PART II

Chapter 4

Sustainable mobility

This chapter reviews the Netherlands' progress in promoting sustainable mobility. It discusses mobility trends in freight and passenger transport and examines their impact on air pollution, greenhouse gas emissions, noise, congestion and traffic safety. The chapter provides an overview of the country's various policy visions for sustainable mobility over the review period, as well as governance arrangements. Finally, it assesses the policy instruments in place to promote sustainable mobility and examines their performance in achieving the country's objectives. The recommendations on sustainable mobility are summarised in a box at the end of the chapter.

1. Introduction

Mobility is an important ingredient of a well-functioning society. Mobility of workers and goods makes the economy more productive, mobility of children and students helps build better human capital and other forms of mobility help sustain the social and cultural network. How to organise this mobility most effectively, however, is not obvious. Individual mobility decisions of firms and households create negative, as well as positive externalities, which are not considered in individual decisions. This is the main challenge of sustainable mobility: how to make sure that a country organises its mobility systems so that individual decisions contribute to the best for society as a whole.

The Netherlands is a small, densely populated country with significant transit activity to and from Rotterdam, the largest port in Europe. As in any densely populated country, this implies a constant tension between the available transport capacities and the demand for transport, as well as a constant pressure on the environment. The Netherlands has two additional features: its housing market policies favour home ownership, which makes people choose to commute rather than to relocate; and its location as a literally "low" country. Its geography is a challenge in terms of flood protection, but also an opportunity for cheap and environmentally friendly freight transport on inland waterways.

2. Mobility trends

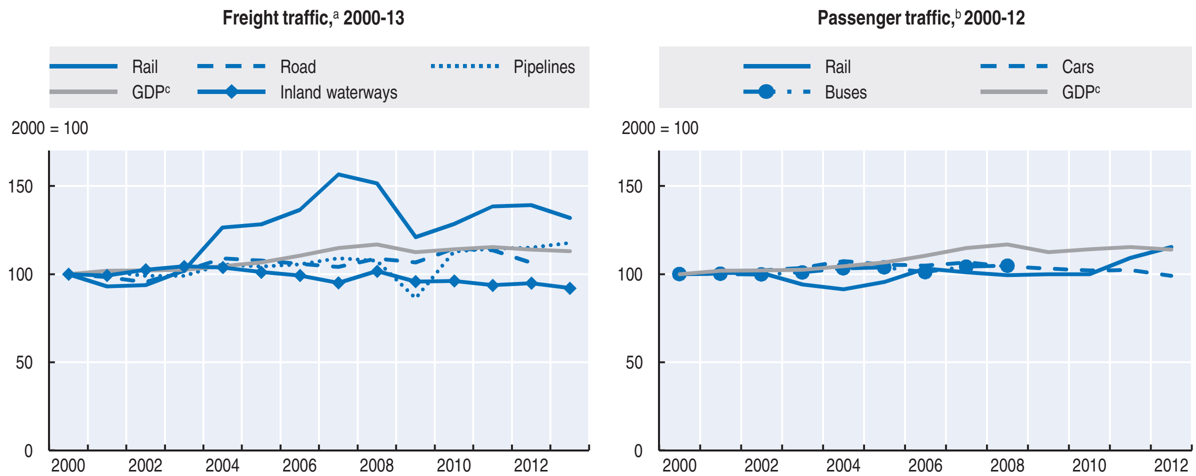
As in many high-income countries, overall freight and passenger transport volumes in the Netherlands have been relatively stable since 2000 (except for rail freight, which is only a small share of total). Figure 4.1 illustrates these trends. Growth in gross domestic product (GDP) has been modest, the share of transport-intensive manufacturing sectors is declining and car ownership is saturated.

2.1. Trends in passenger transport

Total mobility in terms of billion passenger kilometres (km) has been stable since 2000 (Figure 4.2). The total passenger km (pkm) travelled by car has been stable, but solo drivers are responsible for more and more pkm. Rail use represents only 10% of total distance travelled, but grew by 25% over 2004-13. The Netherlands is remarkable in that 10% of total distance travelled is by bicycle.[1] The Netherlands, along with Denmark, has achieved an exceptionally high share of bicycle use compared to other OECD member countries. This is due to relatively flat geography, but also to its policy of separate bike paths that minimise interference with cars (Pucher and Buehler, 2007).

The motives for passenger trips have been changing over the last 20 years, driven by changes in the age structure of the population and lifestyles. Trips related to work (22%) and education (10%) account for less than one-third of all trips. The number of work-related trips grew up to 2008, driven by the increased participation of people 40 years-old and older (mainly women) in the labour force (KiM, 2014). The economic recession caused this growth to slow, and is also partly responsible for a 6% decrease in shopping trips.

Figure 4.1. **Trends in freight and passenger transport relatively stable since 2000**



a) Based on values expressed in tonne-km.
b) Based on values expressed in passenger-km.
c) GDP at 2005 prices and purchasing power parities.
Source: ITF (2015), *Trends in the Transport Sector* (database); OECD (2014), "OECD Economic Outlook No. 95", *OECD Economic Outlook: Statistics and Projections*(database).

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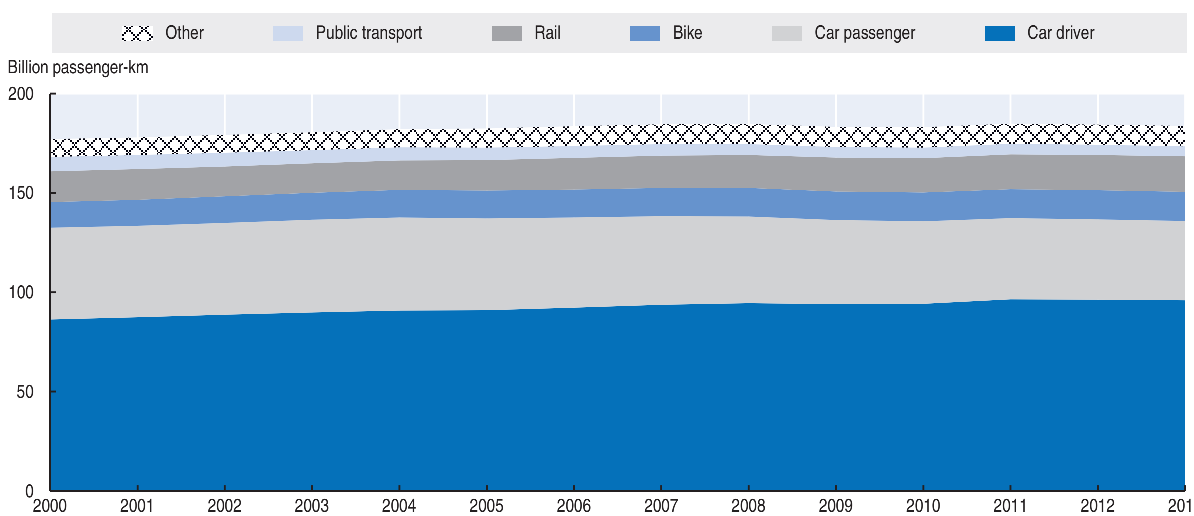
Figure 4.2. **Total passenger mobility stable since 2000**



Source: KiM (2014), *Mobiliteitsbeeld 2014 [Mobility Picture 2014].*

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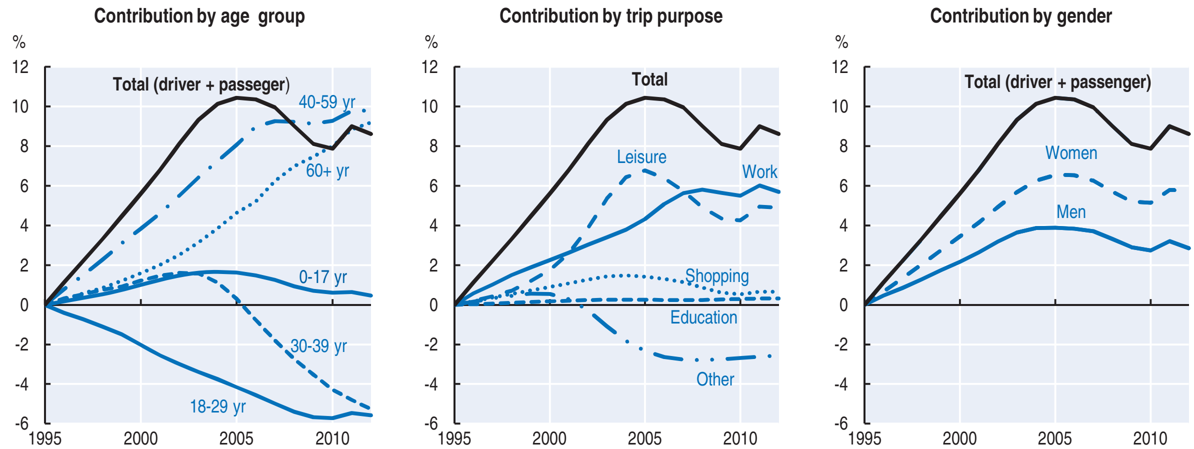
According to KiM (2014), it is not yet clear whether online shopping leads to a net decrease of shopping trips.

The evolution of car use by age, motive and gender for 1995-2012 is shown in Figure 4.3. Car use by people under 35 years has notably decreased, while trips for shopping and leisure have also both declined in recent years. Car use by women and older people has been increasing. Car ownership in the Netherlands is stable, and comparable to other European countries with the same level of income per capita, but on the lower end.

Bicycle use has always been strong in the Netherlands. In recent years, a major change has been increased use of e-bikes by people older than 50 years. With an e-bike, trips are

Figure 4.3. **Shifting trends in car use since 1995**



Source: KiM (2013), *Mobiliteitsbeeld 2013 [Mobility Picture 2013].*

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almost twice as long as with a normal bike. About 10% of the population has an e-bike, and the Dutch are the frontrunner in e-bike use in Europe (KiM, 2014).

Rail use has increased by 24% and local public transport use (bus, tram, metro) has increased by 11% over 2004-13. The main increase in rail use has occurred in the Randstad where some lines increased in use by 75%, while use has decreased on other lines. Almost half of all morning commuters who use a train reach the station by bicycle (KiM, 2014). In aggregate terms, the supply of rail km has followed total passenger km. However, since 2009, passengers are reportedly less satisfied with the quality of service, mainly due to train delays (KiM, 2014).

Air transport has had the strongest increase of all modes of passenger mobility, growing by one-third since 2004. Regional airports accounted for the major part of the growth, with their share increasing from 13% in 2004 to almost 25% in 2013. Supply factors such as the development of low-cost airlines drive the increase, but the trend is also apparent in other high-income countries. The main motives for air transportation are holidays (54%) and business (24%).

2.2. Trends in freight transport

The overall volume of freight transport has been relatively stable over the last ten years. The increase of incoming transit via sea and air has more or less compensated for the decline of freight with an origin and destination in the Netherlands (inland transport flows were 524 million tonnes [Mt] in 2013). Table 4.1 shows the importance of national freight flows versus import and export movements via sea and air. As the Netherlands has the largest port in Europe, a lot of freight arrives via the sea (407 Mt in 2013); a large part (340 Mt)

Table 4.1. **Volume of freight transport, 2004-13**

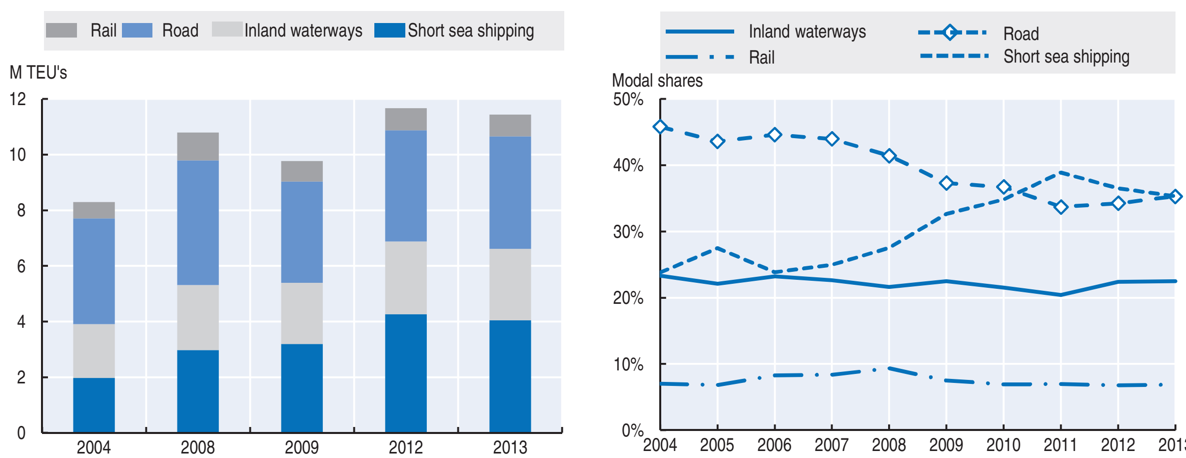
Mt-km	Import via sea and air	Export via sea and air	Inland transport flows	Export over land	Import over land	Transit over land
2004	352	113	575	344	175	80
2013	407	174	524	340	159	98

Source: KiM (2014), *Mobiliteitsbeeld 2014 [Mobility Picture 2014], Kennisinstituut voor Mobiliteitsbeleid [Netherlands Institute for Transport Policy]*, KIM-14-R01, ISBN: 978-90-8902-124-3.

is transferred to the hinterland (Ruhr area and beyond) or transhipped (174 Mt). More goods arrive in the port than leave (174 Mt exported via sea and air, versus 407 Mt imported). The growth of freight transit traffic is directly related to the growing internationalisation of economic activity; the decline of national freight traffic has more to do with the stronger service orientation of the economic activity. Dutch ports are responsible for close to half of total freight volume of all ports in the Le Havre-Hamburg area.

Two main trends are apparent in terms of the mode used to transport freight between the Port of Rotterdam and the hinterland: more short sea shipping (sea to sea) and less road transportation. With respect to freight volume, inland waterways are notably three times more important than rail (Figure 4.4).

Figure 4.4. **More short sea shipping and less road transport in moving containers to and from the Port of Rotterdam, 2004-13**



Source: KiM (2014), *Mobiliteitsbeeld 2014 [Mobility Picture 2014].*

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Government investment in infrastructure (land, transport and water) increased between 2004-09 from 1.6% of GDP to 1.9%, then decreased to 1.5% in 2013 (KiM, 2014, 2013). In 2013, the Dutch government spent around EUR 6 billion on transport infrastructure, split between investment and maintenance. Roads and railways each received about 40% of total transport expenditure.

3. Trends in environmental, congestion and safety impacts of mobility

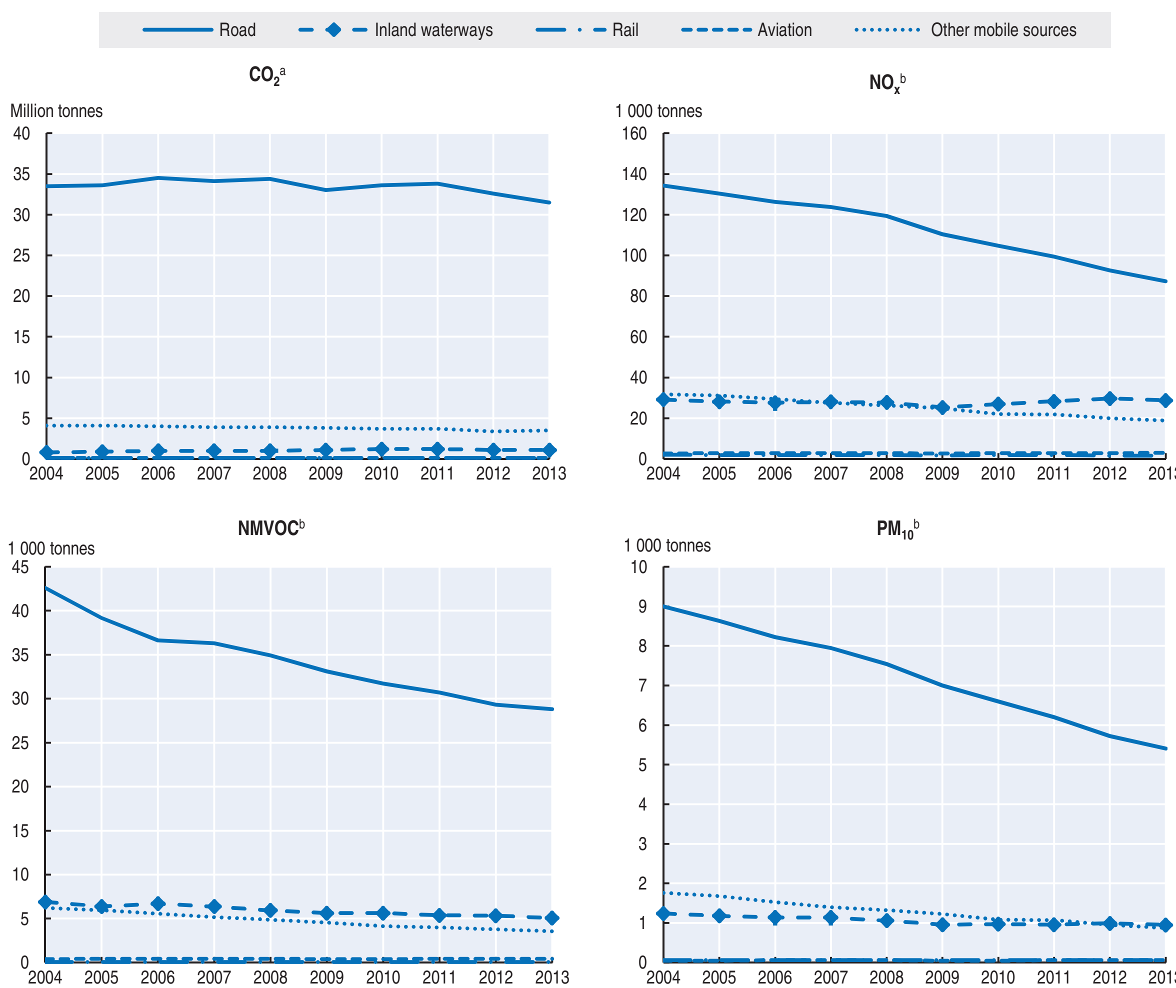
Mobility gives rise to negative effects on the environment (air pollution and noise), as well as congestion and safety externalities. Over the review period, the performance of the Netherlands in reducing these negative impacts has been very good. Air pollution emissions have declined significantly since 2004, except for CO_2 emissions, which have declined only slightly since 2008. Noise levels from transport, and hours lost from congestion (congestion losses), have also declined. Traffic safety has significantly improved. This section discusses each of these in turn.

3.1. Air pollution and greenhouse gas emissions from transport

All air pollution emissions from transport have declined significantly since 2004, with the exception of CO_2 emissions for which there has only been a small decrease since 2008

(Figure 4.5). The bulk of air pollution emissions originate from road transport. CO_2 emissions have decreased only slightly since 2008, driven by the economic recession and subsidies for cleaner cars. NMVOC emissions have declined significantly due to stricter emission standards for cars. NO_x and PM_{10} emissions from gasoline cars declined strongly as a result of better abatement equipment and better fuels. This was not the case for NO_x from diesel cars. According to the European test cycle, NO_x emissions should have gone down for diesel cars, but there seems to be a strong difference between actual emissions and test cycle emissions (Ligterink et al., 2013). Further, monitoring studies have revealed a significant and growing discrepancy between actual CO_2 emission reductions and those calculated on the basis of emission data from the European test cycle results; actual emission reductions turned out to be only half of what was estimated by test values (PBL, 2015).

Figure 4.5. **Declining trends in air pollution emissions from transport, 2004-13**



a) Emissions from road, water, rail and air transport reported according to the IPCC guidelines and calculated on the basis of motor fuel sales in the Netherlands.
b) Emissions from mobile sources, excluding emissions from mobile machinery, fishery and seagoing shipping.
Source: CBS (2015), *StatLine* (database).

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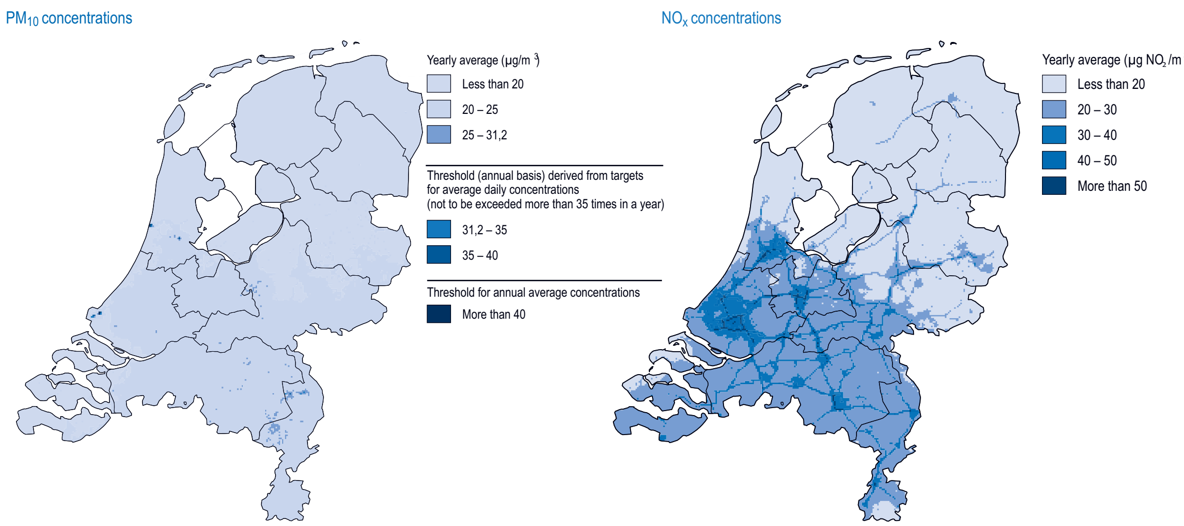
The decline in conventional emissions (NMVOC, NO_x and PM_{10}) has allowed the Netherlands to improve overall air quality, limit average concentrations of pollutants and the number of hot spots that exceed limit concentrations. The spatial variation in average (yearly) concentration is shown in Figure 4.6.

Figure 4.6. **Improvements in average concentrations of PM_{10} and NO_x, while some hot spots remain, 2013**



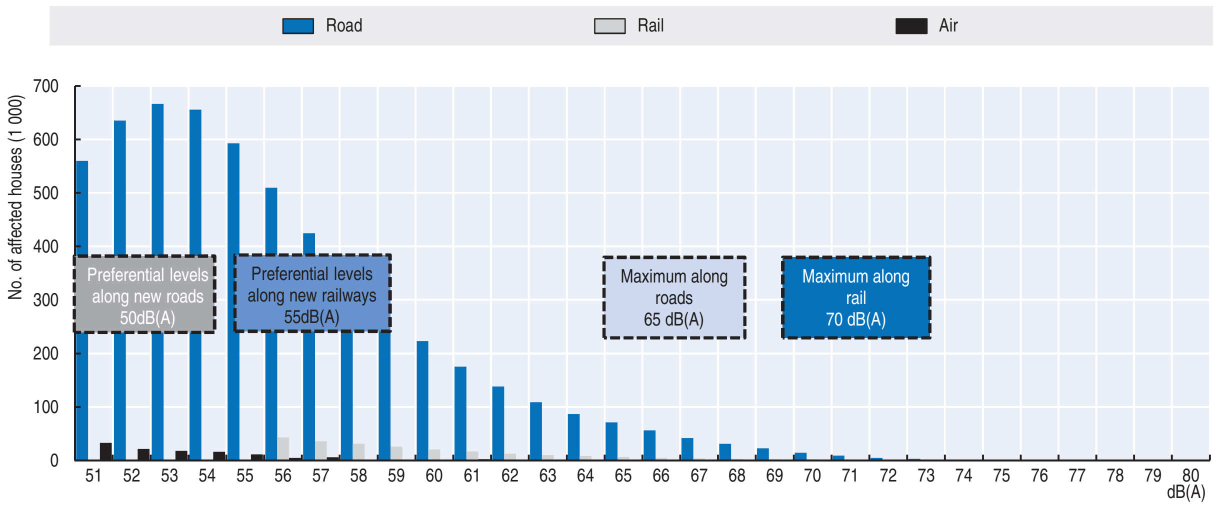
Source: CBS (2014), *Environmental Data Compendium* (website) based on PBL data.

The yearly limit concentrations of PM_{10} and nitrogen dioxide (NO_2) set by the EU are exceeded along a limited number of roads, a clear improvement compared to 2004. The growth of car kilometres of 5% has been largely compensated by the introduction of cleaner cars that satisfy the Euro 4 standard (2005) and the Euro 5 standard (2009/2011). To interpret these data, four points are important. First, some of the emissions responsible for the concentrations originate abroad and, within the Netherlands, from sectors other than transport (industry, agriculture; see Chapter 1). Second, the concentrations depend on weather conditions (wind, inversion, etc.). Third, damage from the concentrations depends strongly on the population density in the high-concentration areas. Finally, even when concentrations remain under the limit, further reductions in densely populated areas may still be valuable in cost-benefit terms.

3.2. Noise levels from transport

The absolute noise levels from transport are decreasing in the Netherlands, while the sensitivity and attention of the population to noise issues is increasing. Sensitivity is rising because low noise hindrance is an income elastic good and well-publicised medical research points to higher than expected damages from exposure to traffic noise, including to cardiovascular health and cognitive function (EEA, 2010). Figure 4.7 shows that many more households suffer from excessive road transport noise than from excessive rail or air transport noise. Along national roads in 2006, 6 300 houses suffered from noise levels that exceeded 65 decibels (dB [A]) (the target for the maximum level of exposure for houses along roads). In 2011, this number was reduced to 4 000 due to changes in infrastructure

Figure 4.7. **Households suffer more from road noise than from noise due to rail or air transport, 2010**



Source: Schroten A. et al (2014), *Externe en infrastructuurkosten van* verkeer [External costs and infrastructure costs of road transport].

StatLink http://dx.doi.org/10.1787/888933280375

such as noise barriers, better road pavement and insulation of houses (Government of the Netherlands, 2014; KiM, 2014).

The noise caused by the Schiphol airport decreased between 2005 and 2013 due in part to fewer very noisy freight flights in the early morning and at night.

3.3. Traffic congestion

All modes of transport suffer from congestion, but congestion is most prominent for road transportation. Congestion losses (measured as number of hours lost) have been declining in all congestion-prone regions in the last three years (with the exception of the provincial roads in Noord-Brabant where the number of lost hours was stable) due primarily to additional lanes on the main roads (KiM, 2014). Since 2004, there has been a 42% decrease of travel time losses due to more road capacity in heavily congested areas along with a 30% increase of travel time losses due to an increase in traffic volumes. The latter was caused by growth in population, employment and car ownership. Peak hour congestion on rail lines reduces the likelihood of all users getting a seat, and thus decreases comfort levels. It also potentially lowers the reliability of the rail system.

3.4. Traffic safety

The Dutch road system performs rather well in international comparisons of traffic safety (OECD/ITF, 2014), (Table 4.2). In 85% of accidents, a car was involved. However, over the last 12 to 15 years, the number of people killed in car accidents has been reduced by 57%. This is due to better car technologies, better road design (the building of roundabouts) and improved traffic regulation (KiM, 2013). Bicyclists are the group with the slowest progress in terms of reduced accidents. The risk for bicyclists per kilometre travelled has decreased, but much less than for car passengers; bicyclists are still 11 times more likely to be killed. Each year, about 200 cyclists are killed. In addition, 11 000 bicyclists are seriously injured each year; a car was involved in only 15% of these accidents. This type of accident is not decreasing partly because of increased cycling by people over 70 years of age.

Table 4.2. **Declines in road fatalities by user group since 1990**

	1990 (reported)	2000	2010	2011	2012	2012 Percentage change from 2011 %	2000 %	1990 %
Bicyclists	304	233	162	200	200	0.0	-14.2	-34.2
Mopeds	95	104	43	43	44	2.3	-57.7	53.7
Motorcycles	72	95	63	52	54	3.8	-43.2	-25.0
Passenger car occupants	702	543	246	231	232	0.4	-57.3	-67.0
Pedestrians	144	114	72	74	68	-8.1	-40.4	-52.8
Others incl. unknown	59	77	54	61	52	-14.8	-32.5	-11.9
Total	1 376	1 166	640	661	650	-1.7	-44.3	-52.8

Source: OECD/ITF, (2014).

4. Overall objectives of sustainable mobility policy

Successive governments have put forward many different policy visions for sustainable mobility over the last ten years. Over this period, six policy documents have shaped Dutch policy orientations with respect to mobility. The frequent shifts in policy vision are related to the country's many coalition governments over the review period. Changes in policy are typically necessary when external conditions change dramatically. The economic recession, for example, required a revision of tax and subsidy programmes. Other issues, however, such as addressing climate change and road and congestion management, have been constant challenges; this makes it more difficult to understand why so many major policy shifts have occurred. The remainder of this chapter will focus on a few key objectives and policy orientations.

In 2005, there was an emphasis on acceptability, reliability and decentralisation of policies. One of the most daring initiatives was a proposal for a national road pricing system called "Paying Differently for Mobility". This system aimed to reform the high vehicle purchase and registration taxes into a system where car users would pay a kilometre fee that varied according to the time and place of car use. However, before the draft bill could be officially discussed in Parliament in 2010, the government resigned and the whole project was put on hold.

In 2008, the new government prioritised reform of car purchase taxes as part of the project "Paying Differently for Mobility". The introduction of a CO_2-based charge in the vehicle purchase tax aimed to encourage the purchase of cleaner and more fuel-efficient vehicles. The tax sought primarily to achieve the medium-term (2012) EU emission targets in the framework of the Kyoto Protocol. The EU translated the objective into an overall country objective for sectors not covered by the EU emissions trading system (ETS) (building, service, transport and agriculture), as well as a set of fuel-efficiency standards for cars and the promotion of non-fossil fuel use. The Dutch government translated the objective into a reduction of CO_2 emissions for the transport sector from 39 Mt to 30-34 Mt in 2005-20. Hekkenberg and Verdonk (2014) expect that CO_2 emissions in 2020 will be in the range of 30-37 million tonnes. For cars, the plan was to introduce very strong incentives to buy more fuel-efficient vehicles, as well as more hybrid and electric vehicles. But the realised emission reduction is smaller than expected (see discussion below).

In 2008, a broad sectorial agreement on mobility, logistics and infrastructure complemented actions at the level of car purchases. It covered a large variety of actions addressing road freight, inland waterways, rail and air transport, as well as supplementary actions to promote new vehicle technologies and biofuels. As these actions are bottom-up efforts and have complex interactions, their overall impact is not easy to assess. Nevertheless, some measures have been assessed. For example, Goudappel-Goffeng (2013) assessed the programme "*Beter Benutten*" (Better Use of Existing Infrastructure), which contained 300 measures, including stimulation of bicycle use and off-peak driving, as well as better road management. They found the measures contributed to an overall reduction of emissions of the order of 1% for CO_2, NO_X and PM_{10}. The most effective measures were those that reduced peak travel and decreased overall demand.

In 2012, a new vision on infrastructure and spatial planning was set out. The National Policy Strategy for Infrastructure and Spatial Planning priorities are: safe, competitive, accessible and liveable. This vision defined plans with a 2040 horizon and strongly decentralised land-use decisions to the regional and municipal governments. The overarching objectives for the medium term (2028) are to improve competitiveness by strengthening the country's spatial and economic structure, to improve accessibility and to aim for a liveable and safe environment (Government of the Netherlands, 2012).

Also in 2012, the new government affirmed it does not plan to reconsider road pricing for cars, but will instead rely on more efficient management of road infrastructure. For trucks, there are no plans to implement kilometre charging before 2020, but the current Eurovignette (a road user charge) for trucks above 12 tonnes will focus more on cleaner trucks as they will have to pay a lower price for the vignette. The aim is to reduce congestion through better road management and additional lanes on existing motorways in high congestion locations.

In 2013, the 2008 sectorial agreements were reformulated and strengthened by the Energy Agreement for Sustainable Growth of the Netherlands Social Economic Council (Chapters 2 and 3). The council, an important advisory body to Parliament and the government, represents the interests of trade unions and industry on all major economic and social issues. Parliament mandated the council to produce an agreement between the different sector-based organisations, government and civil society on environmental policy initiatives for different sectors, including transport. The resulting agreement contains an ambitious plan to reduce GHG emissions through mainly voluntary actions. For the longer term (2035) the aim is to have all new cars driving free of carbon emissions and an overall reduction of CO_2 emissions by at least 60% for the transport sector in 2050 (SER, 2014).

5. Governance for sustainable mobility

In recent years, the government merged different ministries into the Ministry of Infrastructure and Environment to integrate various policy domains that deal with infrastructure, transport, housing and the environment. In addition, the government improved consultation and co-decision with regional authorities through a multi-annual programme for infrastructure, spatial planning and transport ("MIRT") (Government of the Netherlands, 2014).

The Netherlands has a tradition of long-term planning and consensus-based decision making, known as the "polder approach" (Chapter 2). Long-term planning is informed by specialised public research institutions, then discussed in different councils and finally approved by Parliament. There is also a strong tradition of public debate.

The Netherlands was a forerunner in terms of long-term planning and long-term policy visions. It has good public research institutes that can help prepare and assess mobility policies, including the Netherlands Bureau for Economic Policy Analysis (CPB), the Netherlands Environmental Agency (PBL) and the Institute for Transport Policy Analysis (KiM). These institutes have a worldwide reputation for scientific excellence and have kept their independence, which is crucial for good policy making on matters that are inherently complex and technical.

The Netherlands also has a strong tradition of second opinion for large infrastructure projects that has improved policy making. In a second opinion, a different team of experts checks the methodology and calculations of the project assessment using the same basic data. This tradition exists for infrastructure projects, but could be implemented more actively for other important policy interventions related to sustainable mobility. For example, a coherent assessment of climate policy in transport is lacking and the rules for valuing CO_2 emission reductions are not clear (OECD, 2014). In addition, according to Koopmans (2010), an important part of waterway and rail infrastructure projects do not pass the cost-benefit test. Moreover, public transport projects that are decentralised to local authorities, but co-financed by the central government, escape a rigorous cost-benefit test. This is particularly worrisome in the context of the trend to decentralise decision making for infrastructure planning (Chapter 2). According to Wouter (2014), cost-benefit analysis is a guarantee for better decision making if it is based on model analysis, reasonable exogenous inputs and a standard methodology.

There is traditionally strong co-operation and co-ordination between local, provincial and national authorities in addition to co-operation with a broad range of stakeholders. One example is the Sustainable Infrastructure Corporation, a joint initiative of governments, market players and knowledge institutions. It aims to incorporate sustainability into infrastructure projects, as well as to integrate sustainability into all phases of public procurement.

In 2011, the Netherlands launched the Green Deals programme to remove barriers, such as lack of funds and unnecessary legislation that hamper initiatives to “green” the economy” (Chapter 2). By formalising co-operation between interested partners and the government and helping parties overcome barriers, the hope is to realise quick wins. Green Deals cover a large number of initiatives, including some related to transport (such as R&D for new fuels). On the one hand, Green Deals can work quickly by avoiding a long legislative process. On the other, they may end up supporting the wrong projects as the government may not be the best judge of what will likely succeed. There is a risk of a “winners’ curse” for the most rosy R&D project proposals: governments want to support those projects that promise the largest benefits. But, when the ultimate effect of the proposed action is highly uncertain, the proposal that is most optimistic is likely to be the one supported. It may be wise to organise systematically a cost-benefit analysis for each of these initiatives, as well as for combinations of initiatives.

6. Policy instruments for sustainable mobility: An assessment

The Netherlands has a strong record in sustainable mobility policy. In particular, it has a well-developed planning and policy process, a high-quality network of policy research institutes, a relatively high share of environmentally friendly modes of transport (such as biking), a relatively low share of diesel cars and a high share of inland waterways for freight transportation. This section examines policy for road transport, rail, inland waterways and air, as well as local initiatives.

6.1. Road transport policy

The government has several policy levers to address the main externalities related to road transport, which are congestion, climate impacts, air pollution, noise and accidents. It can tax and subsidise the use and purchase of particular types of cars and trucks, regulate the use of roads and increase the capacity of the road network. Table 4.3 lists the main economic instruments available to address externalities from road transport and indicates whether they are implemented in the Netherlands.

Table 4.3. **Main economic instruments for addressing externalities from road transport**

Policy instrument	Cars	Trucks
Gasoline excise tax	Yes	n/a
Diesel excise tax	Yes	Yes
Taxes and subsidies for other fuels	Lower tax (LPG) or subsidy (electricity)	n/a
Vehicle purchase and ownership taxes	Progressive in function of carbon emissions + surcharge on diesel cars	Eurovignette is a fixed sum per year that is a function of axle weight and European norm
Parking charges	In most cities	n/a
Distance charging	No	No
Road pricing by time of day and by place	No	No

Failure to introduce road pricing as a missed opportunity

From an economic point of view, the optimal instrument to regulate congestion is road pricing (or tolling). Road pricing can be restricted to a city or implemented nationally. Such systems are implemented in several cities in Europe, such as London and Stockholm (Anas et al., 2011), as well as in Singapore. In the Netherlands, the cabinet had approved a national road pricing scheme that was to be decided in 2009-10 and would have become fully operational in 2017. Before Parliament could officially discuss the scheme, the government resigned for unrelated reasons. Evaluations of the proposal at the time indicated the cost of implementation, as well as a lack of public acceptance in the media and political support, posed significant barriers. Since then, the new government has affirmed it does not plan to reconsider road pricing for cars through 2017. Instead, recent governments have rolled out very high subsidy schemes for cleaner cars and addressed congestion through better use of road capacity. The 2013 Energy Agreement includes plans to begin studying road pricing again as of June 2016.

The main idea behind the proposed road pricing scheme was to substitute the high fixed charges on cars (high purchase and vehicle ownership taxes) with a variable charge per kilometre. Charges would be based on time of travel (peak versus off peak), location (congested versus non-congested areas) and the pollution characteristics of vehicles. For trucks, the charges would have replaced the Eurovignette. The scheme was expected to decrease the volume of car use, mainly in the congested areas. Koźluk (2010) summarises the Dutch plan and possible alternatives (see Besseling et al., 2005 for more details). The congestion pricing scheme would have cut congestion levels on all roads more or less in half. The reduction of CO_2 and NO_x emissions would have been more or less in line with the reduction of overall traffic volumes (5-10%).

Experience in London and Stockholm (Anas et al., 2011) has shown that implementing road pricing by setting up a cordon around the city can reduce congestion levels in and around cities very sharply through a small reduction of traffic in the peak hours (10% to

20%). Experience in Stockholm has also shown there is less than a one-to-one substitution of road use by public transport. Only one out of five passengers who disappeared from the road at peak times would end up in public transport (Eliasson et al., 2009). This implies that road pricing does not require a massive expansion of public transport capacity. Peak load pricing for public transport can also be an important complement for road pricing (Kilani et al., forthcoming).

The reasons why the proposed road pricing scheme was not accepted in the Netherlands is a challenging question that merits further research. Building on a model of policy reform, De Borger and Proost (2012) identify a number of potential barriers to such a scheme, including the cost uncertainty faced by road users. *Ex ante,* road users are unsure about the individual costs of switching from car use to public transportation. When non-drivers share in the benefit from collected toll revenues, the marginal car driver perceives high expected substitution costs and a low share of revenues from toll charges. After implementation, uncertainty is resolved. As a consequence, the marginal car user will typically enjoy lower-than-expected substitution costs, and thus may support congestion pricing *ex post*. Hence, a majority of drivers may vote against road pricing *ex ante*, or even vote against a pilot project, because their expected gain is negative. But they may support the scheme once it has been implemented. This observation is consistent with evidence from road pricing schemes in London and Stockholm.

Moreover, the Netherlands proposed a nation-wide scheme with strong regional variation, rather than a scheme for one city. This may have been an extra handicap to build consensus as each region may have started negotiating for its own (low) rate. In addition to the perceived effects on drivers, the cost of implementing the scheme and the transaction costs associated with operation can eat away 10-20% of the toll revenues. Technology, however, is making significant progress on this front.

Fuel taxes and parking charges as the main variable charges on road use for cars

In the absence of road pricing, fuel taxes and parking charges remain the main variable charges on road use for cars. Since fuel taxes are uniform over time and place, they cannot really address congestion. At best, they can only charge for CO_2 damage and charge in an imperfect way for the other mileage-related externalities (Box 4.1).

In addition to fuel taxes, high parking charges continue to be an important second-best instrument. These are used intensively in major Dutch cities and have increased over time (KiM, 2014). Good parking policies achieve two objectives. First, they reduce cruising for parking that occurs when on-street parking is too cheap compared to off-street parking (Calthrop and Proost, 2005). Van Ommeren et al. (2012) analysed empirically parking prices in the Netherlands. Using a sample of the National Traffic Survey (2005-07), they found that on-street prices are more or less equal to off-street prices. Amsterdam has one of the highest on-street parking prices (EUR 5 per hour in the centre) in the country. Most other Dutch cities have implemented parking pricing. The average on-street and off-street parking fee is about EUR 1.5 per hour and total parking revenues are about EUR 1 billion (about EUR 125 per car per year). As on- and off-street prices are very close, the assessment found very limited time spent cruising for parking (some 36 seconds per trip). In addition to reducing cruising, an extra levy on all parking (on- as well as off-street) can be a third-best way to limit car use in the city. It is not clear to what extent Dutch cities have used this option or its effectiveness. Finally, parking charges could become even more effective if employer-paid parking was eliminated (Van Ommeren and Wentinck, 2012).

Box 4.1. **A second-best approach to road use externalities**

As fuel taxes are uniform over time and place, they cannot really address congestion. At best, they can charge for CO_2 damage and charge in an imperfect way for the other mileage-related externalities. According to Parry et al. (2014a), the "ideal second best" gasoline tax equals the sum of two terms[a] described in Table 4.4. The first component, climate damage, is directly proportional to gasoline consumption. Climate damage estimated at EUR 25 per tonne of CO_2 equals approximately EUR 0.1 per litre (L).

The second component consists of other external costs associated with driving a particular vehicle 1 km in the Netherlands, including external congestion, air pollution, noise and external accidents. External congestion cost is the additional time and schedule delay one more car adds for all other car users that use the same road. The external accident cost is the increase in accident costs caused by one additional car for all other road users. Estimates of these costs vary strongly (see European Commission, 2014; Parry et al., 2014b). For the sake of illustration, assume these costs equal EUR 0.09 per km, that a car consumes 5 L per 100 km (and drives 20 km with each litre) and that, whenever the gasoline tax increases, half of the reduced gasoline consumption comes from less mileage (the Ω parameter in Table 4.4).

Table 4.4. **Example of calculating an ideal level of a gasoline tax to correct for external costs**

Gasoline tax (Euro/L) =	1
Climate damage per litre of gasoline (Euro/L)	0.10
Mileage-related external costs (Euro/km) x fuel efficiency (km/L) Ω	(0.09)(20)(0.5)

Note: Ω represents the share of the reduction of gasoline that comes from reduced mileage.

This example illustrates two important points. First, when the climate damage associated with the consumption of gasoline is around EUR 0.10 per L, this means that a gasoline tax of EUR 1 per L acts as a EUR 250 tax per tonne of CO_2. It is not called a carbon tax, but it acts as a carbon tax. Second, any gains in fuel efficiency reduce the "power" of a gasoline tax to make drivers pay for externalities: a larger km/litre in Table 4.4 requires a larger gasoline tax to generate the same effect.[c] So the shift to more fuel-efficient vehicles requires an increase in the gasoline tax if this tax is meant to make drivers pay for externalities. Furthermore, if an increase of gasoline taxes is impossible, the introduction of more fuel-efficient vehicles is counterproductive to tackle the other externalities.

Finally, a government will also raise tax revenues from the gasoline tax. From this perspective, the fuel-efficiency reactions and mileage reduction are inefficient as they reduce the revenue base.

a) Parry et al. (2014b) add a third component: the correction of myopic behaviour of car consumers that undervalue the gasoline savings of a more fuel-efficient car or of less driving. It is not considered here because empirical evidence for the EU car market (Grignolon et al., 2014) shows convincingly that consumers take into account on average 87% of the future fuel expenditures when they buy a car. So, the undervaluation is at best very limited.

b) Part of the external accident costs is internalised by drivers themselves via experience-rated insurance premiums.

c) For example, improving fuel efficiency from 5 to 4 L per 100 km means that 25 km can be driven per litre and the gasoline tax should increase to 0.1 + (0.09)(25)(0.5) = 1.225 EUR per L rather than EUR 1 per L.

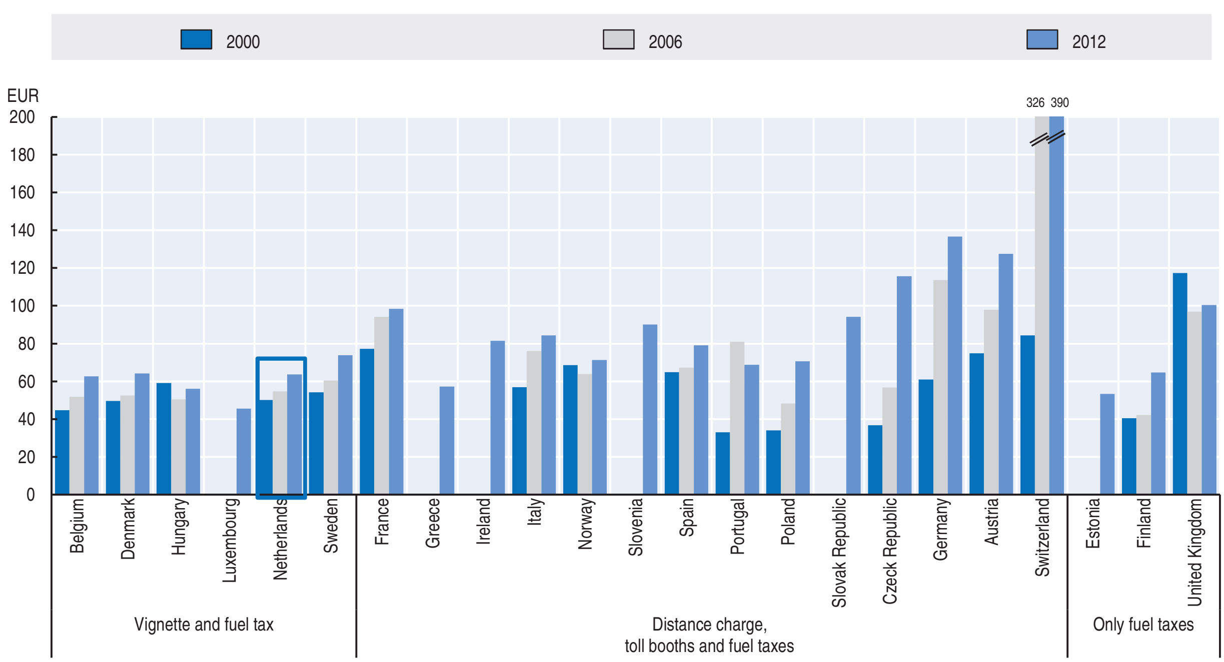
Source: Based on Parry et al. (2014a).

Pricing of road use by trucks

Road use by trucks, priced by diesel excises and the fixed Eurovignette[2] charge, continues to be inefficiently priced in the Netherlands. The Eurovignette charge varies according to the truck's emission characteristics. The Netherlands will soon be surrounded by countries that apply kilometre charging, once Belgium implements such a scheme in 2016; this can threaten the revenue basis of Dutch truck taxes. Distance charges in neighbouring countries tend to generate much more revenue than the Eurovignette. Driving through the Netherlands is much cheaper per kilometre than in Germany (Figure 4.8). The figure shows that countries with distance charges (or tolls on motorways) make trucks pay much more than those that do not. The practice of implementing distance charging is spreading in European countries.

Figure 4.8. **Driving through the Netherlands is much cheaper per kilometre than in Germany**

Total charges for a standard domestic haul of 400 km by a 40-tonne truck



Note: Charging policy as of 2012.

Source: Based on data fom Hylén, B., J. Kauppila and E. Chong, 2013, "Road Haulage Charges and Taxes: Summary Analysis and Data Tables 1998-2012", *International Transport Forum Discussion Papers*, No. 2013/08; analysis by Mandell S. and S. Proost (2015) "Why truck distance charges are contagious and drive fuel taxes to the bottom", *Discussion Paper Series*, March DPS 15.04, KU Leuven, Center for Economic Studies.

StatLink http://dx.doi.org/10.1787/888933280387

A recent study by Mandell and Proost (2015) suggests that countries that do not implement distance charges, like the Netherlands, could risk losing significant amounts of their excise tax revenues. As international trucks can decide where to take fuel, countries with a distance charge can increase slightly their distance charge and lower their diesel excise to encourage fuelling in their country. In this way, they can undercut the diesel excise of neighbours without distance charges. The study concludes that based on geographical developments, the implementation of distance charges appears to follow a sequential pattern: distance charges are contagious. The central EU states already have a distance-based charge and several states bordering them are currently working towards implementing such a charge. The spread of distance charging for trucks in neighbouring countries makes the Netherlands vulnerable as probably at least half of the road freight can fuel abroad.

The reform of the purchase and ownership taxes on vehicles into a progressive carbon tax

Reform of the purchase and ownership taxes on vehicles into a progressive carbon tax was costly and is expected to have only a minimal effect on reducing overall emissions. Purchase and ownership taxes have different effects. Strong evidence suggests that high purchase taxes may encourage consumers to postpone replacing their cars, leading to rather old fleets and high pollution. This was the case in the Netherlands until 2005. In 2006-10, the country restructured vehicle purchase taxes (based on the value of the car) into a progressive CO_2 tax. The new tax implied a significant cost – thousands of euros per tonne of CO_2 abated.[3] Moreover, according to Geilenkirchen et al. (2014), a rebound effect makes the net saving of CO_2 emissions much smaller than expected: when the cost of driving decreases, vehicles are driven more. The net cost for the government budget in terms of base erosion remains to be estimated, but is substantial (EUR 1 to 2 billion in the first years of the reform).[4]

Compared to other countries, such as Denmark (Munk-Nielsen, 2014), the Dutch tax reform avoided the mistake of inadvertently promoting the purchase of diesel cars. The Netherlands has always maintained a specific annual vehicle tax for diesel cars that strongly discourages a shift to these vehicles. Diesel cars generate less tax revenue per kilometre (Harding, 2014) and have a small carbon emission advantage per kilometre driven in test cycles. In the real world, however, their NO_x emissions are clearly higher than those of gasoline cars (TNO, 2013).

Car scrapping subsidies

For a short period (May 2009 to April 2010), a scrapping scheme was implemented to reduce the number of older cars and delivery vans in the Dutch car stock. The objective was to increase car sales and reduce pollution by old cars. The scheme cost EUR 80 million and 80 000 car purchasers benefited from the subsidy. There was no cost-efficiency or cost-benefit assessment of the measure. The Netherlands was not alone in implementing tax incentives aimed at decreasing the share of older fuel-inefficient cars. Several other countries including, France and Germany, also used a scrapping scheme in 2008-10 (ITF, 2011). The net effect on CO_2 of such schemes was low or even negative (D'Haultfoeuille et al., 2014). Moreover, if one does not account for the macroeconomic stimulus (which could have been obtained in many other ways with larger social net benefits), these programmes were also very costly.

Plans for electric vehicle expansion

The Netherlands has strongly encouraged the expansion of electric vehicle use and has achieved the highest penetration of electric cars in the EU. There are diverse motivations for these efforts: to contribute to climate objectives, to reduce air pollution (NO_x, fine particulates) and noise in city centres, and to reinforce the country's economic position. The Netherlands set objectives to put 15-20 000 electric vehicles on the road by the end of 2015 and 1 million by the end of 2025. In 2014, more than 31 000 electric and plug-in electric hybrid vehicles were already on the road. For 2011-15, EUR 59 million was set aside to stimulate demonstration projects and to put the necessary infrastructure in place. Compared to many other countries, the Netherlands has already strongly promoted the purchase of electric hybrid cars: in 2014, it had captured 4% of the market of new car sales (ICCT, 2014). The aim of reinforcing the economic position by promoting the development and use of electric cars is a long shot as many countries with national car manufacturers (France, Germany, Japan) probably have a comparative advantage.

Because the electricity for electric vehicle charging is covered by the EU ETS cap, when driven electrically, they do not contribute to additional carbon emissions (outside of the cap). This is an absolute cap on carbon emissions, so replacing a fossil fuel car with an electric car effectively decreases carbon emissions, provided the cap is strict enough. Electric cars also do not emit almost any conventional air pollution. The EU strongly encourages the adoption of electric vehicles. But while electric vehicles may be a technology of the future, any cost-benefit analysis shows it is still a very costly approach to reduce CO_2 emissions (Proost and Van Dender, 2012).[5] PBL (2012) also finds that reaching the electrification objective is very costly, but recognises it is the only way to achieve the EU objective of decarbonising urban transport at present. There is a need for a thorough cost-benefit assessment of this programme at country level and an assessment of the decarbonisation objective at the EU level (Eliasson et al., 2014).

Stimulation of biofuel use in cars

EU regulations[6] oblige the Netherlands to introduce a minimum share of biofuels in automotive fuels of 5.5% in 2014. This can be achieved by blending biofuels and regular fossil fuels. Under the national subsidy programme for innovative biofuels for transport, the government has awarded support via a tendering process for four projects that produce biodiesel with waste and residues (Government of the Netherlands, 2014). Even if tendering procedures help keep costs down, there is a need to assess the biofuel objective at both the country and EU level; costs are high compared to other ways to reduce carbon emissions and the production of some biofuels has other negative side effects (food supply markets, deforestation, etc.)

Better use of road infrastructure

With one of the most dense and congested road networks in Europe, the Netherlands has everything to gain by capacity-enhancing measures. Small measures can improve the effective capacity of the road system. According to KiM (2014), many different factors explain the evolution of congestion levels on the main roads over the last ten years (Table 4.5).

Table 4.5. **Main factors driving time losses due to congestion on main Dutch roads, 2004-13**

Time losses in 2013 compared to 2004	
Population, employment, car ownership	+30%
Telework	-4%
Fuel price	-9%
Decrease of taxes on commuting trips	+8%
Decrease of speed and speed control	+3%
Other factors	-3%
Additional lanes on roads	-42%
Traffic management	-3%

Source: Kim (2014).

The increase of population, employment and car ownership (time losses +30%) has been, and will remain, the main factor contributing to congestion. The share of teleworkers (part-time) increased from 1-18% in 2000-13, contributing to a decrease of time losses of 4%.[7] The increase in real fuel costs (higher taxes partly compensated by better efficiency) has decreased traffic flows and has therefore decreased time losses (-9%). The tax-free allowance for commuting by car introduced in 2004 (EUR 0.18 per car km and EUR 0.15 per car km for distances longer than 10 km) led to an increase of peak traffic of 8% (van der Loop, 2012).

The main decrease in congestion has come from additional lanes to existing motorways (time losses -42%). Better road management has also contributed (time losses -3%). Adding capacity also attracts new traffic, part of it coming from secondary roads. According to KiM (2012), the additional traffic generated by the new capacity is smaller than the increase in capacity suggesting an increase in capacity of 10% would only generate a maximum increase of traffic of 5% over a few years. Other sources in the international literature (Duranton and Turner, 2011), which take a longer term into account, point to a much larger effect: the latent traffic generated would fully annihilate the gains in capacity. As the easy wins in terms of better road management have likely been exhausted, a further increase of road traffic can no longer be solved by additional road capacity. This leaves road pricing as a principal policy option to address congestion.

The 2013 Energy Agreement has a long list of mostly voluntary measures to reduce congestion. An example of a voluntary measure agreed under a previous programme is the system of 16 regional covenants where regional governments, large companies and regional employer organisations agreed to reduce the number of car trips by 5%. The number of trips was reduced by 1.5% instead of 5% in a period of a few years. This could be expected: when there is congestion, the efforts of a few companies to reduce work trips can be completely eroded by increased driving of non-participants. Goudappel-Goffeng (2013) assessed the environmental performance of most of these measures. The results indicate they have beneficial effects on conventional emissions, but are extremely costly in terms of CO_2 emissions (EUR 1 000-5 000 per tonne of CO_2).[8]

Road infrastructure investments

Over the last ten years, the Netherlands has mostly invested in additional lanes on existing major roads, as the road network was already complete. The country has a strong tradition in the assessment of these types of public investments. Since 2000, there has been a commitment to use CBA for all large infrastructure projects (De Jong, 2013). There is a common methodology ("OEI guideline" published by CPB and the Netherlands Economic Institute, NEI) and a second opinion ensures a thorough check of all major investments. The CBA outcome is not binding for the government, but most of it is public, enhancing transparency. Some projects with poor benefit-cost ratios have gone forward, but the CBA has often improved the quality of investment in the planning phase.

One missing dimension in most CBAs of transport projects is land use. A major investment in transportation infrastructure will change the choice of residences, workplaces and the associated agglomeration and environment effects. These second-round effects have been largely neglected due to the lack of a good spatial general equilibrium model. However, CPB has recently proposed such a new model that allows for estimating these spatial effects (Teulings, Ossokina, de Groot, 2014; Box 4.2). Their analysis

Box 4.2. **Assessing transport projects remains a challenging task: An example from Amsterdam**

One of the most difficult assessments in agglomerations is determining how new infrastructure will affect the job and housing market. According to the New Economic Geography theory, a better connection to more peripheral areas may actually harm an area instead of helping it, as most jobs would relocate to the centre. CPB has a new integrated land-use model that represents the land and job markets, as well as all commuting patterns. Teulings et al. (2014) used the model to show the effects of a policy experiment involving commuting patterns to Amsterdam, which is separated from the area north of the city by an important canal. Many people commute from the north to Amsterdam via five highway tunnels and two rail tunnels. In a theoretical closing of the two rail tunnels, the experiment suggested that a new transportation link (the two rail tunnels) may indeed lead to a higher concentration of jobs in the centre (Amsterdam). But while jobs move south, the north becomes a more attractive area to live in. As the more highly skilled people are more mobile and prefer to travel by train, they will benefit most from the new infrastructure. Table 4.6 shows the breakdown of the welfare effects by education level and land ownership.

Table 4.6. **Welfare effects of new transport infrastructure by education level and land ownership**

Welfare effect (EUR mln)	Education level			Land ownership			Total
	Low	Middle	High	North	South	Else	
Modal split	203	584	1 133				1920
Job relocation	66	191	461				718
Wage effect	0	19	23				42
Home relocation	-83	-149	-99				-331
Land owners				1 638	51	-1 335	354
Total	186	645	1 518	1 638	51	-1 335	2 703

Modal split (indicated in the first line of the table) is an important benefit because an additional rail connection improves the speed of commuting trips (time and comfort gains). It is remarkable that job relocation (from north to south) adds another 40% to the modal split gain. As the north and south of Amsterdam become more interesting for housing and jobs, land owners in these regions gain, while those in the rest of the country lose as total population remains constant. The results also show that only a small part of the total gains of a rail project (354 of 2 703, in EUR mln) is captured by the land owners. The policy experiment shows that planning and assessing new transport projects remains a challenging task.

Source: Teulings, Ossokina, de Groot (2014).

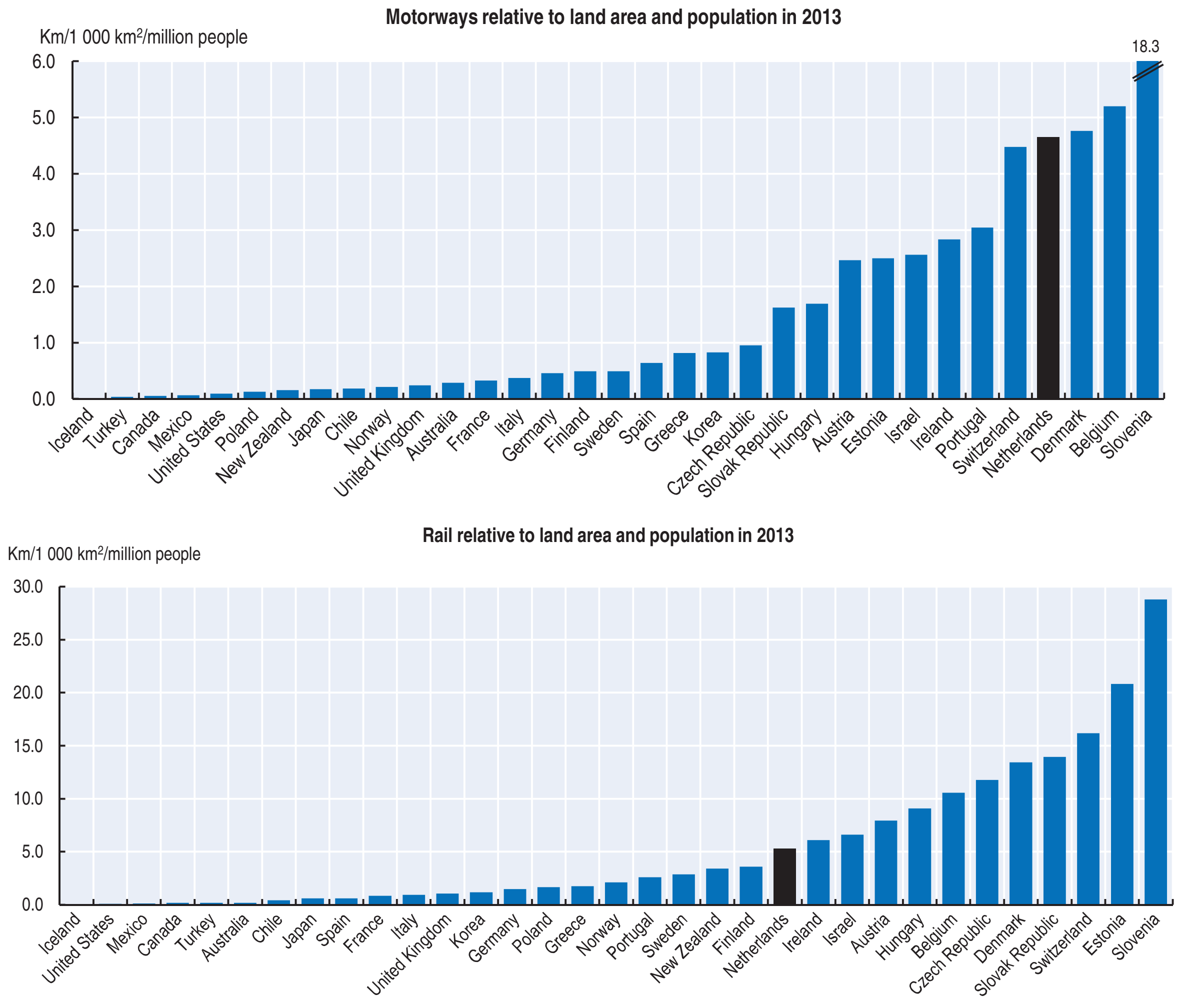
found that positive indirect effects can represent up to 30% of the direct effects and affect people very differently depending on their education level. Higher skilled people, for example, are more mobile and benefit more from rail passenger transport improvements.

6.2. Rail

Compared to other EU countries, the Dutch rail network is relatively small (Figure 4.9). It remains important, however, for commuting to the big cities.

Over the last ten years, rail use in terms of passenger kilometre has grown by 24%. According to KiM (2014), this growth cannot really be explained by substituting car for rail

Figure 4.9. **Compared to other EU countries, the Dutch rail network is relatively small**



Source: Based on International Transport Forum (2015), Infrastructure Investment and Maintenance (website); OECD (2015), *OECD Environment Statistics* (database).

StatLink http://dx.doi.org/10.1787/888933280398

use, but is mainly due to population growth, an increase in the number of students, increases in car fuel prices, as well as increased supply of trains. The supply of more train kilometres compensates for the effect of higher prices for rail. During peak periods, and in the direction of the major cities, the rail network is crowded, which means there is less chance to find a seat and a possible increase in unreliability. The Dutch government expects a strong increase in ridership for lines connecting the big cities in 2011-30. In the Randstad, growth rates can be between 5-76% in total over this timeframe, depending on the particular line (Ministry of Infrastructure and Environment, 2014a). Extending the rail capacity in the peak period is costly. From an economic point of view, the right response is to differentiate prices between peak and off-peak times, and between congested and non-congested lines. This holds as much for rail as for car networks.

In the framework of their sustainability objective, the Dutch railways plan to electrify more regional lines, like the line in Limburg province, through a EUR 30 million project. This may not be a cost-effective climate policy action as the other benefits (time gains) are likely to be small. The Dutch railways also aim to increase their use of green electricity produced in the Netherlands from 50-100% over 2015-18 (Government of the Netherlands, 2014). This may be good marketing for the Dutch railways, but given the total cap on carbon emissions for electricity generation under the EU ETS, more green electricity in the Netherlands comes down to shifting emissions to another country within the system.

6.3. Inland waterways and air transport

The Netherlands is a transit country, but has succeeded in transporting a large share of its transit freight via relatively environmentally friendly means of transport like inland waterways and rail. The Dutch inland waterways and short sea shipping are the main modes of transport to transport goods in and out of the Port of Rotterdam. Dutch authorities have developed a system of green award certificates to stimulate environmentally friendly shipping and are also implementing a River Information System that allows for close monitoring of all ship movements, including their cargo. This is important for safety and also allows for optimisation of logistics (Government of the Netherlands, 2015a). Similar technological developments and co-ordination are needed in the road freight sector.

The airline industry is organised internationally via a system of hubs and spokes. The influence of a small country in this network is limited, as there are many alternative routes. The number of passengers in Dutch airports has grown by 33% since 2004; if real incomes increase, this growth will likely continue. Recently, regional airports have grown more than the international airport, Schiphol, due to the growth of low-cost carriers that use these airports.

An air passenger tax[9] was levied from 1 July 2008 up to 30 June 2009 (Chapter 3). The tax was abolished largely due to concerns that it caused potential passengers to fly from neighbouring countries. Soon after the Dutch tax was abolished, a similar tax was introduced in neighbouring Germany.

As long as CO_2 emissions are not regulated internationally, it is difficult for one country in isolation to address GHG emissions by air transport. However, the Netherlands could consider a passenger tax on extra-European aviation that takes into account associated CO_2 emissions, together with neighbouring countries. Such a tax would need to be considered taking into account potential competitiveness impacts in the broader international context of the airline industry.

The fact that intra-EU aviation is now included in the EU ETS weakens the argument for taxing passenger flights within the EU. But a tax on long-distance flights could help internalise some of the externalities caused by aviation, at least until a global system to address such externalities is agreed upon. To this end, member states of the International Civil Aviation Organization (ICAO) are currently working on the design and implementation of a global market-based measure for the reduction of CO_2-emissions by the aviation sector. A decision on this system will be taken at the ICAO Assembly in September 2016.

A key environmental issue around airports that national governments can tackle is noise. In Schiphol, noise has been regulated principally by limiting the total number of flights. Further refinement of the noise regulation by a system of ambient noise maxima is expected. As airplanes get quieter, and land-use planning and isolation programmes reduce noise impacts on residents, an absolute cap on flight movements or on noise levels becomes suboptimal. A finer instrument is needed to measure real noise damage (residents x scaled noise damage). An ambient noise tax or an ambient tradable noise scheme can be a more efficient solution. An ambient noise tax would charge airplanes based on noise emission, but also on local impact of the noise (which depends on time and place). A tradable ambient noise scheme achieves the same objective, but gives property rights for noise emissions to the existing carriers. This would allow a more balanced approach to the airport noise problem in Schiphol as the most valuable flights can buy rights to fly at certain times and in certain places. This system would make airlines account for the real noise costs associated with their activity.

6.4. Noise reduction plans

In 2012, new legislation came into force (SWUNG) that limits the growth in noise emissions on national road and rail infrastructure. Noise is measured at 60 000 locations along national roads. Between 2006-11, the number of houses with a noise level above 65 decibels along national roads was reduced from 6 300 to 4 000, due to measures like noise barriers and insulation of houses (Ministry of Infrastructure and Environment, 2014b). In the next five years, an additional decrease of 20% is planned. A noise innovation programme (IPG) resulted in cheaper solutions, such as quieter asphalt, to reduce noise at the source. Another programme helps municipal and provincial authorities to reduce nuisance noise.

Generally, there is increasing attention to noise problems created by traffic. Although the measured noise levels have decreased, there is increased sensitivity by the population because of possible health impacts, as well as loss of property values. In a study of the impact of a new bypass in The Hague on property values, Ossokina and Verweij (2014) showed that reducing traffic density by 50% induces, on average, a 1% increase in housing prices.

Reductions in traffic nuisance are valued much more positively when traffic density is already high. A high-density street sees its value increase five times more than a medium-density street. This finding highlights the need to concentrate efforts on the most critical points. It also helps identify a justifiable level of abatement. Currently, the trade-off between costs and benefits of noise reduction programmes is unclear.

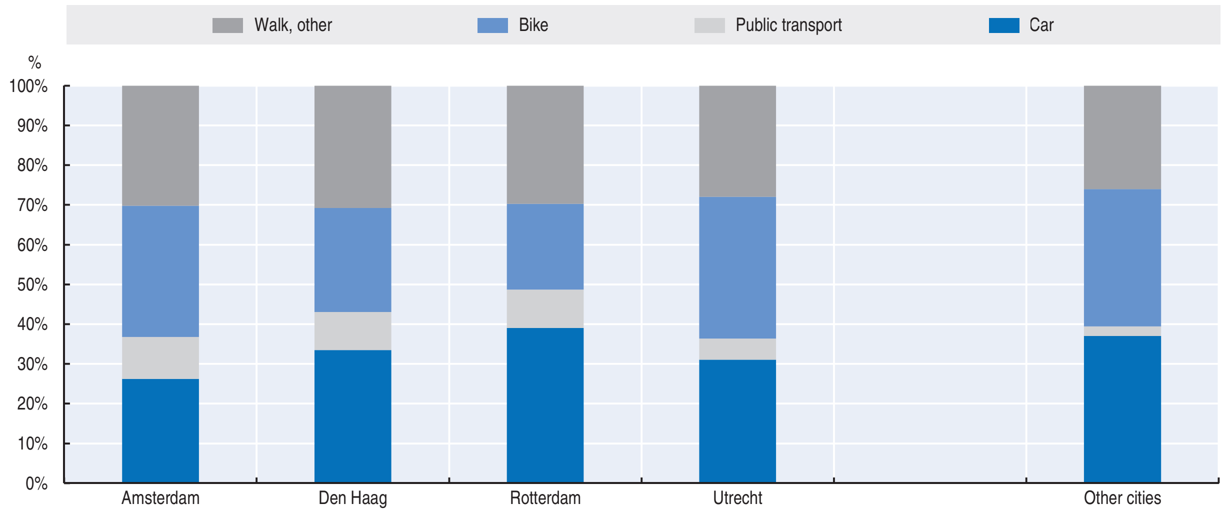
6.5. Local initiatives

Many congestion, air pollution and noise problems are situated at the level of a city or conurbation. Municipalities are responsible for local roads and local public transport. This has led to very different modal shares of transport across cities (Figure 4.10).

Figure 4.10 shows the role of walking is more or less equal in all major cities. The major differences in modes are in the share of cycling, which varies between 20% in Rotterdam to more than 30% in Amsterdam and Utrecht. This shows that cycling has a substantial share of movement, and especially so for movements within 15 km. The role of public transport is limited in urban areas as biking is a cheap and safe alternative.

Provinces and urban conurbations receive a grant for public transport and can choose a private operator for its operations. If contracts choose the right output to reward and leave enough flexibility to the operator, French cities have shown this can be a source of efficiency gains (Gagnepain et al., 2011). According to the Dutch government, tendering allows cost savings of some 10-15% (Government of the Netherlands, 2015b).

Figure 4.10. **Share of cycling varies among major Dutch cities, 2011-13**



Source: KiM (2014), *Mobiliteitsbeeld 2014 [Mobility Picture 2014].*

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Recommendations on sustainable mobility

- Allocate efforts to reduce carbon emissions across sectors based on a cost-efficiency analysis. For example, consider reducing the progressive CO_2 emission differentiation in the motor vehicle purchase tax; this would bring the abatement incentives per tonne of CO_2 emitted from high-emission vehicles more in line with the marginal abatement cost found in other parts of the economy.
- Reconsider the introduction of road pricing for cars, differentiated across place and time, possibly limited to the most congested zone of the country (Randstad). This can be done in a revenue-neutral way by substituting the vehicle purchase and ownership taxes and reducing motor fuel taxes.
- As long as road pricing is not introduced, the second-best option is to continue discouraging car use in urban areas through very high parking charges.
- Reconsider the pricing of public transport (local and rail) so it can cope with growing demand in the peak periods in the Randstad.
- Consider the introduction of distance-based road charging for trucks, as all neighbouring countries have already done or are doing. Trucks have become more fuel efficient and their options to fuel abroad limits the regulating and financing function of diesel charges.
- Consider the introduction of a passenger tax on extra-European aviation, together with neighbouring countries that have not already done so, taking into account potential competitiveness impacts in the broader international context of the airline industry.
- Continue efforts to reduce negative environmental impacts of transport, including through the ambitious plan for noise reduction. Evaluate the potential net benefits of further emission reductions in remaining air pollution hot spots.

Notes

1. International comparisons of modal shares are difficult when a mode with a share of 10% is not reported: the EU Statistical Booklet for Transport does not report the share of bicycling.
2. The Eurovignette is currently levied with Belgium, Sweden, Luxemburg and Denmark. Belgium will leave the Eurovignette system when it introduces the road pricing scheme in 2016.
3. Consider the substitution of a 13.3 L per 100 km car by a car consuming 10 L per 100 km. This provided for a reduction of the purchase tax of EUR 12 500 (based on data in van Meerkerk et al., 2014). Using a purely mechanical calculation, it implies a saving of 5.2 tonne of CO_2 at a cost of EUR 2 403 per tonne. For more fuel-efficient vehicles, the progressive tax will be smaller, but the abatement cost is still some EUR 1 000 per tonne of CO_2. A detailed assessment of this CO_2 tax component can be found in Chapter 3.
4. The greening of purchase tax on new vehicles has resulted in EUR 1.5 billion less in annual tax revenues from the annual vehicle taxes alone since 2007 (PBL, 2015).
5. A modern gasoline car emits some 2 tonnes of CO_2 per year (for 15 000 km) and some 10-15 tonnes over its lifetime. An electric car costs some EUR 10 000 more to produce and pays no usage taxes. This means that the CO_2 savings still come at a very high cost (EUR 666 to 1 000/tonne of CO_2, without discounting).
6. EU Renewable Energy Directive (2009/28/EC) of 23 April 2009.
7. KiM (2014) makes a different assessment than the Platform Smart Work Smart Travel, which claims a reduction of congestion by 40% (Government of the Netherlands, 2014).
8. It is not clear exactly which costs are included.
9. The air passenger tax was levied on passengers two years and older starting their journey from an airport for bigger planes. The tax rate was EUR 11.25 for European destinations and destinations up to 2 500 km (including destinations up to 3 500 km in countries with at least one airport within the boundary of 2 500 km). For other destinations, the tax rate was EUR 45 per passenger.

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From:

OECD Environmental Performance Reviews: The Netherlands 2015

Access the complete publication at:
https://doi.org/10.1787/9789264240056-en

Please cite this chapter as:

OECD (2015), "Sustainable mobility", in *OECD Environmental Performance Reviews: The Netherlands 2015*, OECD Publishing, Paris.

DOI: https://doi.org/10.1787/9789264240056-11-en