50% on their travel costs and employers benefit from savings on their social insurance payments. By 2004 over 1 300 companies were participating. A *cycle to work programme*, introduced in 2009, grants a similar exemption for bicycles and associated safety equipment provided by employers to employees who cycle to work. In contrast, a car parking levy of EUR 200 per year, announced in 2009, will be charged to employees whose employers provided them with parking facilities in the main urban centres (Chapter 6).

Ireland's first *National Cycling Policy Framework* was launched in 2009 and aims to create a new culture of cycling in Ireland by 2020. Actions under the framework include "dublinbikes", a "rent-a-bike" programme launched in September 2009 by the Dublin City Council to facilitate the use of bicycles for short journeys in the city centre.

To support the development of public transport in rural areas, the *Rural Transport Initiative* (RTI) was launched with EUR 6 million under the 2000-06 NDP. The RTI was originally designed as a two-year pilot project to be concluded at the end of 2003, but it was extended and became permanent in 2007 with funding of EUR 90 million under the 2007-13 NDP. It now operates in virtually all counties, supporting 34 community transport groups. Current indications are that passenger numbers are growing. The RTI also benefits from application of a free travel programme for vulnerable populations operated by the Department of Social and Family Affairs (DoT, 2006).

## 5. Future trends in air pollution

Ireland is *on target to comply with the NEC ceilings for three of the four key pollutants: SO<sub>2</sub>, VOCs and NH<sub>3</sub>*. The emission reductions have mostly been due to further implementation of measures to reduce pollution intensity, including widening of the ban on bituminous coal and petroleum coke in urban areas, fuel substitution in power generation and transport, and more stringent “best available techniques” (under the IPPC Directive) in industry, especially the cement subsector. The economic slowdown will put a brake on growth in air emissions in coming years.

However, as in many EU member states reaching the *NEC NO<sub>x</sub> ceiling is a challenge*.<sup>24</sup> Further measures, including regulatory, fiscal and voluntary instruments, should be considered, depending on their viability and cost-effectiveness. The likely overachievement of NH<sub>3</sub> and SO<sub>2</sub> targets should deliver additional reductions of acidification and eutrophication, thus offsetting to some degree the shortfall on the NO<sub>x</sub> target. Future measures in reducing emissions of NO<sub>x</sub> and other pollutants will need to take into account new emission targets for 2020, which will soon be agreed under a new NEC Directive in the context of the Clean Air for Europe programme. Further emission reductions of air pollutants are expected as ancillary benefits from implementation of the National Energy and Climate Strategy (Chapter 8).

*Emissions from road traffic*, particularly PM<sub>10</sub> and NO<sub>x</sub>, remain the main threat to air quality in urban areas. While cleaner technology in cars, introduced as a result of EU standards, has curbed emissions from individual vehicles, this effect has been offset, to some degree, by higher fuel consumption in the sector resulting from the increase in the number of vehicles on Ireland’s roads and bigger engine sizes. Further declines in emissions from traffic in 2010-20 should be supported by the introduction of the Euro 5 and 6 standards. As around 40% of NO<sub>x</sub> emissions from road transport come from light duty vehicles and about 33% are from heavy duty vehicles and buses, the retrofit programmes to address NO<sub>x</sub> emissions in these fleet segments should be pursued cost-effectively. In addition to linking the VRT and motor vehicle taxation to carbon emissions, other measures should include improved mandatory labelling and national efficient driving awareness campaigns. Further use of economic instruments, such as the road pricing implemented for the motorway around Dublin, should be extended along with congestion charges, as recommended by OECD and the Comhar Sustainable Development Council (OECD, 2008b; Comhar, 2008). Their implementation should be co-ordinated with improvement of public transport alternatives.

Despite investment in public transport in large cities and rural areas, travel trends are unsustainable. For example, numbers of commuter trips have risen by 33% over



the past ten years but bus passenger numbers in the Dublin area have increased by only 2% while car trips have risen by 70%. Efforts should be redoubled to promote a modal shift from private car to high-quality public transport, as envisaged in the Transport 21 initiative and the *Sustainable Travel and Transport Action Plan*, adopted in 2009 with a time horizon of 2020 (DoT, 2009). The plan aims to change the transport mix in Ireland to reduce cars' share of total commutes from the current 65% to 45% by 2020. Priority projects in the action plan include extending public transport infrastructure, such as the Luas and DART networks and the suburban rail interconnector, and developing the bus network by upgrading the bus fleet and creating interchange points to allow easy transfer between buses. In addition, electric vehicles are expected to account for 10% of all vehicles on Irish roads by 2020 (DoT, 2009). The costs and benefits of other options, such as metro lines, should also be assessed. A range of relatively low-cost measures could be undertaken fairly quickly. These include introducing smart-card-based integrated ticketing that can be used on all public transport services; developing "park and ride" facilities; installing cycling paths and improving pedestrian facilities to facilitate access to local amenities; and implementing a phased programme of demand management measures, including an integrated public transport information system.

Transport infrastructure development should be supported by enhanced legislative provisions for *closer integration of travel and spatial planning*, including in the early stages of spatial development planning and local area planning. Co-ordination should aim to control urban sprawl by requiring significant housing development in cities and towns to include good public transport connections.

## Notes

1. Emission ceilings for Ireland under the Gothenburg Protocol and the NEC Directive are the same.
2. These are the 1998 protocols on heavy metals and POPs.
3. This was done in the 1999 Ambient Air Quality Assessment and Management Regulations and the 2002 Air Quality Standards Regulations. They also provided for advice to local authorities by Ireland's Environmental Protection Agency (EPA) about the need for air quality management plans in areas where the limit values will be or may be exceeded, and for air pollution action plans to drawn up to deal with short-term risks of exceeding limit values and alert thresholds.
4. The Directive on Ambient Air Quality and Cleaner Air for Europe (2008/50/EC) simplifies the air quality framework directive and "daughter" directives 1999/30/EC, 2000/69/EC and 2002/3/EC, and specifies standards for fine PM.
5. These reductions mostly reflect new measures under the EU Common Agricultural Policy rather than changes in farming practice.
6. By the end of 2007 all new and existing installations using organic solvents had to comply with EU emission limit values for VOCs under the EU solvent emission directive (1999/13/EC).
7. Because NO<sub>x</sub> emission estimates for road transport are based on "fuel sold" statistics but a significant share of the petrol and diesel retailed in Ireland in the review period was consumed elsewhere (mostly in the UK) as a result of price differentials, the estimates are inflated. The 2005 estimate, adjusted for this phenomenon, was 33.5 kt, some 20% below the unadjusted figure of 42.9 kt.
8. There is no municipal waste incineration in Ireland, and only 30 % of hazardous waste is incinerated (Chapter 4).
9. TEQ: mean toxic equivalent.
10. In 2008, there were 48 air quality monitoring stations: 18 formed part of the local authority SO<sub>2</sub> and "black smoke" network, 25 were fixed continuous monitoring stations and five were mobile monitoring units. Specific requirements in relation to PM<sub>10</sub> have replaced black smoke monitoring for assessment purposes. Nevertheless, local authorities are encouraged to monitor black smoke where possible, for trend analysis.
11. The E-PRTR regulations were transposed into the Irish legal framework in 2007.
12. In 2005, the activities licensed by the EPA comprised 715 ongoing and around 50 in various stages of closure.
13. The plants will also help decouple NO<sub>x</sub> emissions from electricity generation.
14. The 2003 Large Combustion Plants (LCP) Regulations transposed the LCP Directive (2001/80/EC) by specifying emission limits for SO<sub>2</sub>, NO<sub>x</sub> and dust for plants of at least 50 MW in operation before 1 July 1987.
15. The oil-fired generation at Tarbert and Great Island may be replaced by gas-fired plants.
16. Construction material (sand, gravel, crushed stone, rock) makes up most of the road freight in Ireland; hence, the increase in tonnes transported was significantly higher than the increase in

- tonne-kilometres; the total weight of goods transported by road increased by over 200% between 1997 and 2000 while tonne-kilometres rose by 174% over the period. Both rates of growth are substantially higher than the increase in GDP for the review period.
17. Since 2000 transport has been the fastest growing contributor to greenhouse gas emissions (Chapter 8).
  18. In February 2007 the Dublin City Council began banning large trucks from Dublin city streets.
  19. Responsibility for ports, shipping, maritime safety administration and marine emergency services were moved to the Department of Transport in early 2006. Local and regional road functions, including the Vehicle Registration Unit and related functions, were similarly shifted in 2007.
  20. One such offence involves the “laundering” of gas oil used in non-road vehicles (*e.g.* farm or construction machinery) by removing evidence of a dye distinguishing it from automotive diesel fuel. This process involves using chemicals such as sulphuric acid and caustic soda as bleaching and neutralising agents. Laundered fuel can severely damage a vehicle’s engine and leave highly toxic waste products that cause serious pollution when inadequately stored or dumped.
  21. In 2006 the share of biofuels in road fuel consumption was 0.09%. Sixty-eight million litres of biofuel were placed on the Irish market in the two first years that the tax relief was in effect, and the number of stations selling biofuel (E85) had reached 26 by 2007.
  22. The share of cars with engine size up to 1 400 cc decreased from 80% of newly registered cars in 2000 to 34% in 2007. The number of newly registered private cars with engine size above 1 900 cc grew from about 6 000 in 2000 to nearly 37 000 in 2007, and they now account for over 16% of the total.
  23. Seven VRT rates, from 14% for cars emitting up to 120 g of CO<sub>2</sub>/km to 36% for emissions over 225 g of CO<sub>2</sub>/km, are applied to the open market selling price, which includes all taxes and duties. The new system applies to new cars and to used imported cars registered on or after 1 July 2008 and covers both petrol and diesel cars.
  24. Among the reasons for this challenge was the failure of the Euro II and III standards to deliver the expected emission reductions. Effects were more acute for Ireland where the scale of economic growth drove significant increases in the vehicle fleet, compounding the effect of underperformance by Euro II and III and thus rendering the national cost-effective abatement policies inadequate.

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