ITF Transport Outlook 2015

OECD
International Transport Forum

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International Transport Forum

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Preface

The 2015 *ITF Transport Outlook* examines the trends and forecasts the development of global transport volumes and related CO_2 emissions and health impacts through to 2050. It examines factors that can affect supply and demand for transport services and focuses on scenarios illustrating potential upper and lower pathways depending on the transport and CO_2 intensity of the future growth and particularly urban transport policies. The analysis highlights the consequences of rapid urbanisation outside the OECD on overall transport volumes, CO_2 emissions and health impacts. The *ITF Transport Outlook* also assesses how the shifting global economic centre of gravity from developed economies towards emerging economies affects production and consumption patterns – and therefore also international trade-related freight transport.

Rather than attempting to establish a likely central forecast for the evolution of transport volumes, the *ITF Transport Outlook* focuses on scenarios that illustrate the potential upper and lower tracks that might unfold depending on policies adopted to shape demand and key external factors including oil prices, population growth and overall GDP. Under any scenario, transport volumes grow very strongly in non-OECD economies. Curbing negative side-effects, including greenhouse gas emissions, local pollution and congestion will be a major challenge.

As in earlier editions, the 2015 *ITF Transport Outlook* addresses topics discussed at the ITF's Annual Summit. The 2014 Summit focused on Transport for a Changing World and this edition incorporates insights from the debate on the challenge of designing future cities in emerging economies for sustainable transport and designing transport policies for the supply chains of the future. As in the previous edition, the Statistical Annex incorporates the data on trends in the transport sector.

The *ITF Transport Outlook* also provides the starting point for discussions at the 2015 ITF annual Summit which takes the theme of Transport, Trade and Tourism.

José Viegas

Secretary-General,

International Transport Forum at the OECD

Foreword

The ITF Transport Outlook *brings together statistics on recent trends in transport, near-term outlook and scenario analysis for the long term. It identifies the drivers of past trends and possible future developments and discusses their relevance to policy making. The* ITF Transport Outlook *aims to be an aid to the analysis of strategic policy issues.*

The ITF Transport Outlook *is a collaborative effort. At the ITF, the model development and implementation as well as analytical framework and the report were prepared by the ITF Outlook and Statistics team and other ITF staff. Jari Kauppila co-ordinated the work and developed the analytical framework for freight transport. Aimée Aguilar Jaber led the development of passenger transport model and scenarios. Luis Martinez developed the international freight model and Vincent Benezech prepared the surface freight projections. Olaf Merk prepared section on Shipping emissions in ports. Mario Barreto and Edouard Chong collected factual information discussed in Chapter 1 and in the Statistical Annex. This* Transport Outlook *benefitted also from the valuable input from Marie Castaing, Dilay Celebi, Philippe Crist and Maël Martinie.*

Projections for transport demand are based on tools developed by the International Transport Forum. The corresponding CO_2 *emissions are calculated on the basis of the International Energy Agency's (IEA) MoMo model; urban health impacts are calculated and analysed by the International Council on Clean Transportation (ICCT); international freight model is based on the OECD Economics Directorate's projections for international trade flows up to 2060; GDP projections are provided by the OECD Environment Directorate. Their willingness to share their models is gratefully acknowledged.*

Several partners have provided support in developing the methodologies and providing data: The Energy and Resources Institute India (TERI), China Academy of Transportation Sciences, Transportation Planning Research Institute China, University College London Energy Institute, United Nations Population Division, Economic Commission for Latin America (ECLAC) and Development Bank of Latin America (CAF).

The ITF Secretariat is grateful for contributions provided by several individuals, including Dr Xumei Chen (Centre for Sustainable Urban Transportation Research China), Dr Christopher Cherry (University of Tennessee-Knoxville), Dr Cristiano Façanha (ICCT), Professor David Hummels (Purdue University), Dr Santhosh Kodukula (ICLEI), Dr Arvin Kumar (TERI), Dr Jeiping Li (Boston Region Metropolitan Planning Organisation), Dr Ziwen Ling (University of Tennessee-Knoxville), François Pelletier and Patrick Gerland (UN-DESA), Dr Laura Puzzello (Monash University), Dr Zhenying Shao (ICCT), Dr Geetam Tiwari and Ms Vidyottama Sharma (Indian Institute of Technology New Delhi), Dr T.P. Sankar (TERI), Dr Tristan Smith (University College London), Dr Gordon Wilmsmeier (ECLAC) and Dr Hua Zhang (Maglev Transportation Engineering R&D Center at the Tongji University).

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Executive summary

Surface passenger transport

Growth in global road and rail passenger travel to 2050 ranges from 120% to 230%, depending on future fuel prices and urban transport policies. This growth is driven by non-OECD economies, where passenger volumes are projected to grow between 240% and 450%.

CO_2 emissions from global surface passenger transport will grow by between 30% and 110%. The lowest growth scenario assumes high fuel prices and urban transport development that is mass transit/public transport-oriented with slow expansion of road infrastructure. The highest growth occurs when fuel prices are low and urban transport development is private-vehicle oriented, with strong road infrastructure expansion.

Urban transport

The growing population and economic concentration in urban areas call for particular attention to be paid to urban transport policies in emerging economies. By 2050, of the 2.7 billion additional urban dwellers, over 90% will live in developing countries. Long-term urban transport planning and policy alignment supporting private transport or public transport-oriented urbanisation will translate into significant differences in urban transport systems in Latin America, China and India

Public transport-oriented urban policies would reduce CO_2 emission growth by around 30% compared with the baseline scenario in Latin American and Chinese cities, and by almost 40% in Indian cities. Alignment of polices that contain sprawl, set higher fuel prices, and prioritise expansion of public transport infrastructure over urban road infrastructure can maintain current shares of public transport in Latin American and Indian cities, and significantly limit the reduction in China (with the public transport share in 2050 being twice what it would be in a baseline scenario in the three cases).

Same policy strategies do not necessarily achieve similar reductions in CO_2 emissions and in negative health impacts. Integrated policies aiming at climate and health objectives work best. Promoting low sprawl and road development, and higher rates of public transit can achieve substantial climate change mitigation, and lower negative effects on health if implemented alongside more stringent controls for vehicle emissions (in particular for buses). Two-wheelers can bring positive results in terms of CO_2 reduction, congestion and affordable mobility, but adequate regulations for motorcycle emissions are critical to avoid severe public health impacts.

Road and rail freight

Growth in world road and rail freight volumes to 2050 ranges from 230% to 420% depending on freight intensity of future GDP growth. The reduction in the transport intensity of

GDP partly results from a dematerialisation of production, mainly driven by growing services shares in GDP. Growing service sector shares in advanced economies or increasing production and trade of lighter weight goods like electronic devices reduces actual tonnages shipped. The related CO_2 emissions are projected to grow between 140% and 350% over the same period, driven by the changes in freight intensity and the share of rail in delivering future freight.

The world growth of surface freight volumes and related CO_2 emissions will be driven by non-OECD economies. Asia, including China and India, will account for over 50% of world surface freight transport by 2050 (compared with 35% today). The growth ranges between 330% and 630% for freight volumes and between 240% and 600% for the CO_2 emissions. The difference between the highest and the lowest scenario for non-OECD economies reflects uncertainties related to the direction these economies will take in terms of composition of production and the share of different types of freight transport.

Trade-related international freight

Trade related international freight is projected to grow by a factor of 4.3 by 2050. Future growth is driven by changes in the product composition of trade and by growth in the average hauling distance caused by changes in the geographical composition of trade. Some 85% of total international freight volume is carried by sea. Road freight share in global trade will increase from 6% to 10% by 2050, driven by increasing intra-regional trade, especially in Asia and Africa where efficient rail networks are underdeveloped.

Over the period 2010-2050, international trade related CO_2 emissions will grow by a factor of 3.9. Road freight accounts for around 50% of the total CO_2 emissions from international trade-related freight and the share is projected to increase to 56% by 2050. International freight requires intermodal transport and is often performed by trucks. This domestic freight linked to international trade accounts for around 10% of total trade-related freight volume globally and 30% of the total trade-related CO_2 emissions.

Multilateral trade liberalisation will have an increasing impact on trade oriented towards the non-OECD area, reflecting stronger underlying growth performance in this area and comparatively larger reductions in tariffs. Under a multilateral trade liberalisation scenario, global freight will grow by 380% (compared with a baseline 330%). This would also yield CO_2 emissions 15% higher than in the baseline scenario.

Increasing international trade will set unprecedented challenges to the transport system, particularly around ports. Port volumes are projected to increase nearly fourfold by 2050 with similar growth in most of the shipping-related emissions in ports. Already today shipping-related Particulate Matter (PM) emissions in port cities are responsible for approximately 60 000 cardiopulmonary and lung cancer deaths annually. This has implications regarding road transport investment and traffic management as well as CO_2 mitigation policies.

Continued efforts should be made to improve the efficiency of the transport system by optimising supply chain structures, increasing vehicle utilisation and introducing CO_2 mitigation policies. Options for such policies include improving the emission intensity of existing fleet, developing alternative modes of transport, improving the efficiency of supply chains and introducing new technologies.

In addition to environmental and social benefits, an efficient and well-organised transport system provides a number of operational benefits, including reduced waiting times and cost reductions. Overall, international freight requires targeted policies to minimise negative impacts while ensuring maximum economic benefits from trade.

Reader's guide

International Transport Forum (ITF) modelling framework

ITF Transport Outlook presents long run scenarios, up to 2050, on the development of global passenger mobility and freight volumes. The scenario outcomes are based on several models, which look at freight transport demand, differentiating between surface freight (road and rail) and passenger transport, both urban and inter-urban. In each case, the outputs are vehicle-kilometres or tonne-kilometres, and are translated into CO_2 emissions by applying transport technology paths built by the International Energy Agency (IEA). In the urban case, local pollutants and health impacts are also computed, using the methodology developed by the International Council on Clean Transportation (ICCT).

Surface freight volumes correlate strongly with GDP and the modelling proceeds by analysing the link between freight volumes and GDP for countries with varying income levels. Projections for international freight by mode of transport are derived from trade flow projections, up to 2050, developed by the OECD Economics Directorate. The ITF international freight model converts flows in value to flows in volume and assigns them to existing itineraries in a multi-modal context.

The urban model acknowledges the primary role played by motorisation rates in the evolution of mobility and modal share, especially in developing countries and investigates the link between income and vehicle fleet numbers under different urban development scenarios. Urban mobility results are then extrapolated at national levels to obtain figures for global passenger transport.

International Energy Agency's Mobility Model (MoMo)

The IEA has been developing its Mobility Model for over 10 years. It is a global transport model for making projections to 2050, with considerable regional and technology detail. It includes all transport modes and most vehicle and technology types. MoMo is used to produce the periodic IEA Energy Technology Perspectives report. MoMo covers 29 countries and regions. It contains assumptions on technology availability and cost at different points in the future and how costs could drop if technologies are deployed at a commercial scale. It allows fairly detailed bottom-up "what-if" modelling. Energy use is estimated using a bottom-up approach. MoMo is used to produce projections of vehicle sales, stocks and travel, energy use, GHG emissions (on a vehicle and well-to-wheel basis). It allows a comparison of marginal costs of technologies and aggregates to total cost across all modes and regions for a given scenario.

International Council on Clean Transportation Global Transportation Roadmap model

The ICCT analysis estimates premature mortality from primary fine particulate matter ($PM_{2.5}$) emitted by on-road vehicles in urban areas. The ICCT Global Transportation

Roadmap model captures well-to-wheel (WTW) transportation sector emissions from 2000 through 2050. The model calculates tank-to-wheel (TTW) emissions of local air pollutants – fine particulate matter ($PM_{2.5}$), nitrogen oxides (NO_x), non-methane hydrocarbons (HC), etc. – as the product of vehicle activity and fleet-average emission factors. Average emission factors for each region and on-road mode (light-duty vehicles, 2-wheelers, and buses) are calculated based on the share of the fleet meeting various vehicle emission standards using a fleet turnover algorithm and a policy implementation timeline. More information on the model is provided in Box 4.5.

Definitions of terms frequently used in this report

Mode: Contrasting types of transport service relevant to the comparison being made: e.g. road, rail, waterway, air or private car, powered two-wheelers, bus, metro, urban rail.

Modal split/modal share: Percentage of total passenger-kilometres accounted for by a single mode of transport; percentage of total freight tonne-kilometres or tonnes lifted accounted for by a single mode.

Four-wheelers: Passenger cars and light trucks.

Two-wheelers: Powered two-wheeled vehicles, motorcycles and scooters.

Three-wheeler: Powered three-wheeled vehicles, such as auto-rickshaws in India.

Land-use: Urban density evolution.

Bus Rapid Transit (BRT): Buses running in lanes separated from the general traffic, with high standards of quality of service, in particular regarding frequency and reliability.

Mass transit: BRT or urban rail (metro included).

Public transport service: Per capita vehicle-kilometres of total public transport.

Quality of public transport: Share of rapid vehicle-kilometres offered as a percentage of total public transport service. Rapid vehicle kilometres are those provided by rail systems, metro or bus rapid transit in segregated corridors.

Road intensity: Kilometres of roads per capita in urban areas.

Oil price scenarios

High oil price: Strong upwards divergence of real oil prices relative to the baseline oil price scenario.

Baseline oil price: The reference oil price scenario used by the International Energy Agency 2012 New Policy Scenario.

Low oil price: Strong downwards divergence of real oil prices relative to the baseline oil price scenario.

Urban land-use scenarios

Baseline: From 2010 through 2050, all urban agglomerations grow in surface area in proportion to population expansion, following their observed population growth-surface expansion path. Urban density of the average city only slightly increases.

High sprawl: From 2010 through 2050, all urban agglomerations grow in surface area following the highest observed population growth-surface expansion path for each region. Urban density of the average city decreases.

Low sprawl: From 2010 through 2050, all urban agglomerations grow in surface area following the lowest observed population growth-surface expansion path for each region. Urban density of the average city increases.

Urban public transport service scenarios

Baseline: Public transport expands according to the *Baseline* evolution of urban density of each country. It follows the observed positive relation between urban density and public transport service. Public transport services grow in pace with urban population growth. Public transport quality follows past observed trends.

High public transport: Increase of public transport service expands beyond levels that correspond to the observed relation between density and expansion. In this way public transport vehicle-kilometres grow significantly more than urban population. Public transport quality grows at the highest speed observed in the country or region.

Low public transport: Supply of public transport service develops in this case according to the *High sprawl* evolution of density in cities. Total vehicle kilometre growth lags behind population growth and public transport quality grows at the lowest speed observed in the country or region.

Urban road infrastructure scenarios

Baseline: Per capita road infrastructure expands at a rate that corresponds to the evolution of urban density under the *Baseline sprawl* scenario. It follows the negative relation between urban density and road intensity observed in historical data.

High roads: Urban roads expand at higher rates than urban population, following the highest trend observed in the country or region.

Low roads: Urban road infrastructure per capita grows following the *Low sprawl* evolution of urban density, following the lowest trend observed in the country or region.

Urban policy pathway scenarios

Baseline: Land use and public transport service and quality develop according to their *Baseline* scenarios; fuel prices follow their reference scenario.

Private transport-oriented: Land use is modelled according to the *High sprawl* scenario; public transport service expands following the *Low public transport* scenario; public transport quality increases at the rate of the *Baseline* scenario; fuel price evolution corresponds to the *Low oil price* scenario.

Public transport-oriented: Land use is modelled according to the *Low sprawl* scenario; public transport service expands following the *High public transport* scenario; public transport quality increases at the rate of the *High quality* scenario; fuel price evolution corresponds to the *High oil price* scenario.

Transport scenarios

Passenger transport

Highest: Corresponds to the *private transport-oriented* urbanisation path, combined with the *High roads* case.

Central: Combines *Baseline* urbanisation path, with the *Baseline* road infrastructure case.

Lowest: Simulates *public transport-oriented* urbanisation under the *Low roads* infrastructure case.

Surface freight transport

Highest: Freight intensity remains unchanged throughout the 2010-50. This constitutes an upper bound for freight volumes by 2050. Linked with *Low rail scenario* which takes the lowest rail share observed in each region, except for the European Union, where rail share is assumed to remain constant after 2015 (low post-crisis levels). These together form the highest scenario for CO_2 emissions.

Baseline: Freight intensity evolves following the growth in income of countries. As countries move to higher GDP per capita levels, their freight intensity declines. This is the most probable outcome if no specific policies are introduced for a stronger decoupling. Combined with *Central scenario for rail share*, according to which rail share will decline for the major emerging economies. We consider this to be the most likely scenario for CO_2 emissions.

Upwards transition: Freight intensity for all countries decreases to 0.7 by 2030 (*decoupling*). This sets a lower bound for freight volumes by 2050. This combined with *Central scenario for rail share* captures the twofold effect of income growth for low and middle income economies; a shift to lower freight intensity but also to higher share of road transport as the goods transported become of higher value.

Lowest: Freight intensity for all countries decreases to 0.7 by 2030 (decoupling) combined with *High scenario for rail share* which takes the highest rail share observed for each region, except for areas where rail infrastructure is notably low and not expected to increase over the projection period (especially in Asia and Africa). We consider this to be the lowest scenario for CO_2 emissions.

Vehicle technology scenarios

IEA New Policy Scenario (NPS): corresponds to a context in which the broad policy commitments and plans that have been announced by governments to date are implemented. Under this scenario fuel economy standards are tightened and there is progressive yet moderate uptake of advanced vehicle technologies.

Regional aggregates

Africa: Sub-Saharan Africa and North Africa.

Asia: South and East non-OECD Asia excluding China and India.

EEA + Turkey: EU28 + Switzerland, Norway and Turkey, non-EU Nordic (Iceland).

Emerging economies: Brazil, China, India, Indonesia, Russian Federation, South Africa, Saudi Arabia.

EU27: European Union countries as per 1 August 2013 excluding the non-ITF member country Cyprus.[1, 2]

Latin America: South America and Mexico.

Middle East: Middle East including Israel.

North America: United States and Canada.

ODA: Afghanistan, Bangladesh, Mongolia, Nepal, Pakistan, Papua New Guinea, Chinese Taipei, Sri Lanka, Samoa.

OECD: All OECD countries.

OECD Pacific: Australia, Japan, New Zealand and South Korea.

Transition economies: Former Soviet Union countries + Non-EU South-Eastern Europe.

Abbreviations and acronyms

ACI: Airport Council International

BRT: Bus Rapid Transit

IATA: International Air Transport Association

ICCT: International Council on Clean Transportation

IEA: International Energy Agency

IMO: International Maritime Organisation

ITF: International Transport Forum

MoMo: International Energy Agency's Mobility Model

PPP: Purchasing Power Parity

RPK: Revenue passenger-kilometres

UNCTAD: United Nations Committee for Trade and Development

UNEP: United Nation's Environment Program

Notes

1. Footnote by Turkey. The information in this document with reference to " Cyprus " relates to the southern part of the Island. There is no single authority representing both Turkish and Greek Cypriot people on the Island. Turkey recognizes the Turkish Republic of Northern Cyprus (TRNC). Until a lasting and equitable solution is found within the context of United Nations, Turkey shall preserve its position concerning the "Cyprus issue".
2. Footnote by all the European Union Member States of the OECD and the European Commission. The Republic of Cyprus is recognized by all members of the United Nations with the exception of Turkey. The information in this document relates to the area under the effective control of the Government of the Republic of Cyprus.

Chapter 1

Near-term outlook for the economy, trade and transport

This chapter reviews recent trends in economic development, trade and transport. It establishes the link between growth and transport demand based on historical data on GDP, trade, and global transport. Together with near-term economic projections, this chapter outlines the expected freight and passenger transport in the near-term. It discusses the shift of economic mass to emerging economies and provides evidence of some rebalancing of trade and transport flows. The chapter also reviews trends in car use in high-income economies and highlights rising uncertainty over future mobility choices.

Economic growth and transport

Historically, there is a close statistical correlation between the growth of Gross Domestic Product (GDP) and growth in transport, both passenger and freight (Bannister and Stead, 2002). Growth in global air-passenger-kilometres is generally linked with economic growth in both the long-term and in relation to the business cycle (Button, 2008; IATA, 2008) and this is true for most other transport sectors. Demand for commuting is somewhat less sensitive to short-term fluctuations in GDP and demand for public transport is therefore somewhat less elastic than other modes. Growth in per-capita income levels also has a positive effect on the ownership and use of private vehicles, tending to increase reliance on private vehicles to meet mobility demand. The elasticity of private ownership with respect to per capita GDP follows an S-shaped curve, with ownership rising slowly with income while income remains low, accelerating while income goes through medium levels, and slowing down again as incomes reach high levels (Dargay et al., 2007).

The relationship between freight transport and economic activity has been studied extensively in the past and it has been fairly well established that surface freight (road and rail) volumes correlate strongly with GDP (Garcia et al., 2008; Meersman and Van de Voorde, 2005; Bennathan et al., 1992). Freight transport is directly tied to the supply chain (both finished and intermediate goods) and, as a consequence, transport of goods reflects growth in sales or activity in the manufacturing sector.

However, in the highest income economies there are signs that at least some forms of mobility, particularly car use, are now growing less quickly than GDP. Over the past 10 to 15 years, the growth of passenger vehicle travel volumes has decelerated in several high-income economies and in some growth has stopped or turned negative. Slowing population growth, population ageing and increasing urbanisation contribute to the change in passenger vehicle use in several countries. There is evidence that car use growth has been reduced through policy interventions, particularly in urban areas and sometimes at the national level.

Recent studies also suggest that the relationship between GDP and tonne-kilometres may not be as enduring as supposed, resulting, for example, in revisions of road traffic forecasts in some countries (McKinnon, 2007; Tapio, 2005). We also find evidence that the relation between GDP and freight tonne-kilometres successively decreases as per capita incomes grow (see chapter *Surface transport demand in the long-run* for more discussion and evidence). There are several reasons for this. A reduction in the transport intensity of GDP can be a result of a dematerialisation of production. Growing service sector shares in advanced economies or increasing production and trade of lighter weight goods like electronic devices reduces actual tonnages shipped.

Because GDP and freight show similar patterns of growth, this does not necessarily imply causality. However, transport contributes to economic growth and to welfare by facilitating access to labour and output markets and to welfare-enhancing activities in general. There is ample evidence that transport activity rises with economic development, and that this is both because transport enables development and development leads to more demand for movement of people and goods. Global economic development is supported by fast, smooth and cheap transport as it facilitates reaping gains from specialisation and from economies of scale while maintaining good connections with markets.

The growth impact of transport infrastructure has been the subject of a body of literature over the past decades (for a summary of empirical literature, see Kamps, 2005; Jong-A-Pin and de Haan, 2008; Crafts, 2009). Since early findings of large growth effects from spending on public infrastructure, e.g. in the seminal study by Aschauer (1989), new and more sophisticated econometric work has produced a wide range of results, including findings of no growth effects at all. A recent work by Melo et al. (2013) concludes that output effects from infrastructure investment are highly context-specific, and not every investment should be expected to engender strong output growth. One possible explanation for the absence of robust findings on growth effects from transport spending in aggregate data is that the growth effects are too diffuse over time and space to be traceable in such data. Alternatively, it may be the case that in fact there is no strong effect on average. Nevertheless, there is some evidence that the productivity of public capital has been declining in advanced economies. This is intuitively logical as the more complete the network becomes, the lower the average impact of another segment. However, it is important to point out that even if the average impact is low, individual projects may have a high economic rate of return and be worth pursuing also in advanced economies.

Transport externalities have a negative impact on the relationship between transport activity and growth as they impose additional costs. Congestion and unreliability impose real costs on individual users and have significant impacts on productivity and growth through, for example, increased inventory holdings and travel time losses (CEMT, 2007; ITF, 2010). The economic cost of air pollution from road transport in OECD countries is estimated at close to USD 1 trillion, measured in terms of the value of lives lost and ill health (OECD, 2014) affecting productivity and growth at several levels.

In a modern dispersed production system, time has become the critical factor and timely delivery of components has replaced traditional stock-holding. Broadening international trade links have brought a greater volume of good, moving further and in increasingly complex and interdependent ways. The cost of transporting goods affects the volume, direction and pattern of trade. Barriers to trade and transport have a significant effect on international trade and therefore growth. OECD analysis shows that a 1% reduction in transaction costs could increase world income by USD 40 billion (OECD, 2009). All components of trade logistics impact trade more significantly, by several magnitudes, than distance or freight costs do (OECD, 2011).

Global recovery expected to continue but downside risks remain

Table 1.1 shows Gross Domestic Product (GDP) measures for recent years and expectations for the coming years from the most recent economic outlooks produced by the Organisation for Economic Co-operation and Development (OECD), the International Monetary Fund (IMF) and the World Bank. The global activity strengthened in 2013 and the recovery is expected to continue at a moderate pace in 2014-15. Global growth expectations are still slightly more pessimistic now than in the recent past. The world GDP growth rate is expected to rise to around 4% in 2015 after a few years of a somewhat weaker performance following the initially quick rebound after 2008. This global average is the result of high growth rates in emerging economies and slow growth in higher income countries. For 2014 and 2015, growth is expected to accelerate especially in the latter, while in emerging economies growth is also firming gradually. Recent growth and near-term expectations differ within the broad groups of "higher' and "lower' income economies. The World Bank forecast the annual growth to rise above trend in the United States (3% in 2015) while the performance of the Euro area has been weak and is expected to gain momentum only slowly. Among the emerging markets, growth is projected to pick up only modestly. In China, growth has eased and is likely to be lower than in the recent past in 2014 and 2015.

Table 1.1. **GDP growth, percentage change over previous year**

	2012	2013	2014	2015
OECD				
World	3.0	2.8	3.4	3.9
OECD countries	1.5	1.3	2.2	2.8
Non-OECD countries	5.2	5.0	4.9	5.3
China	7.7	7.7	7.4	7.3
World Bank				
World	3.2	3.1	3.4	4.0
High income countries	1.5	1.3	1.9	2.4
Developing countries	4.8	4.8	4.8	5.4
IMF				
World	3.2	3.0	3.6	3.9
Advanced economies	1.4	1.3	2.2	2.3
Emerging economies	5.0	4.7	4.9	5.3

Source: *OECD Economic Outlook 95*, Volume 2014/1, May 2014, Table 1.1; *IMF World Economic Outlook*, April 2014, Table 1.1; *World Bank Global Economic Prospects*, June 2014, Table 1.1.

Global economic growth, since the financial crisis, has been slow and downsize risks remain especially for emerging market economies. In China, policy stimulus (via investment in transport infrastructure among others) has supported growth since the financial crisis but an unsuccessful transition from investment led (and debt-financed) growth in the developing world to more consumer driven growth could suppress growth prospects in other regions of the world. Geopolitical uncertainties, partly related to events in Ukraine, have increased risk for negative spillover effects for growth in many of the economies in the region.

Modest trade growth projected for near-term

The fall in world trade during the financial crisis was greater than in previous recessions. A specific feature of the decline was the globally-synchronised nature of the trade collapse. The fragmentation of production and the global nature of supply chains mean any impact on value added is multiplied in each production stage (OECD, 2009). The economic shock of 2008 had a dramatic impact on trade volumes. The rebound was equally quick and spectacular immediately after the shock, but growth rates slowed down strongly as of 2011. In 2012 and 2013, growth in merchandise trade has averaged slightly above 2%, compared with the 20-year average of over 5% (Table 1.2). Expectations are for stronger growth in 2014 and 2015, with growth picking up both in developed and developing economies.

Table 1.2. **World merchandise trade, percentage change over previous year**

	2010	2011	2012	2013	2014	2015
World	13.9	5.4	2.3	2.1	4.7	5.3
Exports						
Developed economies	13.3	5.2	1.1	1.5	3.6	4.3
Developing economies and CIS	15.1	5.8	3.8	3.3	6.4	6.8
North America	15.0	6.5	4.5	2.8	4.6	4.5
South and Central America	4.7	6.8	0.8	0.7	4.4	5.5
Europe	11.4	5.7	0.8	1.5	3.3	4.3
Asia	22.7	6.4	2.7	4.6	6.9	7.2
Other regions	5.6	2.1	4.3	0.3	3.1	4.2
Imports						
Developed economies	10.6	3.4	0.0	-0.2	3.4	3.9
Developing economies and CIS	18.3	8.1	5.1	4.4	6.3	7.1
North America	15.7	4.4	3.1	1.2	3.9	5.1
South and Central America	22.4	13.1	2.2	2.5	4.1	5.2
Europe	9.4	3.2	-1.8	-0.5	3.2	3.4
Asia	18.2	6.7	3.6	4.5	6.4	7.0
Other regions	10.9	8.4	9.8	2.9	5.8	6.6

Source: World Trade Organisation, Press release 14, April 2014.

In recent decades, global economic development has been characterised by the gradual shift of economic mass from developed to emerging economies. More recently, regional differences have emerged in paths of recovery following the financial and economic shocks of 2007-08 and after. Exports and imports of developed economies have grown at below world average rates over the last few years, while trade of developing economies has grown faster than the world average. Expectations for near-term merchandise trade growth suggest these phenomena to continue, with especially exports from Asia growing faster than any other region (Table 1.2).

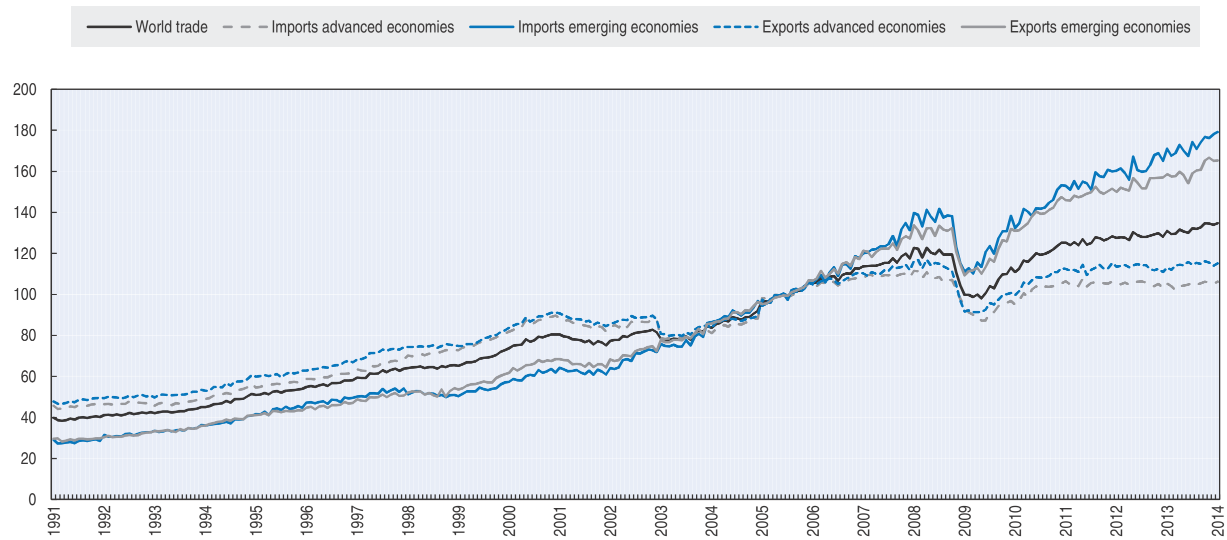
Figure 1.1 highlights the difference in trade growth between emerging and advanced economies, with the former on a higher growth path since the early 2000s and the high growth resumed post-2008. It is not surprising that growth is slower over the long run in advanced economies, but the very weak performance since late 2010 is a cause for concern. The low growth rates of global trade in recent years can be attributed to tepid export growth from advanced economies and in particular to weak demand in these economies, with low import demand growth and – correspondingly – slower growth of exports from emerging economies. Since the last update, the gap between emerging and developed economies has grown further during 2013.

Trade drives global maritime and air freight volumes

The development of global trade is a specific driver of maritime and air freight transport volumes. Trade between countries has grown faster than global output over the past decades, as a consequence of rising levels of development and trade liberalisation in emerging economies, increasing exchange of similar goods, and strong geographic fragmentation of production. The result is that the ratio of international trade in manufactured goods to production of these goods was twice as high in 2010 as it was in 1990.

Figure 1.1. **Monthly index of world trade**

Advanced and emerging economies, 2005 = 100



Source: CPB Netherlands Bureau for Economic Policy Analysis, *World Trade Monitor*, January 2014.

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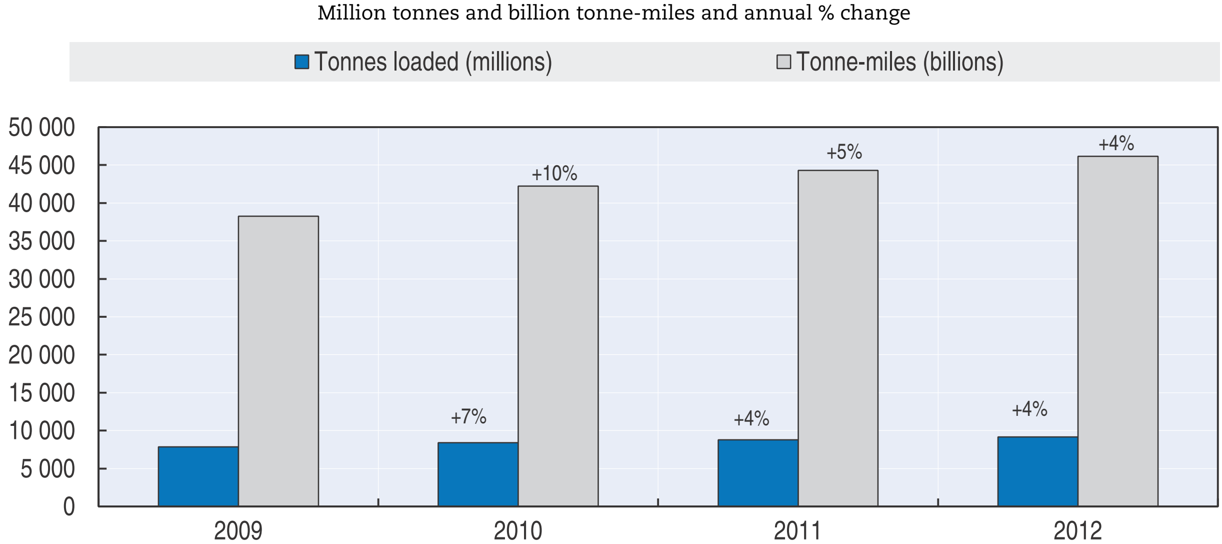
Maritime transport is the backbone of international trade, with over 80% of world cargo by volume transported by sea. Since the recovery from the 2009 recession, international sea cargo continued to outperform world GDP growth. World seaborne trade, measured in tons loaded, grew 4% to 9.2 billion tons in 2012, or 11% above the pre-crisis peak in 2008, according to United Nations Committee for Trade and Development (UNCTAD) preliminary estimation. In tonne-miles, maritime transport grew by 4%, reaching 46 billion tonne-miles (Figure 1.2). Recent trade projections suggest that the world seaborne trade growth will stabilise to moderate levels in the near-term. However, growth is expected to pick-up in the long run (see Chapter 3).

Figure 1.2. **World seaborne trade 2009-12**

Million tonnes and billion tonne-miles and annual % change



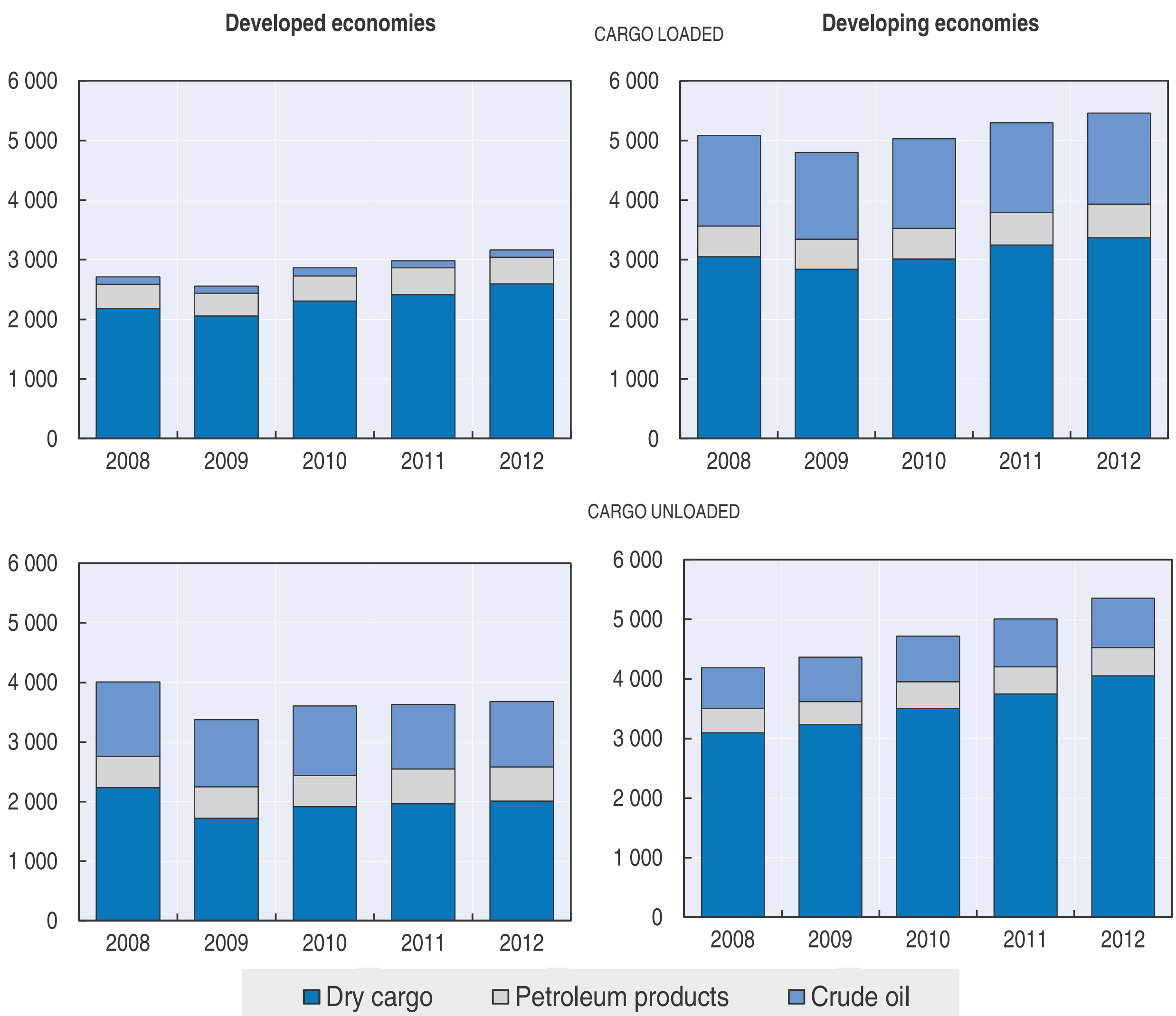
Source: *UNCTAD Review of Maritime Transport 2013.*

StatLink http://dx.doi.org/10.1787/888933168363

The total amount of goods unloaded (in tonnes) in developing economies reached 28% above pre-crisis 2008 peak in 2012 while in developed economies volumes were still 8% below their 2008 peak (Figure 1.3). Goods loaded in developing and developed economies reached 7% and 16% above pre-crisis peak. The above trends suggests strong growth of import demand in developing economies, weaker economic activity in developed countries and increasing trade among developing economies, especially intra-Asian and South-South trade (UNCTAD, 2013). This is also reflected in the development of container traffic. Asia remains by far the most important region for container trade and in 2013 the world's ten leading container ports were located in Asia (Figure 1.4). Container volumes continued to grow at all ports except for Hong Kong where traffic fell for the second consecutive year as a result of increasing competition from rival ports in southern China and the Pearl River Delta area and shift in ocean carrier alliances (Journal of Commerce, 2014).

Figure 1.3. **World seaborne trade by type of cargo and country group**

Million tonnes



Source: UNCTAD *Review of Maritime Transport 2013.*

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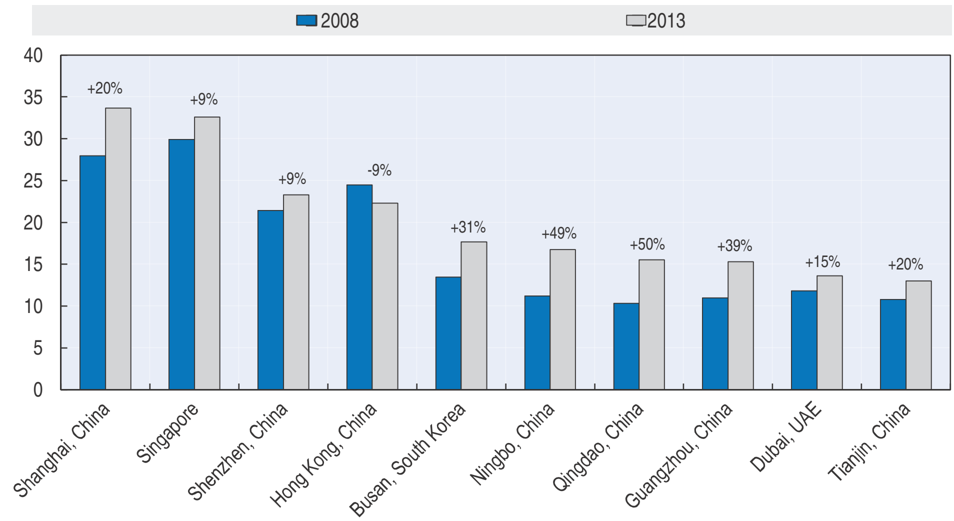
Figure 1.4. **The 10 leading world ports in terms of container traffic**

20 foot equivalent units (TEU) and annual % change



Note: TEU: Container traffic measured in twenty-foot equivalent unit as all containers handled, including full, empty and transshipped containers.

Source: Based on Lloyd's List Intelligence, Ports seize growth opportunity, on 17.3.2014.

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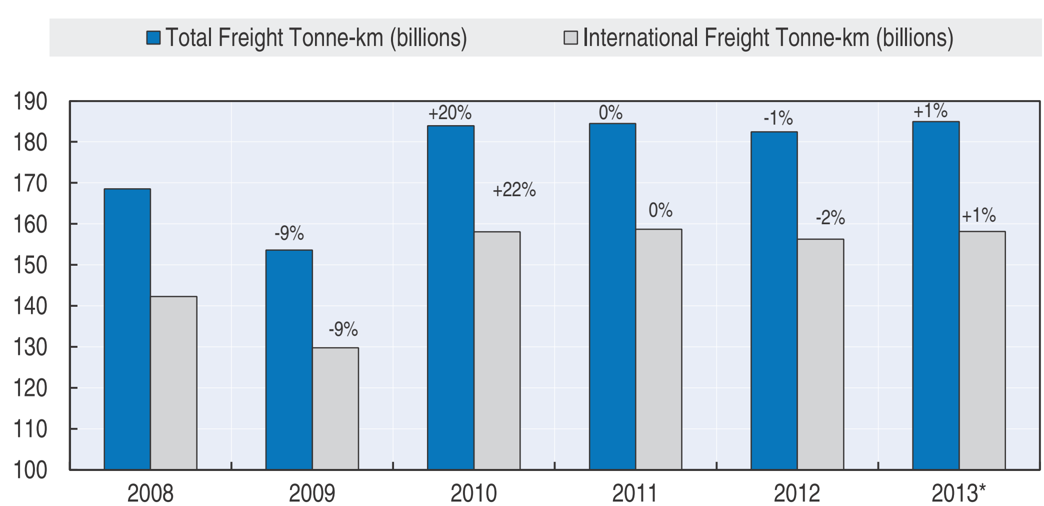
Near-term outlook for air freight suggests slow growth

Air freight transport rebounded in 2010 and grew 20% from the previous year to a new high of 184 billion freight tonne-kilometres (Figure 1.5). The strong performance of air freight in 2010 was partly led by inventory rebuilding after the economic downturn, together with rising consumer demand. This growth did not sustain, however, and air freight stagnated to zero growth in 2011, followed by a decline of 1.1% in 2012, measured in freight tonne-km. The slowdown in world trade growth, shifts in the commodity mix

Figure 1.5. **World air freight traffic**

Total and international



* Data for 2013 a preliminary estimate.

Source: Based on IATA Air Freight Analysis December 2013 and ICAO Annual Report of the Council 2012.

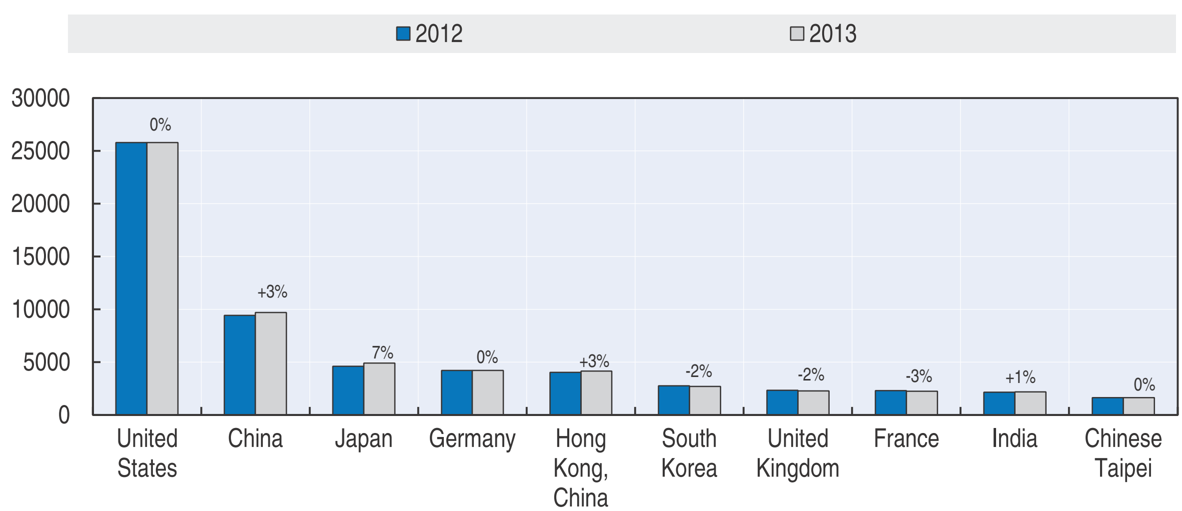
StatLink http://dx.doi.org/10.1787/888933168394

favouring sea transport and continuing economic weakness in developed countries were among the factors contributing to the negative growth in the air freight market in 2012 (IATA Air Transport Market Analysis 12/12). Freight volumes rebounded again by a modest 1.4% in 2013 while average freight load factor remained at 45%, unchanged from the previous year. Although domestic traffic growth (2.5%) outperformed international traffic (1.2%) in 2013, international air freight increased to 11% above the pre-crisis peak while domestic air freight just reached the pre-crisis peak of 2007. The International Air Transport Association (IATA) forecasts an annual average growth rate of 4.3% for 2013-17 (IATA Airline Industry Forecast 2013-17), significantly below long-term historical trend.

Asia Pacific airlines were the most affected by the slowdown in trade growth (-1.0%) in 2013. The government shutdown in October 2013 adversely impacted trade for North American carriers (-0.4%). European airlines recorded a modest 1.8% growth while Middle Eastern carriers experienced a robust 12.8% increase, the strongest of any region, reflecting solid economic and trade growth of nations in the Gulf region and better demand in Europe (IATA Air Freight Market Analysis 12/13).

Figure 1.6. **Air freight volume by country**

Thousand tonnes and annual % change



Source: Airport Council International.

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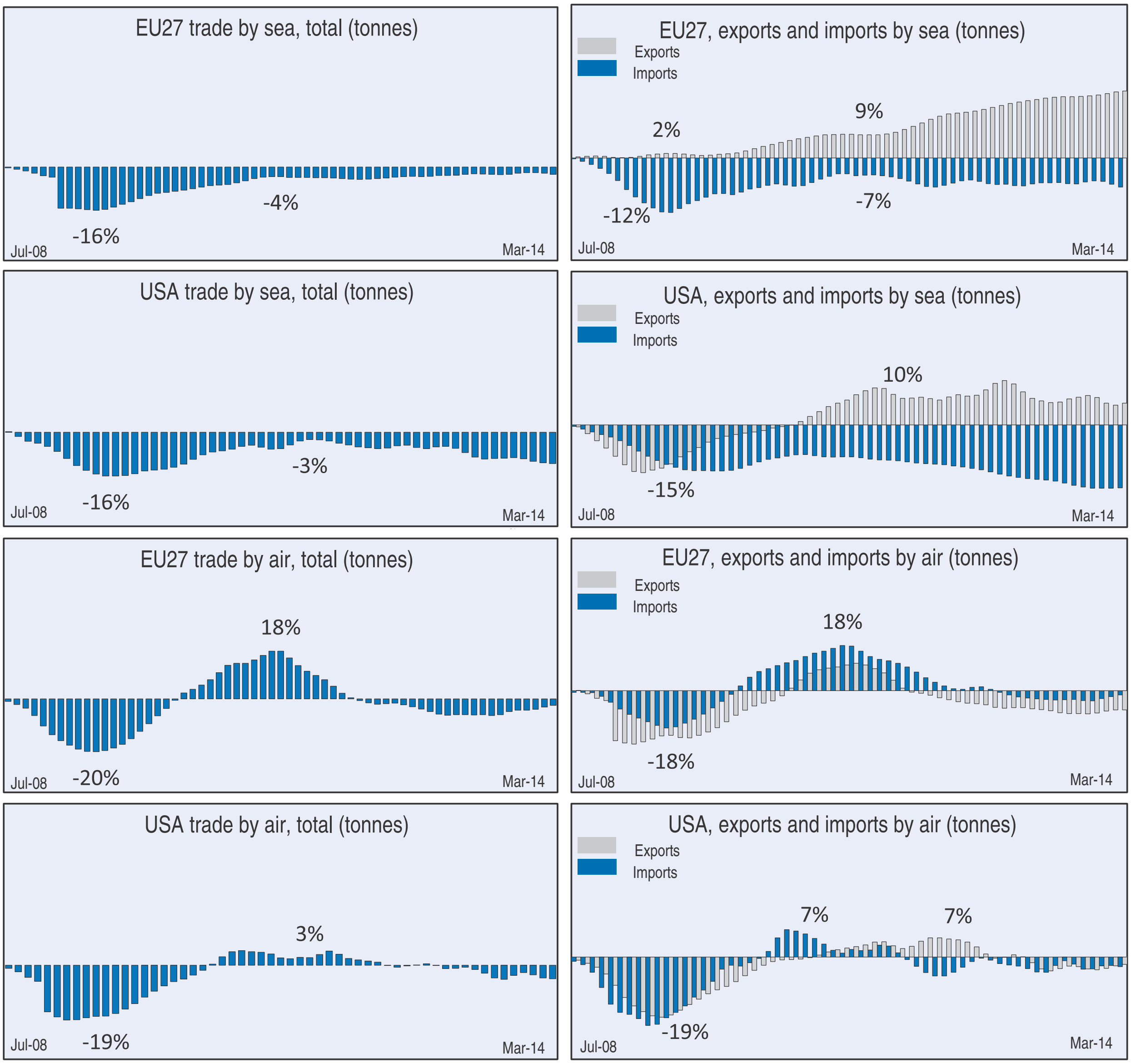
Global freight data reinforces the observation of a continuous shift of economic mass to emerging economies

Data are from the ITF Trade and Transport database, which compiles monthly data from several sources to obtain a picture of weights transported by sea and by air from and to the European Union and United States. Our latest data reinforces the observation of a shift of economic mass to emerging economies and of weak recovery from the crisis in advanced economies and in Europe in particular. Total sea freight transported to and from the European Union (EU) and the United States continued to stagnate below pre-crisis levels. Exports and imports showed diverging trends where exports grew strongly since the 2009 crisis while imports remained weak (Figure 1.7). Exports to BRICS, and more specifically to China and India, have been the locomotive of European and North American growth since the crisis of 2008. According to our latest seasonally adjusted data, exports by

Figure 1.7. **Freight transported by air and sea from the EU and United States**

Monthly trend from pre-crisis peak June 2008, tonnes, % change



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sea from the EU and the United States, especially to BRICS economies, continued to grow reaching 43% and 92% above pre-crisis levels in the first quarter of 2014. However, trade shows signs of slowing down and the challenge of structural change in, for example, China's growth strategy remains strong as ever, with increasing downside risks to continuing along the path of export orientation and a domestic focus on investment rather than consumption.

Air freight tonnes transported to and from the EU and the United States declined strongly after the shock of 2008, then rebounded quickly reaching pre-crisis peak by early 2010. Traffic volume increased to 18% above pre-crisis levels at the last quarter of 2010 in the EU. However, since 2011, cargo volumes for both EU27 and the United States have stagnated slightly below pre-crisis levels. Air freight, considered as a lead indicator, suggests further uncertainty for economic growth particularly in the EU. Recent geopolitical events combined with regional instability in the Middle East and North Africa further increase these uncertainties.

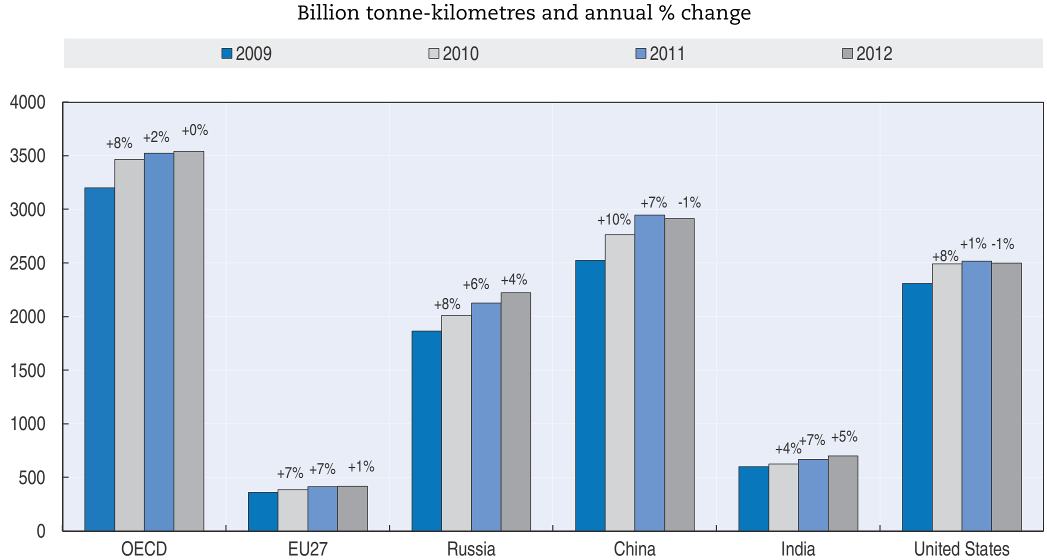
Surface freight volumes slowing down in developed economies

Rail freight growth slowed down in 2012 and preliminary data for 2013 indicate further decline. Rail freight transport in the OECD countries was severely hit by the global crisis in 2009 (-9% compared with 2008). Freight volumes rebounded back to pre-crisis levels by 2011. However, the growth slowed down to 0.4% in 2012. After the initial shock in 2008 (-18%) in the European Union, rail freight volumes increased 7% annually until 2011 after which the growth slowed down in 2012 (1%). According to our preliminary data, growth turned negative in 2013 showing a decline of -1%. In the United States, rail freight volumes increased by 8% and 1% respectively in 2010 and 2011, nearly reaching the 2008 level, only to stagnate again in 2013 (-1%), based on preliminary estimates from our quarterly statistics. Among major emerging economies, India and the Russian Federation continued to register strong year-on-year growth as freight volumes registered 5% and 4% increases in 2012. China, following several years of growth, registered a 1% decline in rail freight tonne-kilometres. The United States, China and India account for nearly 80% of total estimated global rail freight.

Hit hard by the global crisis in 2009, road freight volume grew 3% annually in the OECD from 2010 to 2012. Despite the growth, overall tonne-kilometres were still 9% below the pre-crisis levels in 2012. After initial drop of 10% in 2009, road freight is struggling in the European Union. Tonne-kilometres grew 3% in 2010 but growth slowed to 1% in 2011 and turned finally negative (-5%) in 2012, overall volumes remaining below the pre-crisis peak. Our preliminary estimate for the EU area in 2013, covering 75% of the total road tonne-kilometres, indicates a zero growth decline for road freight in the European Union. Road freight activity in emerging economies, especially China and India, continued to expand throughout the period. Tonne-kilometres increased between 17% and 18% annually in China. In India, freight volume grew 11% in 2010, 7% in 2011 and 4% in 2012.

Figure 1.8. **Rail freight**

Billion tonne-kilometres and annual % change

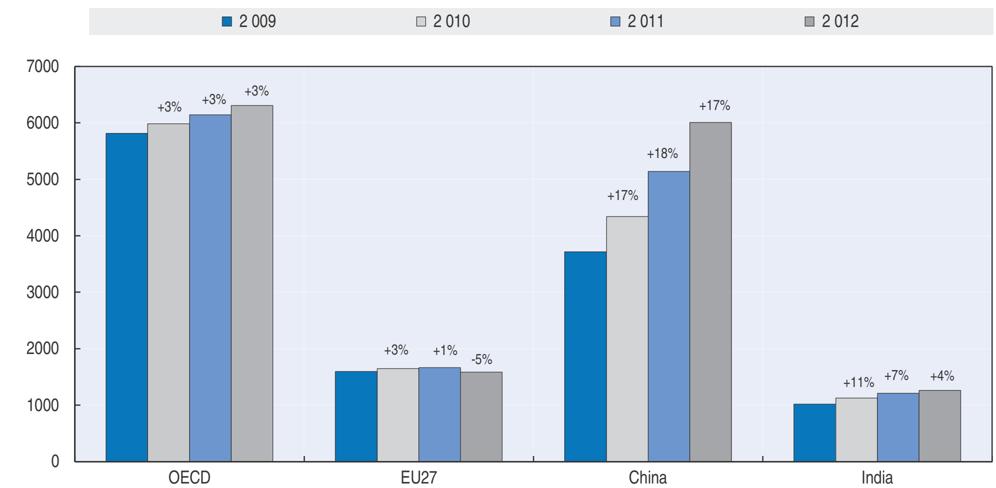


Note: Data for Belgium, Italy, Luxembourg and Russia estimate for 2012.

StatLink http://dx.doi.org/10.1787/888933168428

Figure 1.9. **Road freight**

Billion tonne-kilometres and annual % change



Note: Data for Canada and United Kingdom estimated for 2012. Data for Malta not available.

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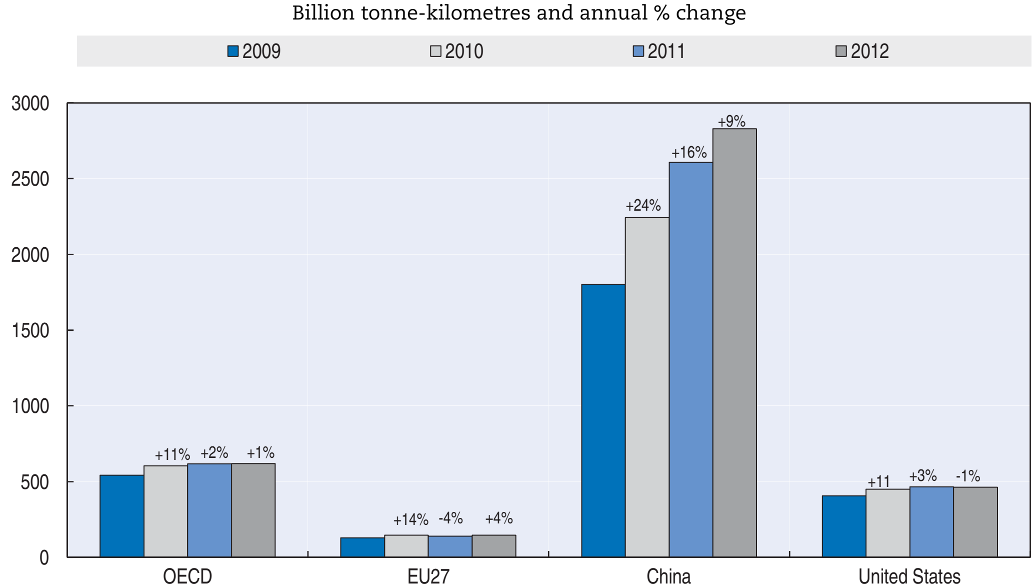
Freight transported by inland waterways also registered strong recovery in the OECD and the European Union in 2010 after the decline in 2009. Freight volumes in the OECD countries rebounded and grew by 11% in 2010. However, the growth in volume slowed done markedly in the OECD as tonne-kilometres grew only by 2% in 2011 and 1% in 2012. In the United States and European Union, growth in volume has turned negative or show only slow growth since 2011. The economic crisis also had an impact on inland waterway freight in China where tonne-kilometres grew only by 4% in 2009. Freight volumes grew rapidly in 2010 and 2011, recording 24% and 16% growth in respective years. Growth shows signs of slowing down also in China. Tonne-kilometres grew by 9% in 2012.

Figure 1.10. **Inland waterways freight**

Billion tonne-kilometres and annual % change



Note: Data for Switzerland estimated for 2011 and 2012.

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Global passenger volumes continue to grow

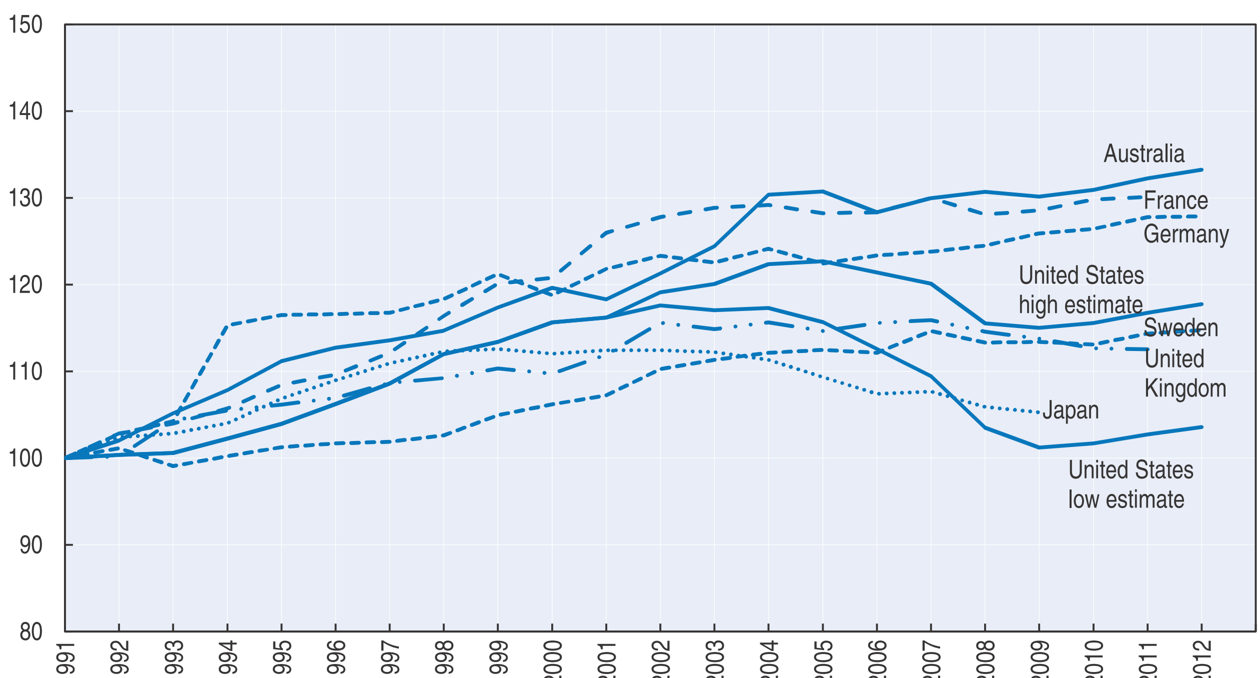
Car use shows plateauing in developed economies

As discussed earlier in this chapter, the growth of passenger vehicle travel has decelerated in several high-income economies and in some growth has stopped or turned negative. This slowdown is evident from Figure 1.11 that shows an index of passenger-kilometre volumes by car (and by light trucks and/or vans where relevant) in a selection of high-income economies from 1990 through 2012. In France, car use is virtually unchanged since 2003. In Japan, the trend is even reversed and car use has been declining since 1999. In the United Kingdom growth turned negative in 2007 having slowed down considerably since 2003. The United States displays a decline since around 2005 or even earlier. More recent data, however, appear to suggest an increase in growth rates. This suggests that the economic recession and relatively high fuel prices could explain part of the recent decline in the growth of travel by car.

Slowing population growth, population ageing and increasing urbanisation contribute to the change in passenger vehicle use in several countries. There is evidence that the growth in car use has been reduced through policy interventions, particularly in urban areas and sometimes at the national level. Research also reveals remarkable changes in the intensity of car use within some socio-demographic subgroups. Notably, car use per capita among young adults (men in particular) has declined in several countries in recent years. It is as yet not entirely clear why this decline occurs, with competing – or complementary – potential explanations relating to attitudinal and lifestyle changes (e.g. starting a family

Figure 1.11. **Passenger-kilometres by private car**

1991 = 100



Note: The Federal Highway Administration estimate of vehicle occupancy in the United States has been revised for 2009 based on the 2009 National Household Travel Survey (NHTS), resulting in a lower occupancy rate than previously. High estimate applies the vehicle occupancy based on 2001 NHTS while low estimate is based on a gradual decline from 2001 rate to 2009 rate.

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at later age), to unfavourable economic conditions for increasing numbers of young adults (e.g. rising inequality and higher unemployment) and to increased availability of options other than car use to participate in activities (e.g. more ubiquitous public transport, internet shopping and socialising). Mobility choices, including car ownership and use, appear to be changing. One emerging insight is that transport users are becoming more diverse, both in terms of preferences for lifestyles and mobility and in terms of budgets.

As a consequence, confidence in projections of mobility and car use volumes is undermined and simple, reduced form approaches based mainly on GDP and population further lose their appeal. Rising uncertainty over mobility choices is exacerbated by rising uncertainty over the future development of factors like household income. The rising uncertainty in forward-looking analysis needs to be acknowledged and if some policies are more robust to uncertainty than others, such policies become relatively more appealing. Rising inequality and unfavourable economic conditions, including low wages and high unemployment, restrain budgets for increasing numbers of households. Rising costs of getting a driving license and of car insurance exacerbate these constraints, perhaps most for young adults. The affordability of mobility is a rising concern. Aggregate car use is the result of location and travel choices made by a diverse set of potential car users. These choices depend on preferences, incomes, and prices of various transport options and alternatives to travel. Some groups choose less car-oriented lifestyles and the increased availability of other transport modes and online alternatives makes it easier for them to do so.

In developing economies, the rule of thumb that mobility, and in particular car use, will develop in line with GDP as long as policies do provide strong steering in the opposite direction, remains broadly applicable (see Chapter 2). Furthermore, strong natural population growth and rural migration to cities where motorisation is often twice that of rural areas due to higher incomes will induce pressure towards higher motorisation. Possibly, attitudinal changes related to the availability of online activities could curb growth at an earlier stage than in high-income economies, and faster urbanisation leading to congestion can reduce growth in car use. However, this curbing effect will not necessarily materialise in the absence of policies that dis-incentivise car use. Balanced mobility policies conceivably could induce levelling off of car use at lower per capita car use volumes than are observed in currently high-income economies. Providing public transport is not enough for this – car use itself needs to be regulated through appropriate prices, and land-use policy. And even when car use is inconvenient because of high congestion and high purchase prices, the preference for personal mobility may lead users to turn to two-wheelers (motorcycles, in particular), as currently is the case in Asian and Latin American cities (see Chapter 4).

Air passenger volumes projected to grow nearly 5% per year in the near-term

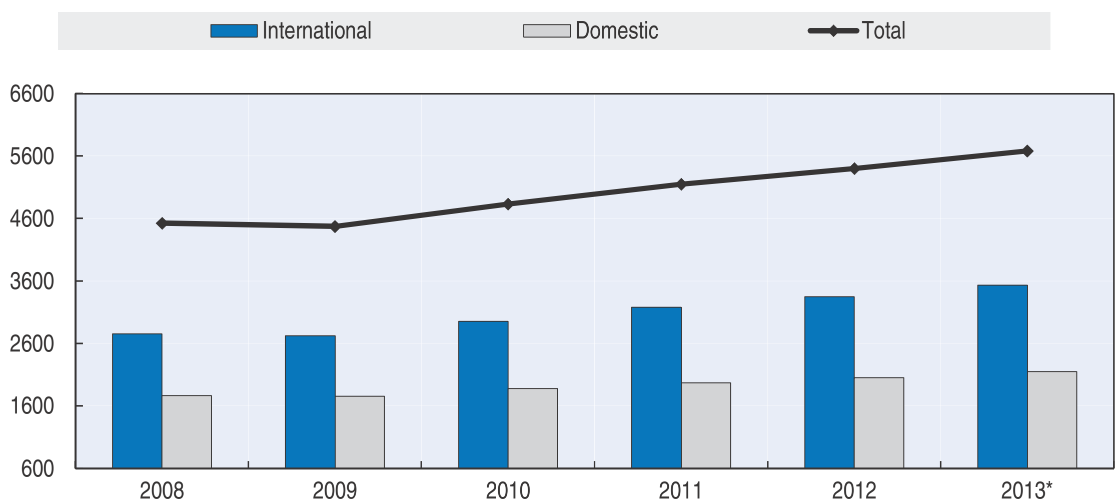
Air passenger-kilometres fell by 1.1% in 2009 as a consequence of the economic crisis. Despite the volcanic ash crises that substantially disrupted air passenger traffic in the first half of 2010, total passenger air transport has recorded a new high each year since recovery started in 2010. Revenue passenger-kilometres (RPK) increased 6.6% in 2011, breaking 5 000 billion threshold for the first time. In 2012 and 2013, passenger volumes grew around 5% per year, despite high fuel costs and relatively slow global economic growth. In total, air passenger volumes totalled 5 830 billion passenger-kilometres in 2013 (Figure 1.12). Growth in emerging regions outpaced growth in Europe and North America. Carriers in the Middle

East recorded the strongest growth of over 12%, benefitting from strong economy in the region, and in particular Saudi Arabia and United Arab Emirates, and solid growth in business related travel linked to other developing markets such as Africa (IATA, 2014). Total international passenger traffic increased by 5.4% in 2013. Domestic passenger-km volume grew by 4.9% in 2013, slightly lower than international RPKs. China, the second largest domestic passenger air transport market, recorded the strongest growth (11.7%) followed by Russia (9.6%). The United States, the world's largest domestic air passenger market with over 900 billion passenger-kilometres, grew 1.9% in 2013 (IATA Press Release No. 6 on 6/2/14). In terms of number of passengers, the world's top ten busiest airports were visited by more than 700 million passengers in 2013. Growth in Dubai airport was particularly significant (15%), surpassing Paris (Charles de Gaulle) airport in number of passengers.

Medium-term outlook for passenger traffic foresees continuing growth. IATA forecasts an overall 4.8% annual average growth rate between 2013 and 2017 (IATA Airline Industry Forecast 2013-17).

Figure 1.12. **World air passenger traffic – international and domestic**

Billion passenger-kilometres



* Data for 2013 a preliminary estimate.

Source: Based on IATA Air Passenger Market Analysis (12/13) and ICAO *Annual Report of the Council 2013*.

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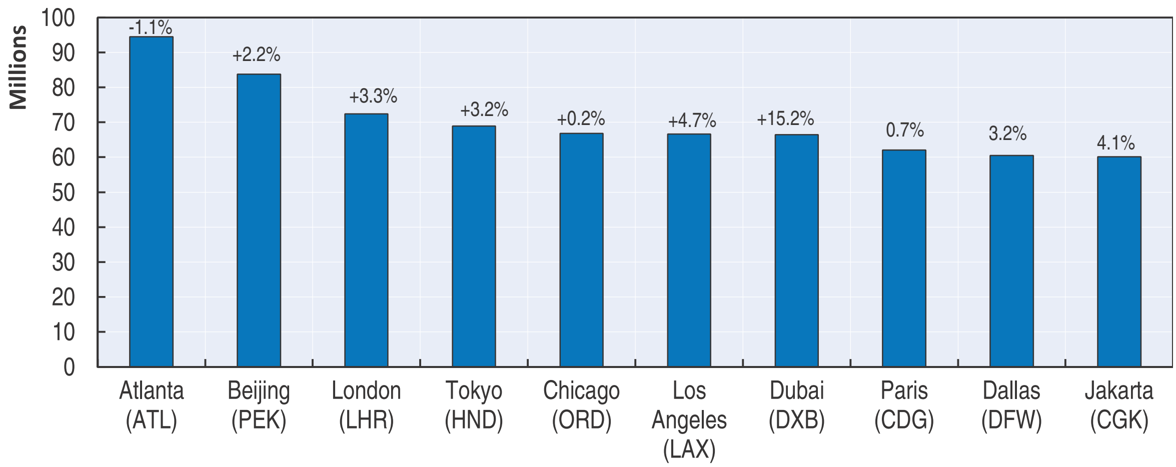
Rail passenger traffic grows at a steady rate in most countries

The economic crisis had a relatively small impact on rail passenger transport. Rail passenger-kilometres fell around 2% in the OECD countries in 2009 after which the volume recovered back to the pre-crisis levels by 2011 (Figure 1.14). In 2012, passenger volumes grew again by a steady 2%. In the European Union, passenger-kilometres stagnated in 2010 after falling 2%. In 2011, rail passenger-kilometres increased again by 2% followed by 1% growth in 2012, reaching the pre-crisis levels. There are marked differences between individual member countries. The United Kingdom registered a solid growth reaching 15% above pre-crisis peak while traffic volume in Italy and Poland remained 7.5% and 13.3% below pre-crisis peak of 2008. Rail passenger volume in Japan stagnated at pre-crisis levels while passenger-kilometres in the United States reached 10% above pre-crisis peak.

Figure 1.13. **Top 10 busiest airports in the world in 2013**

Number of passengers and % change over previous year



Source: Airport Council International Media Release on Preliminary World Airport Traffic and Rankings 2013 on 31/3/14. Available at *www.aci.aero/News/Releases/Most-Recent/2014/03/31/Preliminary-World-Airport-Traffic-and-Rankings-2013.*

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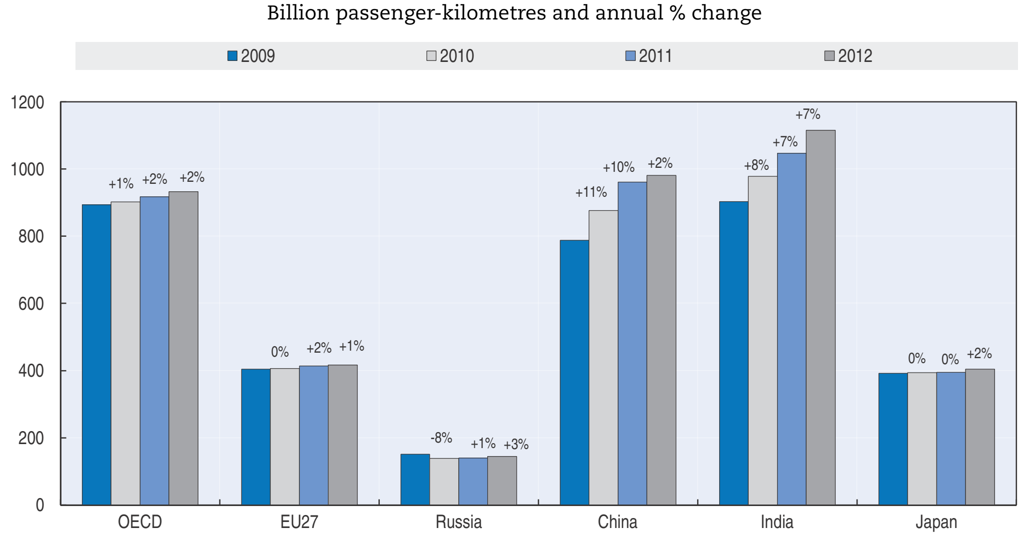
India and China account for nearly 70% of the estimated global rail passenger transport. In India, passenger-kilometres increased 7% in 2011 and 2012 while in China passenger-km growth markedly slowed down to 2% in 2012 compared with previous growth rates. Russia reversed the negative trend and rail passenger-km grew 3% in 2012. Despite the growth, overall traffic volume remains 17% below the 2008 pre-crisis levels. Market share for rail in Russia has been in decline due to a more competitive air transport market.

Figure 1.14. **Rail passenger traffic**

Billion passenger-kilometres and annual % change



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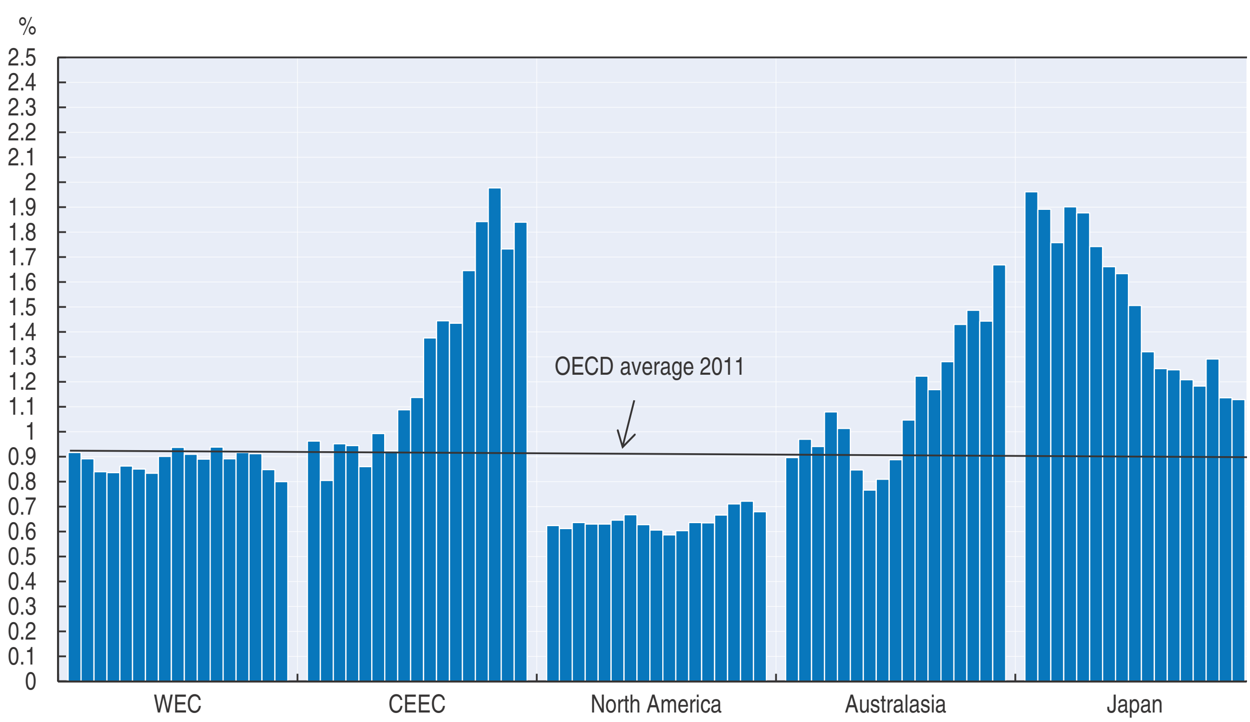
OECD countries spend 1% of GDP on road and rail infrastructure on average

The most recent data on gross fixed capital formation (investment) in inland transport infrastructure (road, rail and inland waterways) as a percentage of Gross Domestic Product (GDP) shows a slowly declining trend for the OECD as a whole over the period since 1995.

The investment share of GDP declined steadily from 1.0% in 1995 to 0.85% in 2004 after which it levelled off for few years. The level of investment rose temporarily between 2008 and 2009, likely driven by economic stimulus spending and declining GDP. After 2009, the investment share dropped to 0.85% in the OECD area (Figure 1.15). The International Transport Forum (and the former ECMT) has collected data on investment and maintenance expenditure on transport infrastructure since the late 1970s. In Western Europe, the investment share of GDP declined steadily from 1.5% in 1975 to 1.2 % in 1980 and further to 1.0% in 1982 after which it levelled off. Our latest data show that since 1995 the GDP share of investment in inland transport infrastructure has remained between 0.8% and 0.9% in Western European countries (WEC). There are only a few exceptions to this trend, notably Greece, Spain, Switzerland and Portugal which show significantly higher GDP shares over the period (reaching 1.6% – 2.0%). Since 2007, however, Greece and Portugal have converged closer to the WEC average, investments declining to around 1.0% of GDP. Data for North America also show a constant GDP share (0.6%) below the OECD average. The latest estimates indicate a slight growth in investment as a share of GDP, reaching 0.7% since 2009. These changes are, however, marginal and the investment share of GDP has remained relatively constant both in Western European countries and North America

Figure 1.15. **Investment in inland transport infrastructure by world region 1995-2011, % of GDP**

At current prices and exchange rates



Note: OECD includes 31 countries; excludes non-ITF states Israel and Chile (at the time of data collection); no data for Korea. WECs include Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Turkey and the United Kingdom. CEECs include Albania, Bulgaria, Croatia, Czech Republic, Estonia, FYROM, Hungary, Latvia, Lithuania, Montenegro, Poland, Romania, Serbia, Slovakia and Slovenia. North America includes Canada, Mexico and the United States. Australasia includes Australia and New Zealand. Data for Japan exclude private investment.

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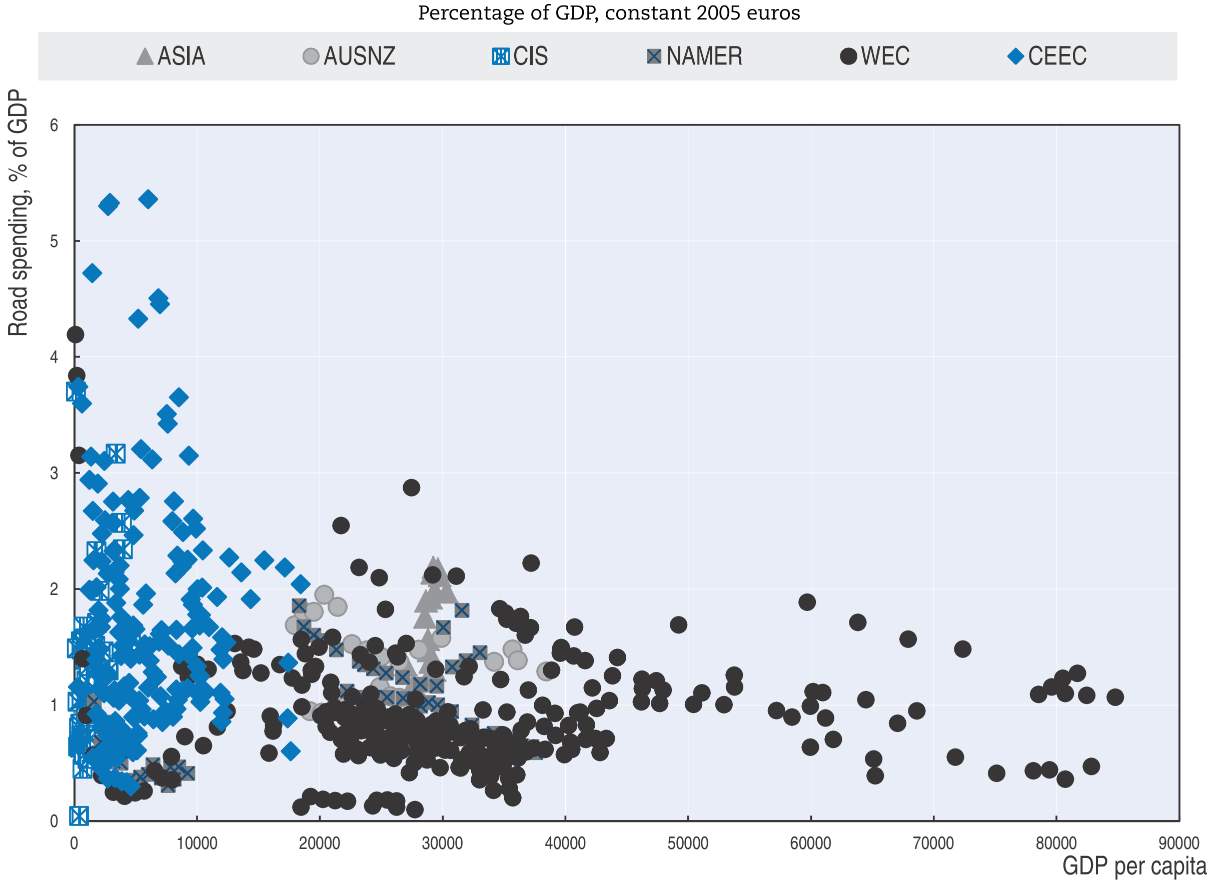
Trends for developing and transition economies differ markedly from those described above. The share of investment in inland transport infrastructure in Central and Eastern European countries (CEECs), which until 2002 had remained at around 1.0% of GDP, has grown sharply, reaching 2.0% in 2009 – the highest figure ever reported by these countries. Rising levels of investment in transition economies reflect efforts to meet rising needs especially for road network capital. Investment share of GDP fell to 1.7% in 2010, likely affected by the economic crisis. Data for 2011 again show increase, investment share reaching 1.8%. In the Russian Federation, investment share of GDP has also been high compared with Western European countries but more volatile. Investment in inland transport infrastructure as a percentage of GDP reached 1.9% in 2000 after which it has varied between 1.2% and 1.7%. For the last two years the share has remained at 1.4% of GDP.

Road spending generally declines with the level of GDP per capita

The difference between Western European countries and developing economies suggests there is a relationship between transport infrastructure spending and the level of income. Figure 1.16 plots total spending (investment and maintenance) on road infrastructure

Figure 1.16. **Road infrastructure spending**

Percentage of GDP, constant 2005 euros



Note: WECs include Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Turkey and the United Kingdom. CEECs include Albania, Bulgaria, Croatia, Czech Republic, Estonia, FYROM, Hungary, Latvia, Lithuania, Montenegro, Poland, Romania, Serbia, Slovakia and Slovenia. CISs include Azerbaijan, Georgia and Moldova. North America includes Canada, Mexico and the United States. Australasia includes Australia and New Zealand. Data for Japan exclude private investment.

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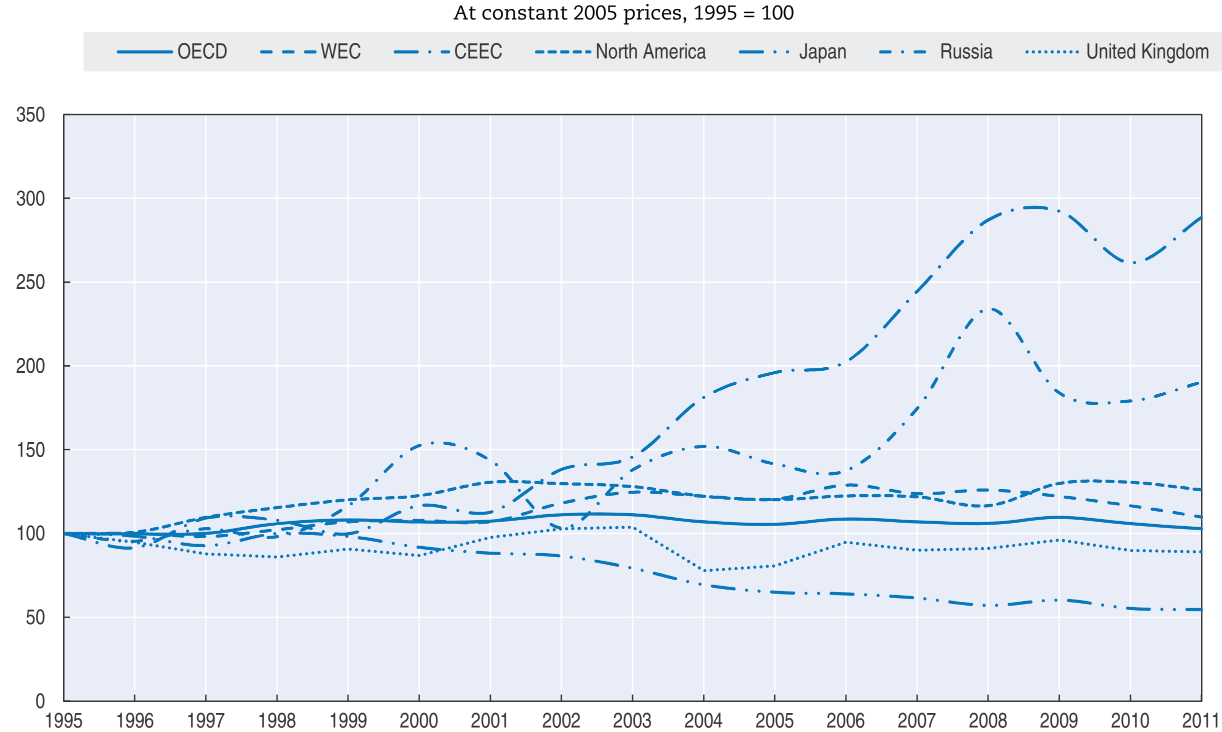
as a percentage of GDP against GDP per capita using data for over 40 countries between 1995 and 2011. This panel of over 600 observations gives strong support to the conclusion that the level of (road) spending generally declines with the level of GDP per capita. There are several potential reasons for this declining trend. As efficiency and productivity increase production becomes less transport intensive, potentially weakening the link between the GDP growth and transport demand and therefore infrastructure investments.

Volume of investment shows diverging trends between developed and developing economies

The volume of investment (expenditure in real terms) in the OECD total (excluding Japan) has grown around 30% in the last 15 years. Japan has followed a different trajectory (volume nearly halving in the same period) and its economy is large enough to affect the overall volume for the OECD significantly. Historically, transport infrastructure investment in Japan was relatively high in relation to GDP but has been in decline since the 1990s. Expenditures were affected by general budget cuts towards the end of the 1990's. Subsequently, modification of the allocation of revenues from gasoline tax, earlier earmarked for highway development and maintenance, has further reduced the level of investment in roads in Japan. If data for Japan are included, the volume of investment in the OECD peaked in 2003 after which it has remained fairly stable slightly above the 1995 level. The latest data show a 6% fall in investment since 2009 as volume declines close to the 1995 level. In Western European countries, the volume of investment started growing in 2002, and was nearly 30% above the 1995 level in 2006 after which the volume declined. The latest data for 2011 show volume only 10% higher than the 1995 level (Figure 1.17). The

Figure 1.17. **Volume of investment in inland transport infrastructure by world region 1995-2011**

At constant 2005 prices, 1995 = 100



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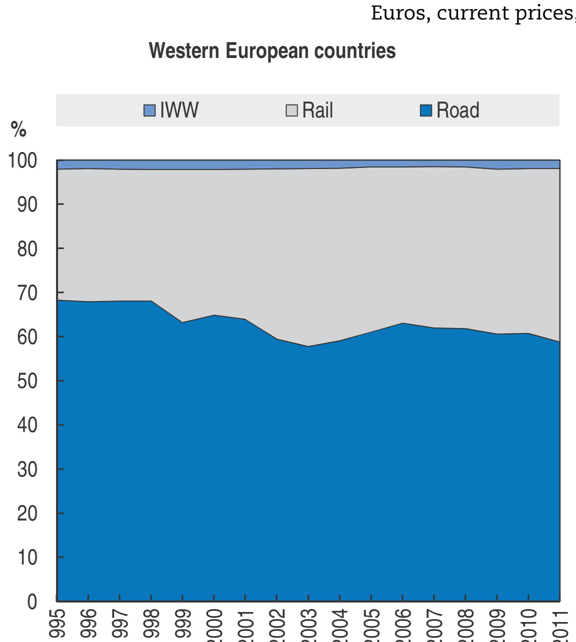
volume of inland infrastructure investment in North America grew by around 30% from 1995 to 2001. Our estimate suggests a slow decline in investment volume that continued all the way through 2008. Recent data indicate growth in the volume of investment in North America, returning to the 2001 level in real terms in 2011. The volume of infrastructure investment has accelerated strongly in developing and transition economies, notably in Central and Eastern European countries since 2003. This growth turned negative after reaching a record level in 2009. Investment in inland transport infrastructure declined 11% in real terms from 2009 to 2010. Data for 2011 show a renewed growth as volume of investment grew again by 10%.

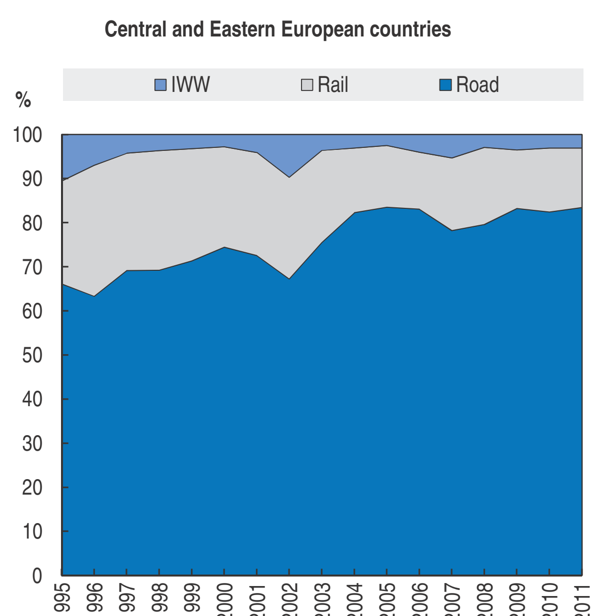
Mature economies invest increasingly in rail while transition economies invest in roads

The share of rail investment of total inland transport infrastructure investment has increased from 17% to 23% for the OECD total from 1995 to 2011, according to our estimates. This trend is mainly determined by developments in Japan and Europe. Data presented in Figure 1.18 show long-run trends in the modal share of investment in Western European and Central and Eastern European countries. In the Western European countries, the share of investment in rail infrastructure has increased steadily from around 20% of total investment in inland transport infrastructure in 1975 to 30% in 1995 and further to 40% in 2011. The trend observed in our data for Western Europe is partly a reflection of political commitment to development of railways and the most recent data does not seem to indicate any change in this respect. Whereas Western European countries have increasingly directed their investment toward rail, Central and Eastern European countries are investing more heavily in roads. The share of roads in inland transport infrastructure investment increased from 66% in 1995 to 84% in 2005 in this region. The last few years, however, suggest a stabilisation of the trend and the modal split of investment remained at

Figure 1.18. **Distribution of infrastructure investment across rail, road and inland waterways**

Euros, current prices, current exchange rates





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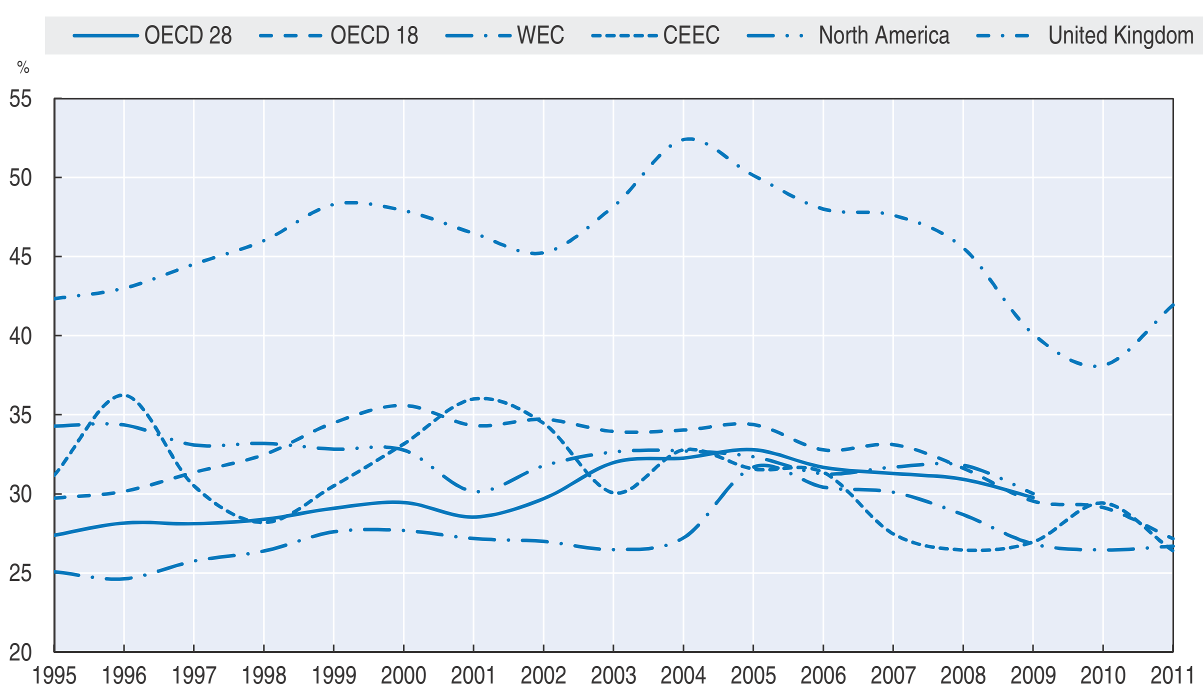
2005 levels in 2011 (Figure 1.18). The Russian Federation differs from the above trends. The share of road in the total inland transport infrastructure investment has declined from 60% in 1995 to around 45% in 2011. Rail share, in turn has increased from 37% to account for over half (53%) in the same period, according to our data.

Data indicate decline in road maintenance spending in relation to investment

In many countries observers have raised concerns about underfunding of road assets and the state of existing road infrastructure and its impacts on the competitiveness of the economy. Funding for road maintenance, particularly, may be postponed on the expectation that a lack of maintenance will not result in imminent asset failure (Crist et al., 2013). This concern is, however, difficult to verify due to lack of data on the condition of road assets. The available data on road spending suggest that the balance between road maintenance and investment has been relatively constant over time in many regions. The share of public expenditure on maintenance in total road expenditure has remained between 25% and 35%. In the 28 OECD countries for which comparable data are available through 2009, the share of maintenance in total road spending grew overall from 27% in 1995 to 33% in 2005 after which it gradually declined, to 30% in 2009. This declining trend is reinforced by data on 18 OECD countries up until 2011 which suggest further decline to 27% in 2011 (Figure 1.19). Data further suggest that funds allocated for road maintenance have declined especially in Central and Eastern European countries over the last few years,

Figure 1.19. **Share of public road maintenance in total road expenditure**

Euros, current prices, current exchange rates



Note: OECD 18 include Austria, Canada, Czech Republic, Estonia, Finland, France, Iceland, Ireland, Luxembourg, Mexico, New Zealand, Norway, Poland, Slovakia, Slovenia, Sweden, Turkey and the United Kingdom. WECs include Austria, Finland, France, Iceland, Ireland, Luxembourg, Netherlands, Norway, Sweden, Turkey and the United Kingdom. CEECs include Albania, Croatia, Czech Republic, Estonia, FYROM, Latvia, Lithuania, Poland, Serbia, Slovakia and Slovenia.

StatLink http://dx.doi.org/10.1787/888933168532

falling from above 35% in early 2000 to 26% of total road spending in 2011. In the eleven Western European countries for which comparable data are available, data suggest a surge in maintenance spending in 2005 after which the maintenance share has gradually fallen back to previous levels (27% of total spending). Similarly, the road maintenance share in North America has gradually declined from 35% in 1995 to around 30% in 2009 after which lack of comparable data hinders further analysis. Although these conclusions are affected by the quality and coverage of data, they do suggest an overall declining share of maintenance on total road spending especially over the last few years. This may not necessarily lead to an immediate asset failure and network disruption. The cumulative impact of deferred maintenance, however, increases asset and network vulnerability to local or systemic disruptions. In the long term, deferring maintenance can make roadway costs much greater than indicated by current expenditures.

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Chapter 2

Surface transport demand in the long run

This chapter presents an overview of long-run scenarios to 2050 for the development of global surface (road and rail) passenger mobility and freight traffic. The transport scenarios are translated into CO_2 emission scenarios by applying potential transport technology pathways. The chapter first introduces the general modelling framework developed by the International Transport Forum. It then summarises total CO_2 emissions from surface transport globally. Finally, alternative development paths for both freight and passenger transport are discussed and regional implications of different scenarios for transport demand and CO_2 emissions are shown up to 2050.

General modelling framework

The *ITF Transport Outlook* presents long-run scenarios, up to 2050, on the development of global passenger mobility and freight volumes. Scenarios on both passenger and freight activity are constructed using ITF modelling tools, which have been partly revised compared to earlier editions of the *ITF Transport Outlook*. The tools are fully compatible with the International Energy Agency's Mobility Model (MoMo), version 2014, and draw partly from its database. A detailed description of the different scenarios used can be found in the Reader's Guide.

Population and Gross Domestic Product (GDP) scenarios are a key driver of the passenger and freight transport scenarios, particularly given the long-run and aggregate modelling approach adopted. Population scenarios are based on world population projections by the United Nations. GDP scenarios are based on OECD's long-term projections developed by the OECD Environment Directorate. We discuss the main features of both these projections in the following chapters. GDP volumes in the *ITF Transport Outlook* are noted in constant 2005 US dollars expressed in purchasing power parity (PPP) terms. This allows for accurate comparison of actual production volumes between countries based on differences in real costs and controlling for inflation. More specifically, using PPP equalised currencies better illustrates the differences in the real value of developed and developing country economies since it corrects for the generally lower price of non-tradable goods in developing countries.

Freight traditionally correlates strongly with GDP especially during early stages of economic development, and we assume a weaker relation as GDP rises. The surface freight transport scenarios show changes in total regional surface freight volumes (measured in tonne-kilometres) following either a business-as-usual relationship to GDP or a slowing relationship between surface freight and GDP growth (for more details of the model, see section *Surface freight volumes and* CO_2 *emissions* below). The latter is more likely during a dematerialisation of the economy as incomes increase.

Projections for international freight by mode of transport are derived from trade flow projections, up to 2050, developed by the OECD Economics Directorate. These projections show significant shifts in the global trade flows. These flows in value are converted to freight flows in tonne-kilometre using ITF modelling tools. The model is based on a global network model with actual routes and related distances. It takes into account mode choice between different product groups and value-weight ratios for different products. Port emissions are calculated using projections by ITF international freight model of port calls by ship type. We use Lloyd's Marine Intelligence Unit database on vessel movements in 2011, containing information on turnaround times of ships in ports across the world and ship characteristics, which allows for a bottom-up estimation of ship emissions during port calls. In this calculation we assume that ship turnaround times remain at a similar level and that all international obligations that have an impact on ship emissions will be implemented in the timelines currently foreseen (Chapter 3 presents the model details and results).

Population and urbanisation trends indicate that rising mobility demand will be concentrated in urban agglomerations and in particular in those of the developing world. Growth in per-capita income levels also generates transport demand and has in particular a positive effect on the ownership of private vehicles. This in turn tends to increase reliance on private vehicles to meet growing mobility demand. The elasticity of private ownership with respect to per capita GDP follows an S-shaped curve, with ownership rising slowly with income at first, accelerating as income rises through medium levels and slowing again as incomes reach high levels (see Chapter 4 and section *Surface passenger volumes and* CO_2 *emission* below for model details).

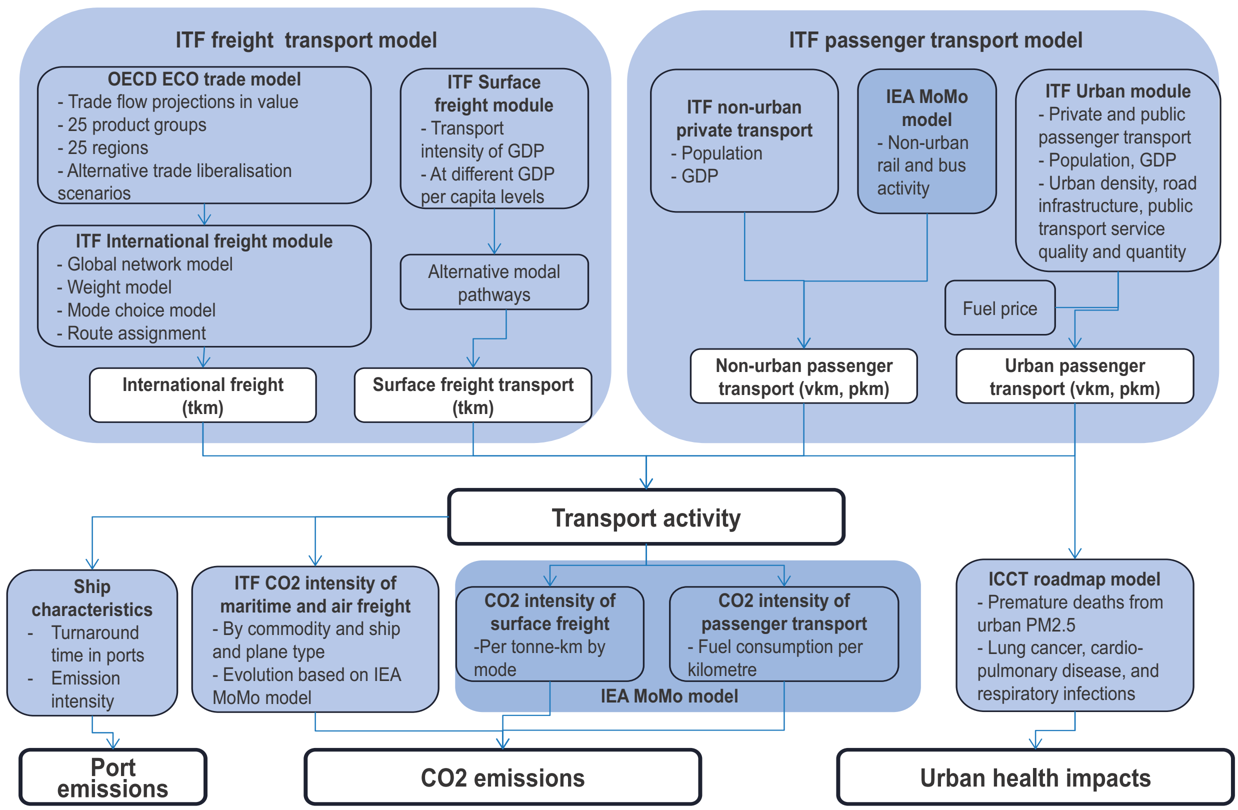
Global passenger trends will be increasingly defined by the modal distribution in urban areas, particularly in developing countries. As discussed in detail in Chapter 4, urban form and infrastructure expansion will play an important role in determining the relative shares of competing modes in meeting rising passenger transport demand in urban centres. High concentration of population allows urban agglomerations to offer transport alternatives to private vehicles. Providing public transport services tends to slow down the increase in car ownership and use as incomes grow. Cities hence have the potential to embark on a less private ownership-oriented pathway and rely more on other modes to meet growing mobility demands. These relationships are modelled in detail in the ITF urban module (see Chapter 4 for model details). Fuel prices will also influence the volumes and modal shares of passenger transport. These have an effect in both urban and rural areas, although their effect is intensified at the urban level due to the higher number of transport alternatives.

We present the world economy, population and related passenger and freight transport projections over the period 2010-50 using two different regional aggregations. In order to illustrate the dimensions of the scenarios we arrange countries by development status and relative size in the global economy (OECD, emerging economies and the rest of the world) and into nine geographical groupings (Africa, Asia, China + India, EEA + Turkey, Latin America, Middle East, North America, OECD Pacific, and the Transition Economies).

The transport scenarios are translated into CO_2 emission scenarios by applying transport technology paths. The technology assumptions and emission calculations are taken from the International Energy Agency's MoMo model and the Energy Technologies Perspectives. The scenario used is the New Policy Scenario (four degree scenario, 4DS, in the World Energy Outlook), which corresponds to a context in which broad policy commitments and plans that have been announced by countries are implemented. Under this scenario fuel economy standards are tightened and there is progressive, moderate uptake of advanced vehicle technologies (IEA, 2013 and Dulac, 2013). The result is a slow but sustained decrease in fuel intensity of travel and carbon intensity of fuel for all vehicles. Such a decrease is in general higher within the OECD region.

The urban passenger transport scenarios are translated into health impacts by applying the methodology developed by the International Council on Clean Transportation (ICCT). The ICCT global roadmap model evaluates health impacts from urban $PM_{2.5}$ (particulate matter with diameter inferior to 2.5 micrometre) as a result of premature deaths from lung cancer, cardio-pulmonary disease, and respiratory infections. This is a streamlined methodology to circumvent the need for detailed air quality modelling emission scenarios by applying transport technology paths for different regional groupings by policy progress, geography, and economic development (ICCT, 2013).

Figure 2.1. **Schematic description of the ITF transport model**



Underlying demographic, GDP and oil price scenarios

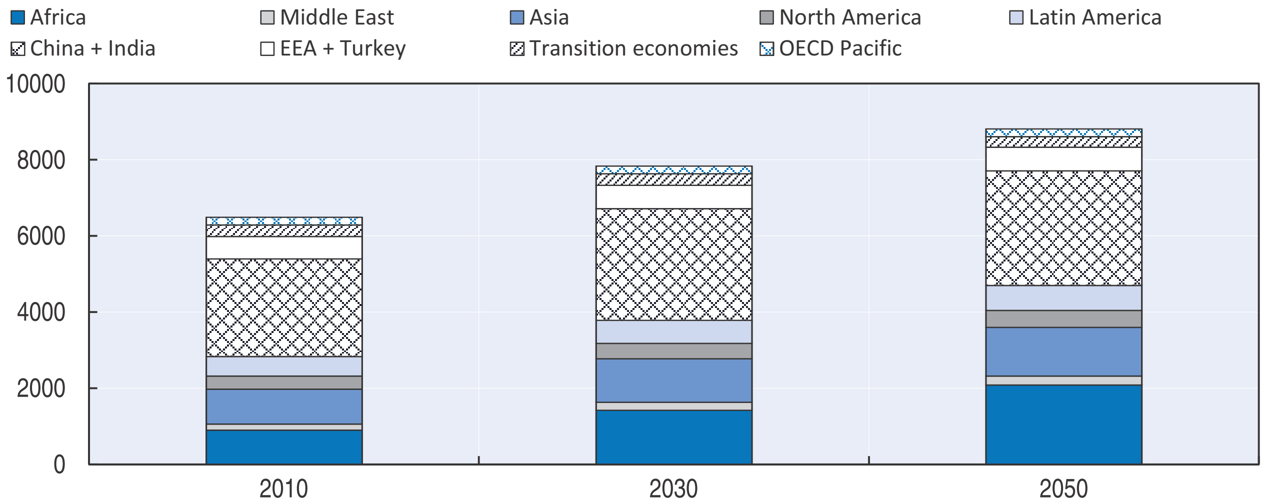
World population to reach 8.8 billion by 2050

World population projections have been updated with the latest available version of the UN World Population Prospects (2014 Revision, medium variant). The update results in slightly lower growth rates compared with the 2012 Revision of the UN data used in the *ITF Transport Outlook 2013*. As seen in Figure 2.2, the world population is expected to grow from 6.4 billion in 2010 to 8.8 billion in 2050 (compared with 6.8 and 9 billion in the 2012 Revision). However, the ranking of growth rates across regions is maintained, with Africa, Middle East and Asia exhibiting the most dynamic population growths.

Revised urban population projections also provide slightly lower figures compared with the previous edition. While in the previous version the share of urban population of the total was projected to grow from 50% to 70% between 2010 and 2050, new projections show slightly smaller increase from 52% to 66%. However, a significant rural-urban shift still takes place over the period, highlighting specifically the importance of the developing world in the phenomenon (see Figure 2.3). Latin America, Africa and Asia have the highest contribution to the world urban population growth, China and India representing 33% of the total urban growth. By 2050, of the 2.7 billion additional urban dwellers, 94% will live in

Figure 2.2. **Population by region, 2010, 2030 and 2050**

Millions



Source: Based on UN World Population Prospects (2014 Revision). Data are ranked by declining growth rates from bottom to top.

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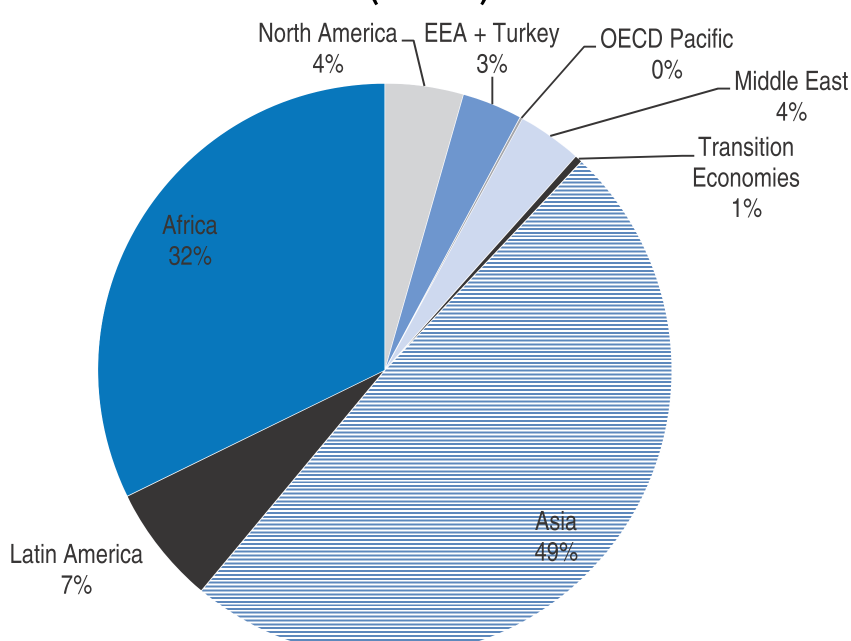
Figure 2.3. **Share of world urban population growth by region of the world (2010-50)**



Source: Based on UN World Urbanisation Prospects (2014 Revision).

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developing countries. The growing population and economic concentration in urban areas call for a particular attention to be paid to transport policies in these regions. We therefore dedicate Chapter 4 to urban transport projections for Latin America, China and India.

World GDP will grow at an annual average rate of 3.3% between 2010 and 2050

GDP scenarios in the *ITF Transport Outlook* are based on the OECD Environment Directorate's growth projections. These are constructed using the ENV-Growth model for more than 190 countries. Box 2.1 presents the general methodology and characteristics of the model (see Chateau et al., 2014 for more details). This model is part of the OECD@100 project "Policies for a shifting world" which combines modelling tools recently developed within the OECD. The GDP projections differ somewhat from the internally produced GDP scenario presented in the 2013 edition of the *ITF Transport Outlook*. The rest of the section presents global GDP projection with a regional breakdown and highlights main differences between 2013 edition and the current version. The GDP and GDP per capita figures are presented in Purchasing Power Parity (PPP) terms and in 2005 US dollars.

Box 2.1. **The ENV-Growth model for GDP projections**

The ENV-Growth model is a two-sector model that aims at projecting GDP and per capita income levels for all major economies in the world (currently more than 190 countries). The core of the model is based on the methodology developed by the OECD Economics Department (for further details see Johansson et al., 2013; OECD, 2014a) which develops a "conditional growth" framework to make long-term GDP projections.

The ENV-Growth model applies this methodology to a longer timeframe (up to 2100), and to a larger set of countries, including other non-OECD countries. The model has also been enhanced to include fossil-fuel energy both as a production input as in Fouré et al. (2012) and as resource revenues for oil and gas producing countries.

The model assumes that income levels in developing economies will gradually converge towards those of the most developed economies (Barro and Sala-i-Martin, 2004), and places special emphasis on a detailed set of the drivers of GDP growth over the projection period rather than projecting convergence only on income levels. Based on this, long-term projections are made for five key drivers of per capita economic growth, using an augmented Solow growth model (Mankiw et al., 1992):

i) physical capital;

ii) employment, in turn driven by population, age structure, participation and unemployment scenarios;

iii) human capital or labour efficiency, driven by education;

iv) energy demand, energy efficiency and natural resources (oil and gas) extraction patterns; and

v) total factor productivity (TFP).

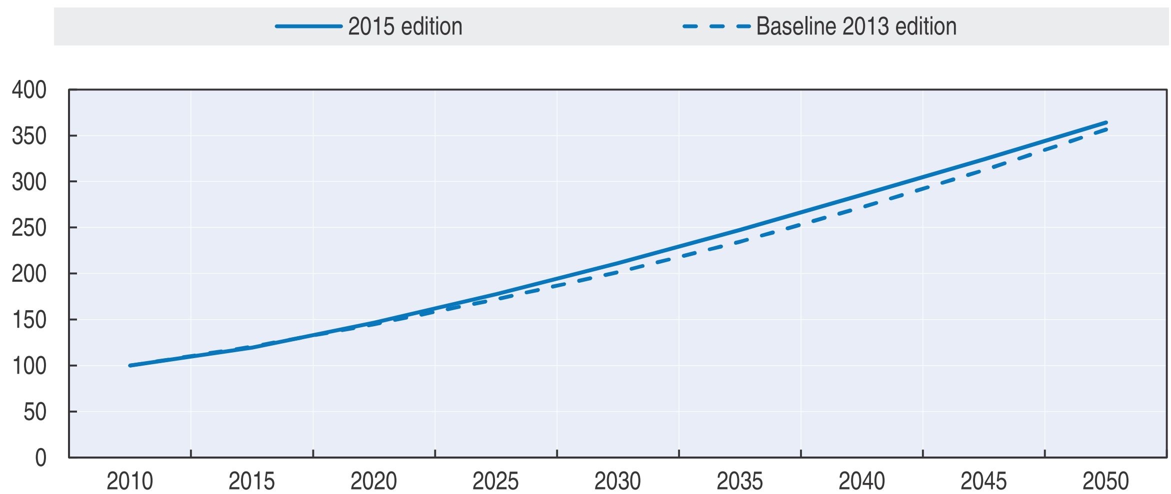
Gradual convergence of regions towards the best performing countries is projected at different speeds, depending on the driver.

This model is part of the OECD@100 project "Policies for a shifting world" which combines modelling tools recently developed within the OECD to analyse key challenges to be faced over the coming decades in the context of multidimensional policy objectives (see OECD, 2014b for more details).

According to the projections, world GDP will grow at an annual average rate of 3.3% between 2010 and 2050. This is close to the 3.2% average annual growth rate in the *baseline scenario* of the *ITF Transport Outlook 2013*. The world GDP growth path is only slightly higher in the 2015 edition and this is illustrated in Figure 2.4 plotting the GDP volume projections (base year 2010) in the two editions.

Figure 2.4. **World GDP volumes**

2010 = 100



Source: Baseline 2013 edition: Based on *OECD Economic Outlook*, Conference Board and IMF World Economic Outlook; 2015 edition: OECD Environment Directorate GDP projections.

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Figure 2.5 presents the same comparison for the OECD, the emerging economies, and the rest of the world. It highlights the main difference between the two projections for the "Rest of the World" group where GDP volumes grow significantly faster according to the 2015 edition, while for the OECD and the emerging economies the two paths are almost identical. Figure 2.6 displays the evolution of the shares of world GDP generated in the same three regions. Here again the main difference concerns the "rest of the world" group. OECD and emerging economies still present a decreasing participation in the world GDP volumes generated but the tendency is emphasised in the 2015 edition compared with the 2013 projections. This partly reflects higher growth projections for Africa and Asia but also slightly lower growth in emerging economies, illustrating the downside risk associated with the transition in emerging economies from export- and investment-led growth to more consumer driven growth (see ITF, 2013).

Tables 2.1 and 2.2 compare the average annual growth rates of GDP and GDP per capita between the two sets of projections and for different time horizons. The 2015 projections present higher growth rates especially for Africa and to a lesser extent in Transition economies. The projections for Africa are also more in line with the IMF economic outlook which projects 5.5% growth for Sub-Saharan Africa for 2015 (IMF, 2014). This is partly due to the difference in the underlying models, especially as the ENV-Growth model takes into account fossil-fuel energy as resource revenues for oil and gas producing countries.

Oil price scenarios

Oil price scenarios from the *ITF Transport Outlook 2013* were updated based on the International Energy Agency (IEA) and United States Energy Information Administration (EIA). The reference price scenario corresponds to the New Policy Scenario of the IEA World Energy Outlook 2014 (IEA, 2014) and is also the reference case scenario used in the Mobility

Figure 2.5. **GDP volumes in OECD, the emerging economies and the rest of world**

2010 = 100

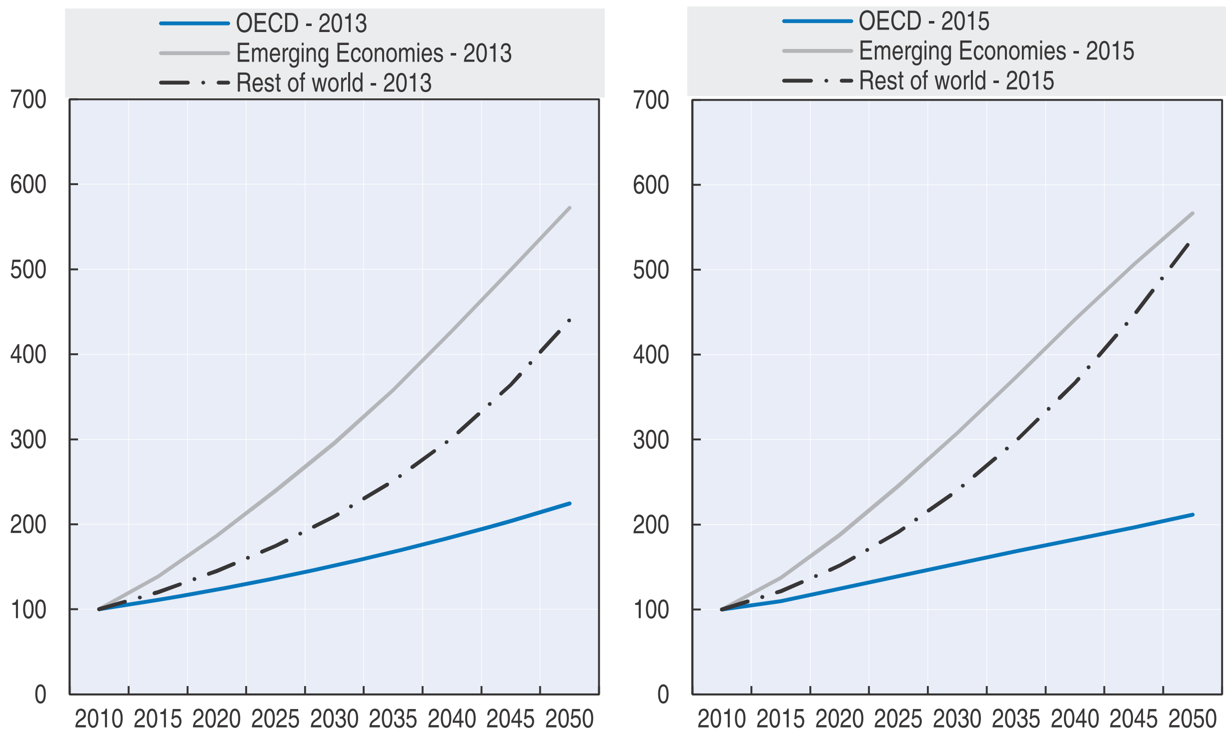

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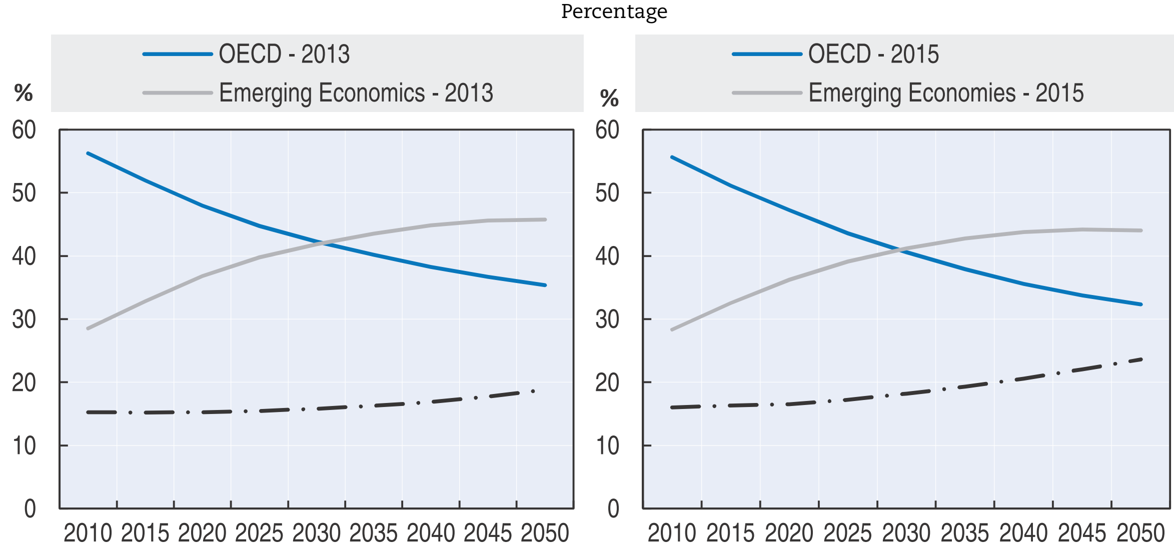
Figure 2.6. **Share of world GDP volumes generated in OECD, emerging economies and rest of world**

Percentage



Source: Based on *OECD Economic Outlook*, Conference Board and IMF Economic Outlook data.

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Table 2.1. **Real GDP**

Average annual growth rates

	2010-20		2020-30		2030-50	
	2015 edition (%)	2013 edition (%)	2015 edition (%)	2013 edition (%)	2015 edition (%)	2013 edition (%)
Africa	5.1	3.8	5.9	3.8	5.1	4.1
China + India	7.5	7.6	5.5	5.1	3.3	3.4
Middle East	3.1	3.6	4.1	3.4	2.8	3.3
EEA + Turkey	2.0	1.8	2.2	1.8	1.5	1.8
Asia	5.1	4.7	5.0	4.4	4.1	4.3
Transition	3.7	2.5	3.4	2.3	1.8	2.2
North America	2.4	2.5	2.0	2.4	1.7	2.1
OECD Pacific	2.0	1.5	1.9	1.7	1.2	1.7
Latin America	3.7	3.4	3.5	3.4	2.9	3.3
World	3.9	3.8	3.7	3.4	2.8	2.9

Table 2.2. **Real GDP per capita**

2005 USD PPP, average annual growth rates

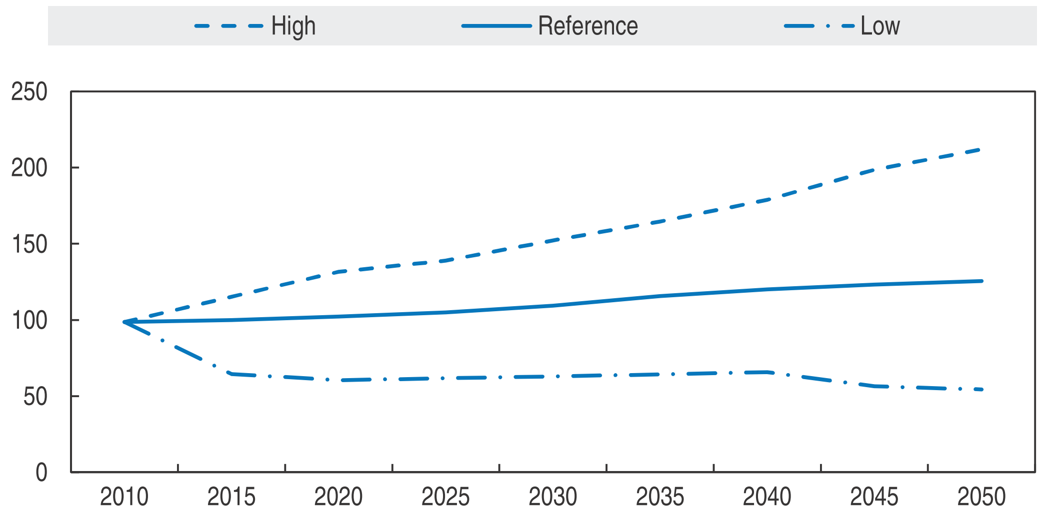
	2010-20		2020-30		2030-50	
	2015 edition (%)	2013 edition (%)	2015 edition (%)	2013 edition (%)	2015 edition (%)	2013 edition (%)
Africa	2.6	1.5	3.6	1.8	3.1	2.3
China + India	6.7	6.8	5.0	4.6	3.2	3.2
Middle East	1.4	1.7	3.0	1.9	2.1	2.2
EEA + Turkey	1.7	1.5	2.0	1.6	1.5	1.8
Asia	3.8	3.4	4.0	3.4	3.6	3.7
Transition	3.7	2.4	3.6	2.4	2.1	2.4
North America	1.6	1.7	1.3	1.7	1.1	1.6
OECD Pacific	1.8	1.4	1.9	1.8	1.4	1.9
Latin America	2.6	2.4	2.7	2.6	2.5	3.0
World	2.8	2.7	2.9	2.5	2.2	2.4

Model of the IEA. The high and low scenarios are based on the continuation to 2050 of projections presented in the 2014 Annual Energy Outlook of the EIA.

The low and high scenarios represent strong deviations from the reference case, as illustrated in Figure 2.7. In the reference case the oil price reaches 125 real USD per barrel by 2050, which is approximately 27% above price levels in 2010, and lies at around 102 real USD in 2020. In the high scenario the oil price reaches 212 real USD per barrel in 2050 (132 real USD in 2020) and in the low scenario it drops to approximately 60 real USD per barrel by 2025 and then slowly increases through 2040. It should be noted that oil prices have been characterised by instability over the last 40 years and that this is likely to continue to be a feature of prices to 2050. The lower scenario relates to long-run elasticities of supply and demand and the potential for new and unconventional sources of oil, oil substitution and energy efficiency to influence prices. The upper scenario relates to short-run elasticities of supply and demand in the presence of market power and political constraints on supply.

Figure 2.7. **World oil price: High, reference and low scenarios**

In 2005 USD



Source: Based on International Energy Agency and United States Energy Information Administration data.

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Global surface transport CO_2 emissions to 2050

Overall transport volumes and CO_2 emissions from both passenger and freight transport will increase strongly between 2010 and 2050. This growth is much more pronounced in non-OECD economies since this is where most economic growth will occur and transport correlates strongly with economic growth.

CO_2 emissions will grow more slowly than transport volumes in part due to policies to improve fuel economy. These are generally more powerful than modal shift policies. In developing countries, the impact of fuel economy improvement will be less marked. Improving fuel economy has the added benefit of containing the cost of mobility in times of high oil prices.

Globally, and for all scenarios considered, CO_2 emissions from surface freight and passenger transport are to rise between 34% and 106%. In non-OECD economies, this range is considerably higher and lies between 162% and 314%. In the OECD, we can expect a decrease of 31% in the lowest case while in the highest case emissions are to stay at their 2010 level over the period 2010-50.

The scenarios also highlight the rising share of surface freight transport emissions in total surface transport emissions. In 2010 emissions from surface freight are 42% of the total emissions but by 2050 they are 60%. In the OECD, freight share of total CO_2 emissions grows from 33% to 45% while in non-OECD economies it grows from 54% to account for 65% of total emissions. Exploiting cheap abatement options in the surface freight sector therefore can be expected to have large payoffs.

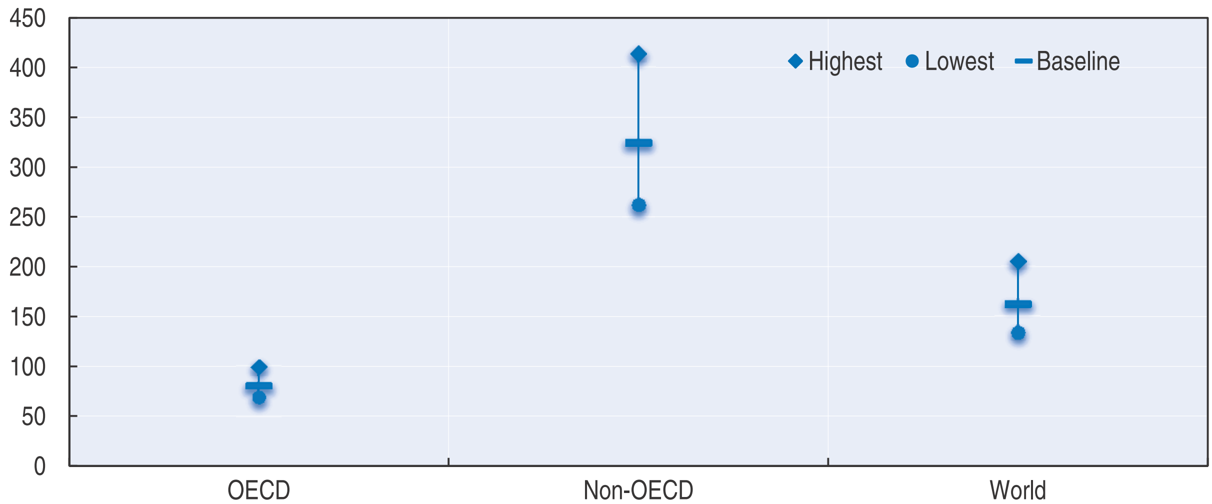
Surface freight transport volumes and CO_2 emissions

Methodology

This section introduces the International Transport Forum projections for surface freight, defined as all freight transported by road or rail within the borders of a country (but which may have origin or destination outside of this country). As discussed in Chapter 1, it

Figure 2.8. **CO_2 emissions from surface freight and passenger transport, 2050**

2010 = 100



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has been relatively established that historically surface freight volumes correlate strongly with Gross Domestic Product (GDP). The freight intensity may decline as lower income economies develop or see more of their added value derive from services. This so-called decoupling of freight volumes and GDP has been pursued by policy makers and, for instance, highlighted in the European Union Communiqué following the Göteborg European Council (2001). However, evidence of this decoupling for individual countries is scarce in the literature and only observed in few countries, including the United Kingdom and the United States. On the contrary, freight intensity in continental Europe increased between 1980 and 2000 when European integration took place, partly because the integration eased the sourcing and marketing of products outside national borders (McKinnon, 2007). The recent expansion of the EU and the advent of large free-trade agreements may accentuate this process.

We find that Gross Domestic Product and freight intensity are highly correlated, with an average long-term elasticity of 0.98 found in the panel of countries. This corroborates a classic result of the literature, establishing this relationship (see for instance Bennathan et al., 1992). According to our estimates, the long-term elasticity (referred to as freight intensity in this section of the Outlook) significantly depends on income level; freight intensity decreases from around 1.2 for low income economies to 0.8 for high income economies (Table 2.3).

Table 2.3. **Freight intensity as a function of GDP per capita**

Income group (PPP, 2005 USD)	Freight intensity
0 – 3 999	1.18
4 000 – 19 999	0.98
20 000 – 39 999	0.87
40 000 –	0.82

A reduction in the transport intensity of GDP can result from a dematerialisation of production, mainly driven by growing services shares in Gross Domestic Product. Our estimates show that the relative importance of the service sector in the economy can explain the difference in freight intensities between countries (see Table 2.4). Although our estimates show that the freight intensity as a function of percentage of services in GDP is statistically more significant than as a function of GDP per capita, the two dataset bear a lot of resemblance as many low income countries have low levels of services in GDP and *vice versa*. Since long-term projections for the percentage of services in GDP are not available, our scenarios for future surface freight volumes are based on freight intensity as a percentage of income (see Box 2.2 for model details).

Table 2.4. **Freight intensity as a function of percentage of service in GDP**

Percentage of services in GDP	Freight intensity
0 – 49	1.17
50 – 69	0.98
70 – 100	0.77

Box 2.2. **Methodology for estimating freight elasticity and tonne-kilometres**

The underlying dataset for model calibration is the International Transport Forum data on surface freight (road and rail) transport between 1992 and 2011. This dataset covers all 54 ITF countries, including major non-OECD countries (China, India and Russia, in particular).

The elasticity of freight volumes to GDP, in tonne-kilometres, is evaluated using log-log models. Because very few data are available as projections up to 2050, only GDP and GDP per capita are used as explanatory variables. One model based on the percentage of service in the economy is also tested, but is not used for predictions.

A preliminary analysis shows that the United States has very high freight volumes compared to what all regression models predict and that it has a great influence on regression results. For this reason, a dummy variable for this country is included in the model.

To examine the impact of income level, elasticities are allowed to depend on GDP per capita. The final model from which the results of this section are derived is the following:

$$\log(Tkm) = C_I + \beta_I \log(GDP) + \beta_{USA} I(USA),$$

where the constants and the coefficients for GDP depend on the income group. The model examining the effect of services in the economy is similar:

$$\log(Tkm) = C_S + \beta_S \log(GDP) + \beta_{USA} I(USA).$$

It must be noted that, since panel data are used, there is a risk of fitting spurious regressions, if freight volumes and GDP are not co-integrated. However, this does not appear very likely here, as there are many countries and few years considered (see Hurlin and Mignon, 2007). Based on existing evidence, the regression chosen should allow the identification of a long-term trend (Phillips et Moon, 1999).

Freight volume projections up to 2050 are then derived using GDP and GDP per capita projections for years 2010-50 and the elasticities given in the model. For the benchmark year 2010 observed tonne-kilometres are used when available. Otherwise, estimates from the final model are used.

Scenarios

Moderate or strong decoupling of freight intensity from GDP is not a certain pathway for all economies. To capture different potential outcomes regarding freight volumes and related CO_2 emissions, we present three different freight intensity scenarios:

- *Business as usual:* freight intensity remains unchanged throughout the 2010-50. This constitutes an upper bound (*Highest*) for freight volumes by 2050.
- *Declining intensity:* freight intensity evolves following the growth in income of countries. As countries move to higher GDP per capita levels, their freight intensity declines as presented in Table 2.3. This is the most probable outcome (*Baseline*) if no specific policies are introduced for a stronger decoupling.
- *Decoupling:* freight intensity for all countries decreases to 0.7 by 2030. This sets a lower bound (*Lowest*) for freight volumes by 2050. The target year (2030) and freight intensity in the decoupling scenario are based on several publications (see for example van Essen et al., 2009 or McKinnon, 2007) and are also linked to the EU White Paper for Transport Policy (European Union 2001).

For arriving at CO_2 emissions, the different freight intensity scenarios are completed by alternative rail share scenarios. Available data show that there is a strong correlation between the modal share of rail for surface freight (expressed in tonne-kilometres), and the level of income of countries. On average, rail accounts for 41% of total surface freight in low income economies, 38% in middle income economies and 22% in high income economies. This correlation is still present once country size is taken into account. This is generally explained by the higher value of the goods transported in high income economies and suggests that, even though a higher rail share is desired by policy makers for more sustainable development, the upwards transition of most economies may imply a higher share of road in internal freight. One notable exception is the United States, which displays a very high rail share of freight. Various explanations have been advanced, ranging from the type of goods transported and size of the country to the particular efficiency of the rail freight system (Vassago and Fagan, 2007).

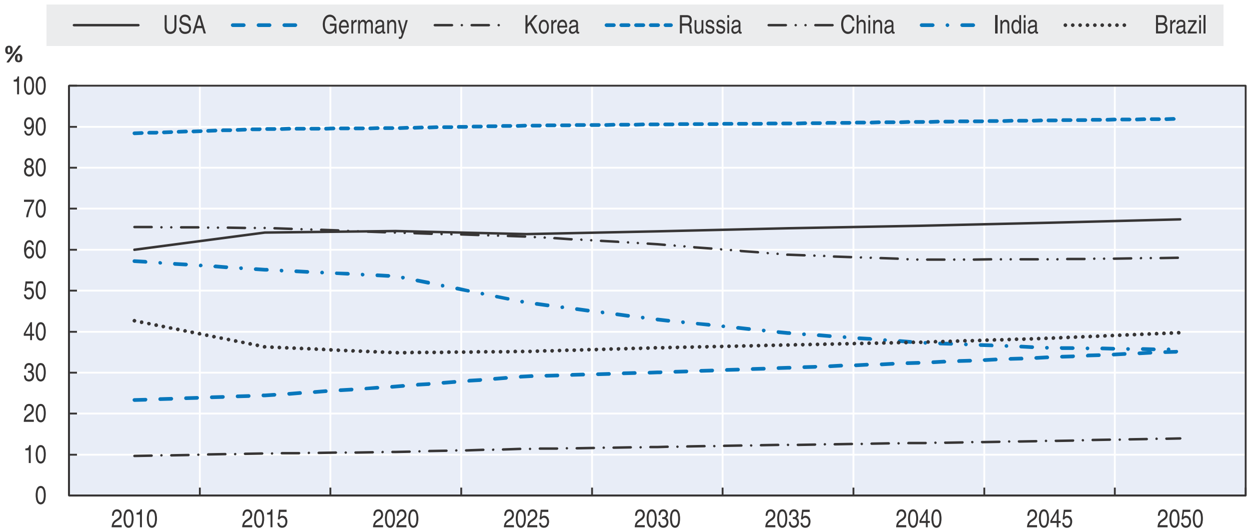
The decline in rail share is also reflected in the International Energy Agency's transport technology paths in the New Policy Scenario we use for calculating CO_2 emissions. Between 2010 and 2050, the modal share of rail decreases significantly for China and India and, between 2010 and 2025, for Brazil. Moreover, at a given income level, there are non-negligible disparities between countries. The graph below suggests that, on top of infrastructure provision, rail share is also strongly influenced by the sectorial composition of economies, the size of countries and national policies.

In order to highlight the impact of alternative modal share scenarios on future CO_2 emissions, we present three different pathways for rail share:

- *Central scenario* consists of modal share presented in the IEA's MoMo model under the NPS scenario, according to which rail share will decline for the major emerging economies. This is also comparable to the modal share underlying the previous edition of the *ITF Transport Outlook*. We also consider this to be the most likely scenario, as discussed above.
- *Low rail scenario* takes the lowest rail share observed in each region, except for the European Union, where rail share is assumed to remain constant after 2015 (low post-crisis levels).

Figure 2.9. **Rail share of surface freight in the IEA New Policy Scenario**

Selected countries, 2010-50



Source: IEA Mobility Model.

StatLink http://dx.doi.org/10.1787/888933168615

- *High rail scenario* takes the highest rail share observed for each region, except for areas where rail infrastructure is notably low and not expected to increase over the projection period (especially in Asia and Africa).

The combination of the freight intensity rail share scenarios results in four alternative CO_2 emission scenarios up to 2050 (Table 2.5). We consider the *Baseline scenario* as the most probable outcome. The *Highest* and *Lowest* scenarios define upper and lower bounds for freight volumes and CO_2 emissions by 2050. The *Upwards transition* scenario attempts to capture the twofold effect of income growth for low and middle income economies: a shift to lower freight intensity but also to higher share of road transport as the goods transported become of higher value.

Table 2.5. **Summary of alternative scenarios for surface freight projections**

Scenario	Freight intensity	Rail modal share
Highest	Business as usual	Low rail
Baseline	Declining intensity	Central
Upwards transition	Decoupling	Central
Lowest	Decoupling	High rail

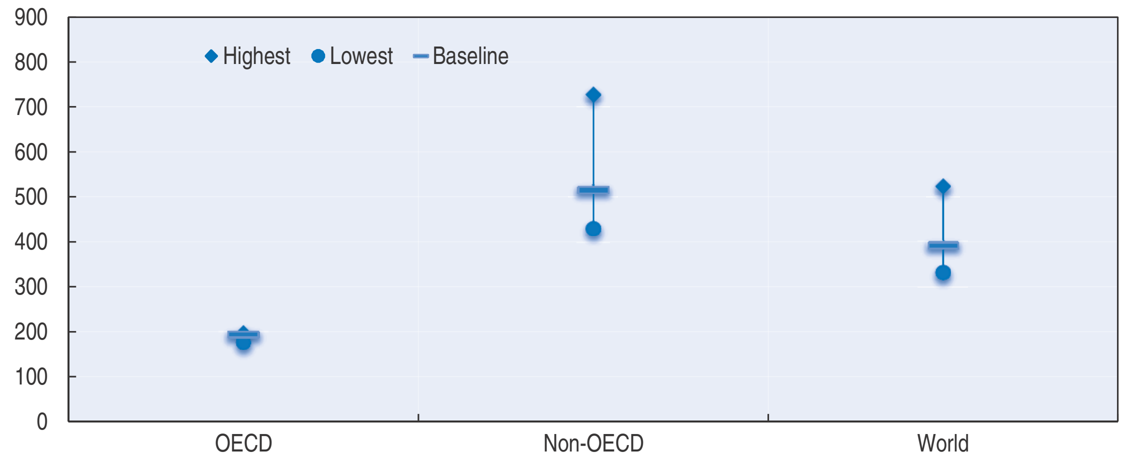
Surface transport projections: results for OECD and non-OECD

Figures 2.10 and 2.11 show the growth of surface (road and rail) freight volumes in tonne-kilometres and related CO_2 emissions for OECD and non-OECD economies, between 2010 and 2050.

The results show a significant increase in both freight tonne-kilometres and CO_2 emissions linked to the surface freight transport sector by 2050. Surface freight growth ranges from 232% to 423% of 2010 levels in the world. The related CO_2 emissions increase from 136% to 347% by 2050. The OECD/non-OECD breakdown shows that this increase

Figure 2.10. **Surface freight transport in tonne-kilometres, 2050**

2010 = 100



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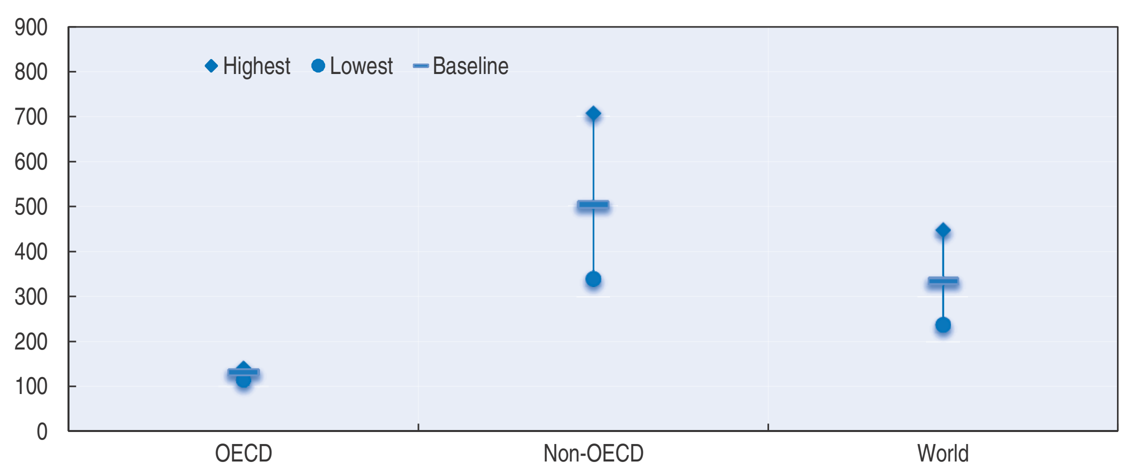
mainly comes from non-OECD economies, which will represent as much as 80% of global surface freight volumes by 2050, compared to around 60% today (see Figure 2.12).

In OECD countries, surface freight growth ranges from 77% to 97%. CO_2 emissions remain nearly at their 2010 levels in the *Lowest* scenario but this would only happen if OECD economies produce less freight per unit of GDP as they do today and would be able to increase the modal share of rail for freight. In a more likely scenario, emissions will grow by 31% by 2050.

Figure 2.11. **CO_2 emissions from surface freight transport, 2050**

2010 = 100



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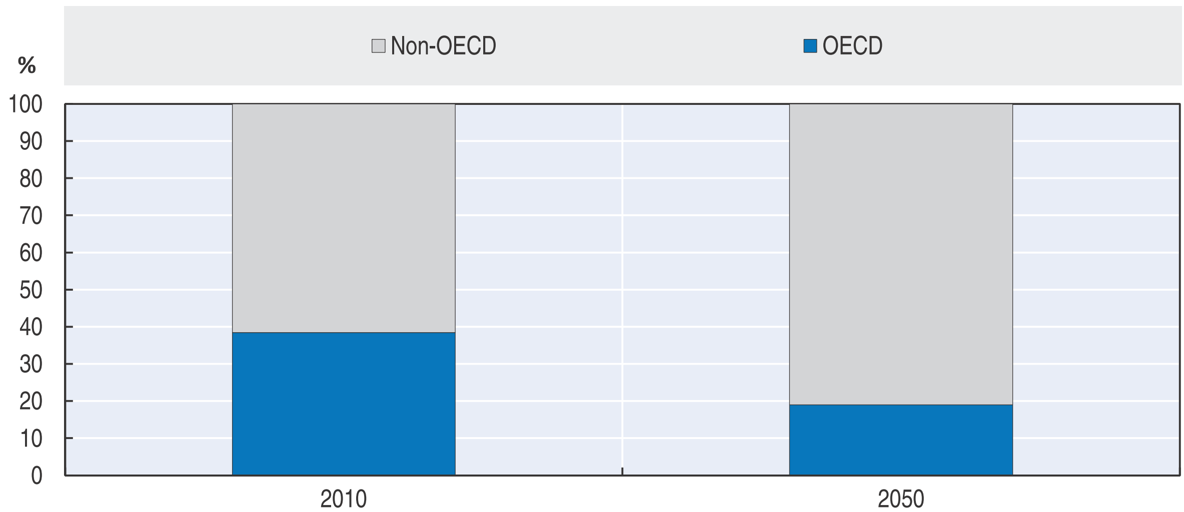
The world growth of surface freight volumes will be driven by non-OECD economies, where growth ranges between 329% and 628% for freight volumes and between 239% and 608% for the CO_2 emissions. The difference between the highest and the lowest scenario for non-OECD economies reflects the uncertainties related to the direction these economies will take in terms of composition of production and the modal share of freight.

Figure 2.12. **OECD and non-OECD share of surface freight transport, 2010 and 2050**

Baseline scenario



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For instance, a growing share of services in the GDP may result in dematerialisation of production and reduction in the transport intensity of GDP.

Regional breakdown of surface freight transport projections

High-income countries (EEA + Turkey, North America and OECD Pacific) witness the lowest increase in tonne-kilometres, with an average doubling of freight by 2050. This results in a decrease of the global share of surface freight tonne-kilometres in high-income countries, from around 35% in 2010 to less than 20% in 2050. The range of outcomes, measured by the difference between the *Highest* and *Lowest* scenarios for freight volumes, is also very narrow compared with other regions. This is due to the already low freight intensity in 2010 in these countries, staying relatively constant in the *Baseline* and *Highest* scenarios while slightly decreasing in the *Lowest* scenario by 2050.

In terms of CO_2 emissions, the growth in surface freight volume will result in only a small variation in emission growth between the different scenarios. CO_2 emissions will remain at around the 2010 levels in the *Lowest* scenario for EEA + Turkey and the United States and increase by 30% in the OECD Pacific region by 2050. There are only small differences between the *Baseline* and *Highest* scenario with emissions increasing around 10%-40% depending on the region by 2050. The biggest difference between scenarios is for the EEA + Turkey region, with a 50% difference between the *Highest* scenario (existing rail share throughout the period) and the *Lowest* scenario, which assumes the modal share of rail reaches that of Germany everywhere in the region.

Latin America, Middle East and Transition economies show moderate growth in tonne-kilometres in all scenarios. According to the *Baseline* scenario, surface freight volumes grow by 140% in Transition economies and over 250% in the Middle East and Latin America. Several countries in the group will see their GDP per capita grow above USD20 000 by 2030, the level at which, according to our estimates, decoupling of freight intensity from GDP occurs. Depending on the development of freight intensity, especially in Middle East and Latin America, and the pace of this development, freight volumes are projected to grow between 177% (*Lowest* scenario for Middle East) and over 343% (*Highest* scenario for Latin America).

CO_2 emissions are projected to grow by 93% in Transition economies and 190% in Middle East and Latin America in the *Baseline* scenario. The difference between the *Highest* and *Lowest* scenarios is relatively large and suggests that the effect of transport growth on CO_2 emissions can be mitigated if adequate measures are taken to ensure that available rail infrastructure is used to its full potential. This is especially true for Russia and Brazil, which account for a large share of surface freight in these regions.

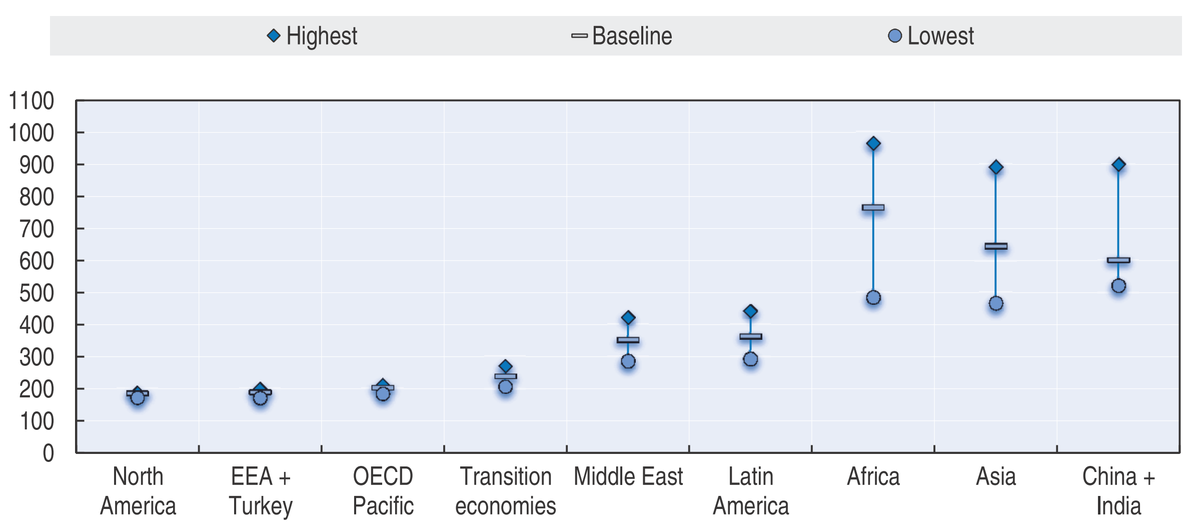
Africa and Asia, including China and India, see the highest growth in surface freight tonne-kilometres by 2050. Surface freight tonne-kilometres are estimated to grow by 667% in Africa, 548% in Asia and 500% in China and India in the *Baseline* scenario. For Africa, projections have been significantly revised upwards from the 2013 edition mostly because of higher GDP projections for the region. The share of surface freight represented by China and India greatly increases from 35% in 2010 to over half of the global tonne-kilometres by 2050, while the share for North America will decline from 25% to around 10%.

The difference in surface freight volumes between the three alternative scenarios is high for these world regions, because of difficulties in predicting the evolution of freight intensity as GDP per capita grows. Future freight growth will strongly depend on the future development path in these countries, with the lowest outcome probable only if developing countries move towards more service-oriented economies.

The biggest growth in terms of CO_2 emissions will take place in China and India, 678% by 2050 in the *Baseline* scenario. More broadly, contrary to developed economies, the growth in surface freight is accompanied by a dramatic increase in CO_2 emissions in Asia and

Figure 2.13. **Growth in surface freight tonne-kilometres by world region, 2050**

2010 = 100



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Africa. This stems from the combination of two factors: the lower penetration of efficient technologies in these countries and the predicted decrease in rail share for China and India as the economy grows. The difference between the *Highest* and *Lowest* scenarios for CO_2 emissions is not significantly larger than the same difference for freight volumes. This leads us to conclude that rail share of total surface freight is not the main determinant of CO_2 emissions. Instead, the main determinant of differences in future CO_2 emissions in these regions is related to the uncertainties coming from growth prospects and the freight intensity of that growth. This is illustrated by the range of alternative outcomes; in the *Highest* scenario (with business as usual rail share and freight intensity) the CO_2 emissions in China and India would grow by almost 800%, while in the *Lowest* scenario the emission would grow by around 350%.

Figure 2.14. **Share of surface freight tonne-kilometres by world region**

Baseline scenario

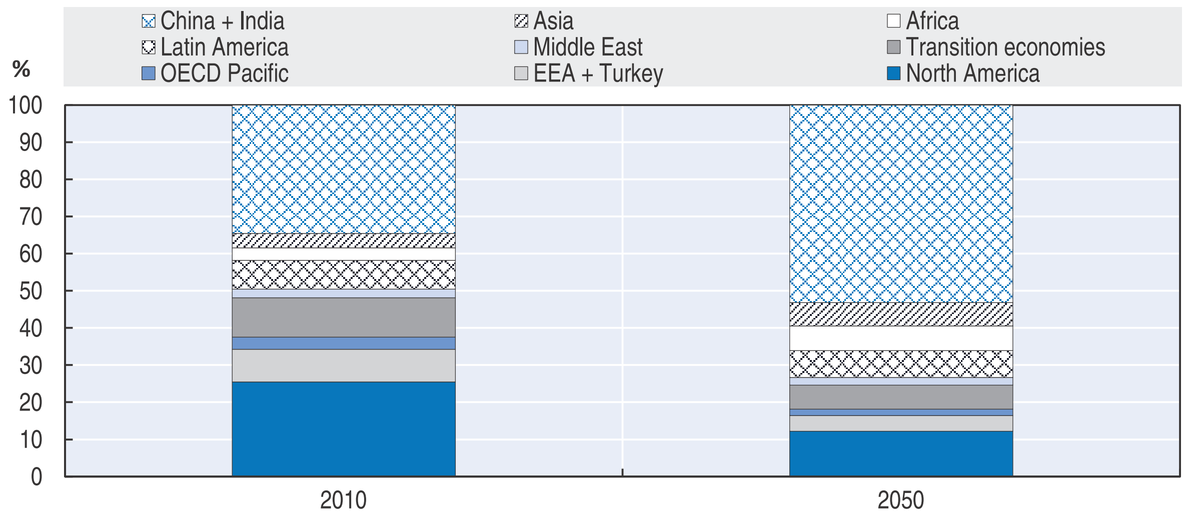

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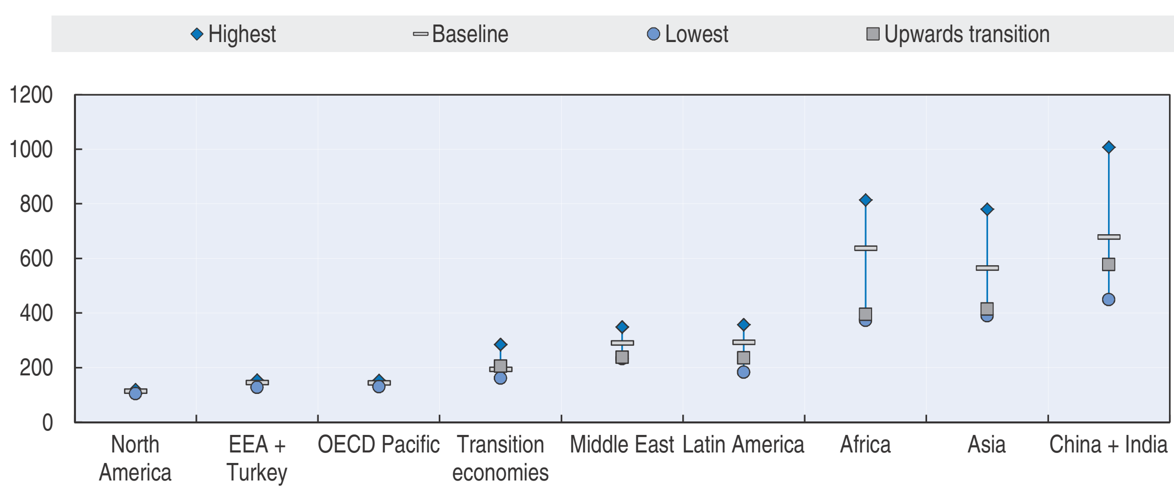
Figure 2.15. **Surface freight CO_2 emissions by world region, 2050**

2010 = 100



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Surface passenger transport volumes and CO_2 emissions

Methodology

This section introduces the International Transport Forum projections for surface passenger transport. These include all trips made by road (private vehicle and bus or coach) and rail. The biggest change concerning surface passenger transport relates to the very likely growth in car stocks. While car usage has peaked, at least in high-income countries (see Chapter 1), developing economies are experiencing a surge in car sales, which is profoundly changing travel patterns in these countries.

Urban mobility patterns are the subject of a specific modelling work in this Outlook, for at least two reasons. First, there are clear differences between urban and rural mobility patterns: trip purposes and available modes are different in both situations. Second, with cities becoming economically very powerful in low and middle income countries, they are experiencing a dramatic shift towards private mobility, with car numbers likely to surge to high levels. This shift, by its magnitude, is modifying mobility patterns at country level, even though it takes place at city level. Because of the different urban contexts globally, the evolution of urban mobility is the object of region-specific studies. Detailed results for Latin America, Indian and Chinese cities, where private travel is likely to grow most, can be found in Chapter 4.

Due to the concentration of income in urban areas and/or the elevated levels of urbanisation in these countries, the urban income-ownership pathways will account for much of the difference in national and regional fleet composition, travel patterns and related externalities. This is why a large part of our scenarios rely on urban variables. These are explained in detail in Chapter 4. Non-urban vehicle ownership and mobility levels also vary in the different scenarios, but to a lesser extent.

Our model is based on vehicle stocks, which are later converted to vehicle-kilometres and passenger-kilometres. The average vehicle-kilometre and passenger-kilometre by vehicle vary by mode, country and scenario (for instance, fuel prices can impact vehicle ownership and vehicle annual mileage) and are benchmarked against current values. Stocks for the various forms of surface transport are either modelled in-house or derived from other modelling framework.

Four-wheelers in Latin America, China and India

At the urban level, we estimate an S-curve linking GDP per capita and vehicle ownership levels. The main urban variables (urban density, public transport quantity and quality, road provision and fuel prices) modify this relationship and allow to study public policies at the urban level. Future vehicle ownership levels are then computed according to different scenarios modelling the evolution of the variables describing the urban context in these countries.

For non-urban four-wheelers ownership, we follow the methodology of Dargay et al. (2007), which include an element of urbanisation level. National ownership rates are the average of urban and non-urban levels weighted by population shares in each sector (see Figure 2.16).

Four-wheelers in other countries

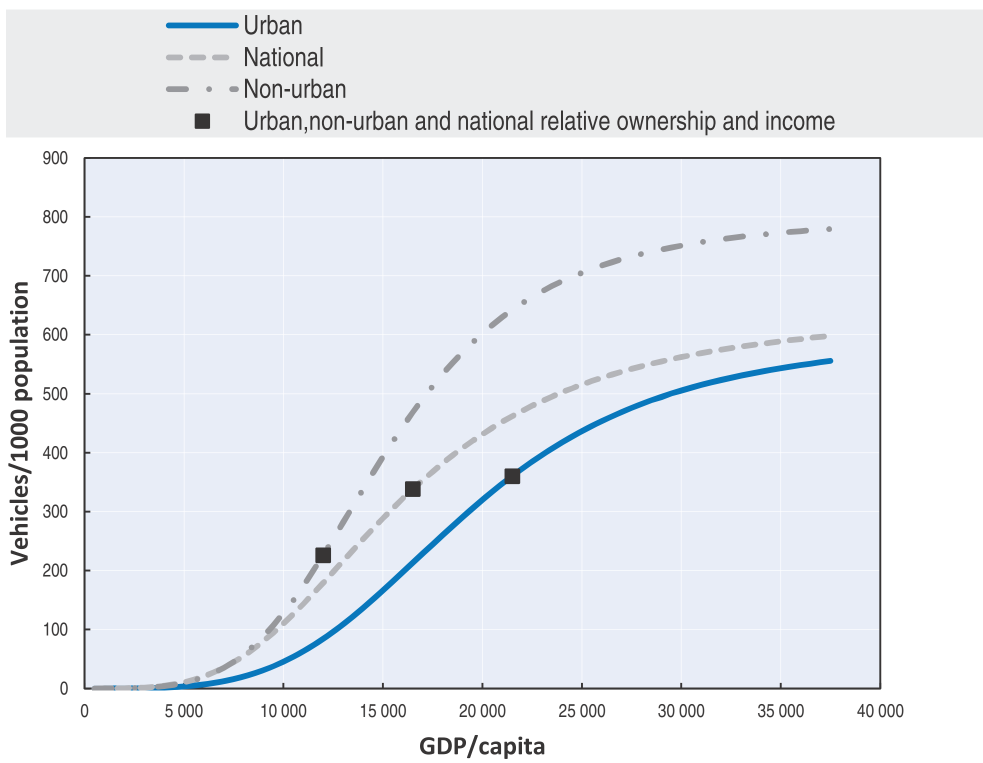
For other countries, we follow the methodology of Dargay et al. (2007) to obtain a business as usual trend for four-wheeler ownership levels. This gives an income-

Box 2.3. Dargay, Gately and Sommer's framework for world car ownership projections

The framework develops a model for vehicle ownership simulations into the future. It is estimated on the basis of pooled time-series (1960-2002) and cross-section data for 45 countries that include 75% of the world's population. The main driver for vehicle ownership is GDP/capita. The framework explicitly models the vehicle saturation level (the maximum level of vehicle ownership in a country) as a function of observable country characteristics: urbanisation and population density.

Source: Dargay et al. (2007).

Figure 2.16. Relationship between urban, non-urban and national vehicle ownership



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ownership pathway for each country or region which was shifted from the average using coefficients calculated in the Latin American case study for every element of the urban context, weighted by the share of urban population in each of the countries. In this way, the methodology produces national scenarios that account for differences in levels of urbanisation. Ownership is also made dependent on the segment of the income-ownership pathway countries belong to. Countries at income levels where the income elasticity of ownership is low will, for example, have lower overall changes.

Urban bus and rail

In the case of Latin America, India and China, public transport (rail, bus and BRT) is part of the scenario variables and passenger-kilometres are an outcome of the model.

In other regions, starting points were taken from MoMo for urban bus and urban rail vehicle kilometres for 2010 were estimated by ITF using data for urban rail track infrastructure from the International Association of Public Transport (UITP) and the vehicle-kilometres/infrastructure ratios calculated from the UITP's Millennium Database. Total public transport service in each scenario was assumed to expand at the same rate relative to urban population as in the Latin American case study in each of the scenarios. The percentage of rapid kilometres was assumed to grow at the same rate, relative to per capita income growth of each region, as in the Latin American case study.

Two-wheelers

There are no world ownership projections similar to the Dargay framework for two-wheelers. For countries and regions where specific research has been conducted, we used these to calculate business as usual income-ownership pathways. This is the case for India, China, and the ASEAN and Other Developing Asia (ODA) regions (Tuan, 2011; Asian Development Bank, 2006; Argonne National Library, 2006). For other MoMo regions we took Baseline trends provided in the MoMo model to calculate the functions to be shifted. The procedure by which such functions where shifted to calculate income-ownership pathways under the different policy scenarios is similar to that used for four-wheel vehicles and accounts for regional differences in the same way.

Inter-urban mobility in all countries

Finally, inter-urban bus and rail passenger numbers and CO_2 emissions are extracted from the IEA Mobility Model. Their values under the NPS scenario constitute a business as usual trend, which we assume in all scenarios.

Scenarios

We developed three alternative policy scenarios for surface passenger transport predictions. They are based on urban mobility in Latin America, India and China (see Chapter 4 for more details). They include elements of the urban context, such as road or public transport provision, as well as fuel prices.

The *Baseline* scenario reflects a business as usual trend for all the variables of interest. It gives an indication of future trends in case no specific policy is applied. The *Highest* scenario assumes the urban development in all countries is towards private mobility, with high road provision and low public transport. Fuel prices remain low during the 2010-50 period. It constitutes an upper bound for CO_2 emissions. Finally, the *Lowest* scenario takes the opposite view that fuel prices will rise, public transport quality and quantity will be significantly improved while road infrastructure will be kept at a minimum level. This is our lower bound for car ownership and urban transport related CO_2 emissions.

Surface passenger transport projections: results for OECD and non-OECD

Figure 2.17 summarises growth in vehicle-kilometres for passenger traffic between 2010 and 2050 for the OECD, non-OECD economies and the world as a whole, under the three scenarios. Figure 2.18 shows the corresponding levels of CO_2 emissions on the basis of the IEA's business-as-usual (New Policies) scenario for the development of vehicle technology.

Vehicle-kilometres will grow between 117% and 233% by 2050 depending on the scenario. Growth is much larger outside the OECD region than within it. This is both

Figure 2.17. **Passenger transport in vehicle-kilometres, 2050**

2010 = 100

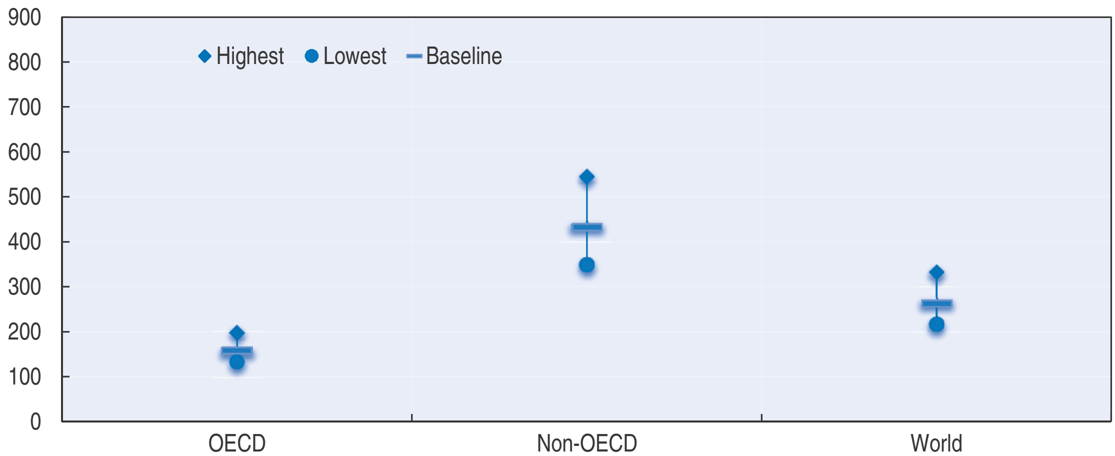

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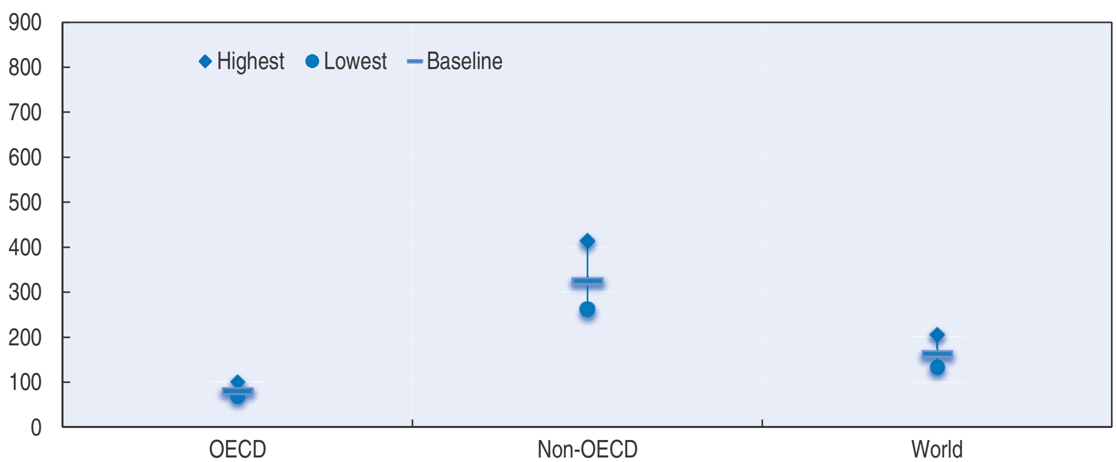
Figure 2.18. **CO_2 emissions from surface passenger transport, 2050**

2010 = 100



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because GDP grows faster and transport demand increases more strongly with GDP outside of the OECD.

For OECD economies, vehicle-kilometres will grow by 57% between 2010 and 2050 in the baseline scenario while the difference between the *Highest* and *Lowest* scenarios is small. Outside of the OECD, higher elasticity of vehicle-kilometres with respect to GDP lead to much bigger differences in the passenger transport volume projections: combining GDP growth with low fuel prices, low public transport expansion, and car-accommodating urban transport policies would lead to vehicle-kilometre volumes increasing 5.5 times. The same economic growth under a context of high oil prices, transit-oriented policies and low road infrastructure expansion would result in a growth of vehicle-kilometres of 3.5 times over 2010 levels.

Applying the IEA New Policy Scenario for the evolution of vehicle technology to these transport volumes leads to increases of CO_2 emissions for passenger transport from 34% in the lowest scenario to 106% in the highest. The central scenario results in 63% emissions growth. The global results reflect declining emissions in the OECD (by about 20% in the central scenario), and rising emissions outside of it, by 224%.

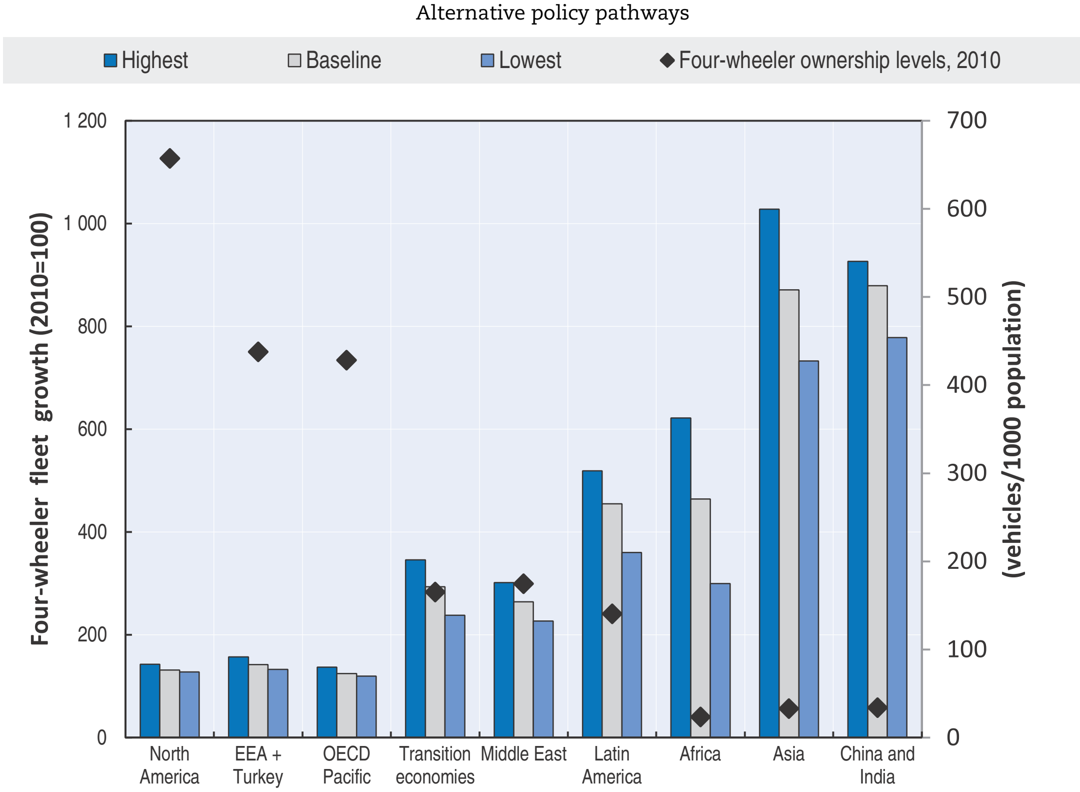
Comparing CO_2 and vehicle-kilometre growth, it is clear that emissions grow more slowly than transport volumes. In the OECD, vehicle-kilometres grow and emissions decline. Outside the OECD, emissions grow only three-quarters as much as vehicle-kilometres. The declining CO_2-intensity of vehicle-kilometre volumes is to a very large extent the consequence of technological change. Changes in modal split, measured in vehicle-kilometres, and changing weights of regions within the broad OECD and non-OECD categories are of minor importance. This holds for all scenarios.

Regional breakdown of surface passenger transport projections

The effects of alternative urban transport policy on future private vehicle fleet growth vary by region. They depend on income and current location on the "S-curve" describing the development of motorisation as well as the present level of urbanisation and speed of future urbanisation. Another important factor is the level of market development for different types of private vehicle rates (four- and two-wheelers). Description of past trends for two-wheelers is based on Montezuma (2012). Figures 2.19 and 2.20 show the 2010 four-wheeler and two-wheeler ownership by world region and expected 2010-50 growth for these vehicles, under the three different urban policy setting scenarios. Figure 2.21 presents passenger travel by region while Figure 2.22 related CO_2 emissions for alternative urban policy scenarios.

Figure 2.19. **Four-wheeler ownership in 2010 and growth to 2050 by world region**

Alternative policy pathways



StatLink http://dx.doi.org/10.1787/888933168715

Figure 2.20. **Two-wheeler ownership in 2010 and growth to 2050 by world region**

Alternative policy pathways

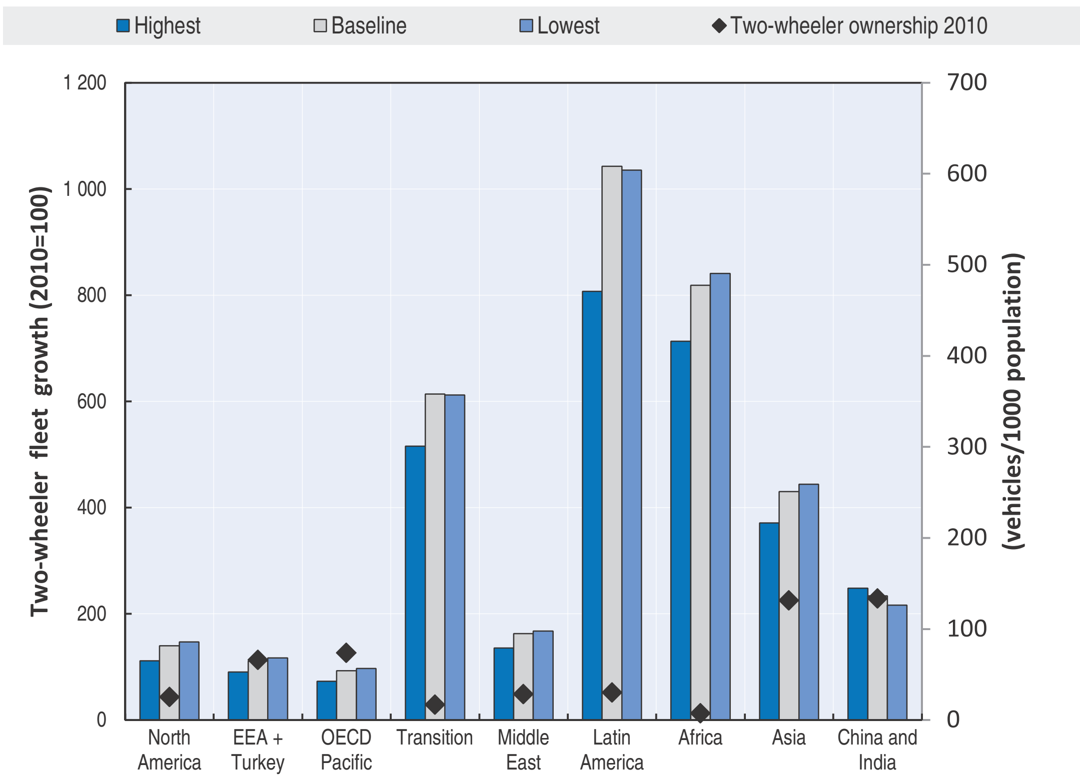


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Figure 2.21. **Vehicle-kilometres for passenger transport by world region, 2050**

Different urban pathways, 2010 = 100

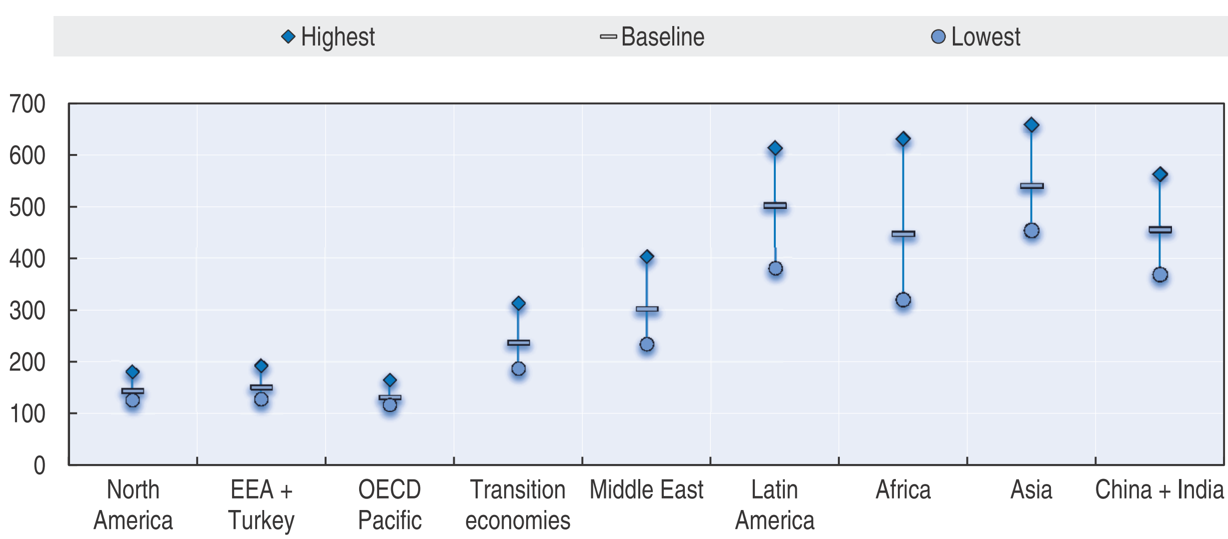

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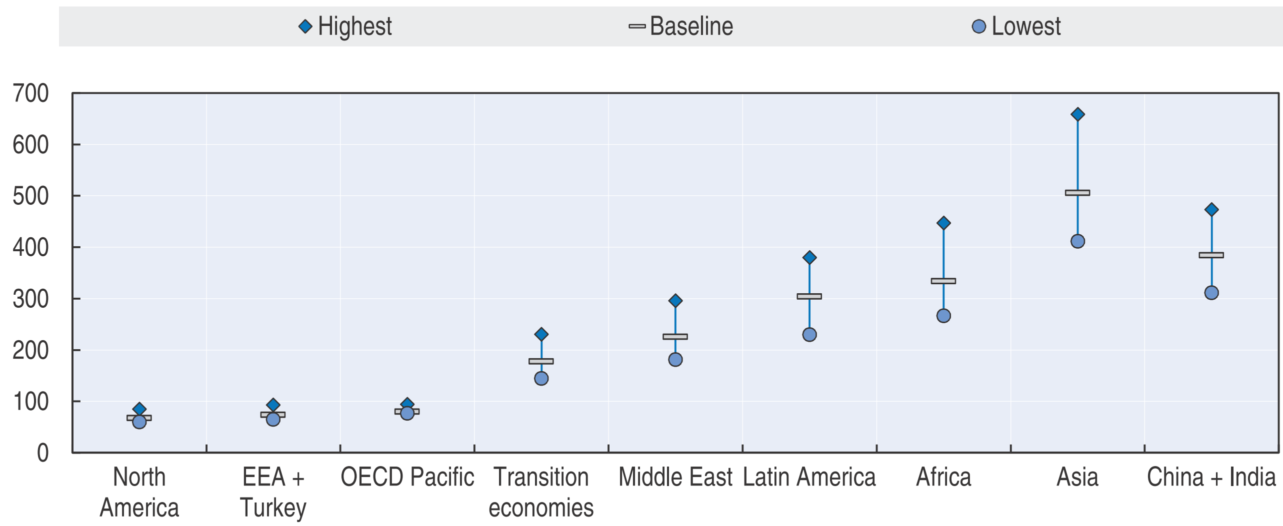
Figure 2.22. **CO_2 emissions from passenger transport by world region, 2050**

Different urban pathways, 2010 = 100



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Higher-income regions (North America, EEA+Turkey, OECD Pacific) have already gone through the accelerated motorisation phase in the past and today show a low and decreasing elasticity of private vehicle ownership with respect to income. The low elasticity between income and private vehicle ownership plus the modest economic growth expected during the period, suggest low growth in the private vehicle fleet of high income regions in the years to come. Since urbanisation rates in these regions are high, diverging urban transport policy has appreciable effects, even when income elasticities are low. The highest differences are generated by higher road infrastructure expansion in urban centres which raise saturation levels for four-wheelers and therefore shift a significant part of the growth towards these vehicles. Overall higher private fleet growth is generated by these scenarios. Differences in public transport and fuel prices have a limited effect because of the small income elasticities in late motorisation stages. Nonetheless, these elements could explain to a great extent the inter-regional difference in the ownership levels at which elasticities began to decrease and therefore, different present private ownership levels between them. Vehicle-kilometres are to rise between 18% and 94% in higher-income regions while related CO_2 emissions are projected to remain at their 2010 levels in the high scenario and decline by 40% in the low scenario by 2050.

Middle-income regions (Transition Economies, Middle East, Latin America) are still on an upward motorisation path, showing high elasticities of income to private vehicle ownership. Relatively high income elasticities of private vehicle ownership and personal income growth rates expected during the 2010-50 period translate into elevated growth in the private vehicle fleet of middle income regions. Growth in the Transition region remains more four-wheeler oriented while the Middle East and Latin American regions show a significant shift to two-wheeler private mobility, and account for a large part of the overall growth of these vehicles. As in the case of higher income regions, greater than baseline urban road expansion generates a shift in the growth of the private vehicle fleet towards private cars. However, because ownership of private vehicles is still far from saturation levels, lower urban road expansion also generates significant differences, shifting private ownership growth towards two-wheelers. Scenarios where there are lower fuel prices and lower expansion of public transport result in higher private vehicle growth while those with high fuel prices and significant expansion in public transport slow-down the translation of increasing incomes into private vehicle fleet growth. Effects in public transport development and pricing scenarios have a larger impact in the development of two-wheelers in the Middle East and Latin America regions. Global effects of urban policy changes modelled are emphasised in the three regions since urbanisation rates are already high and continue to rise. This is more so in Latin America which is and will continue to be the most urbanised region among the three. Vehicle-kilometres are projected to grow between 281% and 514% in Latin America while growth is slightly lower for Transition economies and Middle East (between 88% and 214% depending on the scenario). CO_2 emissions are to rise between 45% and 280% with largest growth taking place in Latin America.

Lower-income regions (Africa, Asia, China and India) are at an early stage of overall motorisation but some of the countries present already high income elasticities of private motorisation. Many others are at income levels at which elasticity is still low. As a group, countries in these regions present the highest income elasticities to vehicle ownership and have the highest economic growth throughout the studied period. Because of this it is in these regions that the highest growth in private vehicle fleets occurs. Compared with our earlier edition, our growth projections are higher for Africa and Asia while slightly lower for China and India. In Asia, growth in four-wheelers is high and accounts for the largest part of the overall four-wheeler growth. Because of the high income elasticity, urban policy alternative scenarios have a greater effect in the increase of these vehicles. Higher urban road provision generates an even higher growth in four-wheelers and accelerates the slow-down in two-wheeler ownership. Higher development and better quality public transport, accompanied with higher fuel prices generates smaller growth in private vehicles and especially in four-wheelers. In Africa, both types of vehicles present relatively high growth and two-wheelers increase their share of the fleet. Better and higher public transport translate into lower overall private vehicle motorisation. The impact of alternative urban transport policies grows as countries become more urban. This will be especially the case after 2050, when urbanisation rates catch up with those corresponding to the middle and higher-income regions. Growth in vehicle-kilometres by 2050 is strongest in other developing Asia (between 355% and 560%). CO_2 emissions are to rise between 167% and 559%, depending on scenario and region. This reflects income growth in different regions but also importance of urban transport policies (low and high scenario).

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Chapter 3

International freight and CO_2 emissions to 2050

This chapter presents results from the ITF's international freight model with projections for international freight flows and related CO_2 emissions for 25 regions and 20 product groups up to 2050. Results are also presented for alternative trade liberalisation scenarios between 2010 and 2050. The importance of domestic transport linked to international freight is highlighted. The chapter then discusses shipping emissions in ports and finally provides several policy conclusions for the supply chains of the future.

As a result of the global and regional increases in population levels and economic activity, the maritime transport is expected to exceed 250 trillion tonne-km by 2050. This increase is driven by the changes in the product composition but also by growth in the average hauling distance caused by changes in the geographical composition of trade. The expected growth of international freight transport by 2050 will set unprecedented challenges to the transport system and lead to increasing capacity constraints and CO_2 emissions. Continued efforts should therefore be made to improve the efficiency of the transport system by optimising supply chain structures and increasing vehicle utilisation.

Understanding long-term linkages between international trade and freight transport

International trade has grown rapidly in the post-war era with trade volume growing twenty-seven fold between 1950 and 2007, three times faster than world Gross Domestic Product (GDP) growth (WTO, 2007). Growth in trade is also expected to outpace GDP growth over the next 50 years, according to recent OECD projections. The value of international trade is estimated to grow by a factor of 3.4 by 2050 in real terms. Trade patterns will however change due to fragmentation of production processes and integration of emerging markets into global markets. Trade liberalisation, either at a global or regional level, can also have an impact on global trade patterns.

Global value chains, dependent on relatively inexpensive, reliable transport links, are key to economic development. Changes in trade and manufacturing specialisation will have potentially significant effects on global supply chains. The transport sector is interrelated with changes in international production and consumption patterns as well as location choices of multinational companies. Freight transport as derived demand depends on the volume and type of goods produced and consumed at different locations. Location of global production and consumption, structure of trade in terms of nature of goods trade and transport costs all influence the volume of freight as well as the related mode and route choice.

Yet, long-term impact of the changes in trade flows on global transport flows has been overlooked in research. This is probably partly due to lack of data and related projections, and partly due to the inability to estimate the transport component of international trade. Literature has therefore focused in examining local or regional transport flows in production centres and evaluating them under traditional location theories to understand companies' strategies (van Veen-Groot and P. Nijkamp, 1999). There is also extensive literature on how transport costs affect international trade (Hummels, 2007; Hummels and Skiba, 2004; McGowan and Milner, 2011; see also WTO, 2013, pages 179-192 for references and discussion). The estimation of the transportation component of international trade and impact of trade liberalisation on transport flows however is scarce in the literature.

The most comprehensive effort to estimate international transport flows and related greenhouse gas emissions associated with changes in trade flows was carried out by Cristea et al. (2013). They use data on value, weight and modal share of trade for different origin-destination pairs for a base year, distances between each bilateral pair and the greenhouse gas intensity of each transport mode to arrive at related tonne-kilometres and CO_2 emissions. The results for this initial year are then projected up to 2020 using a computable general equilibrium model for changes in the value and composition of trade resulting from tariff liberalisation and GDP growth.

We built upon the methodology developed by Cristea et al. (2013) by developing a new international freight model which has a global transport network as a basis and takes into account changes in production/consumption location, changes in value/weight ratios for products over time and reduction in "fixed costs" of transport associated with distance. Our model results in projections for international freight flows and related CO_2 emissions for 25 regions and 20 product groups up to 2050. Results are also presented for alternative trade liberalisation scenarios between 2010 and 2050 (see Box 3.2 for model details).

The starting point for projections is the world trade scenarios developed by the OECD Economics Department for the period 2004-60 (Johansson and Olaberria, 2014). We built a three step international freight model which allows us to convert trade in value into related freight volumes and CO_2 emissions up to 2050. Underlying the model is a global freight network map with actual routes and related distances for all modes of transport.

Trade does not stop at ports. Goods transported by road or rail from/to production or consumption centres to/from ports are a significant element of international freight not accounted for in previous global freight models. The information about the global production and consumption centres together with the global freight network model allows us to estimate the domestic link of the international freight, providing insights into this important part of international freight – more directly also linked with national transport policies compared with inter-regional movements of goods.

International trade to 2050*

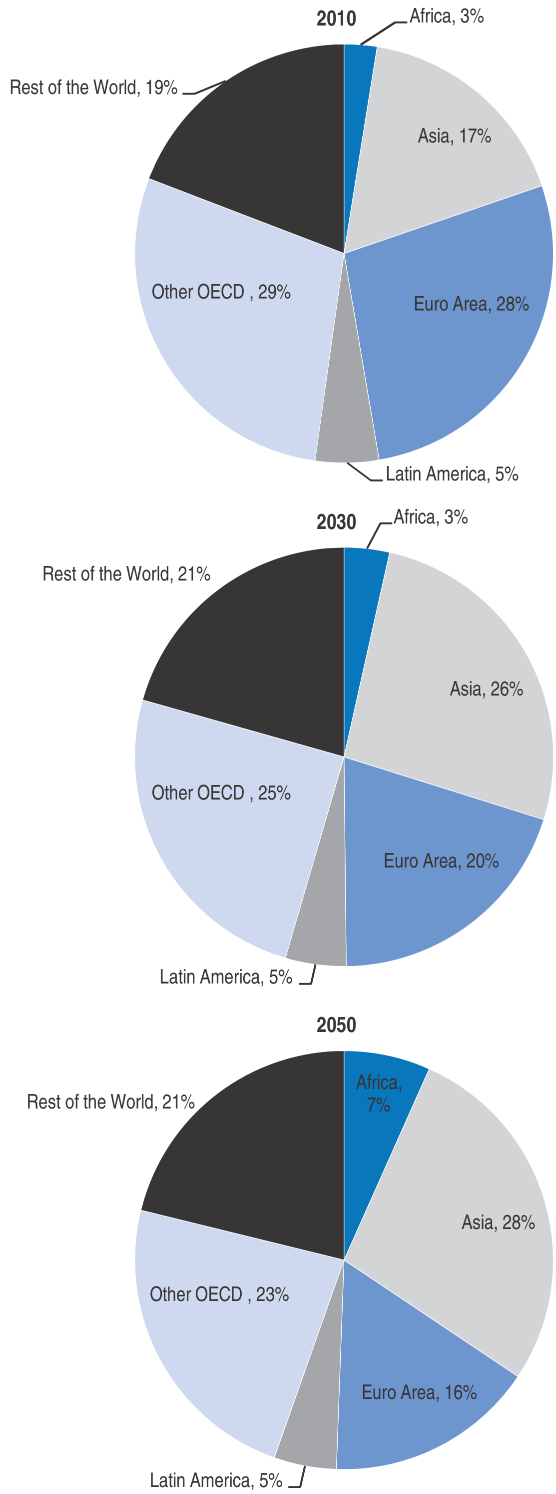
The underlying trade projections assume that GDP will grow at an annual 3% rate, while growth in trade is estimated to grow at around 3.5% yearly. This is almost half of the previous 6.9% growth rate that characterised the period 1990-2007. This indicates that the sensitivity of trade to GDP in the future is expected to be lower than before the financial crisis. The underlying reasons are a decreasing dependency on export-led growth and the assumption of a slowdown of the fragmentation process of global value chains.

Trade patterns are expected to shift geographically, illustrating the unequal distribution of income across world regions and changes in consumption structure and relative productivity. Asia and Africa will face substantial increases in trade shares, thanks to rapid economic growth, mainly after 2030, resulting in large market potential with low production costs. In parallel, trade within the Euro area will perform less efficiently while some OECD countries will undergo a slight decrease of their trade share.

The evolution of the geographical structure of trade towards an increased role of emerging economies matches with the reorganisation of relative importance of different trading partners. Between 2012 and 2060, the baseline scenario of trade projects that trade within the OECD area will halve while it will more than double among non-OECD economies. For instance, trade among Asian economies is estimated to increase from around 6% to 16% over the projection period (see Figure 3.1).

* The results described in this section are based on Johansson and Olaberria, 2014.

Figure 3.1. **Share of world exports, by region**



Source: ITF calculation based on Johansson and Olberria (2014)

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Chemicals, fuels, electronic devices, food and transport equipment account for a large share of world trade in value. Emerging and developing countries will experience sizeable increases in manufacturing market shares at the expense of OECD economies over the projection period. Their shares in service trade are also expected to increase markedly due to the combination of their larger economic size combined with a shift towards higher-value goods as economies become wealthier.

Agriculture and food trade is a significant component in world trade and it is projected to increase to 10% of total trade value by 2050. The United States and Asia (excluding China, India, and Indonesia) will remain the dominant players with an increasing trade share in exports at the expense of Africa and Latin America. Agricultural exports, for example from the United States to China and Africa are to grow significantly over the projection period.

Fast growing emerging economies will see a shift away from low-skilled manufacturing towards services industry as a result of catching-up with income and living standards with more advanced economies. The resulting changes in consumption and domestic demand thus influence their industrial structure. According to the modelling results, there will not be a total shift of industrial activities away from the OECD region due to remaining large trade costs in specific industries.

Box 3.1. **Modelling framework for the long-term global trade scenarios**

The OECD Economics Department (ECO) designed trade scenarios to 2060 using a framework integrating long-term macro projections for the world economy with a sectorial trade model reproducing the key evidence characterising the driving forces of trade and specialisation past trends. The objective is to provide long-term trade scenarios on the assumption that past trends are to continue. This baseline scenario is finally compared with two alternative trade policy schemes. The first one assumes a regional trade liberalisation process involving specific agreements between the United States, Canada, Mexico (NAFTA), the European Union, Switzerland, Iceland and Liechtenstein (EFTA), Australia, New Zealand, Japan and Korea. The second scheme assumes partial multilateral trade liberalisation with a reduction in tariffs on goods, transactions costs, regulatory barriers in services and agricultural support.

The long-run growth model in the OECD Economic Outlook (Johansson et al., 2013; OECD 2013b) provides long-term projections for GDP, saving, investment and current accounts for OECD and non-OECD G20 countries, augmented with projections by Fouré et al. (2012) for other countries. The trade model is a version of MIRAGE, a multi-country, sectorial dynamic micro-founded model developed by the Centre d'Etudes Prospectives et d'Informations Internationales (CEPII) (Fontagné and Fouré, 2013; for details see Château et al., 2014). This computable general equilibrium (CGE) model analyses the global evolution of bilateral trade and sectorial specialisation and covers the world economy for 147 countries and 57 industries, aggregated into 26 regions and 25 sectors in the ECO framework.

Combining aggregate projections and individual (consumers and firms) behaviours underlines the impact of both global trends and country-specific policies on future trade and specialisation patterns, acknowledging international spillovers. Trade projections are presented in value terms, in constant 2004 USD.

Source: Johansson and Olaberria (2014).

International freight and CO_2 emissions to 2050: *Baseline* trade scenario

International trade transferred close to 71 billion tonne-kilometres of freight in 2010, according to the ITF International Freight Model. Comparing the model results with statistics provided by other sources shows that the model reproduces adequately current market behavior. Total maritime and air tonnes and tonne-kilometres estimated by the model are very close to data provided by external sources (see Table 3.1). Of total international freight volume, measured in tonne-kilometres, 85% are carried by sea, 9% by road, 6% by rail and 0.2% by air according to our calculations. These calculations also include freight movement at the domestic link of international freight, usually carried by road. For maritime CO_2 emissions, our model estimate for the base year 2010 falls between the existing IEA figures and calculations done by the International Maritime Organisation (IMO).

Table 3.1. **Comparison of model results for the baseline 2010 statistics**

Variable	Model estimates	Available statistics	Source
Maritime international trade volume [million tonnes]	8 372	8 408	UNCTAD review of Maritime Transport
Air international trade volume [million tonnes]	34	31.8	ICAO
Maritime international trade related freight [billion tonne-kilometres]	60 053	65 599	UNCTAD Review of Maritime Transport
Air international trade related freight [billion tonne-kilometres]	191	158	ICAO
Maritime international trade related CO_2 emissions [million tonnes]	779	644 870	IEA IMO

Sources: UNCTAD Review of Maritime Transport 2012; ICAO Annual Report of the Council, 2012; IEA CO_2 Emissions from Fuel Combustion Statistics; IMO *GHG Study 2009*, International Maritime Organisation.

The growth in world trade in constant value by a factor of 3.4 by 2050 will translate into a growth of world freight volumes by a factor of 4.3 over the same period, measured in tonne-kilometres, under the baseline scenario. This increase is driven by the changes in the product composition but also by growth in the average hauling distance caused by changes in the geographical composition of trade. The average hauling distance is estimated to grow by 12% from 2010 to 2050. Sea continues to account for the bulk of freight transport, although declining slightly to 83% of total international freight in 2050. This is mainly driven by an increase in road share of total freight over the period, from 6% to 10%.

The value density of the goods transported from Africa will increase by 52% by 2050, exceeding the value density of imports from the EEA+Turkey, North America and South America. China and South Korea are predicted to be the leading exporters of high value density products such as electronic components and mobile phones. On the other hand, the United States and Latin America will observe 30%-40% decline in value-weight ratio of exports, primarily due to an increased share of bulk goods in exports.

Rising food demand, especially in Asia and Africa, will prompt a massive increase in food transport volumes. Agricultural products and food imports in China and Africa will grow exponentially, and by 2050 China and Africa will receive almost 32% and 19% of the total world food transport respectively (in tonne-kilometres). On the other hand, the United States will keep its position as the major food supplier in the world and, by 2050, almost 38% of the food transported (in tonne-kilometres) will originate from the United States, followed by Europe (11%) and Brazil (8%), according to projections.

As noted above, significant change will take place in the geographical composition of freight between 2010 and 2050. This is illustrated in Figure 3.3, showing the spatial location of freight corridors and their respective freight volumes in 2010 and 2050 under the baseline scenario. We have divided the world into twelve different transport regions/ corridors and the figure shows that the growth in international freight volume is far from uniform, being significantly stronger in maritime routes and inland connections in Asia.

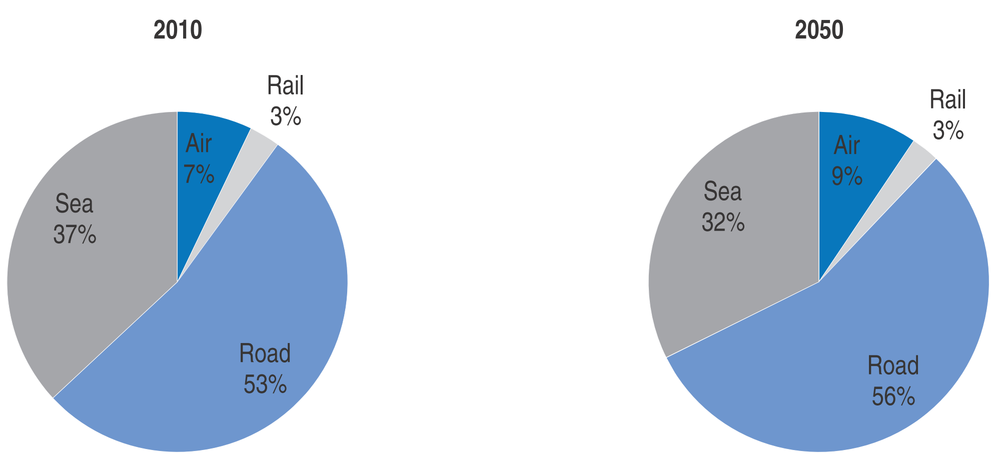
The traditional trade routes between developed economies will grow relatively slowly, whereas the growth of the trade corridors connecting emerging economies will average 17% annually. By 2050, the transportation corridor between the United States and China will be subject to the highest flow of goods both directions. By 2050, the North Pacific corridor will surpass the North Atlantic as the main freight corridor. A significant growth will also take place in the Indian Ocean and Mediterranean and Caspian Sea corridors. This reflects the shift of the economic centre of gravity towards Asia resulting from the greater trade between Asia and the rest of the world, especially North America, Africa and Europe. Despite the slow growth of the intra-European corridor (1.5% annually), it will still remain, in absolute terms, as one of the most active freight transport corridors in the world.

Increasing road share in international freight is attributed to growth in intra-regional trade. Significant growth will especially take place in intra-Asian freight volumes which are projected to grow by over 400% by 2050. Intra-African freight volumes are projected to grow even more significantly (over 700%), although from low initial levels. The share of air transport in landlocked countries will increase close to 2% on average while the share of air transport for coastal countries will stay around 0.3%. Similarly, the share of road transport in coastal countries is expected to remain constant around 4% while road freight transport will constitute almost 12% of the international freight transport in landlocked countries.

These results mirror the trade increase within the Asia and Africa, and also the increasing traffic from/to ports from/to the consumption/production centres. Due to the

Figure 3.2. **International trade related CO_2 emissions by mode**

Baseline scenario



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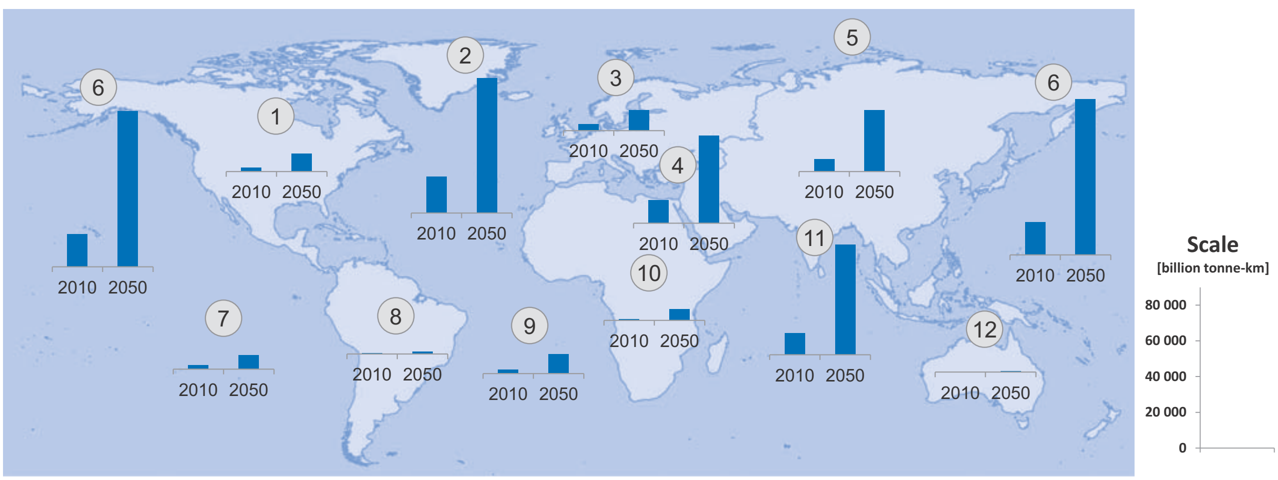
lack of efficient rail network, these movements are mostly carried out by trucks, setting significant pressure on increasing CO_2 emissions.

Indeed, over the period 2010-50, CO_2 emissions related to international freight transport will grow by a factor of 3.9 in the baseline scenario. Road freight accounts for 53% of the total and its share is projected to increase to 56% by 2050. Also air transport will see an increase of 2 percentage points in its contribution to CO_2 emissions by 2050. Sea share is estimated to fall from 37% to 32% (Figure 3.2). These changes are driven by the increasing share of trade by road and air and also by longer average haulage distances. Regionally, or by corridor, the largest increases in CO_2 emissions in absolute terms will take place in Asia and North Pacific, while in relative terms emissions are projected to grow most in Africa (Figure 3.4).

Figure 3.3. **International freight in tonne-kilometres by corridor: 2010 and 2050**

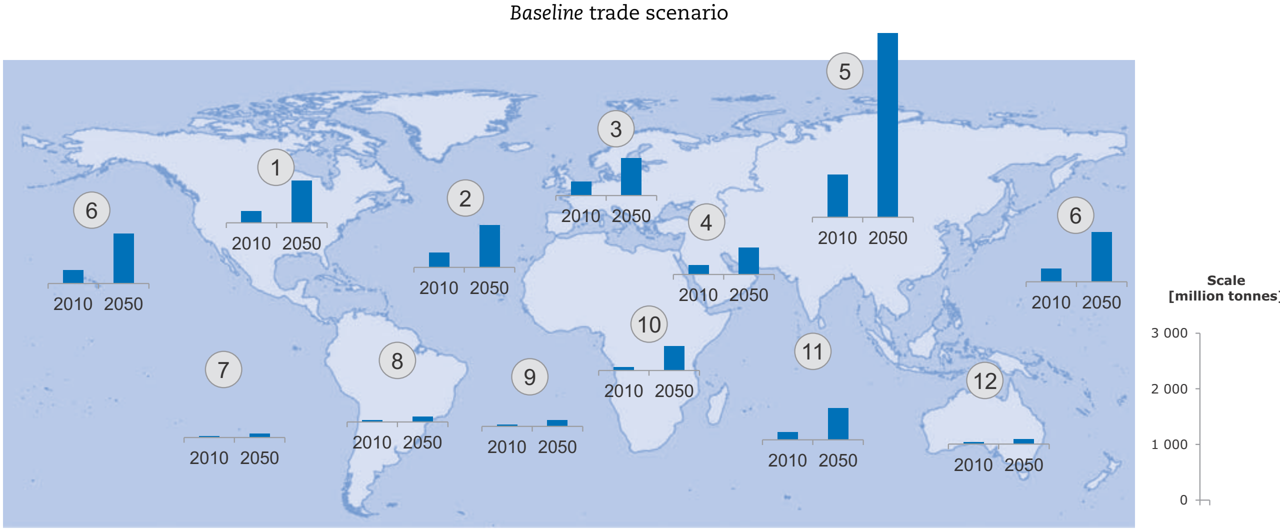
Baseline trade scenario



1) North America; 2) North Atlantic; 3) Europe; 4) Mediterranean and Caspian Sea; 5) Asia; 6) North Pacific; 7) South Pacific; 8) South America; 9) South Atlantic; 10) Africa; 11) Indian Ocean; 12) Oceania.

Figure 3.4. **International freight CO_2 emissions by corridor: 2010 and 2050**

Baseline trade scenario



1) North America; 2) North Atlantic; 3) Europe; 4) Mediterranean and Caspian Sea; 5) Asia; 6) North Pacific; 7) South Pacific; 8) South America; 9) South Atlantic; 10) Africa; 11) Indian Ocean; 12) Oceania.

Relevance of domestic transport linked to international freight

While all freight flows require intermodal transport both at the origin and destination this domestic component of transport related to international freight is usually not accounted for in the literature. Indeed, cargo does not stop at ports but instead continues to economic centres. To incorporate this crucial dimension of freight transport, the ITF model introduces centroids for production and consumption for each region and allows for estimating the freight performed by road or rail from/to ports to/from consumption/production centres.

We estimate that the domestic transport linked to international freight represents around 10% of the total trade related freight globally. This domestic transport link presents great variability, depending on the geographic location of the main producers/consumers in each country. For instance, in China, where most of the economic activity is concentrated in coastal areas, the domestic link represents 9% of the total international trade related freight volumes. In India, on the other hand, where production and consumption centres are located inland, the share is 14%.

Domestic transport linked to international trade represents a large share of total surface freight volume (national and international) in some countries. In China, we estimate this to grow from 9% in 2010 to 11%, assuming that the coastal pattern of GDP concentration in China remains. In the United States, this share is estimated to be 15% in 2010 (our estimate for 2010 corresponds to statistics provided by the US Bureau of Transportation Statistics) but can grow up to 40% by 2050 depending on future trade patterns, and especially on the growth of agricultural exports from the United States to China.

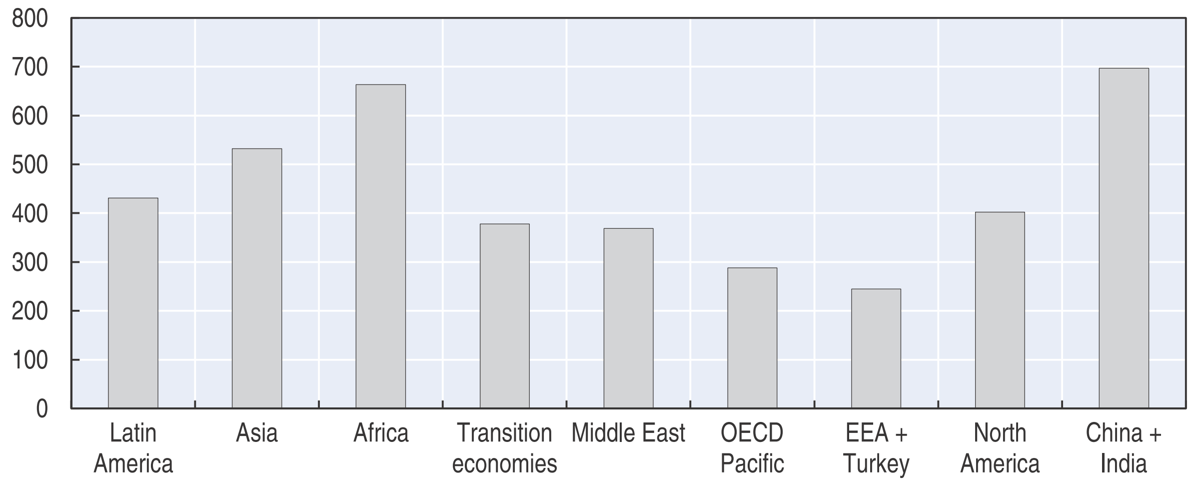
While accounting for 10% of the total tonne-kilometres, domestic freight transport related to international trade accounts for around 30% of the total trade related CO_2 emissions. Because most of the transport of goods from ports to consumption centres is taking place by road, the CO_2 intensity of this freight is significantly higher than for other corridors. These emissions in the domestic link of international trade are further amplified by shipping emissions at ports as illustrated in the section *Shipping emissions in ports*.

Due to the substantial importance of domestic freight related to international trade, some bottlenecks may emerge as a consequence of the expected trade flow changes impacts on freight volumes moving on the national territory. Existing national infrastructure already faces issues of insufficient capacity in some regions of the world. Projected trade flows at the 2050 horizon and the freight related growing volumes highlight the need to assess the capacity of existing national infrastructure such as port terminals, airports or road and rail infrastructure to deal with potential bottlenecks that may emerge.

Indeed, increasing international trade will set unprecedented challenges to port volumes/capacities. Globally, according to our projections, tonnes of goods loaded and unloaded at ports will grow by a factor of 3.8 by 2050 from their 2010 levels. This corresponds to an increase from 17 billion tonnes of goods loaded and unloaded in 2010 to around 66 billion tonnes by 2050. As illustrated in Figure 3.5, growth in port volumes is higher in China and India (600%), Africa (530%), and Asia (430%).

Figure 3.5. **Growth in freight volume in ports by world region, 2050**

Millions of tonnes loaded and unloaded, 2010 = 100



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Impact of trade liberalisation on freight and CO_2 emissions

Impact of trade liberalisation on trade and growth is studied extensively in the literature. However, research on the impact of trade liberalisation on international freight volumes, geographical composition of that freight and related CO_2 emissions is limited. We assess the impact of two alternative trade liberalisation scenarios on freight volumes and CO_2 emissions (for details on liberalisation scenarios, see Johansson and Olaberria, 2014).

In the *bilateral liberalisation* scenario, a free-trade agreement is established in 2012 between the North American Free Trade Area (NAFTA), the European Free Trade Area (EFTA), Australia, New Zealand, Japan and Korea. Tariffs and transaction costs (such as handling at customs) are progressively phased out in this region. Tariffs on goods are abolished by 2060 and transaction costs for goods are reduced by 25% more than in the baseline by 2060. In 2030, bilateral trade agreements are negotiated with key partners of the free trade area including South Africa, The Russian Federation, Brazil, China, India, Indonesia, other ASEAN countries and Chile. With these countries, the free trade area bilaterally reduces tariffs by 50% progressively, until 2060.

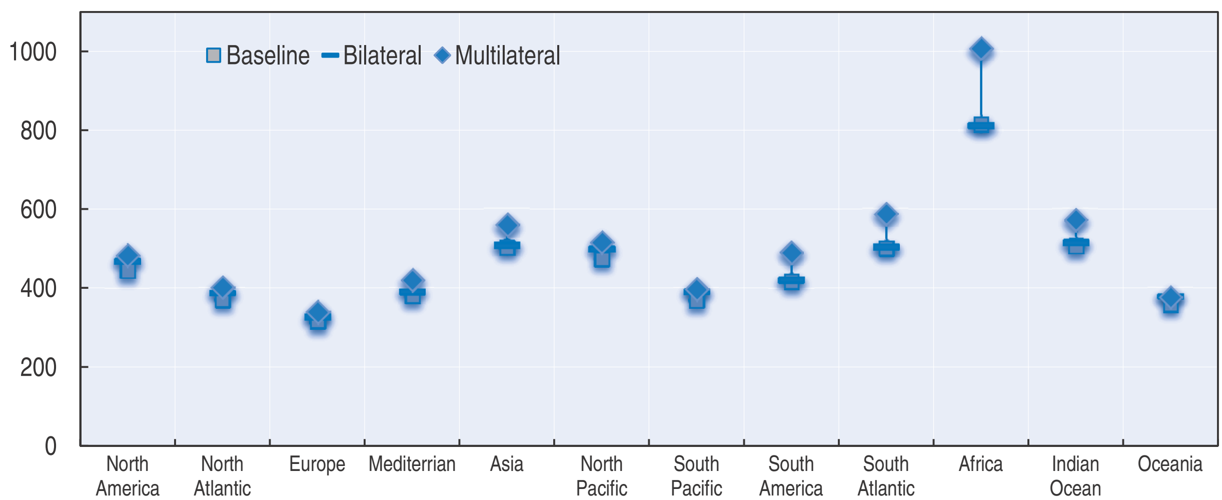
In the *multilateral liberalisation* scenario, tariffs on goods are reduced on a multilateral global basis by 50% by 2060 and transaction costs are reduced by 25% more than in the baseline by 2060. From 2013 agricultural support is reduced by 50% by 2060 in the European Union, the Unites States, Japan, Korea, Canada and EFTA countries.

Overall, the results show that a bilateral trade liberalisation will not significantly affect freight volumes at any of the regions/corridors. In the *bilateral liberalisation* scenario, freight volumes will grow by 350% by 2050, compared with 330% growth in the baseline scenario. By contrast, in the *multilateral liberalisation* scenario trade is reoriented towards the non-OECD area, reflecting comparatively larger reductions in tariffs than in OECD countries as well as stronger underlying growth performance in this area. As a result, global freight will grow by 380% in the *multilateral liberalisation* scenario by 2050 (Figure 3.6). Multilateral trade liberalisation results with significantly more transport volumes especially in Africa, South America, South Atlantic, Indian Ocean and to some extent Asia. The results are driven in part by the increasing intensity of trade and in part by growth in average distance. Liberalisation will not affect significantly the modal split of international freight under any scenario.

The *bilateral trade* scenario results only with a 2% increase in CO_2 emissions compared with the *baseline* emissions in 2050. On the contrary, multilateral trade liberalisation would yield CO_2 emissions 15% more than in the baseline by 2050. The largest increase, in absolute terms, compared to the baseline in CO_2 emissions would stem from Asia, Africa and the Indian Ocean corridor, while in relative terms the greatest increase would take place in Africa (28%), South Atlantic (19%), South America (18%) and Indian Ocean (15%). Under both scenarios, road continues to represent the largest share of CO_2 emissions. However, in the multilateral scenario, the share of air increases more than in the other scenarios. This may underline an effect of trading more valuable goods with more distant, and land-locked, trade partners (Figure 3.7).

Figure 3.6. **Tonne-kilometres by corridor for alternative trade liberalisation scenarios, 2050**

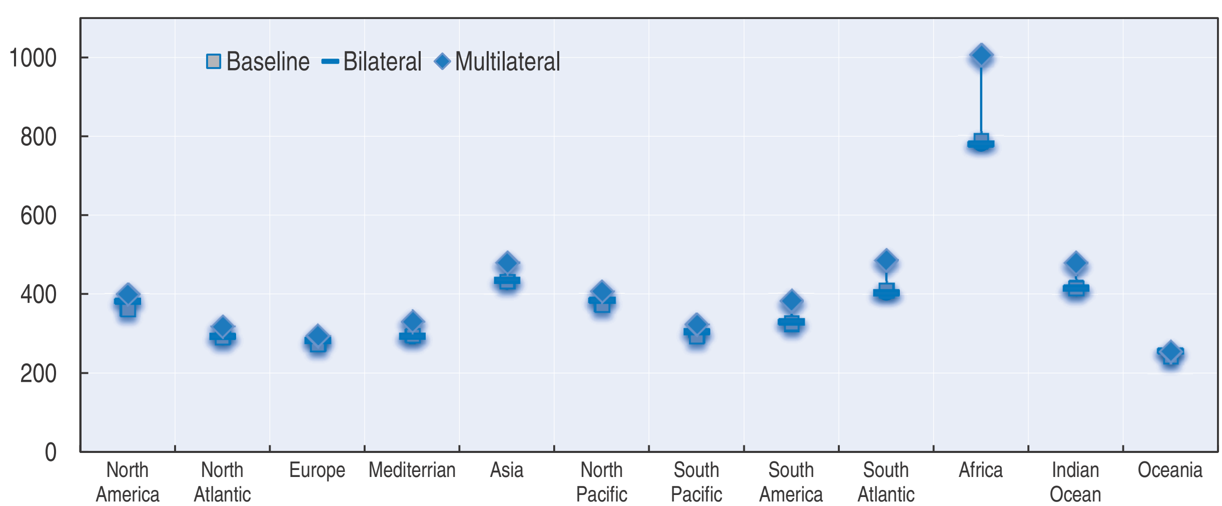
2010 = 100



StatLink http://dx.doi.org/10.1787/888933168788

Figure 3.7. **CO_2 emissions by corridor for alternative trade liberalisation scenarios, 2050**

2010 = 100



StatLink http://dx.doi.org/10.1787/888933168790

Box 3.2. **The ITF International freight model**

The model projects international freight transport activity and related CO_2 emissions up to 2050 based on alternative world trade scenarios. The model includes six main components, each feeding into the next calculations:

- a general equilibrium model for international trade, developed by the OECD Economics Department, covering 26 world regions and 25 commodities of which 19 require transport (see Box 3.1 for more details);
- a global freight transport network model based on 2010 data;
- global production/consumption centroids;
- an international freight mode choice model calibrated using Eurostat and ECLAC data;
- a weight/value model to convert trade in value into weight, calibrated for each commodity and transport mode; and
- CO_2 intensities and technology pathway by mode.

The final outputs of the model are freight tonne-kilometres by transport corridor by mode and related CO_2 emissions. Each of the model components are described in more detail below.

Transport network model

The model consolidates and integrates all freight transport networks based on open GIS data for different transport modes. Seaports and airports are physically connected to road and rail networks with data on intermodal dwelling times. Travel times by type of infrastructure and dwelling times between transport modes are estimated using average speeds based on available information by region. The model then computes the shortest paths between each production/consumption centroid for each transport mode (for the modes available for each link), generating two main inputs:

- The average travel time and distance by mode for each origin destination pair. For countries with multiple centroids, a weighted average of all centroid pairs is used;
- The shortest path between each centroid for each transport mode.

Centroids

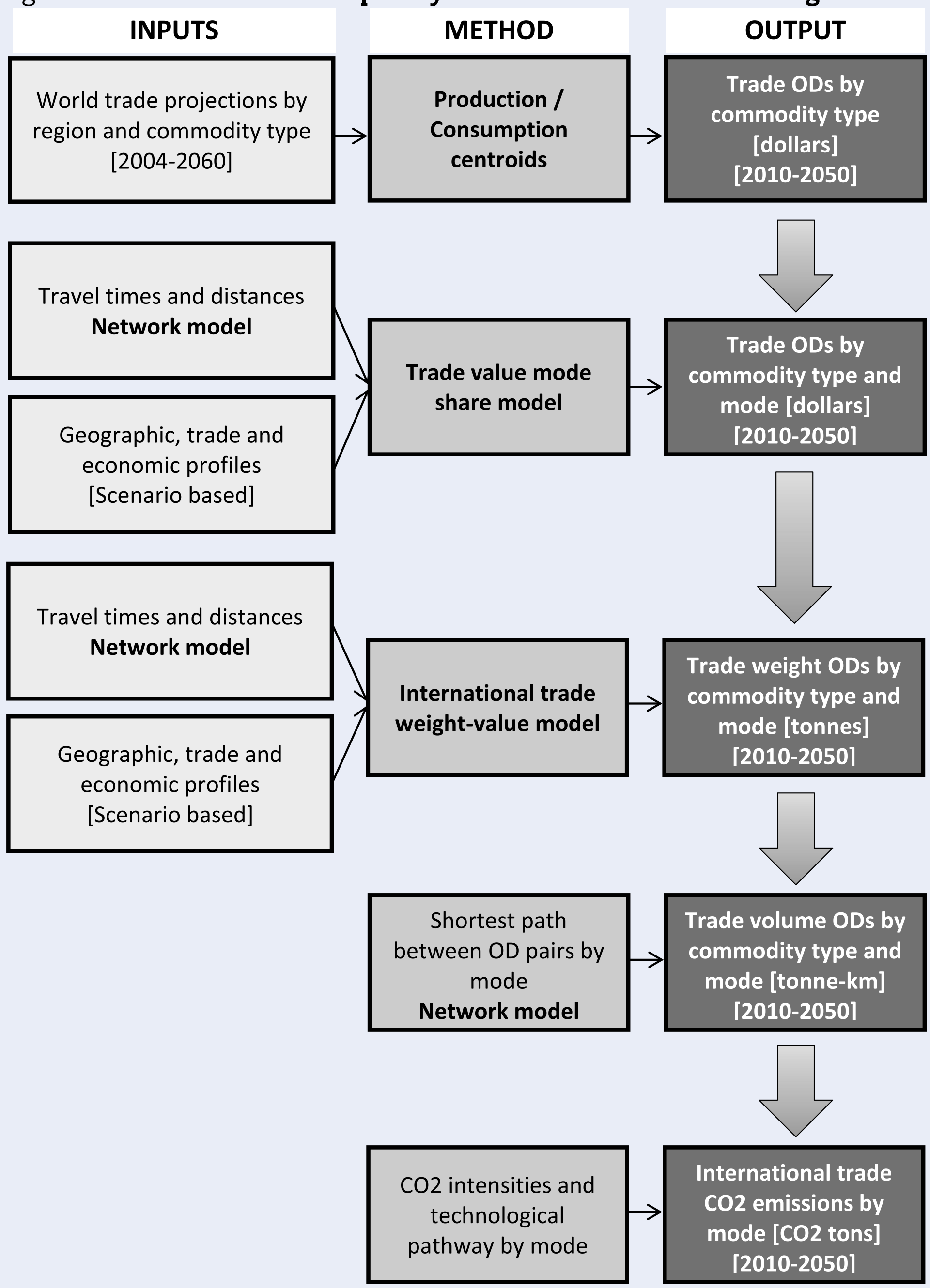
The underlying trade projections are done with a regional aggregation of 26 zones. This introduces significant uncertainties from a transport perspective as it does not allow a proper discretisation of the travel path used for different types of product. Therefore, we disaggregate the regional origin-destination (OD) trade flows into a larger number of production/consumption centroids. The centroids were identified using an adapted p-median procedure for all the cities around the world classified by United Nations in 2010 relatively to their population (2,539 cities). The objective function for this aggregation is based on the minimisation of a distance function which includes two components: GDP density and geographical distance. The selection was also constrained by allowing one centroid within 500 km radius in a country. This resulted in 294 centroids globally, with spatially balanced result also for all continents.

Freight mode choice model

The mode share model (in value) for international freight flows assigns the transport mode used for trade between any origin-destination pair of centroids. The mode attributed to each trade connection represents the longest transport section. All freight will require intermodal transport both in the origin and destination. This domestic component of international freight is usually not accounted in the literature, but is included in our model. The model is calibrated using a standard multinomial logit estimator including a commodity type panel term, variables on travel times and distances taken from the network model while two geographical and economic context binary variables are added, one describing if the OD pair has a trade agreement and the other for the existence of a land border between trading partners.

Box 3.2. **The ITF International freight model** *(cont.)*

Figure B.3.2. **Modules developed by ITF for the international freight model**



Note: For technical details of the model, see Martinez, Kauppila, Castaing (2014).

Weight/value model

We used a Poisson regression model to estimate the rate of conversion of value units (dollars) into weight units of cargo (tonnes) by mode, calibrated using Eurostat and Latin American data on value/weight ratios for different commodities. We use the natural logarithm of the trade value in millions of dollars as offset variable, a panel terms by commodity, travel time and distances, and geographical and cultural variables: the binary variables for trade agreements and land borders used above and a binary variable identifying if

Box 3.2. **The ITF International freight model** *(cont.)*

two countries have the same official language. Moreover, economic profile variables were included to describe the trade relation between countries with different types of production sophistication and scale of trade intensity. The resulting dataset was then divided according to each transport mode, leading to different calibrations by mode.

Generation of the model outputs

The model components result with the value, weight and distance travelled (with path specification) between 2010 and 2050, for each centroid pair, mode, type of commodity and year, stemming from international trade. The tonne-kilometres are then combined with information on related CO_2 intensities and technology pathways by mode, obtained from the International Energy Agency's MoMo model and the International Maritime Organisation (IMO, 2009). In case of road and rail, these coefficients and pathways are geographically dependent, while the maritime and air CO_2 efficiencies are considered to be uniform worldwide.

Shipping emissions in ports

Overview of shipping emissions in ports

Shipping related CO_2 emissions in ports represent only about 2% of total international shipping CO_2 emissions. However, locally, shipping emissions have important health impacts. Various urban emissions inventories show the large share that shipping can represent in total emissions in cities, e.g. more than half of the SO_2 emissions in Hong Kong come from shipping and 45% in Los Angeles/Long Beach. NO_2 and CO emissions in ports have been linked to bronchitis symptoms, whereas exposure to SO_2 emissions is associated with respiratory issues and premature births. Additionally, the California Air Resources Board attributed 3 700 premature deaths per year to ports and the shipment of goods (Sharma, 2006). On a global scale, calculations suggest that shipping-related PM emissions are responsible for approximately 60 000 cardiopulmonary and lung cancer deaths annually, with most deaths occurring near coastlines in Europe, East Asia and South Asia (Corbett, 2007).

Table 3.2. **Shipping emissions in ports (2011)**

Million tonnes

Pollutant	Shipping emissions in ports
CH_4 – Methane	0.002
CO – Carbon monoxide	0.03
CO_2 – Carbon dioxide	18.3
NOx – Mono-nitrogen oxides	0.4
PM_{10} – Particulate matter with diameter inferior to 10 micrometre	0.03
$PM_{2.5}$ – Particulate matter with diameter inferior to 2.5 micrometre	0.03
SO_x – Sulfur oxides	0.2

Around 85% of these emissions come from container ships and tankers. This is partly explained by their dominant presence in terms of port calls, around three quarters of all calls. Both containerships and tankers have more emissions than could be expected based on the number of port calls. For tankers this can be explained by their relatively long turnaround time in ports. However, this is not the case for containerships. Containerships

Box 3.3. **Estimating shipping emissions in ports**

The ITF freight model predicts the flows of 18 different cargo types between 226 places in 84 different countries. These growth rates were translated into growth projections of port calls of the corresponding ship types in each country.

The calculation of shipping emissions in ports makes use of a database of Lloyd's Marine Intelligence Unit on vessel movements in 2011, containing information on turnaround times of ships in ports across the world and ship characteristics, which allows for a bottom-up estimation of ship emissions during port calls. In these calculations, various policy measures implemented in ports to mitigate air emissions have been taken into account, such as the EU regulation to use low sulphur fuel at berth (reduction of the maximum allowed sulphur content in fuels to 0.5% by 2020, and to 0.1% by 2015 in emission control areas), shore power and various fuel switch programmes. It is further assumed that ship turnaround times remain at a similar level.

The methodology and dataset used for the calculations are explained in more detail in Merk (2014).

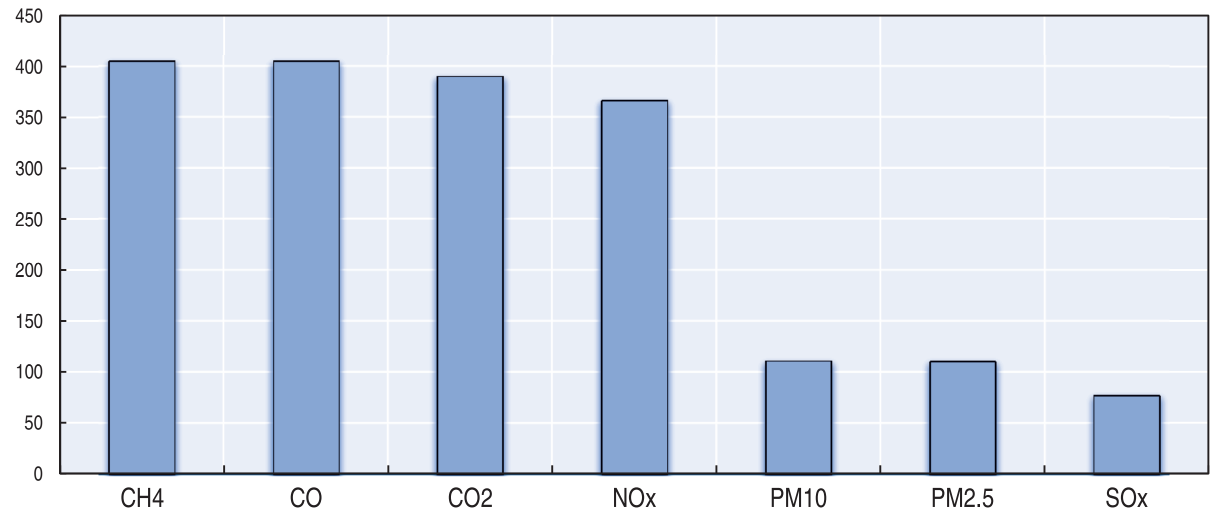
have relatively short stays in ports, but have relatively high emissions during these stays. On the contrary, bulk carriers have long turnaround times, but relatively lower emissions during their stays in ports. Also Roll-on/Roll-off (Ro/Ro) ships are relatively clean: representing 8% of port calls and 5% of port time, they only represent 2% of the total shipping emissions in ports.

Most of the shipping emissions in ports (e.g. 58% of the CO_2 emissions) are concentrated in Asia and Europe where most of the world's port activity is taking place (Asia and Europe represent 70% of total port calls). European ports have much less emissions of SO_x (5% of world total), PM_{10} (7%) and $PM_{2,5}$ (8%) than their share of port calls (22%) would suggest, which can be explained by the EU regulation to use low sulphur fuels at berth. Also its share of CO_2 emissions (19%) is relatively low, due to port air emissions policies, such as shore power facilities and incentives for fuel switching. Ports with high emissions relative to their port traffic can be found in Africa, the Middle East, Latin America, and – to a slightly lesser extent – in North America.

Most shipping emissions in ports will grow fourfold up to 2050. This is the case for CH_4, CO, CO_2 and NO_x-emissions (Figure 3.8). Asia and Africa will be subject to the sharpest increases in emissions, due to their projected strong port traffic growth to 2050 and the lack of regional mitigation measures (such as Emission Control Areas, ECA). Asian port traffic is projected to reach half of the global total in 2050, which corresponds to the share of projected shipping emissions in Asian ports. European and North American ports show relative declines of emissions, due to relatively slower traffic growth and to stricter regulatory measures, such as emission control areas. For example, due to the emission control areas and the 0.1% maximally allowed sulphur content in these areas from 2015, SO_x emissions in European and North European ports are projected to be 5% of the total SO_x emissions in ports, whereas their total port traffic would account for 24% in 2050 (Figure 3.9).

Figure 3.8. **Growth in shipping emissions in ports, 2050**

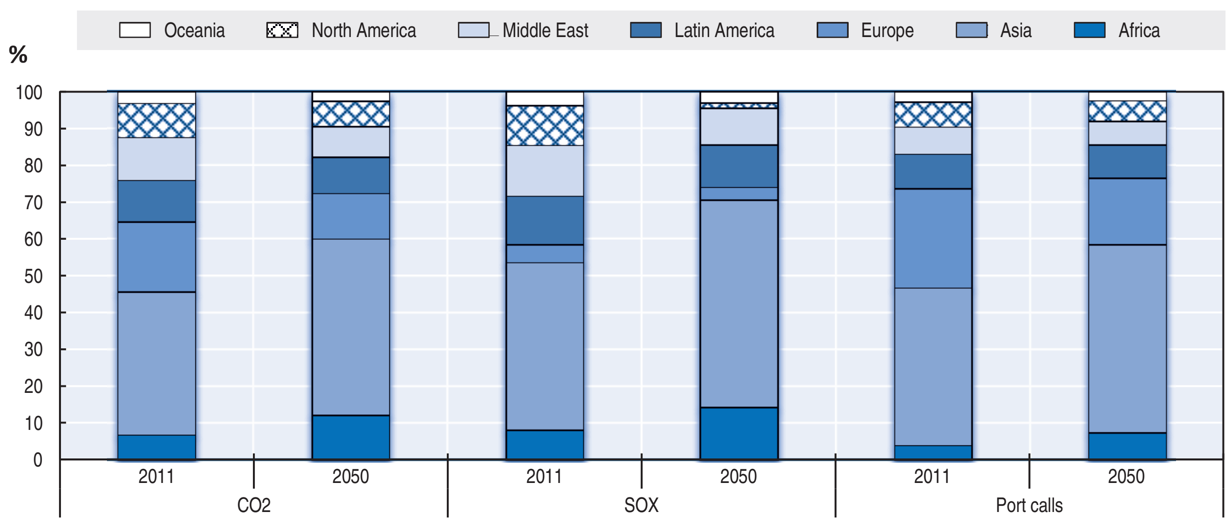
2010 = 100



Note: CH_4 – Methane, CO – Carbon monoxide, CO_2 – Carbon dioxide, NO_x – Mono-nitrogen oxides, PM_{10} – Particulate matter with diameter inferior to 10 micrometre, $PM_{2.5}$ – Particulate matter with diameter inferior to 2.5 micrometre, SO_x – Sulfur oxides.

StatLink http://dx.doi.org/10.1787/888933168807

Figure 3.9. **Shares of emissions and port calls, 2011 and 2050**



Note: CO_2 – Carbon dioxide, SO_x – Sulpfur oxides.

StatLink http://dx.doi.org/10.1787/888933168818

Policy measures to reduce shipping emissions in ports

Measures to reduce CO_2 emissions in ports can be classified into four different categories (DNV, 2010):

i) Alternative fuels or power sources. Alternative fuels include gas-fuelled engines (such as LNG and LPG) and biofuels. Alternative energy sources to power ships could be solar power, wind and nuclear energy.

ii) Operational measures. These measures cover operation of the ship itself (hull condition, propeller condition, trim/draft optimisation) and routing measures, such as voyage execution and weather routing (avoiding navigation in areas with bad weather conditions).

iii) Technical measures. These cover the machinery (main and auxiliary engines) and measures under water (propeller and hull).

iv) Structural changes. These changes include port efficiency, vessel speed reduction (through fleet increase) and cold ironing (using shore power while at berth).

Measures from each of these categories can take place at different levels: international regulations, national legislation or port-specific measures.

Significant progress in terms of global policy making has been made with respect to operational and technical measures. The International Maritime Organisation (IMO) added a new chapter on "Regulations on Energy Efficiency for Ships". It includes two measures that came into force in early 2013 and apply to all vessels over 400 GT (gross tonnage). The Energy Efficiency Design Index phases in progressively stringent criteria into the building standards for different types and sizes of ships. Energy efficiency levels are measured in CO_2 emissions per capacity mile, and are designed to bear upon all production components of a given ship. The Ship Energy Efficiency Management Plan constitutes a mechanism for benchmarking and improving operable ships. Owners and operators are periodically brought to review and upgrade their energy performance, focusing on such measures as engine tuning and monitoring, propeller upgrades, trim/draft improvement and enhanced hull coating.

The levels of SO_x and PM are not expected to increase up to 2050, due to regulations that will come into force in the coming years. Substantial decreases of SO_x and PM would also be possible by extending the boundaries of existing Emission Control Areas and by introducing more of these zones. This has been discussed for the Pearl River Delta (Merk and Li, 2013) and the Mediterranean Sea.

A lot could also be gained by policy initiatives of ports themselves. Various ports have developed infrastructure, regulation and incentives that mitigate shipping emissions in ports. Many of these instruments could be considered the fourth category of abatement measure indicated above: structural measures. An example of infrastructure that reduces ship emissions are shore power facilities that allow ports to shut of their engines when berthing in a port

Other measures that ports can take to limit emissions include the promotion of alternative fuels. For instance, Bremenports, which is responsible for the management and development of Bremen and Bremerhaven, has decided to actively support the future use of liquefied natural gas (LNG). In addition to the construction of an LNG depot in 2011, one of its main strategies is to use LNG itself, through the creation of ship services powered by LNG in 2012.

Port regulations have so far covered vessel reductions in proximity of port and mandatory fuel switches. Incentives applied by ports include lower tariffs for ships that use cleaner fuels, are more energy efficient or reduce their speed when close to a port. For example, the Port of Long Beach, through its Vessel Speed Reduction programme (VSR), rewards ships that voluntarily lower their speeds as they approach or depart the port (OECD, 2011). More generally, the use of differentiated tariffs according to emission standards or actual emissions in the port area should be investigated, both at the port and national levels.

Mitigating shipping emissions in ports requires the interplay of different levels of intervention from local to global. Given the nature of the shipping industry, some environmental impacts of shipping are best tackled at the global level. Self-regulation of ports can work, but in most cases, external measures are needed.

Conclusions: Transport policies for the supply chains of the future

The analysis in this chapter signals a number of policy priorities for improving global supply chains. The trade-off between transport and inventory costs is one of the key mechanisms which determine the trade and transport structure. When the transport costs are low relative to inventory costs, centralised logistics structures will emerge to exploit the low costs of scale economies and reduced risks of inventory pooling. On the other hand, when transport rates are high, there will be increasing orientation toward service quality and structures with many depots and small and frequent shipments will emerge.

There exists a number of external influences which change the situation around the spatial equilibrium caused by this trade-off. The transportation costs will increase as a result of internalisation of environmental costs, congestion, unreliability and related variability in lead times (ITF/OECD, 2010). Meanwhile, increased value density of products, higher interest rates, and increased number of product varieties will increase the inventory carrying costs and bring a shift towards faster and more reliable modes of transportation. Estimates shows that, on average, the value density of the goods transported from and to OECD economies is rising. The further reduction of transport costs, coinciding with increased value density, will lead to a further globalisation of production and growth of international trade.

Increases in tonne-kilometres will not necessarily translate into a growth in vehicle traffic as vehicle load factors change. Increasing transport efficiency over optimising supply chain structures and increasing vehicle utilisation, will strongly influence the environmental impact of road freight transport. This is especially true for landlocked countries, where trade is often carried by road and CO_2 emissions are expected to grow significantly.

The efficiency of transport systems may be increased to provide high quality logistics services at low costs and reduced environmental burden by promoting innovative solutions capturing new transport technologies and intermodal systems. Besides environmental and social benefits, an efficient and well-organised transport infrastructure provides a number of operational benefits, such as accelerating the supply chain process and thereby helping companies realise reduced waiting times and generating significant cost reductions.

The expected growth of freight transport within the next few years will lead to increasing capacity constraints. As a result of the global and regional increases in population levels and economic activity, the maritime transport is expected to exceed 250 trillion tonne-km by 2050 under the baseline scenario while port demand may exceed 66 billion tonnes over the same time period. Most of the facilities still operate with low utilisation rates and capacity management plays a vital role in infrastructure efficiency. Better resource allocation and higher utilisation of existing physical infrastructure still provide opportunities for improvement.

Maritime vessels typically have greater capacity than a single freight truck, generally moving large volumes of commodities over long distances at lower unit costs. It is generally supported that maintaining modal equilibrium should be part of public policy where each mode would compete based upon its inherent characteristics (Rodrigue et al., 2013). A superior transport infrastructure supports intermodal transport systems, including access roads to terminals and seaport channels. While an intermodal systems view should be the basic reference, modal policies should also focus on building missing links and improving inefficient connections between modes.

The projections highlight a number of possible changes in the trade routes. These changes raise new challenges but also opportunities in maritime transport. As a result of trade-related transport requirements, new and bigger vessel types are expected to emerge with expanded frontiers of weight and speed. Extension of the Panama Canal will increase the capacity allowing for bigger ships to transit through the Panama straits.

While the analysis above has not assessed changes in the infrastructure capacity, it is obvious that capacities of ports and seashore facilities need to be adjusted with higher container volume handling capabilities and inland freight connections. If not managed, growth in hinterland transport will result in increasing congestion levels and local pollution, weakening future economic growth. Further, harbour waters, berths, and channels must be of sufficient depth, large enough, and properly equipped to handle the larger vessel types.

Measuring transport flows in tonne-kilometres or vehicle-kilometres is an over-simplification which does not take into account, for example, the speed or reliability of the transport. An overall evaluation must account not only for the quantitative but also the qualitative changes in transport patterns (ECMT, 2002). The comparative efficiency of a country's logistics chain has a vital importance in attracting investment and enhancing industrial competitiveness. In this context, the World Bank's Logistics Performance Index (LPI) provides the most comprehensive international comparison tool to measure the trade and transport facilitation friendliness of countries (World Bank, 2014). Understanding and decomposing the components of trade and logistics performance can help countries to improve freight transport efficiency and highlight where international cooperation is helpful to overcome barriers. Mapping policy actions with the LPI components will help in identifying policy actions to improve future performance of the logistics sector (see Celebi et al., 2014).

There is ample evidence that appropriately designed liberalisation and introduction of competition in these sectors can improve efficiency, reduce costs and expand service access to users (Mann, 2014). Today, the biggest obstacles to international trade are physical, administrative and informal restrictions on the movement of goods. Reductions in supply chain barriers have a larger effect on economic growth and competitiveness than removing tariffs. Trade facilitation does not always require investments in "hard" infrastructure. Softer measures for harmonised technical and market conditions are crucial for linking countries so that infrastructure can fully serve its trade purpose (see ITF, 2014 for a summary of the panel discussion at the International Transport Forum's Annual Summit session "Constructing Supply Chains of the Future: How Shifts in Global Economic Balance Affect Transport").

Standardisation of procedures across the supply chain can reduce trade costs as effectively as investing in infrastructure. The impact of an extra day spent getting across borders has a significantly greater negative impact on trade flows than an extra day spent at sea delivering a container of goods (Korinek and Soudin, 2009). Customs efficiency is one of the two lagging components of the LPI in 2014, especially the two lowest quintiles (Arvis et al., 2014), yet low and lower middle-income countries have progressed the fastest in this dimension. Customs and border management or the improvements of transit regimes are a few areas where policy makers can adopt comprehensive policies. The impact of customs clearance and border policies on trade are most of the time direct.

The development of information and communications technologies (ICT) provides a convenient way to improve tracking and traceability. It enables the gathering, organisation and distribution of information on products, services and trade regulations at a global level. However, traceability of shipments is still one of major problems in most developing countries. This is partially due to the lack of understanding of how to manage the new technology and how to adjust logistics procedures. One of the major barriers confronting companies in the uptake of advanced ICT technologies is the high investment risk, which imposes great uncertainties on the willingness of the private sector to invest in ICT, particularly if there is uncertainty surrounding governments' communications policy and spectrum allocation. Hence, policy makers need to keep up with the rapid development of ICT and develop a stable communications framework that is conducive to logistics planning by the private sector (OECD, 2002).

Logistics developments in the world lead to changes in the demands for skills and require more highly educated employees. Even today, most countries, including OECD, suffer from a lack of adequate human resource capable to adapt to new trends. There exist various government actions to support private sector in developing logistics competencies for participation in modern supply chains, such as increasing managerial capacity or setting quality standards by supporting professional organisations, regulating business certification, and ensuring standardisation of operations.

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Chapter 4

Urban passenger transport scenarios for Latin America, China and India

This chapter presents long-run scenarios to 2050 for the development of urban passenger mobility and related emissions and health impacts in Latin American, Chinese and Indian cities, based on the ITF urban transport model, IEA's MoMo model and ICCT's health impacts methodology. The model projects levels of transport activity and modal shares under different urban policy scenarios. The chapter highlights the importance of urban agglomerations to economic development while also taking into account the challenges related to containing the negative externalities. The chapter discusses the importance of designing comprehensive urban policies in emerging economies on the basis of an empirical analysis using extensive data.

The growing population and economic concentration in urban areas call for particular attention to be paid to urban transport policies in emerging economies. By 2050, of the 2.7 billion additional urban dwellers, 94% will live in developing countries. Containing urban sprawl and expanding public transport could help slow growth in the number of vehicle-kilometres travelled by private vehicles without sacrificing the overall passenger mobility but reducing CO_2 emissions. Long-term urban transport planning and alignment of policies towards private transport-oriented or public transport-oriented urbanisation will translate into significant differences in modal composition of urban mobility in Latin America, China and India.

Urbanisation, economic growth and transport

Urbanisation and economic growth

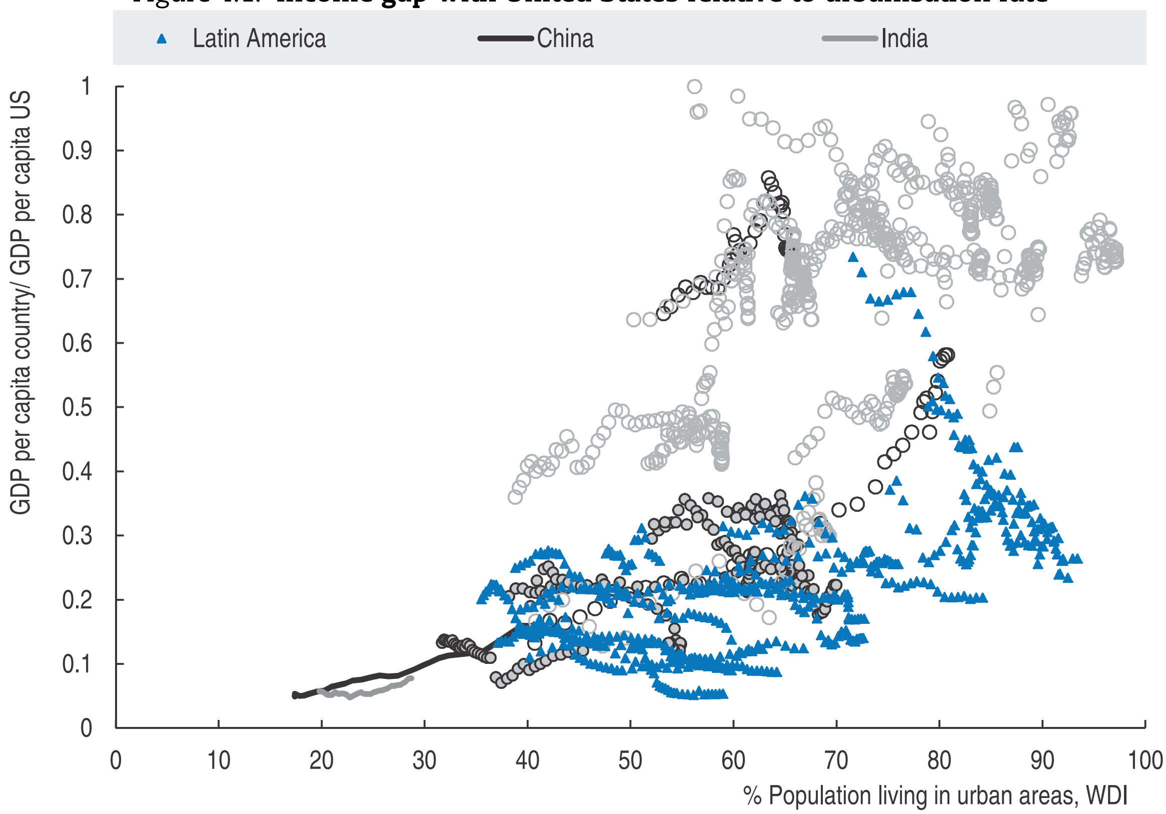
Urban agglomerations, and in particular large ones, tend to drive national economic development. Among the most important reasons for this are agglomeration economies: the effect by which "the concentration of firms and workers in space makes them more productive" (Combes, 2012). Agglomeration effects include localisation economies, which benefit particular industries through technological spillovers, opportunities to share intermediate inputs and access to a larger number and wider variety of skilled workers. Another set of effects are termed urbanisation economies. These provide benefits to the city as a whole and include the existence of larger markets, the availability of public goods that are only economically viable when provided on a large scale and the ease of inter-industry interactions (Graham, 2007).

But having a large concentration of population also brings important challenges that can undermine agglomeration advantages. Urban centres face strong pressures to maintain and expand infrastructure to ensure that access to opportunities for employment and services reach all parts of the population, and to contain negative externalities. Cities that do not manage to develop a "framework for urban life that can encourage the good interactions that density and connectivity allow whilst limiting the bad" (Romer, 2014) face diseconomies of scale very soon and turn into an obstacle to growth rather than an engine of economic development.

International experience shows divergent stories regarding how urbanisation has been translated into overall economic growth. Figure 4.1 shows the relation between urban population shares and the gap in per capita income of various countries relative to US per capita income. As it can be seen, Latin America and Eastern Europe (including Turkey in this data set) have not reached the income levels of Europe and Japan at similar levels of urbanisation. Korea has significantly closed the gap during the last decade. For China and India, which are still in early urbanisation stages, the future trend will depend on how well new and growing cities are able to remain competitive as they develop.

Even if the capacity of cities to maintain higher economic growth in the long-term varies, Gross Domestic Product (GDP) concentration in urban centers leads to urban

Figure 4.1. **Income gap with United States relative to urbanisation rate**



Source: Public Governance and Territorial Development Directorate (GOV) at OECD.

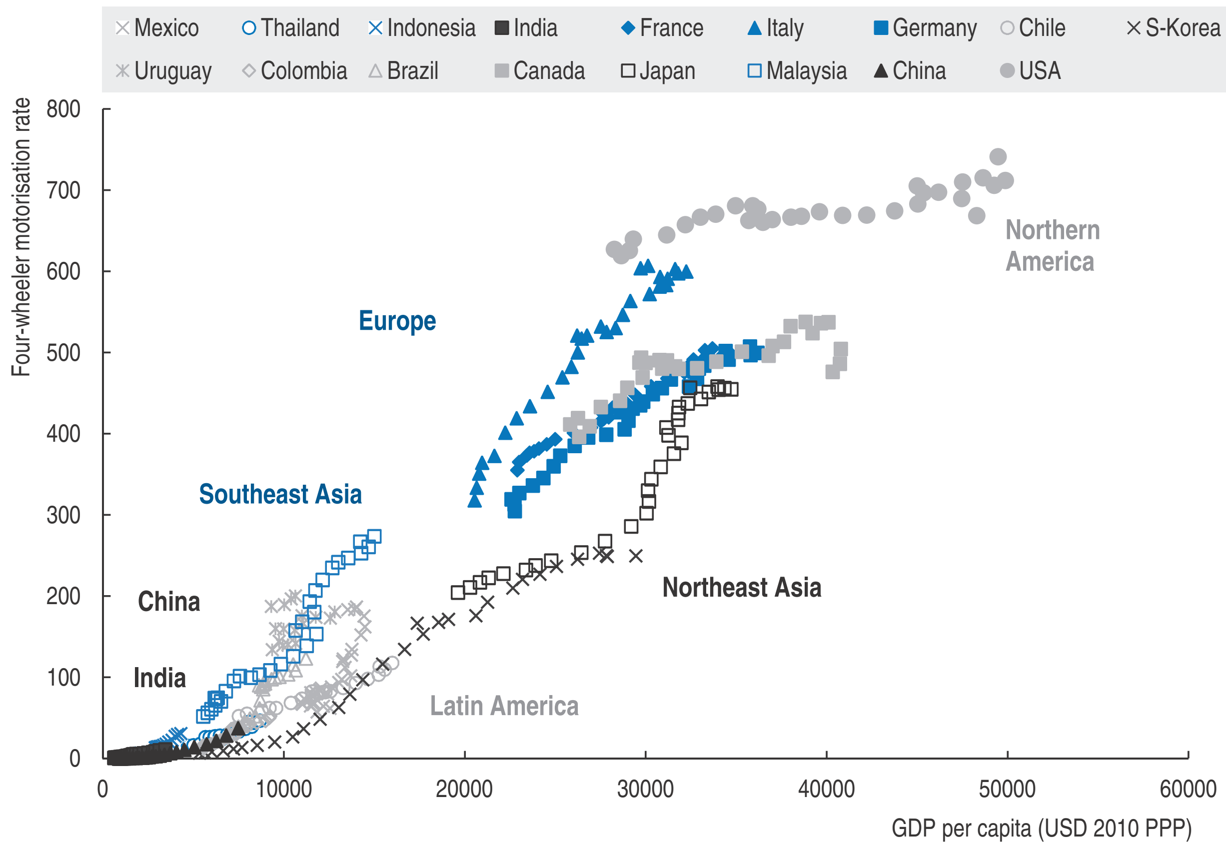
StatLink http://dx.doi.org/10.1787/888933168825

populations arriving at higher income levels earlier than for a country as a whole. The relatively higher purchasing power causes private motorisation to start earlier in cities.

Nonetheless, due to higher density of demand, the scope for relying on public transport to meet mobility needs is broader in cities than elsewhere. Higher densities also make it more feasible for non-motorised transport modes to play a relevant role in urban mobility. Because road space is a resource that is particularly scarce in the urban context, and more so as motorisation grows, higher levels of congestion also tend to reduce earlier the benefits of using private transport in urban centers. Due to all of these reasons, the relation between economic growth and private motorisation would be expected to follow a less intensive pathway in cities. Urbanisation would therefore tend to decrease reliance in private modes in overall national mobility.

Looking at world historical car and two-wheeler motorisation relative to income growth, it is clear that the extent to which urbanisation has decreased the intensity of this relation has varied significantly between countries (Figure 4.2). The United States and Canada present higher car ownership rates than the selected Western European countries at similar personal income levels despite the fact that the United States and Canada have higher shares of urban population. Contrarily, in the case of Japan, very high urbanisation rates (97%) would seem to have decreased significantly intensity of car ownership relative to economic growth. South Korea also shows very low car motorisation when compared to that wich Europe, the United States, and Canada had at comparable income levels (urbanisation rates of Korea are similar to those in the the United States and Canada).

Figure 4.2. **Four-wheeler motorisation relative to per capita income, selected countries**



Source: IMF (2014); International Energy Agency. Momo ETP 2014 (2014); INEGI (2013); INE (2013); DANE (2013); data provided by Dr. Hua Zhang.

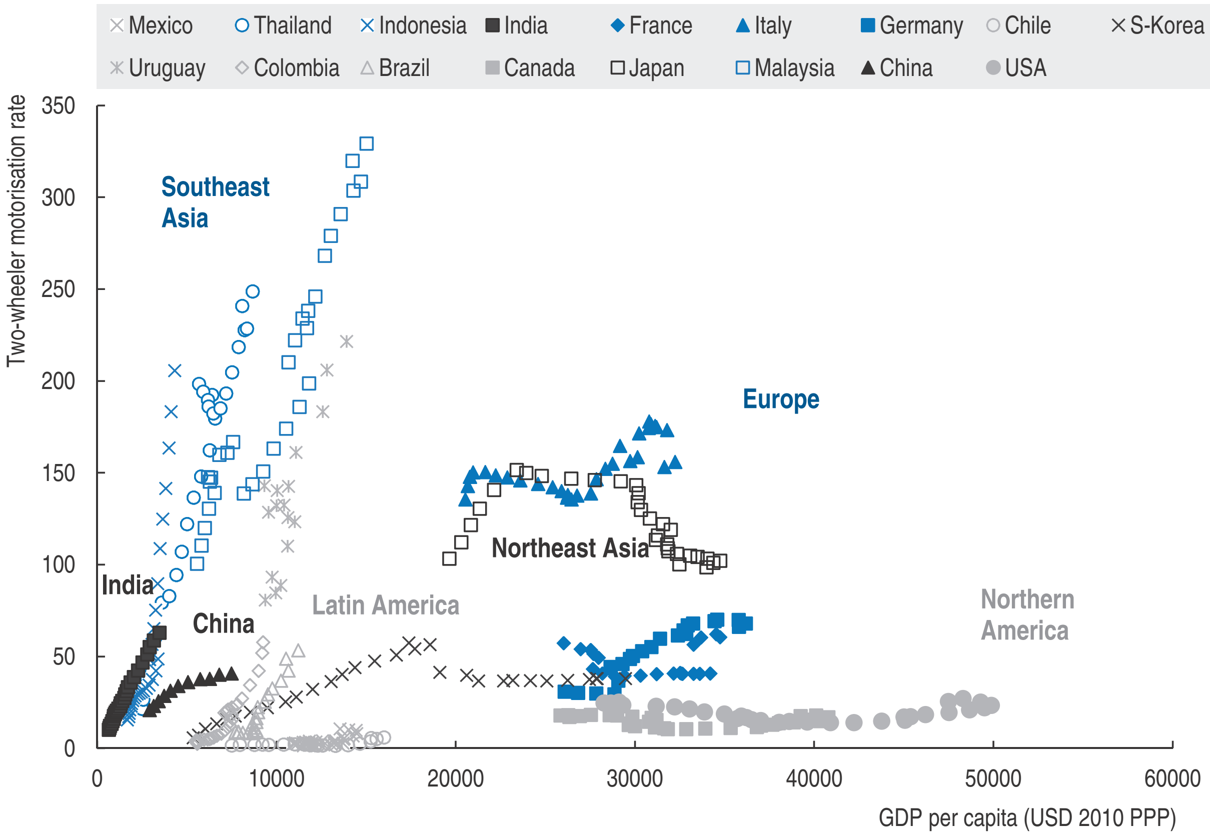
StatLink http://dx.doi.org/10.1787/888933168835

In the case of two-wheeler ownership (Figure 4.3), the United States, Canada, and most selected Western European countries show very low levels at high income stages. Italy, Korea, and Japan show some acceleration toward middle-income levels but a reduction when reaching higher incomes.

Developing regions such as Latin America and Southeast Asia have shown relatively high intensity of private motorisation with respect to income. Latin America is a highly urbanised region but it is far from closing the income gap with developed countries with similar urbanisation rates. This explains why the region has a lower private car motorisation rate. However, Figure 4.2 shows that the intensity of car motorisation relative to income growth is very high in countries such as Uruguay, and Brazil. If continued into the future, the region would arrive at very high car ownership at the income levels that developed countries have now. Contrastingly, Chile's pathway shows itself to be more like the one presented by South-Korea. In the case of China and India, income levels are still low and car motorisation has just started to accelerate. Nonetheless, China already shows more intensive car motorisation than Korea, similar to Latin American trends at those income levels.

Regarding two-wheeler ownership, Southeast Asia has shown extraordinary levels compared to those shown by developed countries. Early introduction of two-wheelers into these markets was possible as many of these countries developed their own industries

Figure 4.3. **Two-wheeler motorisation relative to per capita income, selected countries**



Source: IMF (2014); International Energy Agency. Momo ETP 2014 (2014); INEGI (2013); INE (2013); DANE (2013); data provided by Dr. Hua Zhang.

StatLink http://dx.doi.org/10.1787/888933168844

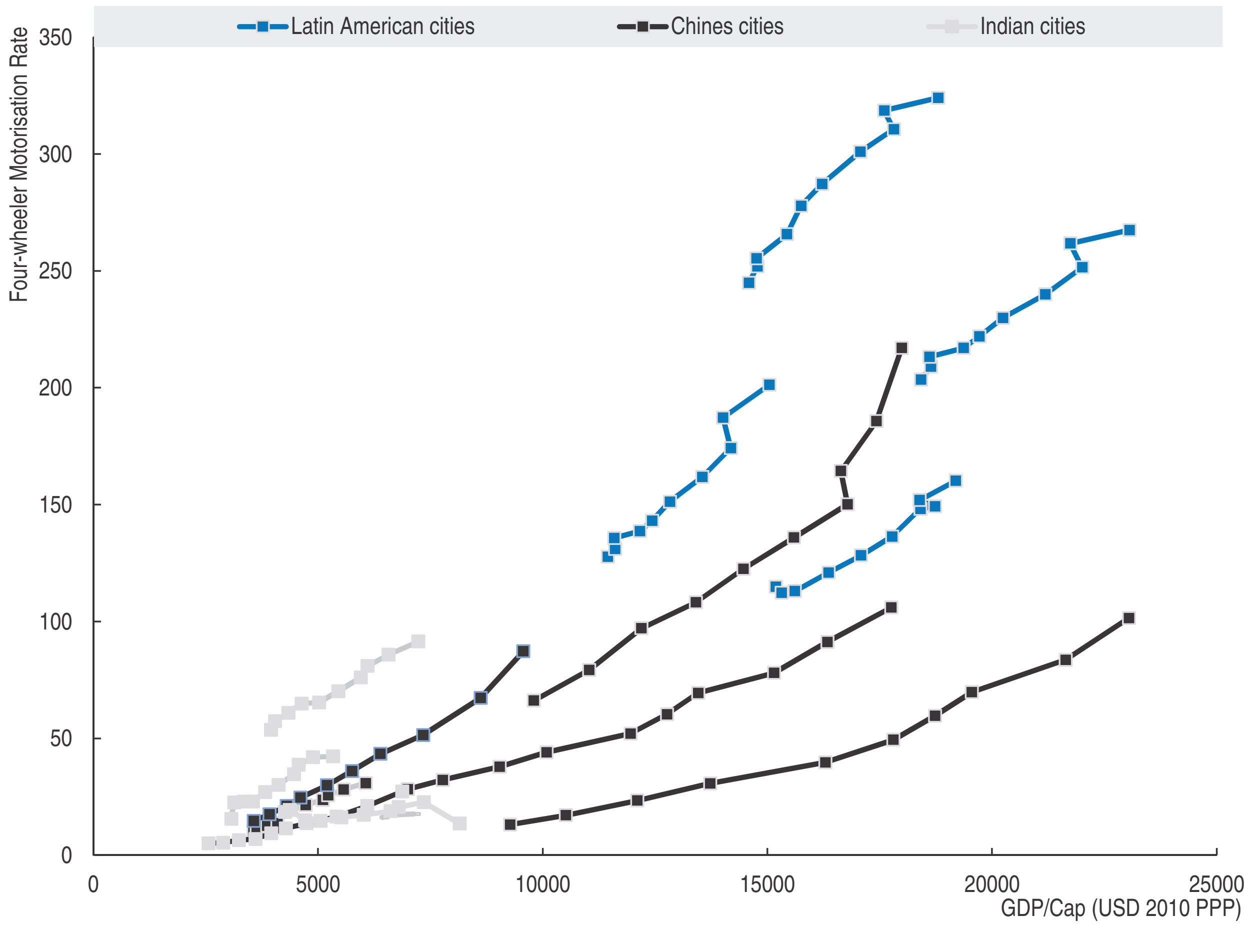
(e.g. Malaysia, Indonesia, Thailand). India and China (that also developed industries of their own) have shown pathways that are also very intensive. In the case of China, two-wheeler motorisation seems to have curbed before entering middle income levels. Data in the graph only refers to gasoline two-wheelers, which have been banned in many major cities. Electric two-wheeler ownership has recently grown very fast and is most likely off-setting this trend (see Box 4.4). In the case of Latin America, the first stage of motorisation was done only through car ownership. However, two-wheeler ownership has grown rapidly in some countries over the last decade (Figure 4.3).

In addition to differences between countries and regions, it is also interesting to note that the relation between economic growth and private motorisation shows differences even within countries and regions. Figures 4.4 and 4.5 show the relation between per capita income and car and two-wheeler motorisation in selected cities of Latin America, China and India. The different trends in intensity and income threshold at which motorisation has accelerated could lead the region and countries into different motorisation futures if all cities were to follow.

Overall, policies implemented at the urban level can play a crucial role in the extent to which urbanisation can translate into mobility that is less dependent in private modes while meeting growing mobility demand. This can significantly reduce negative externalities such as congestion, pollution and CO_2 emissions.

Figure 4.4. **Four-wheeler motorisation relative to GDP per capita**

Cities in Latin America, China and India



Source: Urban Mobility Observatory (CAF) (2007); TERI (2014); McKinsey Global Institute, Cityscope 2.0 database (2010); data provided by Dr. Hua Zhang.

StatLink http://dx.doi.org/10.1787/888933168850

Urban transport policy scenarios for Latin America, China, and India

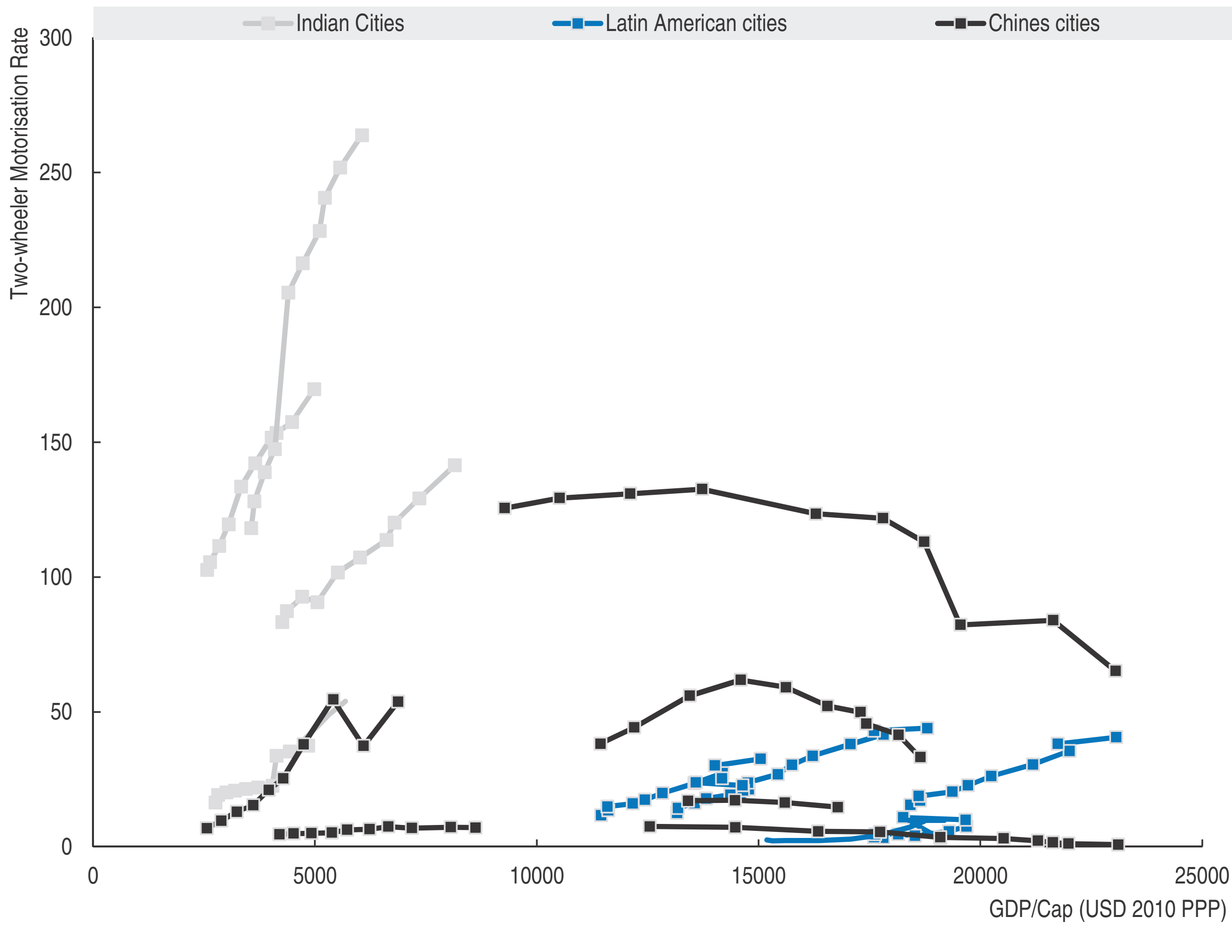
Urban transport case studies for Latin America, China and India were developed using the ITF urban transport model (Box 4.1). All scenarios are modelled under the same assumptions for urban population and economic growth. The model simulates transport volumes and modal shares for the 2010-50 period for all urban agglomerations above 500 000 population under different policy scenarios. We calculate CO_2 emissions that would result from the transport activity levels using the Mobility Model (MoMo) of the International Energy Agency (IEA). All scenarios are modelled under the *New Policy Scenario* developed by the IEA. Emissions of local air pollutants and health impacts related to urban transport activity in each scenario are calculated by the International Council for Clean Transportation (ICCT).

General modelling framework

Vehicle ownership for cars and two-wheel vehicles is modelled using an S-shaped relation between economic growth and private motorisation. Variables of the urban context, such as quantity and quality of public transport, fuel prices and road intensity are

Figure 4.5. **Two-wheeler motorisation relative to GDP per capita**

Cities in Latin America, China and India



Source: Urban Mobility Observatory (CAF) (2007); TERI (2014); McKinsey Global Institute, Cityscope 2.0 database (2010); data provided by Dr. Hua Zhang.

StatLink http://dx.doi.org/10.1787/888933168860

Box 4.1. **ITF urban transport model for Latin America, China and India**

The ITF urban transport model simulates the evolution of variables of the urban context that are relevant to transport demand in urban agglomerations under different policy scenarios (land-use, public transport, road infrastructure and fuel prices). The model derives levels of transport activity and modal shares that would result from each scenario. Agglomerations included are those that have 500 000 population or above. The model adopts assumptions on load factors, fuel economy and CO_2 emission factors from the MoMo mobility model of the *International Energy Agency*. Emissions of local air pollutants and health impacts that would result from each scenario are calculated by the *International Council for Clean Transportation (ICCT)*.

The ITF urban transport model framework is built on the projections of urban agglomeration of the UN Urbanization Prospects, 2014 Revision. We extend their projections from 2035 up to 2050 using the United Naion's methodology described in United Nations (2011), comparing the results to existing literature where possible.

Urban GDP per capita scenarios are calculated from national GDP projections provided by the ENV-Growth model of the OECD Environmental Directorate, using the estimated relation between the concentration of population and the concentration of GDP shown by urban agglomerations in each country.

Box 4.1. **ITF urban transport model for Latin America, China and India** *(cont.)*

Data for this analysis is taken from the MGI cityscope, provided by the *McKinsey Global Institute*. This database contains 2010 population and GDP observations for 51 agglomerations in the Latin American region, 203 for China and 234 for India. The database then provides a 2025 forecast for these same cities. Using these data for projections up to 2050 implies the assumption that countries maintain the same relation between population and GDP concentration for the 2025 -50 period as between 2010 and 2025. The relation between urban concentration of population and GDP is modelled with an S-shaped curve. This reflects the fact that, when urban agglomerations are relatively small, the elasticity between wealth and population concentration is lower, then rises as agglomerations grow, and when agglomerations get very big the marginal benefit of increasing the concentration of population begins to decrease.

The model is composed of individual regional modules. This allows flexibility to use the available urban transport data of each region and set relations between variables according to the specific trends found in each of them. Three modules have been constructred to date: Latin America, China, and India.

For Latin America, relations between urban variables and transport activity were estimated using data from the Urban Mobility Observatory created by the Development Bank for Latin America-CAF. This database contains information for fifteen Latin American cities for 2007: Buenos Aires, Bogotá, Caracas, Mexico City, Guadalajara, León, Lima, Sao Paolo, Rio de Janeiro, Curitiba, Porto Alegre, Belo Horizonte, Montevideo, Santiago, San José. Data from this source was complemented with time series on private motorisation available from Government sources.

In the case of China, province level car motorisation and GDP per capita time series were collected from the China Statistical Yearbook (see general modelling framework for details on methodology to use province level calibrated model for urban projections). Two-wheeler motorisation, urban buses and urban road area time series were taken from a database provided by Dr. Hua Zhang, from the Maglev Transportation Engineering R&D Center at the Tongji University. This database contains data for Beijing, Shanghai, Tianjin, Guangzhou, Shenzhen, Nanjing, Suzhou, Wuxi, Wuhan, Hangzhou, X'ian , Ha'er'bin and Chongqing for the last 15-20 years.

These data was complemented with urban buses and road area for the years 2003, 2007, and 2011, for 173 cities of above 500 000 population. This last database was provided by Dr. Hao Han from the Tsinghua University. Data on urban buses, road provision, and income per capita was also complemented for the year 2010 by databases provided by Dr. Cherry and Dr. Ziwen Ling from the University of Tennessee-Knoxville, and Dr. Jeiping Li from the Boston Region Metropolitan Planning Organisation. Mass transit data was taken from the China Statistical Yearbook and the ITDP mass transit database.

As for India, data on 35 major cities on private cars, two-wheelers, three-wheelers and public transport fleets were provided by the Energy and Resources Institute (TERI) for the years 2001 and 2011. Data for vehicle ownerships at state level were retrieved from Indiastat. The ITDP metro database was used for mass transit systems (metro and BRT). Complementary data was provided by Dr Geetam Tiwary from the Indian Institute of Technology, New Delhi.

also introduced as explanatory variables. This implies that economic growth is an important driver of private motorisation, but that the evolution of the urban context has an impact on how intensive the relation between income and private motorisation is.

In the case of Latin America, S-curves for both cars and two-wheelers are modelled based on the econometric analysis of data from the Urban Mobility Observatory and car and two-wheelers time series available from local and national Government sources. We control for differences found in cities regarding the effect of public transport on vehicle ownership by calculating three different coefficients (cities above 10 million population, cities from 5-10 million population, and cities below 5 million population).

In the case of China, we found limited data for constructing time series for private-ownership that could give us a representative sample of cities of different sizes and various regions. For this reason, in the case of car-ownership we constructed province level income-car motorisation curves. In the case of the urban context variables, we used bus and road information obtained for individual cities (see data description in Box 4.1). In the case of mass transit, we used data available in the ITDP mass transit database.

Total urban variables (public transport and road area) for cities above 500 000 population in each province were divided by the total urban population in these cities. In this way, we constructed urban variables for the average agglomeration of 500 000 population and above for each province. We weighted this indicator by the percentage of population in urban agglomerations relative to total population in the province. This allowed us to come up with coefficients that reflect how available public transport and road infrastructure service in cities impact the province level intensity of car ownership relative to income. We account for both the effect of average public transport and road provision in urban centers and the weight of urban access due to urban population shares in the province. The specification can then be used at the urban level with urban context variables being simply multiplied by 1 (since all population is urban).

In the case of two-wheeler ownership, province level data series were not available. Therefore we worked with a set of thirteen cities for which this information is available. The model is calibrated using data from before cities introduced a restriction on two-wheelers (whether on ownership or use). Data used corresponds only to gasoline two-wheelers but since data corresponds to a period when most two-wheelers were gasoline based we assumed that the trend calculates two-wheeler levels regardless of the penetration of electric two-wheelers (see Box 4.2). We assume the two-wheeler technology shares depicted in the International Energy Agency (IEA) MoMo New Policy Scenario.

In the case of India, we encountered similar data constraints as with China to arrive at a reasonable sample with detailed time series with ownership information. For this reason, we constructed state level income-motorisation curves and applied a methodology with the same logics as for China's province level car ownership curves (see above). Because we did not count detailed bus and urban road infrastructure by city (as in China), we used state level data of state carriages as a proxy for total urban buses. Urban road infrastructure was extracted from cities in each state from open data sources. Mass transit network length was taken from the ITDP mass transit database.

Since, in the case of India, state level motorisation time series are available for both car and two-wheeler motorisation, we used the same methodology for both. In the case of India, three-wheelers are included in the model. The number of three-wheelers is also computed using an S-shape curve; it then serves as an input for the model concerning two-wheelers.

Implications of results for mobility

The results of our modelling exercise suggest that, in the case of Latin American cities, fuel prices will have an effect on the income threshold at which vehicle ownership starts to accelerate: higher fuel prices will result in ownership accelerating only at higher levels of income. This applies to both cars and two-wheelers. In the case of public transport service, higher levels and better quality (higher % of mass transit service) tend to slow-down motorisation growth (the relevant coefficient is that affecting approach to

Box 4.2. **The development of two-wheelers in China**

Electric two-wheelers (E-2Ws) emerged at the end of the 1990's in China. The expansion of the fleet rocketed in only a few years, from 40 000 to 10 million units produced per year between 1999 and 2005 (Jamerson and Benjamin, 2005). The denomination "E-2Ws" includes both E-bikes and E-scooters, subcategories for which reliable data is not available to the best of our knowledge. Current E-2Ws ownership is estimated to be one for every ten people (Fu, 2013).

The rise of E-2Ws results inform the convergence of several factors: the steady increase in GDP per capita, the massive urbanisation process coupled to a large urban sprawl and the lack of public transport provision, which dramatically increased the number of conventionally fuelled cars and motorcycles on Chinese roads. This generated massive congestions and air pollution in urban areas. To counter these disastrous effects, numerous cities restricted registration of conventionally fuelled cars and motorcycles, registrations even banning them in some city centres. This context, coupled to technological break thru in the electric battery industry, led to the extremely fast emergence of E-2Ws as a private mobility alternative.

Several factors are restraining a further expansion of E-2Ws, however: heterogeneous quality of the products and reckless driving that has resulted to in numerous road accidents; congestion caused by the slower speed of E-2Ws compared to cars; lack of charging facilities; improvement in the provision of mass transit systems; negative environmental impacts (lead pollution) due to from worn-out batteries. To offset the negative externalities of E-2Ws, several Chinese cities included them in the ban of conventional gasoline two-wheelers. Indeed, as of 2007, at least 8 large cities were already in such the process of banning or partially restricting E2Ws (Weinert and al. 2008), and it seems that this trend is on-going.

The issue balance of pros and cons of E-2Ws is not clear cut yet. Since E-2Ws are an alternative to cars (Chinadialogue 2013), they provide a way to limit car motorisation and consequently traffic congestion and air pollution. Restricting E-2Ws might then be counterproductive, at least in the short to medium term: although China is investing in improving mass transit systems in its cities, effects will not be immediate and if the ban on E-2Ws is largely extended widely, it could lead to an even larger increase in the number of cars on Chinese roads.

Although the phenomenon of the development of the E-2W fleet is important to the evolution of mobility and emissions, it was not possible to take it into account in the scenarios. Indeed, the denomination "E-2Ws" includes both E-bikes and E-scooters, subcategories for which reliable data is not available to the best of our knowledge.

For further reading, see Weinert et al. (2008), Jamerson and Benjamin (2004), Fu (2013), Chinadialogue (2013).

saturation). Higher road intensity has the effect of increasing car saturation levels but decreasing saturation level for two-wheeler vehicles.

As China is only at the beginning of the S-curve for car ownership and therefore not close to the saturation level, the road variable gives more consistent results when introduced in the approach to saturation rather than the saturation level itself. Public transport provision is also introduced in the approach to saturation (just as in the case of Latin America). The results of our modelling exercise suggest that, in the case of Chinese cities, higher levels of public transport service tend to slow down the car motorisation growth rate, while higher road intensity significantly increases it. The public transport indicator is here defined as mass transit length of network per capita since buses are not found to have a significant impact on car ownership. Cities in provinces that are in the Northwest and Southwest regions have higher intensity between income and car ownership *per se*. We control for this effect by allowing a different coefficient for income, depending on the geographical location of the city.

Regarding two-wheeler ownership, road infrastructure has a direct impact on the saturation level for these vehicles. As in the case of Latin America, higher road intensity decreases saturation level for two-wheeler vehicles. In the case of public transport provision, both buses and mass transit per capita slow down the speed at which the saturation level is approached.

The underlying analysis for our model suggests that public transport quality and quantity modify ownership levels for all types of vehicles in Indian cities. High bus and mass transit provision slow down the growth of cars, motorcycles and three-wheelers per capita, but the effect of mass transit is preponderant in the case of cars: buses do not appear to act as an effective replacement of cars.

Our model also confirms that three-wheelers may serve as a replacement for more official forms of public transport. The level of public transport provision has a negative impact on three-wheeler motorisation. In turn, high three-wheeler penetration rates are associated with lower two-wheeler ownership levels but do not affect four wheelers.

A main difference with the models described for Latin America and China lies in the role played by road provision. Higher road provision accelerates the growth of ownership; this effect is most preponderant for cars than for two and three-wheelers but, contrary to Latin America and China, road provision also accelerates growth of motorcycle ownership. A possible explanation is that due to the lower incomes relative to those in Latin America and China two-wheelers are overall a cheap alternative and much less of a replacement for cars in congested environments in India. Road provision is generally much lower in India than in China or Latin America. This may explain why any improvement in roads is beneficial for two-wheelers as well as four-wheelers.

Urban population and economic growth 2010-50

Between 2010 and 2050, the urban population in agglomerations with 500 000 population or more is expected to grow at an average yearly rate of 1.15% in Latin America, 1.64% in China and 2.41% in India. Latin America is already a highly urbanised region with around 45% of its population living today in agglomerations of more than 500 000 population. Contrastingly, China and India had in 2010 only 26% and 16% of their respective population living in such agglomerations. By 2050, urban population in centers of above 500 000 inhabitants will account for 54% of the total population in Latin America. In China and India, the proportion will remain lower than in Latin America. Nonetheless, the proportion will have doubled for both these countries, reaching 49% in China and 28% in India.

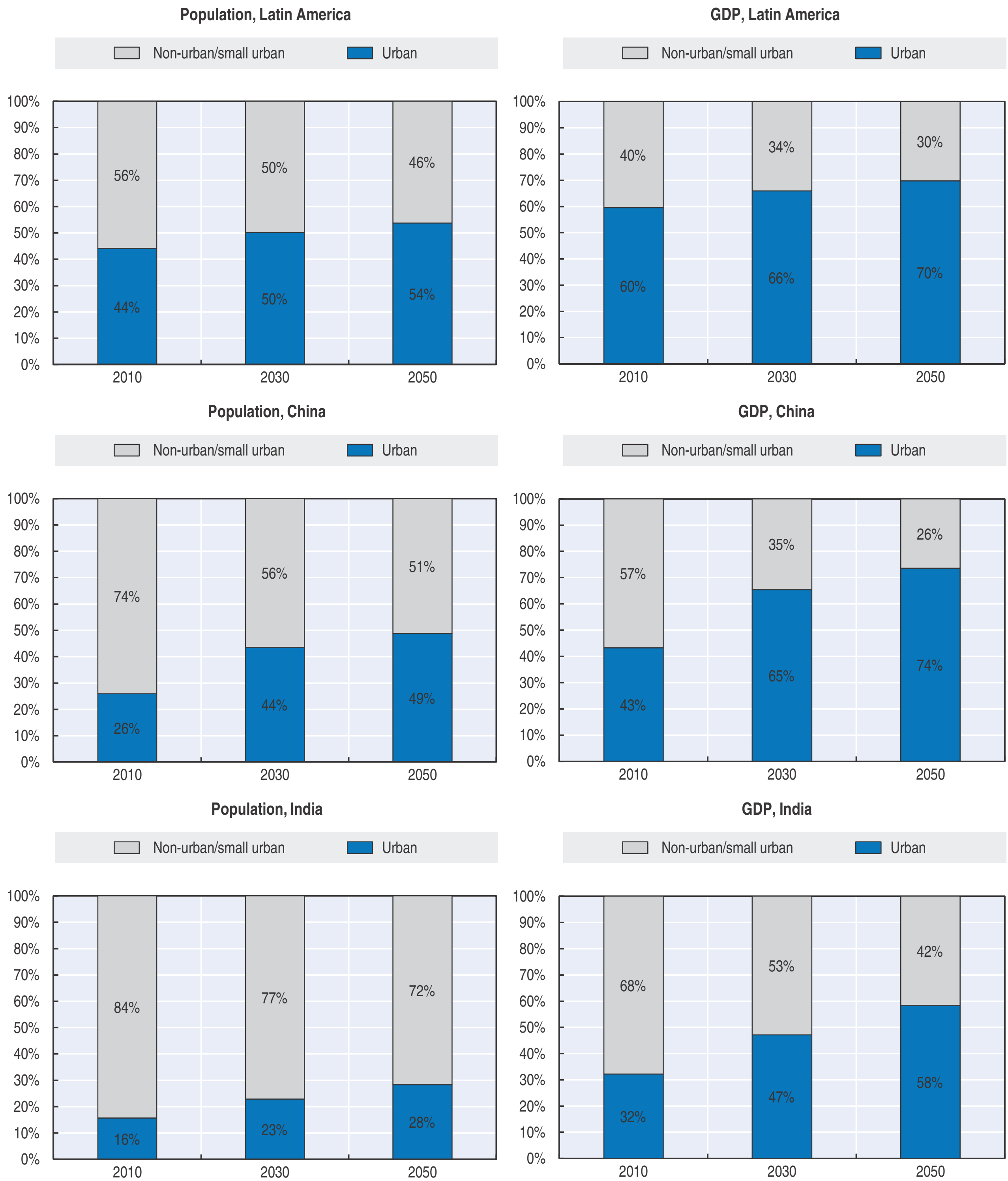
Among the three, India will be the most dynamic in terms of total output growth. Per capita average growth rates will be very similar for China and India and significantly lower for the Latin American region. Table 4.1 shows average annual growth rates for GDP, GDP per capita and total population for the 2010-50 period.

Table 4.1. **Annual national average growth rate of GDP and GDP per capita (real USD PPP) for Latin America, China and India**

	Latin America (%)	China (%)	India (%)
GDP	3.25	4.68	5.54
GDP per capita	2.61	4.53	4.73
Total Population	0.62	0.05	0.74

Source: ITF calculations based on ENV-Growth GDP projections and UN World Population Prospects (2014 Revision).

Figure 4.6. **Population and GDP concentrations**



Source: ITF calculations based on UN World Population Prospects (2014) and the Cityscope database from the McKinsey Global Institute

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The increasing shares of urban population will also be reflected in important increases in the concentration of economic wealth in urban areas above a population of 500 000. In Latin America these cities accounted already for 60% of the region's GDP in 2010. By 2050 they will represent more than 70% of total output. In the case of China, urban agglomerations over 500 000 inhabitants will make up more than 50% of GDP in the short-run (2015) and 74% by 2050. In India, the 50% threshold for GDP concentration in this size urban agglomeration will take a longer time to be reached: in 2040 urban areas will generate 51% of GDP.

Urban policy scenarios

Scenarios for Latin America, China and India were constructed with the aim of testing the long-run impact that diverse urban transport policy packages could have if adopted as a general strategy for the region. We identify four types of variables of the urban context that are relevant to transport demand: land use, public transport, road infrastructure, and fuel prices.

Baseline scenarios for all variables are built by assuming that what we identified as business as usual trends in each of the contexts will continue into the future. Two divergent policy pathways were modelled:

1) A *private transport-oriented* urbanisation scenario is constructed by applying policy trends that intensify the shift to private mode use. These are high sprawl, low expansion of public transport, and low fuel prices. This scenario was combined with a scenario of rapid expansion of road infrastructure (high roads).

2) A *public transport-oriented* urbanisation scenario was built by assuming alignment of policy trends that increase the role of public transport in urban mobility. This scenario is the combination of low sprawl, high public transport expansion, and high fuel prices. This policy pathway is modelled with a scenario where urban road infrastructure lags behind urban population growth (low roads).

The difference in the evolution of each variable between the different scenarios is limited to stay within the bounds of what has been identified as high and low bound in each region. Summary tables with the growth of each variable in each scenario are provided below for each region. In the case of China, assumptions about the future of car ownership restrictions were also incorporated into the baseline and the two alternative scenarios.

Besides the two main diverging policy pathways described, additional scenarios for each region were also constructed to analyse particular aspects of urban transport evolution in each of the contexts: the recent growth in use of two-wheeler vehicles in Latin America, the possible ban of auto-rickshaws in India, and the impact of private-oriented or public transport-oriented urbanisation under the same assumption for future car ownership restrictions in urban China.

Latin American cities

Urban policy scenarios for the Latin American region presented in this section were modelled for the first time for the *ITF Transport Outlook 2013*. Inputs for GDP and urban population have been updated for this publication with the latest ENV-model economic projections of the OECD Environmental Directorate and the 2014 revision of the Urbanization Prospects of the United Nations. Differences between the evolution of variables described in Table 4.2 and those presented in the *ITF Transport Outlook* 2013 are explained by changes in urban population and distribution of population among different size cities.

Land-use scenarios. Land-use scenarios adopt alternative paths for the evolution of urban density. Pathways describing the relation between urban population growth and urban surface expansion were constructed by country. Argentine urban agglomerations were found to have on average the greatest surface expansion relative to population growth. Contrastingly, Colombian cities were found to have patterns with the least sprawl.

In the *Baseline* scenario, all urban agglomerations in the region expand in urban surface area, relative to population growth, following their own pathway. The average density of all urban agglomerations is maintained at values similar to 2010 through 2050.

In the *High sprawl* scenario, urban agglomerations in the region expand in surface area following the Argentine trend. By 2050 the cities have on average a density that is 30% lower than in 2010.

In the *Low sprawl* scenario, urban agglomerations in the region expand in surface area following the Colombian trend. By 2050 the cities have on average a density that is 20% higher than in 2010.

Data analysis for Latin America shows evidence that urban density is positively related to public transport service per capita and negatively related to road infrastructure provision per capita. For this reason, public transport and road infrastructure scenarios are influenced by sprawl scenarios. Urban density is also assumed to be positively related to ridership of public transport. The elasticity used is derived from the Singapore Land Transport Authority (LTA) Academy. This work finds a positive elasticity that increases as density rises.

Public transport scenarios. Public transport variables used in the Latin American module are total vehicle-kilomtres per capita of public transport service and the share of public transport service provided by mass transit modes. In mass transit modes we include urban rail (heavy, light and underground) and BRT in confined lane segments.

In the *Baseline* scenario, expansion of public transport service per capita corresponds to the baseline urban density evolution. From 2010 to 2050 total vehicle kilometres of public transport service grow 1.7 times. This results in a per capita service that is only slightly above 2010 levels. Under this scenario, public transport services offered through mass transit modes increase from 4.2% in 2010 to 10% in 2050. Overall capactiy of public transport (seat kilometres per capita) double by 2050.

In the *High public transport* scenario, cities follow the *Low sprawl* scenario but also intensify policies of urban transport service expansion. Total vehicle-kilometres of public transport service increase 2.5 times, while per capita service grows 55%. Mass transit participation also grows more rapidly and accounts for 15% of total public transport service. Capactiy of public transport service per capita is three times the 2010 levels.

In the *Low public transport* scenario, expansion of public transport service per capita reflects the *High sprawl* trend assumed. Total vehicle kilometres of service only grow 9% between 2010 and 2050. As a consquence, public transport service per capita decreases by 30%. The growth in the share of mass transit service is maintained similar to the *Baseline* scenario (10% by 2050). Total public transport capacity per capita grows by only 43% by 2050.

Road infrastructure scenarios. The variable used for road infrastructure for this module is length of urban road kilometres per capita.

In the *Baseline* scenario, per capita roads grow according to the *Baseline* land use scenario. The result is an expansion of total kilometres of 55%. In per capita terms, road provision is maintained similar to 2010 levels.

In the *High road* scenario, cities follow the *High sprawl* scenario which increases expansion of road infrastructure. Cities also intensify their policy towards urban road expansion. Total urban roads in the region expand 2.4 times relative to 2010. Per capita road length grows 50%.

In the *Low road* scenario, expansion of roads per capita responds to the *Low sprawl* trend assumed. Total urban road length increases only 36%, making roads per capita decrease by 16%.

Table 4.2. **Latin American urban context under different scenarios**

			2010	2030	2050
Population			100	134	164
GDP			100	203	361
GDP/Capita			100	169	278
Land use	Urban Density of Average urban agglomeration	Baseline	100	102	103
		High sprawl	100	79	72
		Low sprawl	100	114	120
Public transport service	Total vkms of public transport	Baseline	100	141	168
		High public transport	100	158	251
		Low public transport	100	100	109
	Per capita vkms of public transport	Baseline	100	103	104
		High public transport	100	114	155
		Low public transport	100	73	68
	Share of rapid vkms (quality)	Baseline	4.2%	4.9%	10.0%
		High quality expansion	4.2%	6.2%	15.0%
	Public transport capacity seat.km/capita	Baseline	100	142	205
		High public transport	100	168	331
		Low public transport	100	106	143
Road infrastructure	Total kms of road	Baseline	100	134	155
		High roads	100	153	235
		Low roads	100	122	136
	Per capita kms of road	Baseline	100	98	96
		High roads	100	110	146
		Low roads	100	89	84
Oil prices		Baseline	100	150	160
		High oil prices	100	253	264
		Low oil prices	100	65	64

Chinese cities

In the case of Latin America we construct our scenarios based on divergent trends found in the different countries. Since China is such a large country, we conduct the same type of exercise accounting for geographical trends found within the country. We divide China into seven regions: Center, East, North, Northeast, Northwest, South and Southwest (Table 4.3 shows provinces included in each region).

Table 4.3. **Provinces included in each region for Chinese model**

Region	Province
Center	Henan, Hubei, Hunan
East	Shanghai,Fujian, Jiangsu, Jiangxi, Shandong, Zhejiang, Anhui
North	Beijing, Heibei, Inner Mongolia, Shanxi, Tianjin
Northeast	Heilongjiang, Jilin, Liaoning
Northwest	Gansu, Ningxia, Qinghai, Shaanxi, Xinjiang
South	Guangdong, Guangxi, Hainan
Southwest	Chongqing, Guizhou, Sichuan, Yunnan

Note: Only provinces with agglomerations above 500 000 population are included.

Land-use scenarios. Just as in the case of Latin America, land-use scenarios refer to different evolution of urban density. In the case of China, pathways describing the relation between urban population growth and urban surface expansion were constructed by region of the country. Urban agglomerations in the Northeast region were found to have on average the most intensive surface expansion relative to population growth. Cities in the Northwest region were found to have the less intensive pathway.

In the *Baseline* scenario, all urban agglomerations in China expand in urban surface, relative to population growth, following the average pathway of the region that they belong to. By 2050 the average density of all urban agglomerations is 10% higher than in 2010.

In the *High sprawl,* scenario urban agglomerations expand in surface following the Northeastern trend. By the end of the 40 year period cities have on average a density that is similar to the 2010 level.

In the *Low sprawl* scenario, Chinese cities expand in surface following the Northwestern trend. By 2050 the cities have on average a density that is 20% higher than in 2010.

In contrast to the case of the Latin American region, we did not find evidence of a significant relation between density and public transport or road provision in the Chinese context. For this reason, land-use scenarios have no influence on public transport or road infrastructure scenarios.

Density however has the same positive effect on ridership of public transport as in the Latin American module.

Public transport scenarios. Public transport variables in the Chinese module are buses and network length of mass transit per 1000 population (urban rail and bus-rapid transit). Increase in buses per capita is modelled based on the calculation of average growth rate of total buses relative to population growth in the different regions. A significant difference in the relation between bus and population growth was found where cities have population of less than 5 million, and where they pass such thresholds. Therefore for every region, two different coefficients are calculated, depending on the size of cities. In the case of cities below 5 million inhabitants, those in the Eastern region were found to have the highest average growth in buses relative to population growth, while cities in the Southern region show the lowest. In the case of cities above 5 million inhabitants, those in the Central region were found to have the most intensive growth in buses relative to population and cities in the Northeast the lowest.

Mass transit network length also grows relative to population growth. Coefficients are not region specific because no significant differences could be found in the available

Chinese data. Three coefficients were computed to reflect *Baseline*, *High* and *Low* expansion of the mass transit network. In the *Baseline* scenario, the average growth of mass transit length relative to population was used. In the *High public transport* scenario, the growth of mass transit relative to population was computed using only the 25% of cities with the highest per capita levels of mass transit. In the *Low public transport* scenario, only the 25% of cities with the lowest per capita levels are used. Finally, in all scenarios, we only assumed that there is mass transit when the predicted length is at least 15 kilometres. The figures were then benchmarked against mass transit planned openings by 2025 (reported in the ITDP mass transit database), which constitute a reference value for mass transit length in the *High public transport* scenario for this horizon.

The length of the mass transit network is divided between BRT and urban rail based on the positive correlations found between the proportion of urban rail in mass transit and GDP per capita, population density, and urban area size: large, rich and dense cities are more likely to develop an urban rail network than small, low-income and sparsely populated urban areas. These last favour BRTs when they build a mass transit network. Finally, the data for Chinese cities also shows that the number of buses per 1 000 inhabitants decreases with the length of the mass transit network in a city. Buses per capita figures are corrected in each scenario to account for this effect, thereby producing public transport provision measures that reflect the quality, as well as the quantity, of public transport provision.

In the *Baseline* scenario, buses in cities grow relative to population following the average growth rate found for the region they belong to. After converting buses into bus kilometres travelled the *Baseline* scenario is one where total bus-kilometres grow 56% from 2010-50. In per capita terms, bus kilometre expansion lags behind population growth and is 5% lower than in 2010. At the same time, total mass transit length increases by 120%, while in per capita terms the increase is much less pronounced (+40%). Overall per capita capacity of public transport (seat-kilomtres per capita) is 5% above 2010 levels.

In the *High public transport* scenario, urban buses in Chinese cities grow relative to population following the trend found for the Eastern region, if they are below 5 million population, and the trend found for cities in the Center when they reach 5 million inhabitants. Total vehicle-kilometres of bus service increases by 29%, while per capita service decreases by 20%. However, mass transit participation grows in almost 40% (this high increase explains the lower increase in regular bus service expansion). Mass transit grows 5 fold and is three times the per capita 2010 levels. Overall, total per capita capacity grows 32% by 2050.

In the *Low public transport* scenario, urban buses in Chinese cities grow relative to population following the trend found for the Southern region, if they are below 5 million population, and the trend found for cities in the Northeastern region when they reach 5 million inhabitants. Total vehicle kilometres of bus service grow by 17% between 2010 and 2050. As a consequence, bus service per capita decreases even more, by 28%. Mass transit service grows by 81% in total terms and by 17% in per capita terms. The share of mass transit is slightly lower than in the *Baseline* scenario (21% *versus* 25% by 2050). Total capacity of public transport service (per capita) is 20% smaller than in 2010.

Road infrastructure scenarios. The variable used for road infrastructure is urban road area per capita. As in the case of buses, we calculate the increase in urban road area relative to population growth based on our data. We calculate a coefficient by region in

China. Agglomerations in the Central region were found to have the highest average growth in urban road area relative to population, while those in the Southern region were found to have the lowest.

In a *Baseline* scenario, urban road area in cities grows relative to population following the average ratio found for the region that each city belongs to. Total urban area grows three times between 2010 and 2050. This is equivalent to an average growth of 58% in the urban area per inhabitant in China.

In the *High roads* scenario, urban road area in cities grows relative to population following the average relation found for cities in the Central region. In 2050, total urban road area is 3.6 times the 2010 level. The average growth in urban area per capita is equal to 91%.

In the *Low roads* scenario, urban road area in cities grows relative to population following the average relation found for cities in the Southern region. In this scenario total urban road area is 26% larger than in 2010. This translates into 40% less average urban area per capita in urban agglomerations.

Car restriction scenarios. In addition to differences in the evolution of variables shown in Table 4.5, the three Chinese scenarios incorporate assumptions regarding car ownership restrictions and their evolution. The definition of future restrictions is based on the analysis of seven Chinese cities that had implemented such restrictions by 2010: Beijing, Guangzhou, Guiyang, Hangzhou, Shanghai, Shijiazhuang and Tianjin.

Under the *baseline* scenario, future evolution of car ownership restrictions is based on two assumptions. First, the seven cities already restricting car ownership are assumed to maintain their policy in place during the next 40 years. We assume a constant number of licences issued yearly, defined according to official announcements for each city. Second, a city will impose a restriction if it reaches 2.5 million population coupled with a ratio of cars over road area that the seven cities with car ownership restrictions had in 2010. In that case, the number of licences issued each year is defined applying a constant coefficient relative to the car-road area ratio, extracted from the econometrics analysis of permits and congestion on the sample of seven cities. Differently from the case assumed for the *public transport-oriented* scenario (see below), car restrictions in this scenario are not adjusted by changes in the population.

Under the *public transport-oriented* scenario, we assume a stringent expansion of car restrictions. Here again, the seven cities with existing restrictions will extend their policy to the end of the period. Additional restrictions will be imposed in cities reaching the same population and road congestion thresholds as above. However, the number of licences issued now also depend on the evolution of population to counter-act the demographic plateauing effect of Chinese cities. In this way, car ownership slow down is maintained despite the marginal growth in population towards the end of the period.

In the *private transport-oriented* scenario, there is no expansion of the car restriction policies to other cities in China. Therefore only cities that already had a car ownership restriction by 2010 will continue to do so until the end of the period.

Table 4.4 summarises the number of new cities imposing a restriction in each period. The *baseline* and the *public transport-oriented* scenarios differ mainly in the timing of the imposed restriction. The two scenarios show the same number of cities imposing a restriction by the end of the period. This shows that despite higher levels of road infrastructure expansion, the *baseline* scenario results in similar levels of cars relative to road area (due to the higher growth in car motorisation).

Table 4.4. **Number of car restrictions imposed in Chinese cities under different scenarios**

Scenario	2010	2015	2020	2025	2030	2035	2040	2045	2050
Baseline	7	+0	+35	+6	+0	+4	+0	+0	+0
Public transport-oriented	7	+0	+33	+8	+0	+4	+0	+0	+0
Private transport-oriented	7	+0	+0	+0	+0	+0	+0	+0	+0

Table 4.5. **Chinese urban context under different scenarios**

			2010	2030	2050
Population			100	154	163
GDP		Baseline	100	592	1137
GDP/Capita		Baseline	100	330	592
Land use	Urban Density of Average urban agglomeration	Baseline	100	109	110
		High sprawl	100	99	100
		Low sprawl	100	118	121
Public transport	Buses vkms	Baseline	100	148	156
		High sprawl	100	126	129
		Low sprawl	100	115	117
	Buses vkms/capita	Baseline	100	96	95
		High public transport	100	82	79
		Low public transport	100	74	72
	Mass transit vkms	Baseline	100	200	220
		High public transport	100	425	488
		Low public transport	100	168	181
	Mass transit vkms/capita	Baseline	100	134	141
		High public transport	100	284	312
		Low public transport	100	112	117
	Public transport capacity seat.km/capita	Baseline	100	104	105
		High public transport	100	128	132
		Low public transport	100	83	81
Road infrastructure	Total road area (km^2)	Baseline	100	211	304
		High roads	100	232	366
		Low roads	100	188	242
	Road area per capita	Baseline	100	117	158
		High roads	100	129	191
		Low roads	100	105	126
Oil prices		Baseline	100	150	160
		High oil prices	100	253	264
		Low oil prices	100	65	64

Indian cities

Similarly to the case of China, we divided India into four regions: North-West, North-East, Central, and South. Table 4.6 shows the States that are included in each region.

Table 4.6. **Regional division of India**

Region	States and Union territories
North-West	Chandigarh, Delhi, Gujarat, Haryana, Himachal Pradesh, Jammu Kashmir, Punjab, Rajasthan, Uttarakhand
North-East	Assam, Manipur, Maghalaya, Mizoram,Nagaland,Sikkim,Tripura
Central	Bihar, Chhattisgarh, Jharkhand, Madhya Pradesh, Orissa, Uttar Pradesh, West Bengal
South	Andaman and Nicobar Islands, Andhra Pradesh, Goa, Karnataka, Kerala, Maharashtra, Pondicherry, Tamil Nadu, Telangana

Note: Only states and union territories with agglomerations above 500 000 population are included.

Land-use scenarios. Land-use scenarios refer again to different evolutions of urban density. In the case of India, no relevant regional trends were found for the relation between population and urban surface expansion. However, significant differences were found in relation to city size. Three sets of coefficients describing growth of urban surface relative to population are computed. Each set applies to cities with population from a certain size interval: below 2 million, between 2 and 8 million, more than 8 million inhabitants.

In the *Baseline* scenario, the coefficients are computed using all cities from each city category. In this scenario the averge urban density in Indian cities is 30% higher in 2050 than in 2010.

In the *High Sprawl* scenario, the coefficients are based on the 25% of cities with the highest sprawl in their category. In this scenario, the average urban density is reduced by 24% between 2010 and 2050.

In the *Low Sprawl* scenario, the coefficients are based on the 25% of cities with the lowest sprawl in their category. In this scenario, the average urban density is doubled between 2010 and 2050.

Urban density plays a role in infrastructure development through its impact on road provision (see the road provision scenarios below for more details). Furthermore, load factors of public transport depend on urban density to reflect higher public transport use in denser urban areas. We use the same elasticity than for Latin America and China.

Public transport scenarios. The evolution of public transport is computed in a similar fashion to China. Variables used to describe public transport provision in the Indian module are buses and network length of mass transit per 1 000 population (urban rail and BRT).

The number of buses per 1 000 inhabitants is found to grow with population, with growth rates depending on the region and also the size of cities: in small urban areas (under one million inhabitants), growth of public buses with population is almost half of what it is for large metropolises. In addition, in many of the smallest urban centres there is no public provision of buses. This is reflected in the *Baseline* and *Low public transport scenarios*. The Indian region found to have the highest growth in the number of buses relative to population was the Central region. Cities in the North-West region presented the lowest growth in buses relative to population.

Similarly to China, mass transit length grows with population and there are positive correlations between the proportion of urban rail in mass transit and GDP per capita, population density, and urban area size. In the absence of sufficient relevant data for India, the Chinese models were applied to India, controlling for the planned length of mass transit as well as the share of BRT in 2025: in the *High public transport* scenario, all planned mass transit projects referenced in the ITDP mass transit database are assumed to be in operation by 2025 (the same trend is continued up to 2050). Finally, buses per capita figure are adjusted to account for the presence of mass transit (including BRT).

In the *Baseline* scenario, buses in cities grow relative to population following the average growth rate found for the region they belong to. Total vehicle-kilometres of bus service double, but do not keep up with urban population growth; per capita service decreases by 17%. This is explained by two phenomena. The first one is the expansion of the mass transit network, with vehicle kilometres of mass transit being multiplied by almost 15. According to our data analysis, growth in mass transit tends to slow down growth in conventional buses. The second is the low development of buses in small cities in this scenario. Still, overall capacity of public transport (seat-kilometres per capita) grows by 40% by 2050.

In the *High public transport* scenario, urban buses in Indian cities grow relative to population following the trend found for the Central region. Total vehicle-kilometres of bus service increase by 90%, while per capita service decreases by 26%. There is a strong shift to mass transit as the network length increases: it is multiplied by almost 20 between 2010 and 2050, when 35% of cities above 500 000 inhabitants have developed a BRT and/or subway network (compared to 5% in 2010). Public transport capacity per inhabitant grows 56% from 2010 to 2050.

In the *Low public transport* scenario, expansion of public buses corresponds to that observed in the Northwest region; mass transit networks only develop in the largest cities and many small cities remain without any form of formal public transport. Bus vehicle kilometres double between 2010 and 2050. Mass transit still grows 11 times, but coming from a very low base in 2010. Compared to the *Baseline* and *High public transport* scenarios, the number of buses per capita is higher in this scenario. However, mass transit is much less present and the overall quality and quantity of public transport provision is lower. Capacity of public transport per capita only grows 18% by 2050.

Road infrastructure scenarios. The variable used for road infrastructure is length of road kilometres per capita. In our dataset, road provision grows with population. There are significant differences in the growth rates between regions. Urban density has a negative impact on per capita road infrastructure expansion. Therefore, for each region (except the North East which is more rural and for which no high density city exists) two coefficients linking population and road provision are computed: one for cities with less than 10 000 inhabitants per square kilometre and one for cities above this threshold. This trend creates a link between road develoment and urban sprawl scenarios.

The *Baseline road* scenario assumes road length in each city evolves according to the growth rates of the region it belongs to, with urban sprawl following the *Baseline* sprawl scenario. In this scenario, road length increases by 354% in absolute terms, and by 76% when computed per inhabitant.

In the *High road* scenario, urban density evolves according to the *High Sprawl* scenario and road length evolves according to the growth rate of the Central region, which witnesses the strongest relationship between population and urban area in our historical data. The resulting growth in road length is 654% and road provision per capita almost triples.

Finally, in the *Low road* scenario, urban density increases according to the *Low Sprawl* scenario and roads expand relative to population according to the coefficients found for the NorthWest region, which has the weakest link between population and road provision in the historical data. In this scenario, road length increases by 168%, but remains stable in per capita terms.

Table 4.7. **India urban context under different scenarios**

			2010	2030	2050
Population			100	200	258
GDP		Baseline	100	356	854
GDP/capita		Baseline	100	291	643
Land use	Urban Density of Average urban agglomeration	Baseline	100	115	130
		High sprawl	100	75	76
		Low sprawl	100	156	204
Public transport	Buses vkms	Baseline	100	214	200
		Low public transport	100	155	206
		High public transport	100	215	190
	Buses vkms/capita	Baseline	100	112	83
		Low public transport	100	87	80
		High public transport	100	121	74
	Mass transit vkms	Baseline	100	391	1 472
		Low public transport	100	313	1 103
		High public transport	100	497	1 971
	Mass transit vkms/capita	Baseline	100	219	570
		Low public transport	100	175	427
		High public transport	100	278	763
	Public transport capacity seat.km/capita	Baseline	100	128	140
		Low public transport	100	99	118
		High public transport	100	145	156
Road infrastructure	Total kms of road	Baseline	100	289	454
		High roads	100	430	754
		Low roads	100	186	268
	Per capita kms of road	Baseline	100	162	176
		High roads	100	241	292
		Low roads	100	104	104
Oil prices		Baseline	100	150	160
		High oil prices	100	253	264
		Low oil prices	100	65	64

Mobility and CO_2 emissions to 2050

Urban agglomerations of above 500 000 population in Latin America, China and India account for about 9% of total world motorised passenger surface transport CO_2 emissions in 2010. In our *baseline* scenario, this share is likely to grow to about 20% in the next 40 years. This means that 38% of the total world growth in CO_2 emissions related to passenger surface transport would stem from these cities.

As will be seen in this section, long-term implementation of alternative policy scenarios can significantly impact the modal shares and CO_2 emission growth in urban agglomerations in the three contexts.

Latin American cities

Difference between results shown in this section and the *ITF Transport Outlook 2013* for the Latin American case study are explained by updates in the population and GDP scenarios used within our model.

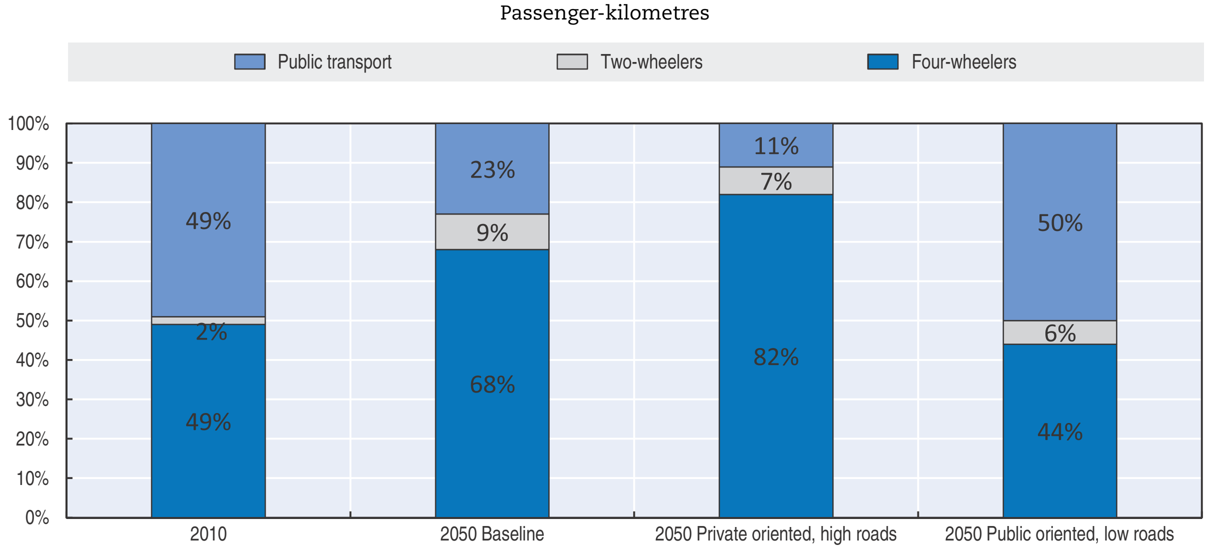
In the *private-oriented* urbanisation scenario with high roads, cars and two-wheelers significantly displace public transport in urban mobility by 2050. The rapid expansion of urban road infrastructure delays the build up of congestion and thus slows down the penetration of two-wheelers in the private fleet to a certain extent. At the end of the period, car mobility occupies 82% of motorised transport. This is 30 percentage points more than in 2010 and 14 percentage points more than in the *baseline* scenario in 2050.

Despite the higher expansion in urban roads (which tends to increase attractiveness of cars), with public transport infrastructure expansion lagging behind population growth, the two-wheeler's role in mobility increases significantly in this scenario (from 2% to 7% of total passenger-kilometres). By the end of the period, the share of public transport in mobility is only 11%. This represents a decrease of 38 percentage points with respect to 2010 and 12 percentage points less than in the *baseline* scenario in 2050.

In the *public transport-oriented* scenario with low roads, rapid expansion of public transport service per capita and a growing share of services delivered through mass transit prevents high shifts from public to private mobility. Total private mobility is slightly reduced and 2010 public transport participation in total motorised mobility is maintained at similar levels. With urban road expansion lagging behind population growth in cities, congestion pressures increase the competitivity of motorcycles relative to cars. Car participation in mobility is reduced from 49% to 44% between 2010 and 2050, while the share of two-wheelers in urban mobility grows from 2% to 6%.

Figure 4.7. **Modal shares for urban Latin America mobility under different policy scenarios**

Passenger-kilometres



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Mobility-wise, the *private-oriented* urbanisation scenario with high roads increases total mobility levels throughout the period in comparison to the *baseline* scenario (+19% by 2050). Much of this is driven by having higher travel per private vehicle as a consequence of low-oil prices.

Total mobility levels resulting from the *public transport-oriented* urbanisation scenario with low roads show that the shift in policy strategy will have a certain cost in mobility levels, especially during the first periods. This is due to the increasing costs of driving imposed by high oil prices, while public transport provision remains relatively low and with limited service in mass transit modes. Mobility levels in this scenario catch up with the *baseline* scenario towards the end of the period, when public transport network

Figure 4.8. **Total mobility growth under different scenarios Latin America**

Passenger-kilometres (2010 = 100)

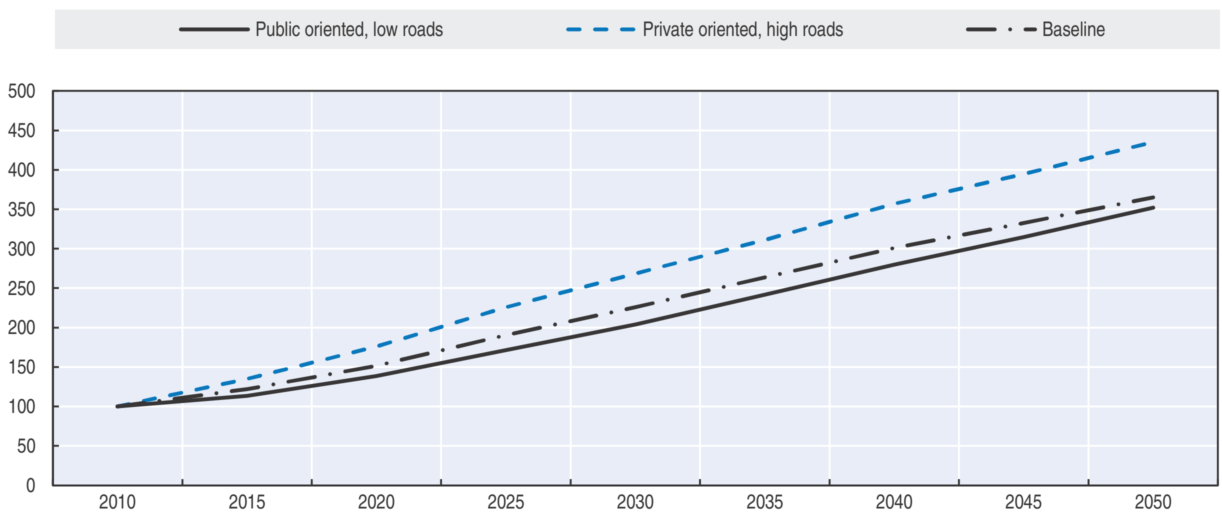

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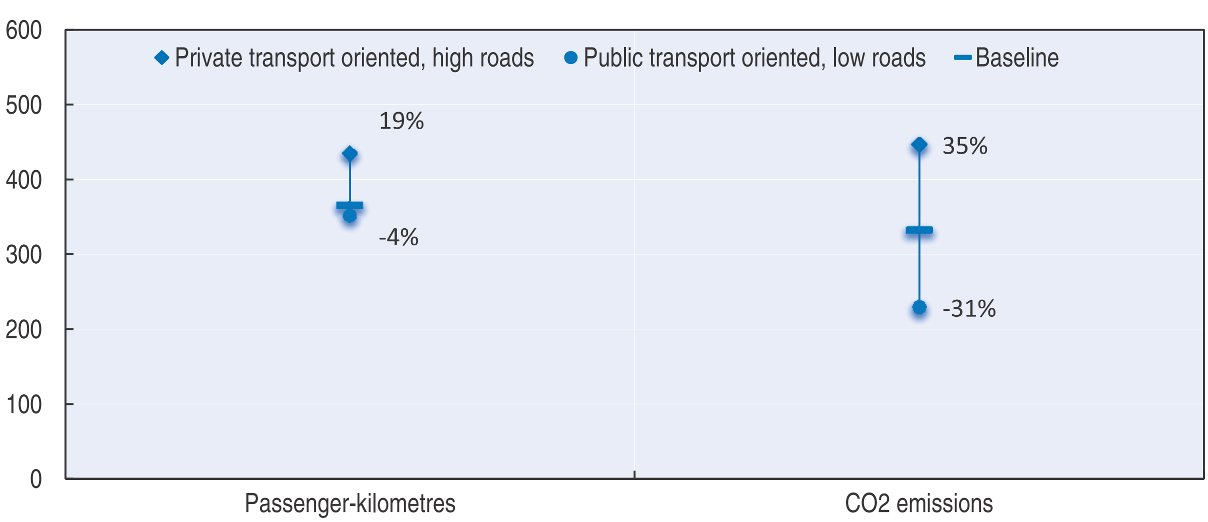
Figure 4.9. **Growth in mobility and CO_2 emissions under different scenarios in Latin American cities**

2010 = 100



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expansion and improvement are able to off-set restrictions to private mobility. By 2050, this scenario is only 4% below mobility levels in the *baseline* scenario.

The increase in mobility in the *private transport-oriented* urbanisation scenario with *high roads* generates even higher additional CO_2 emissions (35% higher than in the *baseline* scenario). This implies an increase in the carbon intensity of urban transport relative to the baseline trend. On the other hand, the small reductions in mobility shown by the *public transport-oriented* urbanisation scenario result in significant reductions of CO_2 emissions (31% lower than the baseline). Therefore in this scenario, urban mobility is provided at a lower marginal cost in terms of the external cost of CO_2.

Future perspectives for two-wheelers in the Latin American region

Until recently, motorisation in the Latin American region had been almost entirely characterised by the growth in cars. Recent trends however show that two-wheelers are an important player in mobility in the region, and suggest that their role will increase in the future. Globalisation in the production of two-wheelers has allowed the introduction of low-price models in the Latin American markets. Countries like Brazil, Colombia and Argentina have also developed their own motorcycle production industry, which has further reduced costs and increased supply (Montezuma 2012). Added to the low purchasing costs, inexistent or lax regulation also account for the low relative cost of owning and using two-wheeler vehicles.

The response of demand to decreasing prices has been very high in most countries in the region, despite the fact that both average income and motorisation are already at middle level stages. A possible explanation is that high levels of congestion in many cities have increased the competitiveness of two-wheelers. Another important driver has been the conjunction of the very high income inequalities in the region and the deficient quality and insufficient supply of public transport in urban centres. Two-wheelers have therefore become first stage motorisation vehicles for the many captive users of public transport. Box 4.3 illustrates the reliance of a high proportion (especially in the poorest segments) of the population on inferior modes of public transport in the metropolitan region of Mexico City.

Box 4.3. **Transport expenditure by income decile in the metropolitan region of Mexico City**

Figure B.4.3.a below shows the percentage of transport related expenditure in public and private modes in the metropolitan region of Mexico City by income decile of the population. As can be seen, public transport expenditure (without taxis) makes up more than 1/3 of total expenditures on transport for people in deciles one through eight. In the first two deciles it accounts for 80% of total transport related expenditure.

Disaggregating this expenditure by mode of public transport (Figure B.4.3.b) it is evident that the highest share of public transport expenditure is allocated to “colectivos”, combis, and microbuses. This type of vehicle is the most available throughout the city, and the only available services in many of the suburban areas. Nonetheless, these are low capacity vehicles characterised by old fleets that are far from meeting with safety standards. Because these services are mixed with all other traffic, their travel times are also affected by the growing congestion levels in the city. It can also be seen that only higher income deciles allocate a significant share of total expenditure on public transport to mass transit. At the same time these segments of the population rely very little on public transport, contrasting wtih the poorest segments, which rely heavily on public transport and meet a large part of their demand for these services with poor quality modes.

Box 4.3. **Transport expenditure by income decile in the metropolitan region of Mexico City** *(cont.)*

Figure B.4.3.a. **Transport related expenditure in the metropolitan region of Mexico City**

Percentage

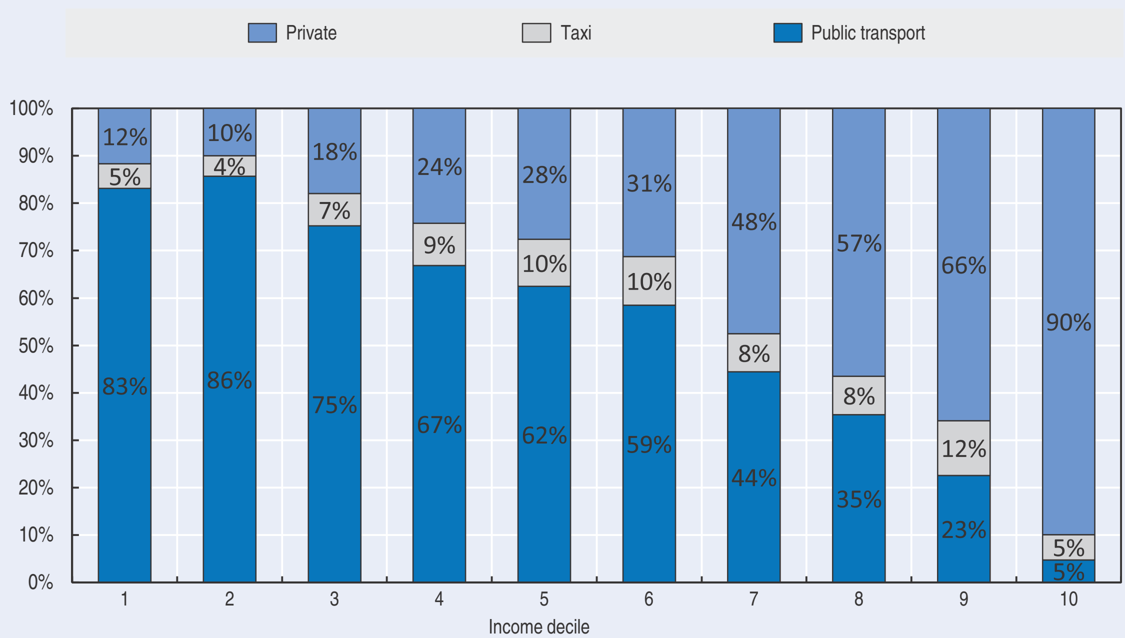

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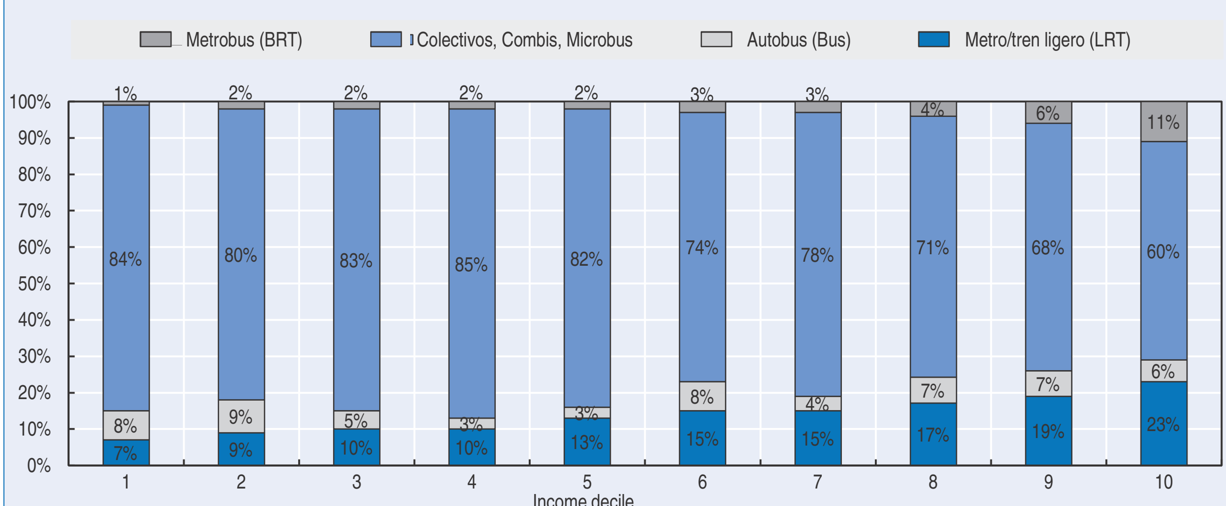
Figure B.4.3.b. **Transport related expenditure by mode in the metropolitan region of Mexico City**

Percentage



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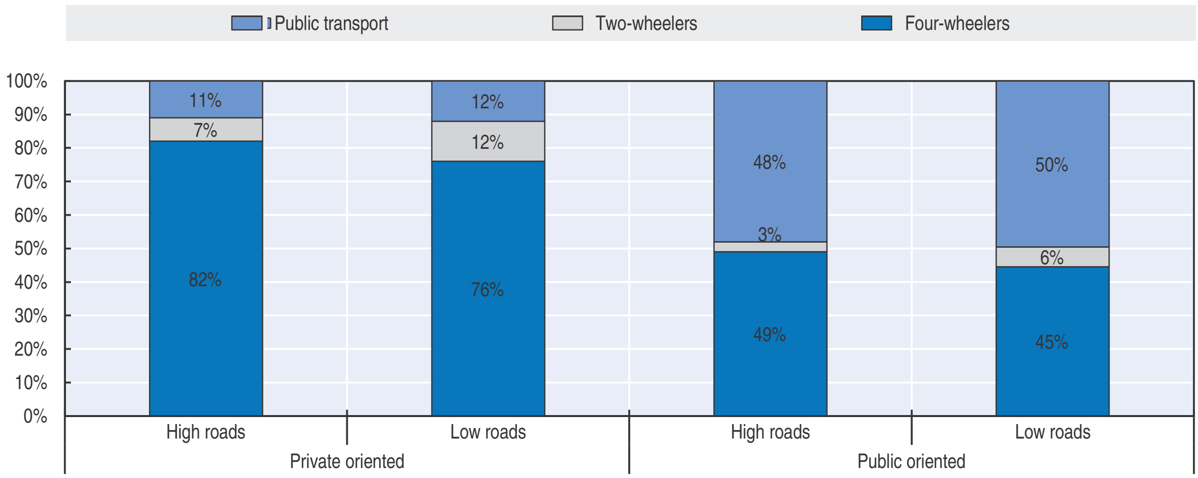
In order to further explore the future perspectives of two-wheelers in the region, we compare the *public transport-oriented* and *private transport-oriented* urbanisation scenarios under high and low road infrastructure perspectives. As shown by Figure 4.10, in the *private transport-oriented* urbanisation scenario, with low roads, a higher share of mobility

Figure 4.10. **Modal shares for urban Latin America under different policy scenarios, 2050**

Passenger-kilometres, alternative road scenarios



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transferring from public to private modes is captured by two-wheelers (relative to the same scenario with high roads expansion). Under this scenario, two-wheeler participation in urban mobility is higher than in all other scenarios. In the *public transport-oriented* urbanisation scenario with rapid expansion of road infrastructure, two-wheelers participation in urban mobility only grows from 2% in 2010 to 3% in 2050.

In terms of private fleet growth, Figure 4.11 shows the growth (index) of car and two-wheeler fleets during the 40 year period in the baseline and the four scenarios modelled. In the *baseline* scenario, the car fleet in urban centres with more than 500 000 population in Latin America grows 5.1 times, while the two-wheeler fleet grows 21 times. This represents an average annual growth rate of 4% and 8% for cars and two-wheelers respectively.

Figure 4.11. **Private fleet growth by 2050 in Latin America**

2010 = 100

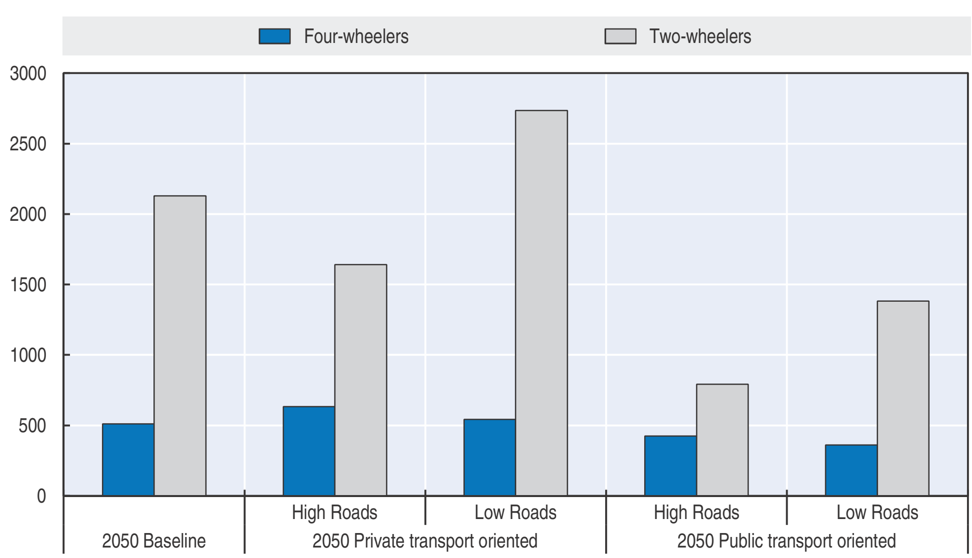

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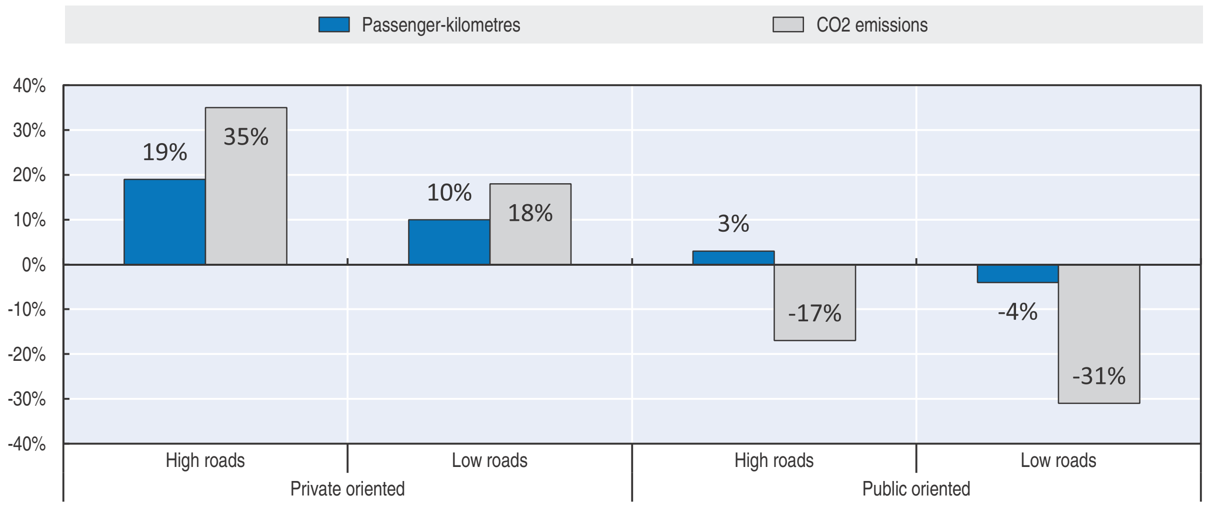
Figure 4.12. **Mobility and CO_2 emissions in Latin American cities, compared to *baseline* scenario**

Alternative road scenarios



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In the *private transport-oriented* scenario with high roads, the car fleet grows 24% more than in the *baseline* scenario (5% average annual growth). This is due both to the delay in congestion (caused by the rapid expansion of urban roads) and the slow expansion of public transport services and moderate quality improvements. The relative alleviation of congestion levels slows down private vehicle demand shift towards two-wheelers. As a consequence, growth in the fleet of two-wheelers is only 77% of their growth in the *baseline* scenario. In this scenario, the two-wheeler urban fleet grows 16 times (7% average annual growth).

In the *private transport-oriented* scenario with low road expansion, the car fleet expands slightly above baseline levels. This means that due to congestion pressures generated by slow road expansion, a large part of the growh in the private fleet (which is accelerated by the lower expansion of public transport in this scenario) comes from two-wheelers. In this scenario the two wheeler fleet expands 28% more than in the *baseline* scenario (9% average annual growth).

Both *public transport-oriented* scenarios show slower fleet growth relative to baseline levels for both cars and two-wheelers. This is the consequence of significant expansion and improvement of public transport service. In the case where this scenario is combined with a high road expansion scenario, car and two-wheeler fleets are 20% and 60% smaller than in the *baseline* scenario. In the case where urban roads lag behind urban population growth, the car and two-wheeler fleets are 30% and 40% less than in the *baseline* scenario.

Just as in the case of the *private transport-oriented* urbanisation scenario with high road infrastructure expansion, the case under low road infrastructure yields higher increments in CO_2 emisssions than mobility (relative to baseline levels). In the case of the *public transport-oriented* mobility scenario with high road infrastructure, total mobility is slightly higher than in the *baseline* scenario. CO_2 reductions in this scenario amount to 17% relative to *baseline* scenario levels. Again, this shows a lower marginal cost of mobility in terms of CO_2 emissions than results in the *baseline* scenario.

Chinese cities

The *baseline* scenario for China assumes a business-as-usual evolution in car ownership restrictions over the 2010-50 period, as described in Table 4.4, with 52 cities imposing a restriction by 2050. Despite these restrictions, car share grows by 33 percent points and total private vehicle share by 35 percent points.

The *public transport-oriented* scenario corresponds to a higher public transport expansion and a higher mass transit share, coupled with a stronger car restriction policy (adapted to the evolution of population), and high fuel prices. In this case, car participation only grows by around 12 percent points. This scenario also reduces the extent of growth in two-wheeler participation compared to the *baseline* scenario. However, as congestion pressures related to a slower urban road expansion tend to slow down the transition from two- to four-wheelers, there is still a significant increase in participation of two-wheelers compared to 2010.

The shift to align policies towards the most public oriented trends in the country, taking into account mass transit contruction according to future plans, limits the loss of public transport participation between 2010 and 2050 compared to the *baseline* scenario. However, it does not allow 2010 levels to be maintained as in Latin America.

The *private transport-oriented* scenario significantly reduces the participation of public transport in urban mobility in China. The decrease of public transport service per capita, coupled with a higher road expansion, a lower oil price and a less restrictive car ownership policy, explains the participation of cars in urban mobility doubling compared to 2010. Compared to the baseline, the increase is 11 percent points for total private participation, while the share of two-wheelers remain the same between the two scenarios.

In the *private transport-oriented* urbanisation scenario, total mobility levels increase 9% over the period in comparison to the *baseline* scenario by 2050. Most of this growth is driven by higher travel per vehicle, as a consequence of low-oil prices.

Figure 4.13. **Modal shares in Chinese cities under different policy scenarios**

Passenger-kilometres

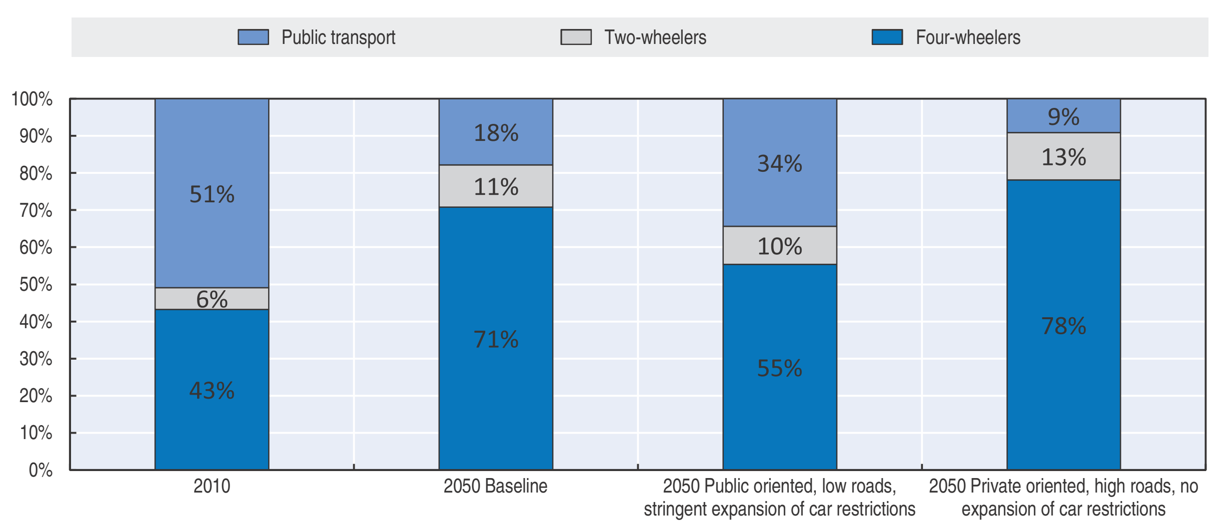

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Figure 4.14. **Mobility in Chinese cities under different policy scenarios**

Index, 2010 = 100

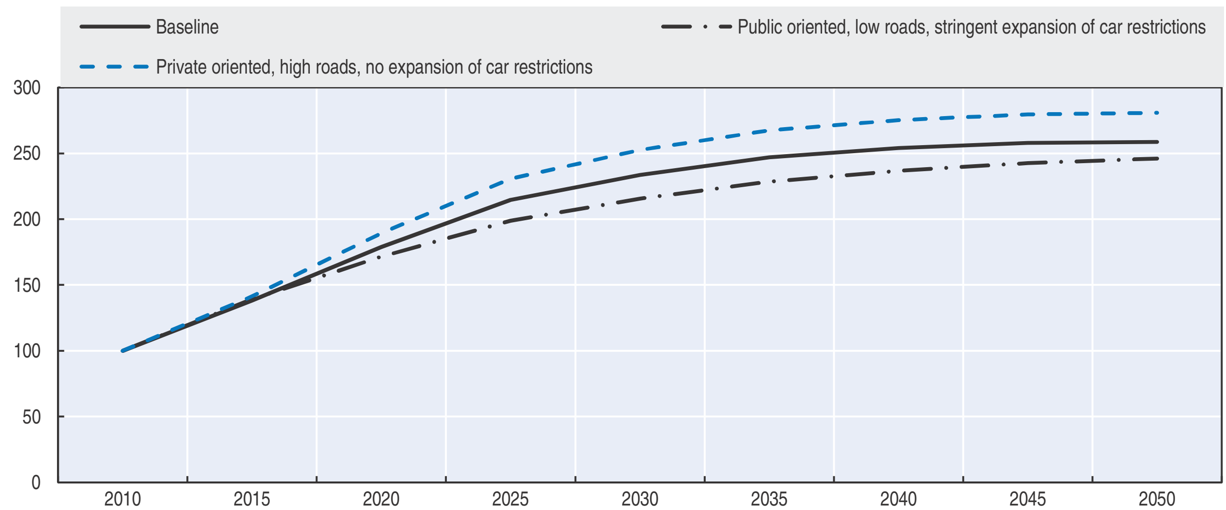

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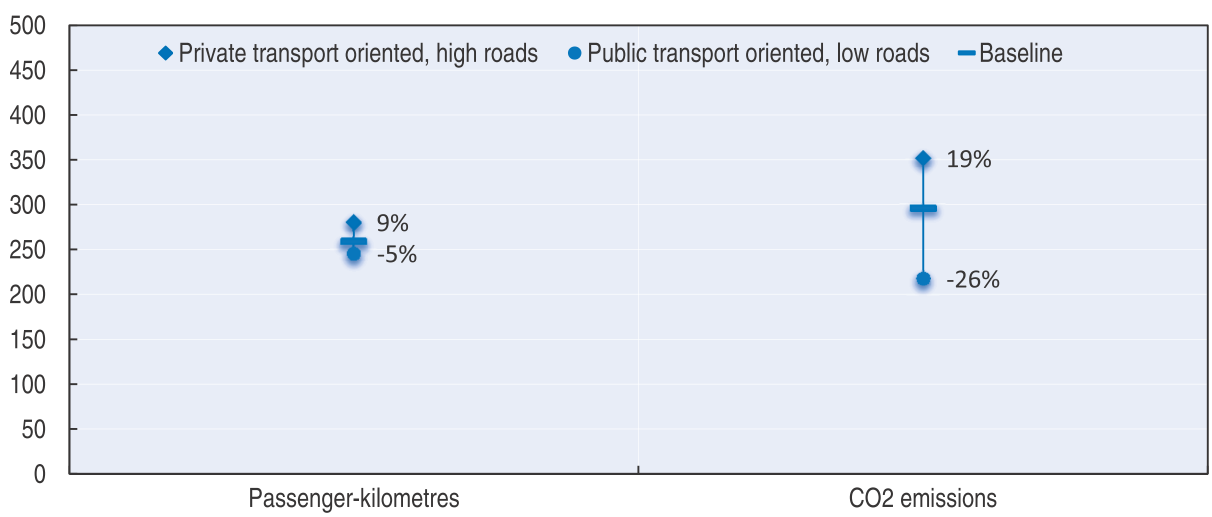
Figure 4.15. **Growth in mobility and CO_2 emissions under different scenarios in Chinese cities**



StatLink http://dx.doi.org/10.1787/888933168969

Total mobility levels resulting from the *public transport-oriented* urbanisation scenario show a similar evolution to that of the Latin American case, with the shift towards a public transport strategy imposing some mobililty costs in the beginning of the period but then catching up towards the end of the period. By 2050, the gap in mobility between these scenarios is only 5%. This shows that long-term shift to the public transport-oriented policy allows to overcome the mobility costs arising from private travel restrictions coupled with the most stringent car ownership restriction policy. Stabilisation of mobility levels towards the end of the period in all scenarios is explained by the plateauing of the population.

Regarding CO_2 emissions, results for the Chinese case study provide similar conclusions to those for Latin America. The *private transport-oriented* scenario generates an increased carbon intensity of urban transport relative to the baseline trend: in the Chinese case, the *private transport-oriented* scenario results in 19% higher CO_2 emissions compared with the baseline. As for Latin America, the *public transport-oriented* scenario results in a significant reduction in CO_2 emissions (26% lower than the baseline). Here again, urban mobility is provided at a lower marginal cost in terms of CO_2 emissions.

Effect of car ownership restrictions in China under different urban scenarios

Car ownership restriction policies are likely to be adopted in a growing number of cities in order to deal with the fast growing CO_2 and pollution emissions and congestion issues Chinese cities are facing.

In order to investigate the potential impacts of restrictive measures on car ownership under different policy frameworks, we define two intermediate scenarios, using the same assumption for car ownership restrictions. We use the baseline assumption as we consider this a more plausible scenario. Under this assumption medium and large cities with high ratios of car to road area impose a car ownership restriction. Quotas are not adjusted to account for changes in population growth. The two scenarios then differ in the orientation of the urban policy, with one using the *public transport-oriented* urbanisation scenario with low road expansion while the other uses the *private transport-oriented* urbanisation scenario with high road expansion.

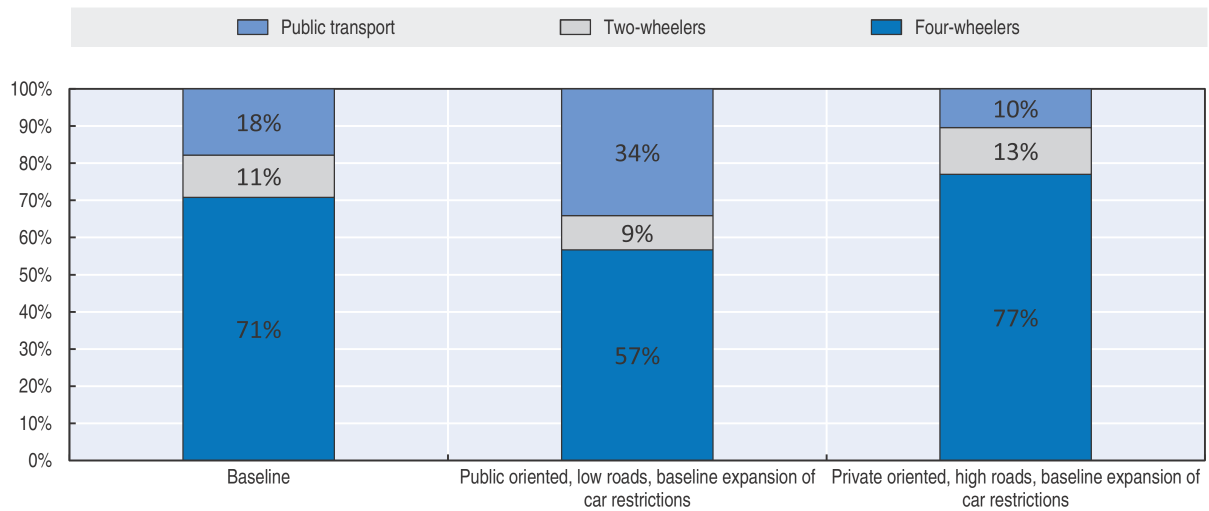
Figure 4.16 shows that the car restriction, without population adjustment, coupled with the *public-oriented* scenario with low road expansion, reinforces the impact of car restrictions, as the participation of cars is 14 percentage points lower compared to the baseline. The participation of two-wheelers is also less due to the high public transport expansion, the low road infrastructure growth (which increases congestion pressures) and the high oil prices. The scenario based on the same assumptions about car ownership restriction development but coupled with the private oriented scenario with high road expansion shows only a slight increase in two-wheelers participation. The bulk of increase in car participation is driven by low oil prices and a high road expansion. Notice that in this scenario, two-wheelers account for a higher participation in urban mobility than public transport.

Figure 4.17 compares the evolution of total urban mobility under the three scenarios. Expanding car ownership restrictions to medium and large cities that have severe congestion problems will end in higher than baseline mobility whether implemented under a *public transport-oriented* urbanisation scenario with low road expansion, or under a *private transport-oriented* urbanisation policy with high road expansion. However, the reasons behind the gains in mobility compared to the *baseline* scenario differ between the two settings, as do the environmental consequences. The private oriented urbanisation policy with high road expansion results in more private vehicles in cities that do not have a restriction. Also, cities that implement car restrictions under this scenario do it after arriving at higher car ownership levels than in the *public transport-oriented* scenario since expansion of road infrastructure will generate similar congestion levels at higher vehicle ownership.

Finally, all vehicles travel more in this scenario because of the low oil prices assumed in this scenario. Contrastingly, the *public transport-oriented* urbanisation scenario with low road expansion gives similar levels of mobility under the same car restriction assumption,

Figure 4.16. **Modal shares in urban China, 2050**

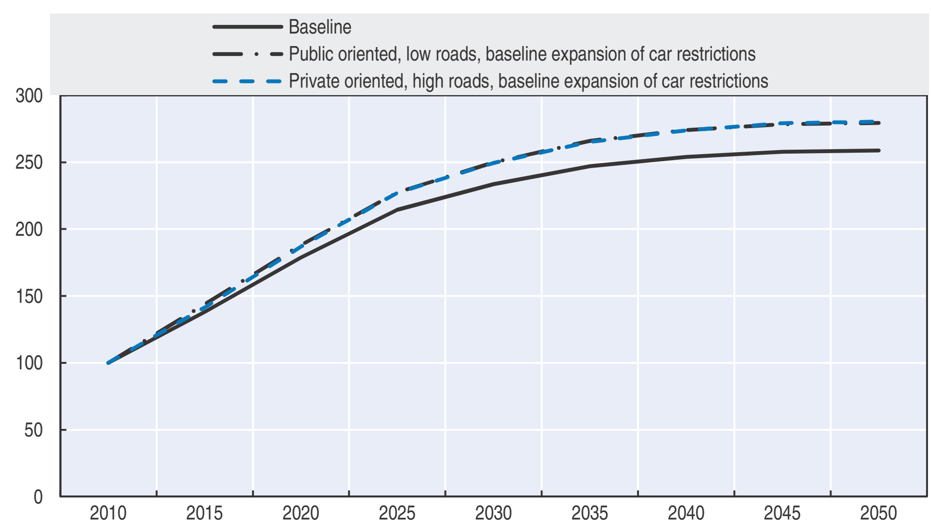
Passenger-kilometres, baseline expansion of car ownership restriction



StatLink http://dx.doi.org/10.1787/888933168976

Figure 4.17. **Mobility in urban China under different policy scenarios**

Baseline expansion of car ownership restrictions



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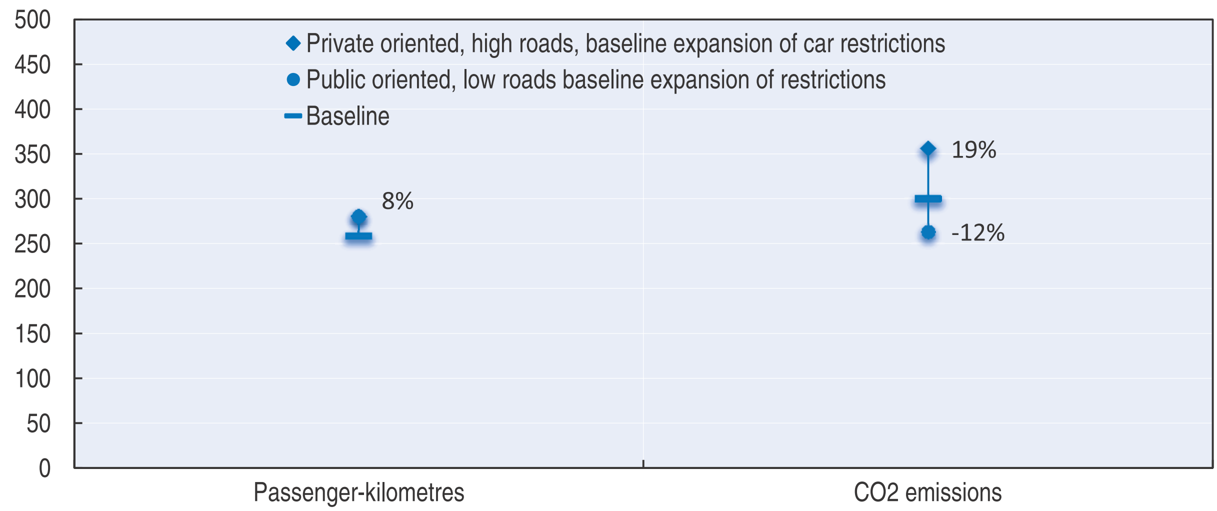
due to the increase in public transport provision. The growth in public transport capacity counterbalances the lower level of private mobility generated.

Figure 4.18 illustrates the differences in environmental consequences of the three scenarios and highlights the beneficial impact of coupling car ownership restriction with a policy shift towards public transport. The figure shows that the gain in mobility under this scenario translates into significantly less CO_2 emissions compared to baseline (-12%), while the increased mobility resulting from the same car restriction assumption but associated to a private oriented scenario creates additional CO_2 emissions (+19%). These results emphasise that a car restriction implemented without an adequate setup for public transport would still produce more CO_2 emissions. Notice that the *private transport* scenario with high roads generates the same level of CO_2 emissions when coupled with the baseline expansion of car ownership restrictions and when such policies were assumed to be implemented only in seven cities. The reason for this is that other policies assumed in this scenario significantly accelerate car ownership growth. As cities approach high ownership levels, elasticity of motorisation relative to income decreases significantly. Under this context, car ownership restrictions have a marginal impact in car travel and related externalities.

Figure 4.18. **Growth in mobility and CO_2 emissions under different scenarios in Chinese cities**

Baseline expansion of car ownership restrictions, 2010 = 100



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Indian cities

As for Latin America and China, we examine the outcomes of the urban scenarios through modal shares, total mobility (passenger-kilometres) and CO_2 emissions.

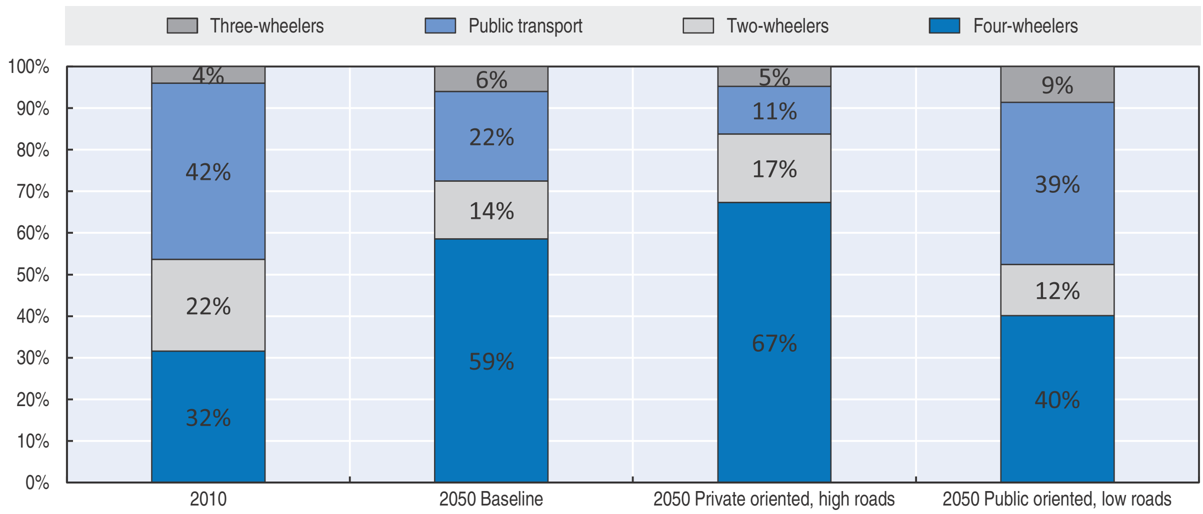
The outcomes in terms of modal shares show very contrasting trends for the different scenarios (Figure 4.19). In the *baseline* scenario, the modal share of private cars increases from 32% in 2010 to 59% in 2050, to the detriment of public transport (from 42% to 22%). This shows that the natural evolution of mobility patterns in urban India is towards private mobility.

The *public transport-oriented* scenario with low roads maintains public transport shares at 2010 levels. This however will require a very significant enhancement, in quantity and quality, of public transport provision. Resulting modal shares is enough to significantly reduce CO_2 emission growth, which is 37% (Figure 4.21) less in the *public transport-oriented* scenario than in the *baseline* scenario. However, total growth in mobility in this scenario is 29% smaller than in the *baseline* (Figure 4.20).

In the *private transport-oriented* scenario with high road expansion, public transport develops slowly and this accelerates private vehicle ownership. As a consequence, the modal share of four-wheelers more than doubles, and that of two-wheelers only marginally decreases, from 22% to 17%. The modal share of public transport is four times smaller than in 2010. Because of these new modal shares, the 23% increase in mobility compared to the *baseline* scenario result in CO_2 emissions that are 47% higher than in the *baseline* scenario. The additional passenger-kilometers of the *private transport-oriented* scenario are thus more CO_2 intensive.

Figure 4.19. **Modal shares under different policy scenarios in Indian cities, 2010 and 2050**

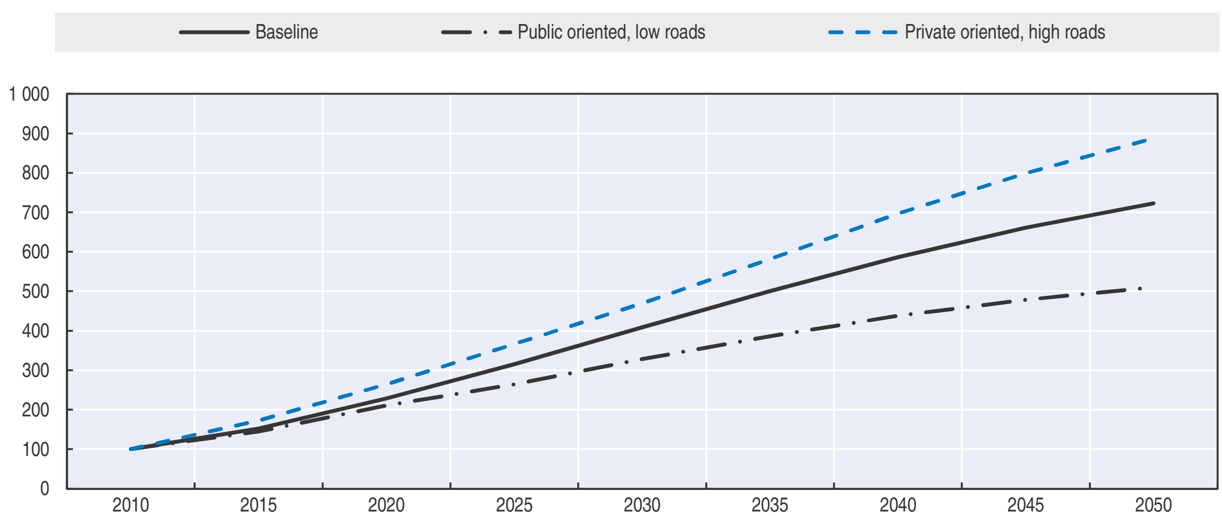
Passenger-kilometres



StatLink http://dx.doi.org/10.1787/888933169004

Figure 4.20. **Evolution of urban mobility in Indian cities under different scenarios**

2010 = 100



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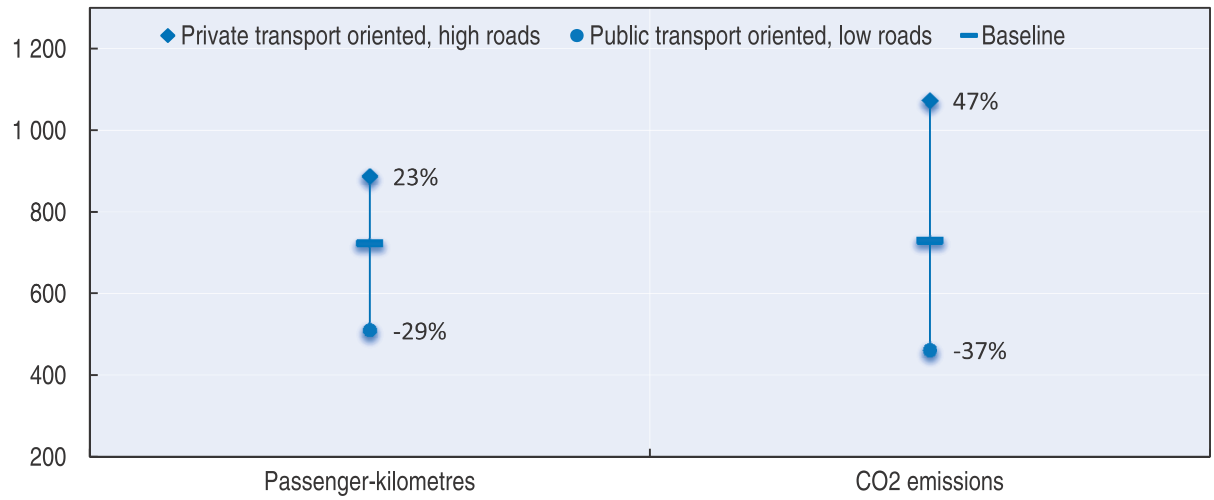
As said before, the three scenarios differ significantly in terms of mobility. The lower cost of fuel and the positive effect of high road provision on private vehicle fleet explain the relatively high growth in the *private transport-oriented* scenario with high roads. Contrary to Latin America and China, the *public transport-oriented* scenario with low roads does not converge with baseline mobility levels during the studied period. One possible explanation is the limited capacity offered by public transport in India, which cannot accommodate all the private mobility of the *private transport-oriented* scenario (even when expansion of public transport is high in the *public transport-oriented* scenario, the starting point is low relative to the levels of Latin America and China). Limited road expansion delays growth of both four-wheelers and two-wheelers in this scenario, which also increases the mobility

Figure 4.21. **Growth in mobility and CO_2 emissions under different scenarios in Indian cities**

2010 = 100



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gap. One challenge for Indian cities thus lies in the development of public transport at a pace that does not hinder mobility.

Three-wheeler ban in large Indian cities

Three-wheelers are an important part of the mobility mix in Indian cities. However, legislation banning some forms of three-wheelers in city centres are gaining momentum in India, with bans already in place in the central part of Mumbai and in Pune and a few municipalities considering the introduction of at least a limited (i.e. two-stroke three-wheelers) ban. Locally, the objectives of such policies are twofold: to reduce congestion on the small roads of city centres, and limit CO_2 and other pollutants.

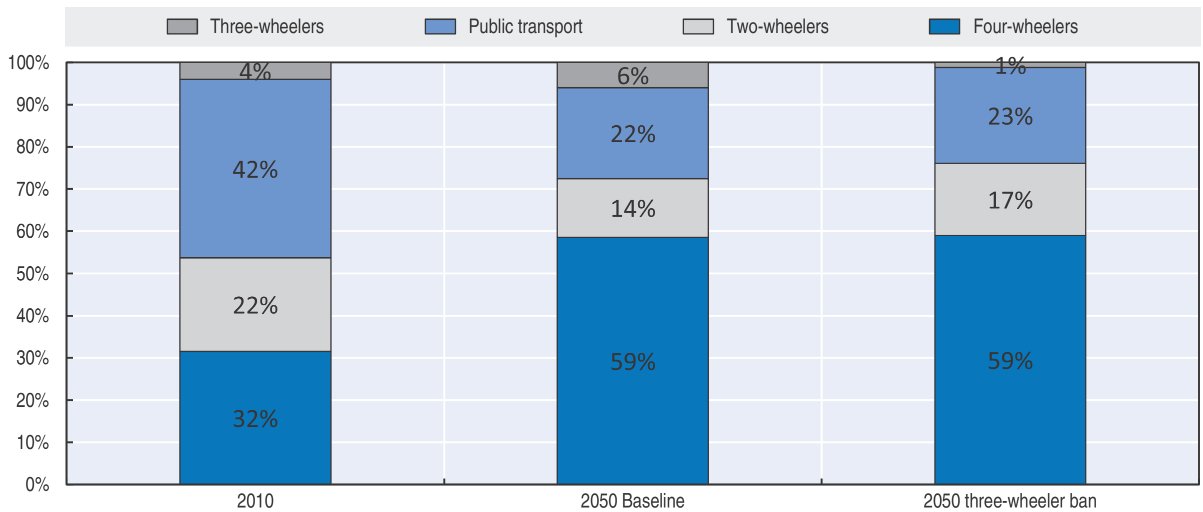
To assess the impact of such a policy on a larger scale, a fourth alternative urban scenario is tested in India. In the *three-wheeler ban* scenario, cities above two million inhabitants gradually ban three-wheelers from 2015. All other variables remain at their baseline values.

Under this scenario, results show that under these assumptions, a ban on three-wheelers is in place in one third of all cities above 500 000 inhabitants in 2050, and that the total number of three-wheelers in India is reduced by 80% compared to the *Baseline* scenario (the last 20% remain in cities below 2 million people therefore not targeted by the ban). The absence of three-wheelers in the case of a ban will be compensated by an increase of 18% in the number of two-wheelers in urban areas compared to baseline. However, there will be no increase in cars. All in all, the total number of both two- and three-wheelers is higher in this scenario than in the *baseline* scenario.

As auto-rickshaws are usually very CO_2 intensive compared to two-wheelers, CO_2 emissions decrease by 4% in the *three-wheeler ban* scenario. In terms of health impacts from local air pollutants, banning three-wheelers would have a marginal effect when compared to the *baseline* scenario (see pollution and health impacts section). Another alternative to the ban on three-wheelers to reduce emissions could be the replacement of conventionally fuelled three-wheelers by electric auto-rickshaws (see also Box 4.4).

Figure 4.22. **Modal shares in Indian cities, 2010 and 2050 for the *baseline* and *three-wheeler ban* scenarios**

Passenger-kilometres



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Box 4.4. **Emergence of electric rickshaws in India**

Electric auto-rickshaws (e-rickshaws) are three-wheeled rickshaws powered by electric batteries. They emerged in 2011, mainly in Delhi, and the number of e-rickshaws rocketed to reach an estimated 100 000 units in mid-2014, overtaking CNG-powered auto-rickshaws – around 55 000 in the capital city (Pai, 2011) – in only a few years. The reasons for such growth are threefold: a general lack of feeder transport modes in the capital city such as conventional auto-rickshaws, despite a recent increase in the licences issued by the Delhi government; the absence of regulation for such vehicles which are not regulated by the Motor Vehicle Act of India, and therefore do not require any licence; they are around four times cheaper than conventional auto-rickshaws to own and run due to the absence of licences and the relatively low price of electricity (Harding and Rojesh 2014).

The sudden and massive expansion of these last mile connectivity e-vehicles created intense debate in the media, mainly because of poor quality construction (resulting in numerous road accidents) and the absence of regulation. In mid-2014, Delhi's High Court of Justice pronounced a ban on e-rickshaws that is meant to last until the Motor Vehicle Act is amended to regulate them.

It is currently difficult to say what the future of electric three-wheelers will be. If e-rickshaws were regulated and controlled, without making them entirely uncompetitive, they could represent around 60% of the three-wheeler fleet in 2050, a proportion similar to that predicted for electric two-wheelers in India and China in 2050. This could contribute between 7 and 11 $MtCO_2$ mitigation per year at the national level (depending on assumptions for the fuel mix for the rest of the fleet). This figure only represents around 1% of total urban CO_2 emitted by private and public transport. However in very dense areas, where auto-rickshaws are generally concentrated, significant reductions in air (Aggarwal and al. 2012) and noise pollution would be achieved, with a direct positive impact on health.

The results from the *three-wheeler ban* scenario show that the analysis of local policies limiting the use of three-wheelers should consider the effects on two-wheeler growth, and related externalities. Although not in our model, the impact of banning three-wheelers in terms of mobility also needs to be considered carefully. This policy would need to be accompanied by significant reinforcement of other forms of transport, such as buses or mass transit. In the controversial debate about the ban on auto-rickshaws, the introduction of e-rickshaws within a regulated framework on a large scale, in India, could be a better alternative and provide the last mile connectivity that remains vital for millions of commuters. It can help to slow down the increase in two-wheelers and contribute to emission reduction in urban transport.

Pollution and health impacts

In addition to the climate change impacts due to emissions of CO_2 and short-lived climate pollutants, urban transport is also an important contributor to local air pollution, leading to severe health problems such as cardiovascular, respiratory diseases and numerous cancers. Exposure to outdoor air pollution is one of the main causes of premature mortality, leading to 3.2 million early deaths globally in 2010 (Lim et al., 2012). On-road vehicles are a major contributor to outdoor air pollution, in particular in urban areas where population will grow most rapidly.

OECD estimated the health impact costs of outdoor air pollution in OECD countries at about USD 1.7 trillion in 2010, suggesting that road transport is responsible for close to USD 1 trillion (OECD, 2014). While the number of deaths from outdoor air pollution fell by 4% in OECD countries between 2005 and 2010, partly due to stricter vehicle emission controls, China and India have seen increases of 5% and 12%, respectively. Health impact costs of outdoor air pollution in China and India in 2010 were estimated at USD 1.4 trillion and 0.5 trillion, respectively, but sufficient evidence was not available to determine road transport's contribution. The cost of air pollution in developing countries represents a heavy burden on national budgets in addition to its dramatic consequences on public health.

In addition to providing future perspectives on CO_2 emissions for different urban policy scenarios, it is important to estimate their effects on local air pollutants and health impacts. NO_x and $PM_{2.5}$ emissions as well as health impacts from primary $PM_{2.5}$ in urban areas resulting from urban transport scenarios in Latin America, China and India, were calculated by the International Council for Clean Transportation (ICCT). See Box 4.5 for additional details on the emissions and health impacts calculation methodology.

Even in the most optimistic scenario of motorisation rates, passenger vehicle activity and CO_2 emissions will increase in Latin America, China, and India. Although increased vehicle activity typically degrades air quality, stringent vehicle emission and fuel standards in place in many developed countries have decoupled the relationship between vehicle activity and emissions since the most advanced emission controls can effectively eliminate over 99 percent of local air pollutants from engines (Chambliss et al., 2013). As a result, the impacts of different urban scenarios on emissions of local air pollutants and health impacts are highly dependent on national standards for vehicle emissions. In addition to alternative policy scenarios, this analysis therefore considers two scenarios for

Box 4.5. **The International Council on Clean Transportation Global Transportation Roadmap model**

The International Council on Clean Transportation (ICCT) is a non-profit research organisation dedicated to improving the environmental performance and efficiency of transportation to protect public health, the environment, and quality of life. The ICCT provides national and local policymakers with sound technical analysis of regulations, fiscal incentives, and other technology-based measures for clean vehicles and fuels. The ICCT works across modes including passenger cars, light commercial vehicles, heavy-duty trucks and buses, two- and three-wheelers, international aviation and marine, conducting global outreach with a focus on major and growing vehicle markets. The ICCT maintains a staff of about 40 technical and policy experts, and a network of council participants who provide input on regulatory and research priorities.

The analysis of health impacts from different urban activity scenarios was developed by the International Council on Clean Transportation (ICCT). The analysis estimates premature mortality from primary fine particulate matter ($PM_{2.5}$) emitted by on-road vehicles in urban areas. In addition to the urban activity scenarios, this analysis considers two technology scenarios: a *reference* scenario that includes currently adopted vehicle emission standards, and an *accelerated* scenario that assumes all countries adopt the most stringent vehicle emission standards currently adopted by most developed countries (i.e., equivalent to Euro VI/6 standards adopted in Europe).

The emissions and health data presented in this chapter are produced by the ICCT using the Global Transportation Roadmap model, which captures well-to-wheel (WTW) transportation sector emissions from 2000 through 2050 (ICCT, 2014). In this analysis, the model calculates tank-to-wheel (TTW) emissions of local air pollutants – fine particulate matter ($PM_{2.5}$), nitrogen oxides (NO_x), nonmethane hydrocarbons (HC), etc. – as the product of vehicle activity and fleet-average emission factors. Average emission factors for each region and on-road mode (light-duty vehicles, 2-wheelers, and buses) are calculated based on the share of the fleet meeting various vehicle emission standards using a fleet turnover algorithm and a policy implementation timeline, a method consistent with that described in previous work by the ICCT on vehicle and fuel standards impacts (Chambliss et al., 2013).

This analysis is specific to transportation activity, emissions, and health impacts within urban areas. The emission factors reflect a mix of low-, mid-, and high-speed driving conditions experienced in downtown high-traffic areas, on highways through cities, and in the urban periphery. The model employs a global set of emission factors (expressed in grams of pollutant per kilometer traveled) for multiple local air pollutants that are specific to vehicle type, fuel type, and emission certification level (e.g., Euro 1/I through Euro 6/VI). Emission factors are derived from COPERT, an emissions model developed for official road transport emission inventory preparation in European member countries and widely adopted by research and academic institutions (EMESIA, 2009). In regions that follow United States standards, those certification levels are mapped to equivalent European emission standards and assigned appropriate Euro-level emission factors. $PM_{2.5}$ emission factors are further adjusted to account for the effect of diesel sulfur content using a mass-balance (or conservation of mass) approach, assuming a 2 percent conversion of fuel sulfur to sulfates. The calculation of vehicle emissions for this analysis did not include evaporative emissions, cold-start emissions, or brake-, tire-, and road-wear emissions.

Total premature mortality and years of life lost are estimated from exposure to primary $PM_{2.5}$ from on-road vehicles in urban areas. The Roadmap model produces an aggregate total of $PM_{2.5}$ emissions across all urban areas within a region. Urban $PM_{2.5}$ exposure, translated from aggregate emissions by intake fractions, is expressed in terms of pollutant concentration – micrograms per cubic meter ($\mu g/m^3$) – and is assumed to be equal across the urban population in each city. The impacts of exposure to this concentration are then calculated using a set of concentration-response functions from published literature documenting the increased risk of death from cardiopulmonary disease, lung cancer, and acute respiratory infections due to $PM_{2.5}$ exposure (Krewski et al., 2009; Cohen et al., 2004). Years of life lost are calculated by comparing the number of premature mortalities in 5-year age categories against a standardized life expectancy table (Murray et al., 2012). The estimation of health impacts from urban

Box 4.5. **The International Council on Clean Transportation Global Transportation Roadmap model** *(cont.)*

emissions follows a standard methodology described previously by Chambliss et al. (2013), and appendix III of that report includes further details of these calculations.

This methodology results in a conservative estimate of premature mortality from on-road vehicle emissions. It is limited to exposure to tailpipe emissions of primary $PM_{2.5}$, and excludes the additional impact of secondary $PM_{2.5}$ formed in the atmosphere from vehicle emissions. It also omits the impacts of exposure to ozone, which forms from other chemicals emitted by vehicles and is also known to have adverse health effects (Jerrett et al., 2009). In addition, this method does not quantify the broader non-fatal effects of vehicle pollution on the population ranging from an increase in asthma attacks and chronic bronchitis to greater numbers of hospital visits for lung and heart disease. These estimates of premature mortality indicate the overall trends in the health impacts of vehicle emissions, but these results should be considered a highly conservative assessment of the overall benefits of clean fuel and vehicle policies.

vehicle emission standards to account for the level of emission control technology adoption:

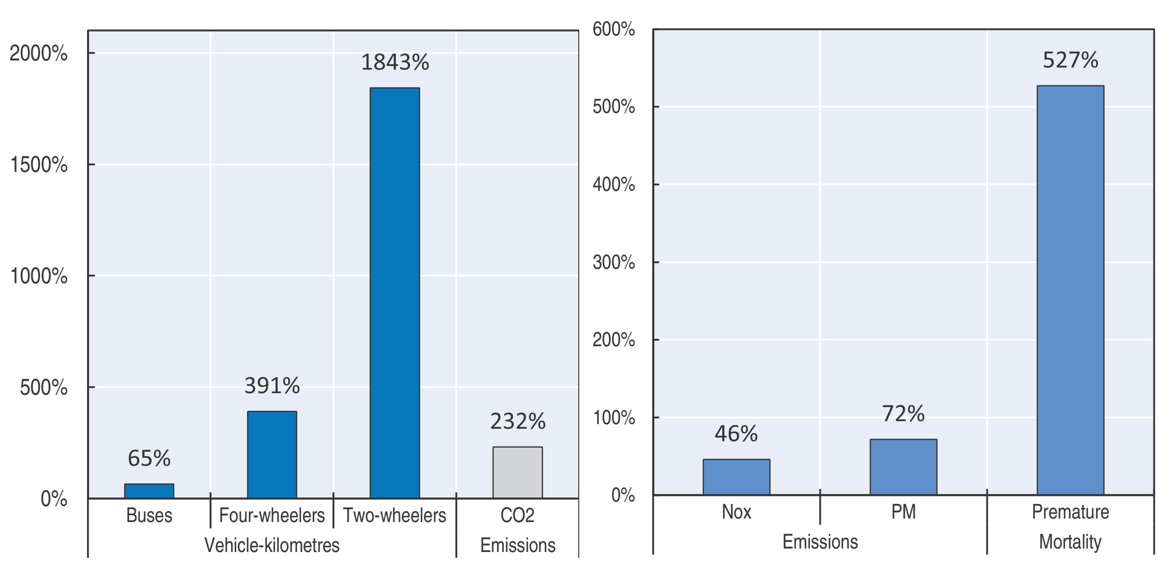
- *Reference* scenario: assumes that no additional progress is made beyond current vehicle emission standards;
- *Accelerated* scenario: assumes that world-class standards equivalent to Euro 6/VI are implemented based on a policy roadmap established by the ICCT (Chambliss et al., 2013).

Because emissions of local air pollutants and health impacts are strongly influenced by the level of emission control technology, vehicle type, and fuel type, the effects of urban activity scenarios on CO_2, local air pollutants and health impacts are not always correlated.

Latin American Cities

Figure 4.23 illustrates the growth in vehicle activity, emissions of CO_2, NO_x, and $PM_{2.5}$, and health impacts in the *baseline* activity scenario in Latin America between 2010 and

Figure 4.23. **Growth in activity, emissions, and health impacts in *baseline* scenario in Latin American cities**



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2050 assuming current vehicle emission controls (*reference* scenario). CO_2 emissions related to urban transport in Latin American cities above 500 000 will grow by 232% between 2010 and 2050. Growth in CO_2 emissions will be less than total growth in motorised vehicle travel due to a significant improvement in CO_2 intensity of cars and more moderate improvement in CO_2 intensity of buses and two-wheelers. Overall CO_2 intensity of motorised travel will also be reduced due to a higher share of two-wheelers. NO_X and $PM_{2.5}$ emissions will grow by 46% and 72% in the same time period, respectively, primarily stemming from the growing share of two-wheeler travel. Higher $PM_{2.5}$ emissions and increasing population exposed to $PM_{2.5}$ concentrations in urban centers will generate an increase of over 500% in premature deaths during the 40 years.

Figure 4.24. **Changes in activity, emissions and health impacts from *baseline* scenario in Latin American cities, 2050**

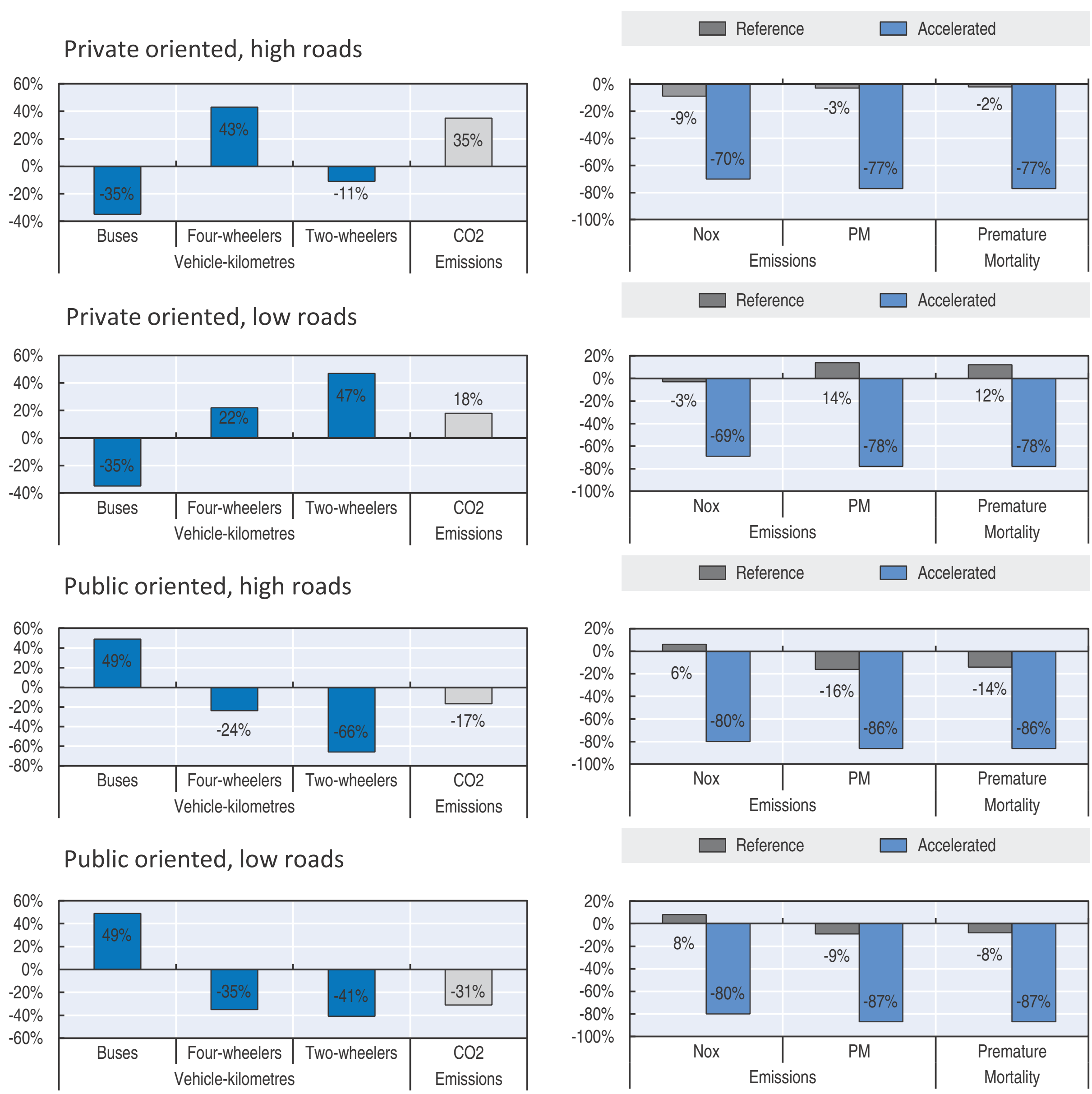

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Figure 4.24 compares vehicle activity, emissions of CO_2, NO_x, and $PM_{2.5}$, and health impacts between the alternative activity scenarios and the *baseline* activity scenario in 2050 in Latin America.

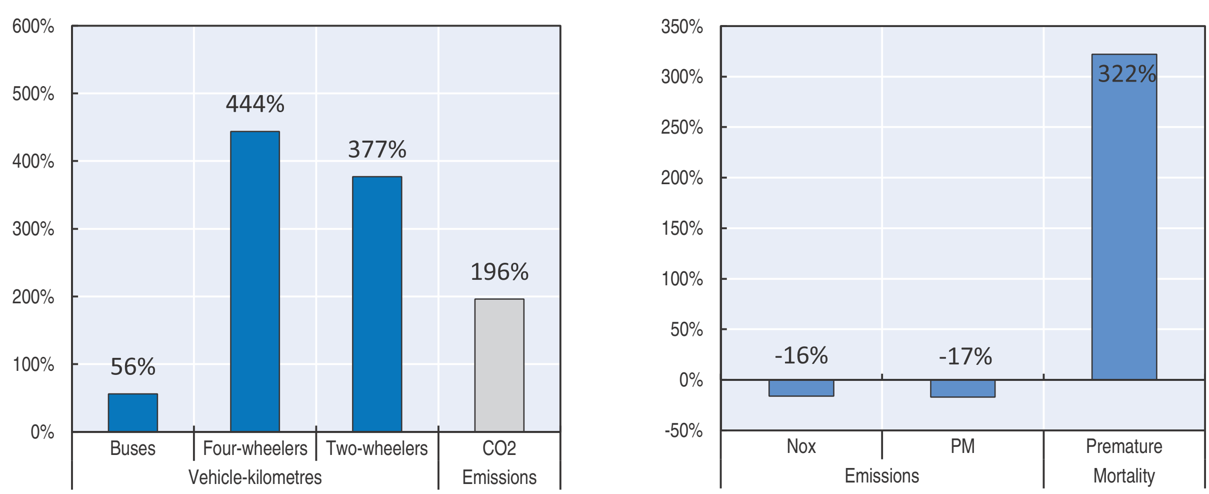
As highlighted previously, the private high road scenario results in the highest growth in CO_2 emissions (35% more than in the *baseline* scenario). On the other hand, the public low roads scenario would generate 30% less growth in CO_2 emissions compared with the baseline.

Without additional emission control technologies (*reference* scenario), $PM_{2.5}$ emissions and premature mortality are the highest in the *private low road* scenario as more activity is shifted to two-wheelers, which emit considerably more than automobiles. Despite decreases in vehicle activity in public-oriented scenarios compared to the *baseline*, relative NO_x emissions increase more than in the baseline because diesel buses without additional emission control technologies emit considerably more than gasoline automobiles. Compared to the baseline, the *private low road* scenario results in higher pollution growth than the *private high road* scenario because of the increased of two-wheeler travel. By introducing advanced emission control technology (*accelerated* scenario), emissions of $PM_{2.5}$ and NO_x, and premature mortality could be largely avoided (i.e., 70-90% reduction from the baseline), with the *public low road* scenario achieving the highest reductions from baseline levels in 2050.

Chinese Cities

Figure 4.25 illustrates the growth in vehicle activity, emissions of CO_2, NO_x, and $PM_{2.5}$, and health impacts in the *baseline* activity scenario in China between 2010 and 2050 assuming current vehicle emission controls (reference scenario). CO_2 emissions grow 200% from 2010 to 2050. As in the case of Latin America, CO_2 emission growth is limited to a certain extent by significant improvements in the car fleet (China has an important penetration of gasoline hybrid vehicles). Also buses will reduce their CO_2 intensity, although to a lesser extent than cars. The shift from two-wheeler to car travel is an element delaying reduction in carbon intensity of total motorised travel. Total emissions of NO_X and $PM_{2.5}$ decrease by 16% and 17% during the 2010-50 period in Chinese cities. The

Figure 4.25. **Growth in activity, emissions, and health impacts in *baseline* scenario in Chinese cities**

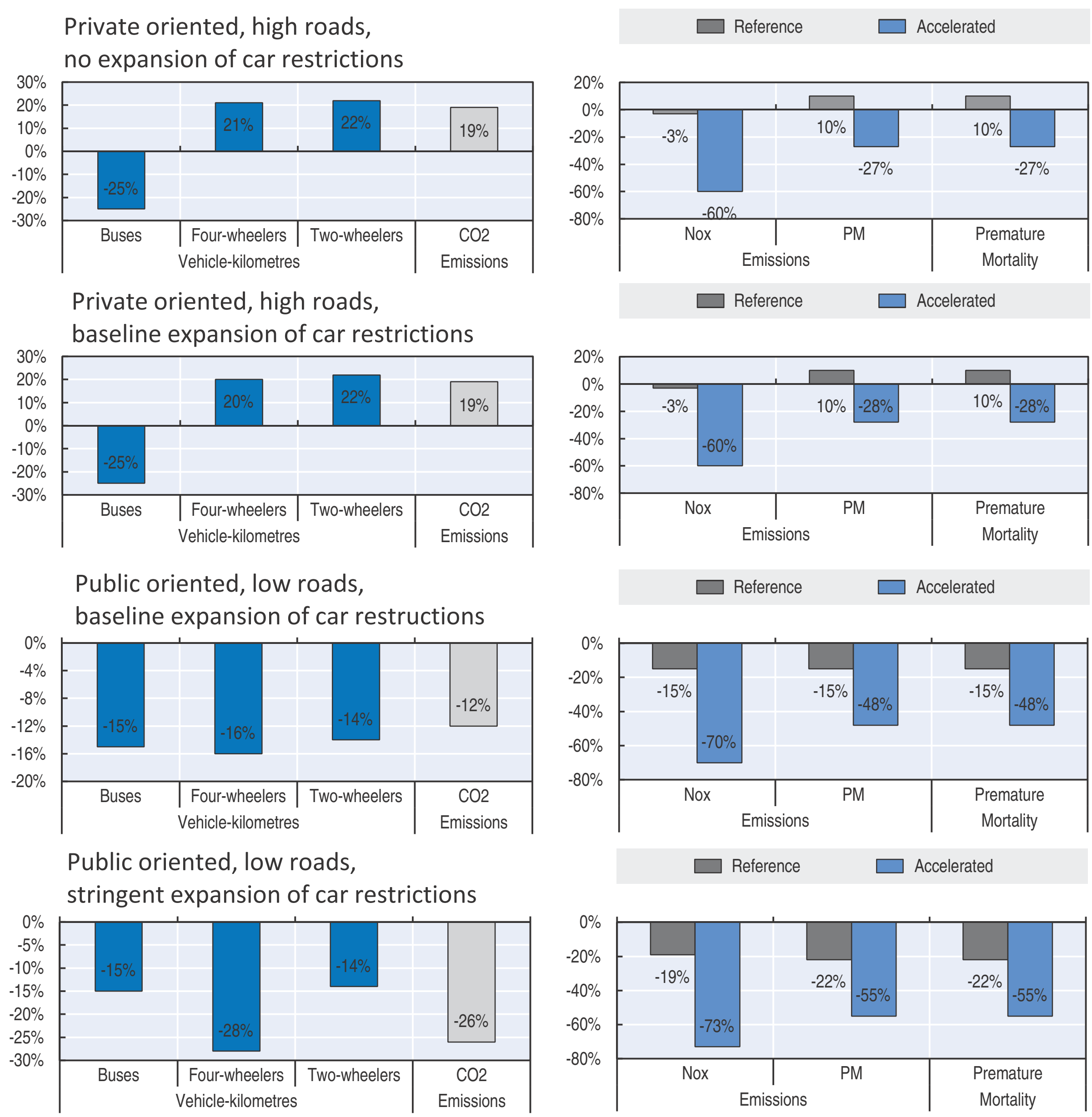


StatLink http://dx.doi.org/10.1787/888933169065

main drivers for this reduction are the shift from two-wheeler to car travel, the high penetration of electric two-wheelers (since two-wheeler travel maintains a significant share of total motorised travel), and significantly higher reductions in NO_X and $PM_{2.5}$ intensity of buses than in Latin America. Despite the lower overall levels of $PM_{2.5}$, increasing numbers of urban population exposed to such concentrations by 2050 translate into a 300% increase in premature deaths compared to 2010.

Figure 4.26 compares vehicle activity, emissions of CO_2, NO_x, and $PM_{2.5}$, and health impacts between the alternative activity scenarios and the *baseline* activity scenario in 2050 in China.

Figure 4.26. **Changes in activity, emissions, and health impacts from *baseline* scenario in Chinese cities, 2050**



StatLink http://dx.doi.org/10.1787/888933169078

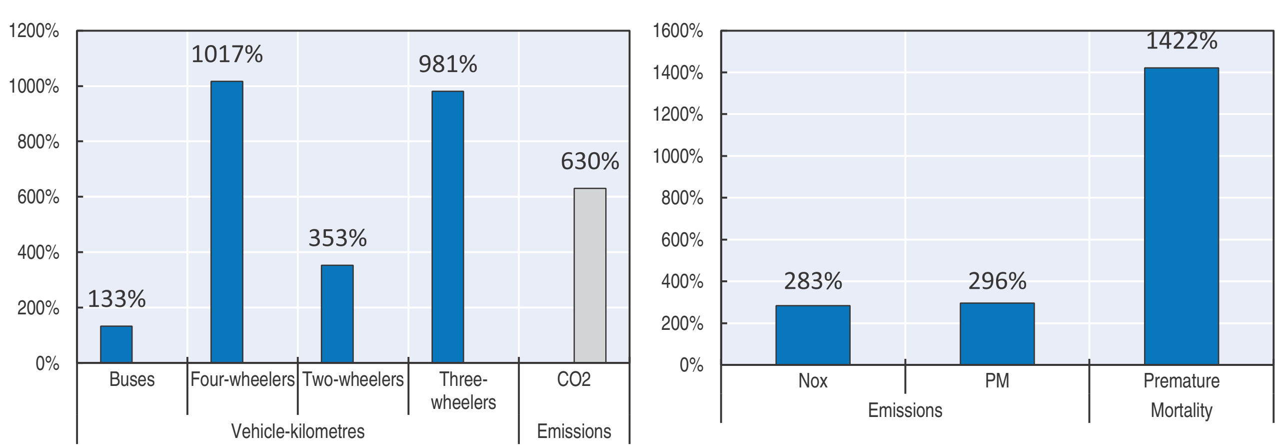
As for Latin America, the *public transport-oriented* scenario results in a significant reduction in CO_2 emissions compared with the baseline. The impact of coupling car ownership restriction with a policy shift towards public transit translates into significantly less CO_2 emissions compared to the baseline, while the increased mobility resulting from the same car restriction assumption but associated to a private oriented scenario creates additional CO_2 emissions.

Public-oriented scenarios result in larger reductions of emissions of local air pollutants and premature mortality. The *public transport-oriented* scenario, coupled with *low road* expansion results in the largest reductions when congested cities adopt stringent car ownership restrictions especially when advanced vehicle emission controls are considered (*accelerated* scenario). Meanwhile, expansion of car restriction policies has a marginal effect on car travel when these are implemented under a private-oriented scenario (since many cities approach saturation in any case, due to accelerated car ownership growth). For this reason both private scenarios show the same results in terms of the growth in CO_2, pollution and premature mortality. As in Latin America, advanced emission control technologies (*accelerated* scenario) could reduce emissions of $PM_{2.5}$ and NO_x.

Indian Cities

Figure 4.27 illustrates the growth in vehicle activity, emissions of CO_2, NO_x, and $PM_{2.5}$, and health impacts in the *baseline* activity scenario in India between 2010 and 2050 assuming current vehicle emission controls (*reference* scenario). Total CO_2 emissions will grow over 600% between 2010 and 2050 in Indian cities of above 500 000 population. To a certain extent, CO_2 emission growth will be slowed down by more significant shares of diesel cars (around 35% on average). However, overall reductions in CO_2 intensity of cars will be smaller than in Latin America and China. The shift from two-wheelers to car travel will still increase carbon intensity of the overall private travel. NO_X and $PM_{2.5}$ emissions will grow nearly by a factor of four in urban India between 2010 and 2050 in the *baseline* scenario. High growth in car travel will be an important driver for this growth since

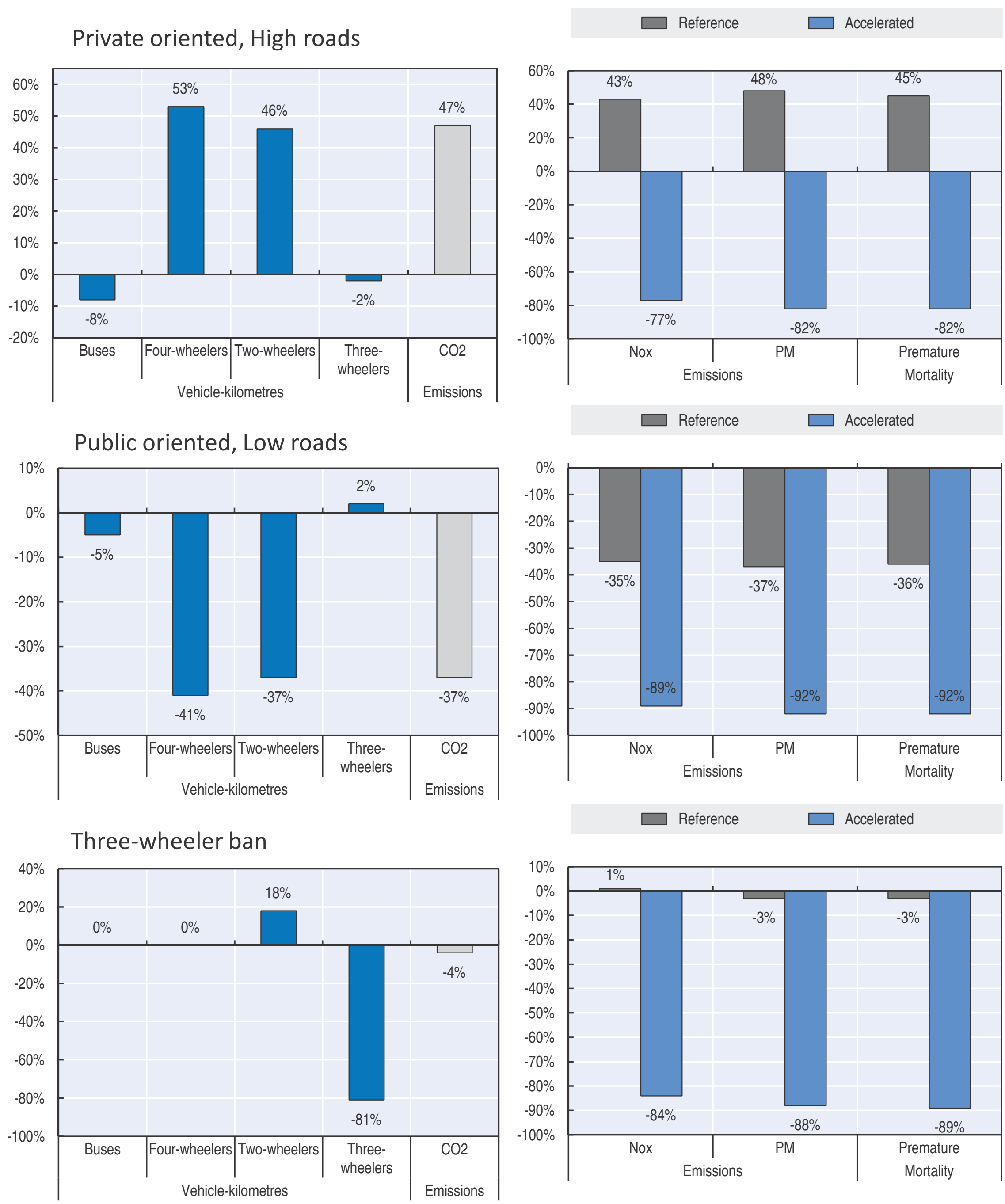
Figure 4.27. **Growth in activity, emissions, and health impacts in the *baseline* scenario in Indian cities**



StatLink http://dx.doi.org/10.1787/888933169088

pollution generated by these vehicles is significantly higher than in Latin America and China (per kilometer of travel). Three-wheeler and two-wheeler vehicle growth will also contribute to the high increases in pollution. The very high growth in $PM_{2.5}$ emissions and increasing urbanisation rates in Indian cities will generate 1422% more premature deaths by 2050 compared to 2010.

Figure 4.28. **Changes in activity, emissions, and health impacts from *baseline* scenario in Indian cities, 2050**



StatLink http://dx.doi.org/10.1787/888933169095

Figure 4.28 compares vehicle activity, emissions of CO_2, NO_x, and $PM_{2.5}$, and health impacts between the alternative activity scenarios and the *baseline* activity scenario in 2050 in India. With the quick expansion of the vehicle market, transport activity in India is expected to increase most rapidly among the three regions evaluated. Under a *private transport-oriented* high roads scenario, the impacts on $PM_{2.5}$ and NO_x emissions, and premature mortality will grow substantially if India remains at its current emission control level (*reference* scenario), but the public low scenario can reduce these impacts even with current vehicle controls. By adopting world-class emission control standards in the accelerated scenario, $PM_{2.5}$ and NO_x emissions could be largely reduced in the long term compared to the baseline in 2050, by about 90% in the best case (public low scenario). Banning three-wheel vehicles in India shows very slight improvements on all metrics evaluated (CO_2, $PM_{2.5}$, NO_x, and premature mortality) compared to the *baseline* scenario.

Conclusions: Implications for urban transport policies

Long-term urban transport planning decisions and choices in the alignment of policies towards promoting private transport or public transport-oriented urbanisation will translate into significant differences in the modal composition of urban mobility in Latin America, China and India.

In a scenario where urban policies promote private transport use, and in particular car use, by permitting sprawl, letting public transport expansion lag behind population growth, heavily investing in urban road infrastructure expansion and maintaining low fuel prices, public transport accounts for only 11% of urban mobility in Latin America and India, and 9% in China by 2050.

In contrast, alignment of polices that contain sprawl, set higher fuel prices, and prioritise expansion of public transport infrastructure over urban road infrastructure can maintain current shares of public transport in Latin American and Indian cities, and significantly limit the reduction of public transport participation in China (with public transport's participation being twice what it would be in 2050 in a *baseline* scenario).

The set of policies modelled in the *private transport-oriented* urbanisation scenarios increase mobility levels relative to baseline mobility in the three cases. An important driver is the increase in travel per private vehicle as a result of low oil prices. Additional mobility is in the three cases more carbon intensive and therefore generates even higher CO_2 emissions than the respective *baselinee* scenarios. Under this policy framework CO_2 emissions related to urban transport in Latin American, China and India grow 35%, 19%, and 47% more than in the *baseline* scenario respectively.

Alignment of policies toward *public transport-oriented* urbanisation reduces the carbon intensity of urban mobility. This cuts transport related CO_2 emission growth by 31%, 26%, and 37% in urban Latin America, China, and India. When combined with world-class standards for vehicle emission controls, *public transport-oriented* urbanisation can reduce premature mortality caused by urban transport emissions by 87%, 55%, and 92% in urban Latin America, China, and India.

The shift to *public transport-oriented* urbanisation has certain mobility costs, as significant public transport expansion with major extensions of mass transit systems needs to be carried out before public transport systems can absorb the mobility displaced by higher costs for private mobility. For Latin America and China, mobility under the *public* *transport-oriented* scenario with low road expansion infrastructure would catch up with baseline levels towards the end of the period, with a gap of only around 5% of growth in passenger-kilometres. In the case of India, despite the lower initial private mobility shares, the relatively poor public transport infrastructure has more difficulty in expanding sufficiently to meet growing mobility needs. Therefore, mobility in the *public transport-oriented* urbanisation scenarios with low roads remains below the levels delivered under baseline and *private transport-oriented* urbanisation policy frameworks in India.

Public transport and urban road investments will be a key determinant of the speed and magnitude of future two-wheeler development in Latin America. A scenario where policies are oriented towards significantly expanding and improving the public transport system can effectively limit the shift of public transport users towards these vehicles. In combination with higher fuel prices and containing sprawl this will lead to more moderate growth of two-wheelers in the region (5% average annual growth). In contrast, a scenario that aligns urban policies towards private transport use, but sees road infrastructure expansion lagging behind population growth, would generate the highest expansion of two-wheelers (9% average annual growth).

Our analysis shows that the growing share of two-wheelers in Latin American cities could be associated with CO_2 emission reductions. However, higher participation of two-wheelers in urban mobility generates major increases in pollution with negative health impacts. Effective regulation of two wheelers is critical to avoid severe damage to the health of the population.

Car ownership restrictions implemented by Chinese cities will have to be put in place with a *public transport-oriented* urbanisation policy framework in order to bring about a reduction in negative externalities. Our projections show that implementing car ownership restrictions while permitting urban sprawl, letting public transport expansion lag behind population growth and continuing to invest in urban road infrastructure expansion would generate 19% higher CO_2 emission growth than the same restriction under baseline policies. In contrast, combining car restrictions with *public transport-oriented* urban policies with low road expansion would generate 8% more mobility growth and 12% less growth in CO_2 emissions. Electric two-wheelers have a positive impact on CO_2 emissions and local air pollution but do not solve congestion issues.

India is at the beginning of its motorisation process for private cars. Under the *private transport-oriented* scenario, modal share of private cars could double by 2050. While efforts are being made to improve public transport in larger cities, several medium and small size cities do not have bus service or mass transit systems. To compensate the lack of public transport provision, Indian urban population relies on two-wheelers which explain the high motorisation rate for scooters and motorcycles. It is expected that with income growth the share of private cars will increase especially in the *private transport-oriented* scenario.

Private transport-oriented urbanisation in all three regions could lead to significant increases in vehicle activity compared to other scenarios. On the other hand, *public transport-oriented* scenarios could slow growth in urban vehicle activity. By shifting activity from private to public transportation, CO_2 emissions growth is expected to be reduced between 26% and 37% depending on the region. However, benefits in terms of local air pollutants and health impacts are very limited without stringent vehicle emission controls (*reference* scenario for technology adoption). For Latin America, largely promoting public buses could result in an increase in NO_x emissions relative to baseline growth, which can contribute to smog and secondary PM in urban areas. This is mostly a result from higher emission rates from diesel buses without advanced emission control technologies. By implementing advanced standards for emission control (*accelerated* scenario for technology adoption), emissions growth of local air pollutants and health impacts could be reduced by up to 87%. With world-class standards for vehicle emission controls equivalent to Euro 6/VI standards, a move towards higher rates of public transit and less reliance on private automobile could bring substantial climate and health benefits.

This analysis illustrates the potential pitfalls of considering policies targeting climate while disregarding local air pollution and health impacts. It also shows that integrated policies aiming at climate and health objectives work best, and it is possible to achieve substantial climate change mitigation, less reliance on private car and lower health impacts by promoting low sprawl and road development, and higher rates of public transit alongside more stringent controls for vehicle emissions. More specifically, results also show that for all regions analysed, increasing the share of public transport in urban mobility will only bring significant health benefits if coupled with regulations that assure improvement in emission control technologies for buses. They also show that the increasing role of two-wheelers in urban mobility can be positive in terms of CO_2 reduction, congestion and affordable mobility, but adequate regulations for motorcycle emissions are critical to avoid additional public health impacts.

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Statistical annex

Rail freight transport

Million tonne-kilometres

	2006	2007	2008	2009	2010	2011	2012	2013
Albania	36	53	52	46	66	50	25	23
Armenia	668	771	705 e	718	..	..	..	..
Australia	189 425	198 961	218 684	237 163	258 624	261 831 p	290 677 p	..
Austria	20 980 |	21 371	21 915	17 767	19 833	20 345	19 499	19 278 |
Azerbaijan	11 059	10 375	10 021	7 592	8 250	7 845	8 212	7 958
Belarus	45 723	47 933	48 994	42 274	46 224	47 384 e	48 475 e	43 143 e
Belgium	8 587	8 148	8 469	5 947	6 264 e	6 698 e	..	..
Bosnia-Herzegovina	372	1 088	1 242	992	877	1 018	1 150	1 243
Bulgaria	5 396	5 241	4 693	3 145	3 064	3 291	2 908	3 246
Canada	241 556	245 534	236 842	216 287	240 292	248 468	256 622	245 405
China	2 195 441	2 379 700	2 510 628	2 523 917	2 764 413	2 946 579	2 918 709	..
Croatia	3 305	3 574	3 312	2 641	2 618	2 438	2 332	2 086
Czech Republic	15 779	16 304	15 437	12 791	13 770	14 316	14 266	13 965
Denmark	1 885	1 776 |	1 863	1 696	2 240	2 614	2 278	2 448
Estonia	10 418	8 430	5 943	5 934	6 638	6 261 e	5 129 e	4 688 e
Finland	11 060	10 434	10 777	8 872	9 750	9 395	9 275	9 470
France	41 179 |	42 612	40 436	32 129	29 965	34 202	32 539	32 010
FYROM[1]	614	778	743	497	525	479	423	421
Georgia	7 393	6 927	6 515	5 417	6 228	6 055	5 976	5 526
Germany	107 008	114 615	115 652	95 834	107 317	113 317	110 065	112 613
Greece	662	835	786	537	601	352	283 e	238 e
Hungary	10 167	10 137	9 874	7 673	8 809	9 118	9 230	9 722
Iceland	x	x	x	x	x	x	x	x
India	483 400	521 370	551 450	600 548	626 000	668 000	692 000	725 000 e
Ireland	207	129	103	79	92	105	91	99
Italy	22 907	23 289	21 981	15 224 |	13 405	12 961	..	..
Japan	23 192	23 334	22 256	20 562	20 398	19 998	20 471	20 534 e
Korea	10 554	10 927	11 566	9 273	9 452	9 997	10 271	10 459
Latvia	16 831	18 313	19 581	18 725	17 179	21 410	21 867	19 532
Liechtenstein	x	18	17	10	11	10	10	9
Lithuania	12 896	14 373	14 748	11 888	13 431	15 088	14 172	13 344
Luxembourg	441	287	280	200	309 e	270 e	230 e	215 e
Malta	x	x	x	x	x	x	x	x
Mexico	73 726	77 169	74 582	69 185	78 771	79 729	79 353	77 717
Moldova, Republic of	3 656	3 092	2 873	1 058	959	1 196	960	1 227
Montenegro, Republic of	182	185	184	101	151	136	73	105
Netherlands	6 289	7 216	6 984	5 578	5 925	6 378	6 412	6 078
New Zealand	4 312	4 329	4 556	3 962	3 919	4 178	4 581	4 585
Norway	3 351	3 502	3 629	3 506	3 498	3 574	3 489	3 383
Poland	53 427	54 253	52 043	43 554	48 795	53 746	48 903	50 881
Portugal	2 529	2 586	2 549	2 174	2 313	2 322	2 421	2 290
Romania	15 791	15 757	15 236	11 088	12 375	14 719	13 472	12 941
Russian Federation	1 950 830	2 090 337	2 116 240	1 865 305	2 011 308	2 127 835	2 222 389	2 196 217
Serbia, Republic of	4 232	4 551	4 339	2 967	3 522	3 611	2 769	3 022
Slovak Republic	9 988	9 647	9 299	6 964	8 105	7 960	7 591	8 494
Slovenia	3 373	3 603	3 520	2 668	3 421	3 752	3 470	3 799
Spain	11 599	11 124	10 287	7 391	7 872	8 018	7 477	7 394
Sweden	22 271	23 250	22 924	20 389 |	23 464	22 864	22 043 p	20 763 p
Switzerland	12 466	11 952	12 265	10 565	11 074	11 526	11 061	11 812 p
Turkey	9 676	9 921	10 739	10 326	11 462	11 677	11 670	11 177
Ukraine	240 810	262 504	257 007	196 188	218 091	243 866	237 722	224 434 e
United Kingdom	21 919	21 265	21 077	19 171	18 576	20 974	21 467	22 401
United States	2 709 558	2 656 604	2 525 364	2 309 811	2 491 450	2 524 667	2 500 300	2 542 000 p

.. Not available; | Break in series; e Estimated value; x Not applicable; p Provisional data

Note: Detailed metadata at: http://metalinks.oecd.org/transport/20141023/e865.

1. FYROM: the Former Yugoslav Republic of Macedonia

Source: ITF Transport statistics

Road freight transport

Million tonne-kilometres

	2006	2007	2008	2009	2010	2011	2012	2013
Albania	3 306 e	3 584 e	4 098 e	4 445 e	4 626 e	3 805 e	3 223 e	3 497 e
Armenia	432	710 e	1 034 e	..	..	..	..	..
Australia	167 695	174 928	182 664	184 077	187 732	193 163	200 783	204 870
Austria	18 846	18 648	18 160	16 276	16 539	16 997	16 143	15 524
Azerbaijan	8 568	9 492	10 317	11 021	11 728	12 776	13 744	14 575
Belarus	15 779	19 200	22 767	..	..	..	..	..
Belgium	43 017	42 085	38 356	36 174	35 001	33 107	32 105	32 105
Bosnia-Herzegovina	..	1 648	1 873	1 711	..	1 718	2 310	2 658
Bulgaria	13 765	14 624	15 321	17 741	19 454	21 212	24 387	27 237
Canada	130 600	130 600	129 380	118 903	135 294	136 193	141 865 e	..
China	975 425	1 135 469	3 286 819	3 718 882	4 338 967	5 137 474	5 953 486	..
Croatia	11 095	11 429	11 042	9 429	8 780	8 927	8 649	9 133
Czech Republic	50 369	48 141	50 877	44 954	51 833	54 830	51 228	54 893
Denmark	11 494	11 800	10 718	10 002	10 573	12 025	12 292	12 222
Estonia	8 857	10 660	8 279	6 290	5 986	6 567 e	7 097 e	6 475 e
Finland	29 741	29 818	31 035	27 657	30 337	26 917	25 458	24 429
France	198 829	207 025	195 515	166 052	174 409	177 993	165 808	165 315
FYROM[1]	8 299	5 938	3 978	4 035	4 235	8 933 |	8 965	7 466
Georgia	586	594	600	611	620	628	637	646
Germany	330 008	343 439	341 550	307 575	313 097	323 848	307 106	305 781
Greece	16 510 e	17 359 e	16 960 e	16 940 e	20 146 e	20 426	20 416	19 203 p
Hungary	30 495	35 804	35 744	35 373	33 720	34 529	33 735	35 817
Iceland	786 e	825 e	805 e	813 e	806 e	777 e	786	808
India	766 200	852 000	920 000	1 015 000	1 128 000	1 212 000	1 256 000	1 303 000 e
Ireland	17 686	19 146	17 290	12 068	10 924	9 941	9 895	9 138
Italy	155 426	152 398	165 385	156 341	149 258	142 843 e	124 015 e	..
Japan	346 534	354 800	346 420	334 667	246 175 |	233 956 e	209 956	210 586
Korea	109 008	105 222	101 437	99 089	102 808	104 477 e	108 365 e	..
Latvia	10 937	13 142	12 344	8 115	10 590	12 131	12 178	12 816
Liechtenstein	340	340	330	264	305	312	281	318
Lithuania	18 135	20 278	20 419	17 757	19 398	21 512	23 449	26 338
Luxembourg	8 879 e	9 222 e	9 566 e	8 401 e	8 658 e	8 838 e	6 687 e	7 215 e
Malta	..	..	..	..	..	..	..	..
Mexico	209 392	222 391	227 290	211 600	220 285 |	226 900	233 464	235 427
Moldova, Republic of	2 567	2 743	2 966	2 714	3 233	3 597	3 954	3 610
Montenegro, Republic of	73	92	137	179	167	102	76	67
Netherlands	33 417	32 867	34 344	33 642	36 113	35 829	33 628	..
New Zealand	18 867	19 452	20 898	17 613	20 050	20 534	20 944	21 286
Norway	16 008	16 391	17 763	16 245	17 334	17 167	18 087	19 166
Poland	136 490	159 527	174 223	191 484	214 204	218 888	233 310	259 708
Portugal	17 591	18 374	16 768	13 969	12 554	12 838	9 278	8 443 e
Romania	57 278	59 517	56 377	34 265	25 883	26 347	29 662	34 026
Russian Federation	198 766	205 849	216 276	180 136	199 341	222 823	248 862	250 054
Serbia, Republic of	798	1 161	1 112	1 185	1 689	1 907	2 474	2 824
Slovak Republic	22 114	27 050	29 094	27 484	27 411	29 045	29 504	30 005
Slovenia	2 279	2 572	2 635	2 276	2 289	2 176	1 849	1 889
Spain	241 758	258 869	242 978	211 891	210 064	206 840	199 205	192 594
Sweden	35 455	36 376	37 933	32 118	32 738	33 417	30 367	30 708
Switzerland	16 330	16 993	17 262	16 924	17 057	17 506 p	17 238 p	..
Turkey	177 399	181 330	181 935	176 455	190 365	203 072	216 123	224 048
Ukraine	11 337	14 284	19 800	33 193	34 391	38 596	38 951	..
United Kingdom	167 524	173 080	161 600	140 854	153 829	154 370 e	..	..
United States	3 445 085	3 573 139	4 018 805	3 576 215	3 668 077	3 859 535	..	..

.. Not available; | Break in series; e Estimated value; p Provisional data

Note: Detailed metadata at: http://metalinks.oecd.org/transport/20141023/e865.

1. FYROM: the Former Yugoslav Republic of Macedonia

Source: ITF Transport statistics

Inland waterway freight transport

Million tonne-kilometres

	2006	2007	2008	2009	2010	2011	2012	2013
Albania	x	x	x	x	x	x	x	x
Armenia	x	x	x	x	x	x	..	..
Australia	x	x	x	x	x	x	x	x
Austria	2 419	2 597	2 359	2 003	2 375	2 123	2 191	2 406
Azerbaijan	x	x	x	x	x	x	x	x
Belarus	109	93	132	..	..	..	..	..
Belgium	8 973	9 006	8 746	7 086	8 210	9 251 e	10 420	..
Bosnia-Herzegovina	x	x	x	x	x	x	x	x
Bulgaria	1 429	1 711	1 936	1 794	1 813	1 422	1 397	1 196
Canada	24 800	22 900	22 800	21 059	23 934	25 000 e	26 300 e	26 600 e
China	1 290 845	1 559 895	1 741 170	1 803 267	2 242 853	2 606 884	2 829 548	..
Croatia	117	109	843 |	727	941	692	772	771
Czech Republic	767	898	863	641	679	695	669	693
Denmark	x	x	x	x	x	x	x	x
Estonia	..	..	..	..	..	..	..	..
Finland	66	101	80	61	76	90	124	124
France	7 952	7 546	7 504	7 423	8 060	7 907	7 738	7 953
FYROM[1]	x	x	x	x	x	x	x	x
Georgia	x	x	x	x	x	x	x	x
Germany	63 975	64 716	64 061	55 497	62 278	55 027	58 488	60 070
Greece	x	x	x	x	x	x	x	..
Hungary	1 913	2 212	2 250	1 831	2 393	1 840	1 982	1 924
Iceland	x	x	x	x	x	x	x	x
India	2 857	2 806	2 950	3 710	4 030	3 800	3 063	..
Ireland	x	x	x	x	x	x	x	x
Italy	76	93	64	76	135	144 e	81 e	..
Japan	x	x	x	x	x	x	..	..
Korea	x	x	x	x	x	x	x	..
Latvia	0	0	0	0	0	0	..	..
Liechtenstein	x	x	x	x	x	x	x	x
Lithuania	2	11	13	4	4	4	2	1
Luxembourg	376	345	366	279	359	305 e	290 e	315 e
Malta	x	x	x	x	x	x	x	x
Mexico	x	x	x	x	x	x	x	x
Moldova, Republic of	1	1	1	1	0	1	1	1
Montenegro, Republic of	x	x	x	x	x	x	x	x
Netherlands	43 577	45 037	44 446	35 638	46 592	47 303	47 520	48 600
New Zealand	x	x	x	x	x	x	x	x
Norway	x	x	x	x	x	x	x	x
Poland	1 237	1 338	1 274	1 020	1 030	909	815	768
Portugal	..	..	..	..	..	..	..	..
Romania	8 158	8 195	8 687	11 765 |	14 317	11 409	12 520	12 242
Russian Federation	86 727	86 027	63 705	52 686	53 955	59 144	80 762 |	80 101
Serbia, Republic of	1 640	1 584	1 369	1 114	875	963	605	701
Slovak Republic	936	1 004 |	1 101	899	1 189	931	986	1 006
Slovenia	x	x	x	x	x	x	x	x
Spain	x	x	x	x	x	x	x	x
Sweden	x	x	x	x	x	x	x	x
Switzerland	x	x	x	x	x	x	x	x
Turkey	x	x	x	x	x	x	x	x
Ukraine	6 307	5 670	4 498	2 745	3 837	2 218	1 748	..
United Kingdom	160	140	160	133	125	143	157	..
United States	486 000	472 315	454 376	406 608	450 529	464 667	..	..

.. Not available; | Break in series; e Estimated value; x Not applicable

Note: Detailed metadata at: http://metalinks.oecd.org/transport/20141023/e865.

1. FYROM: the Former Yugoslav Republic of Macedonia

Source: ITF Transport statistics

Oil pipeline transport

Million tonne-kilometres

	2006	2007	2008	2009	2010	2011	2012	2013
Albania	x	x	x	x	x	x	x	x
Armenia	x	x	x	x	x	x	..	..
Australia	x	x	x	x	x	x	x	x
Austria	2 419	2 597	2 359	2 003	2 375	2 123	2 191	2 406
Azerbaijan	x	x	x	x	x	x	x	x
Belarus	109	93	132	..	..	..	..	..
Belgium	8 973	9 006	8 746	7 086	8 210	9 251 e	10 420	..
Bosnia-Herzegovina	x	x	x	x	x	x	x	x
Bulgaria	1 429	1 711	1 936	1 794	1 813	1 422	1 397	1 196
Canada	24 800	22 900	22 800	21 059	23 934	25 000 e	26 300 e	26 600 e
China	1 290 845	1 559 895	1 741 170	1 803 267	2 242 853	2 606 884	2 829 548	..
Croatia	117	109	843 |	727	941	692	772	771
Czech Republic	767	898	863	641	679	695	669	693
Denmark	x	x	x	x	x	x	x	x
Estonia	..	..	..	..	..	..	..	..
Finland	66	101	80	61	76	90	124	124
France	7 952	7 546	7 504	7 423	8 060	7 907	7 738	7 953
FYROM[1]	x	x	x	x	x	x	x	x
Georgia	x	x	x	x	x	x	x	x
Germany	63 975	64 716	64 061	55 497	62 278	55 027	58 488	60 070
Greece	x	x	x	x	x	x	x	..
Hungary	1 913	2 212	2 250	1 831	2 393	1 840	1 982	1 924
Iceland	x	x	x	x	x	x	x	x
India	2 857	2 806	2 950	3 710	4 030	3 800	3 063	..
Ireland	x	x	x	x	x	x	x	x
Italy	76	93	64	76	135	144 e	81 e	..
Japan	x	x	x	x	x	x	..	..
Korea	x	x	x	x	x	x	x	..
Latvia	0	0	0	0	0	0	..	..
Liechtenstein	x	x	x	x	x	x	x	x
Lithuania	2	11	13	4	4	4	2	1
Luxembourg	376	345	366	279	359	305 e	290 e	315 e
Malta	x	x	x	x	x	x	x	x
Mexico	x	x	x	x	x	x	x	x
Moldova, Republic of	1	1	1	1	0	1	1	1
Montenegro, Republic of	x	x	x	x	x	x	x	x
Netherlands	43 577	45 037	44 446	35 638	46 592	47 303	47 520	48 600
New Zealand	x	x	x	x	x	x	x	x
Norway	x	x	x	x	x	x	x	x
Poland	1 237	1 338	1 274	1 020	1 030	909	815	768
Portugal	..	..	..	..	..	..	..	..
Romania	8 158	8 195	8 687	11 765 |	14 317	11 409	12 520	12 242
Russian Federation	86 727	86 027	63 705	52 686	53 955	59 144	80 762 |	80 101
Serbia, Republic of	1 640	1 584	1 369	1 114	875	963	605	701
Slovak Republic	936	1 004 |	1 101	899	1 189	931	986	1 006
Slovenia	x	x	x	x	x	x	x	x
Spain	x	x	x	x	x	x	x	x
Sweden	x	x	x	x	x	x	x	x
Switzerland	x	x	x	x	x	x	x	x
Turkey	x	x	x	x	x	x	x	x
Ukraine	6 307	5 670	4 498	2 745	3 837	2 218	1 748	..
United Kingdom	160	140	160	133	125	143	157	..
United States	486 000	472 315	454 376	406 608	450 529	464 667	..	..

.. Not available; | Break in series; e Estimated value; x Not applicable

Note: Detailed metadata at: http://metalinks.oecd.org/transport/20141023/e865.

1. FYROM: the Former Yugoslav Republic of Macedonia

Source: ITF Transport statistics

Total inland freight transport

Million tonne-kilometres

	2006	2007	2008	2009	2010	2011	2012	2013
Albania	3 348	3 643	4 154	4 497	4 694	3 855	3 248	3 520
Armenia	2 697	3 439 e	3 697 e	..	..	..	..	..
Australia	357 120	373 889	401 348	421 240	446 356	454 994 p	491 460 p	..
Austria	49 901	49 842	49 955	43 350	45 747	46 693	44 979	45 600
Azerbaijan	35 306 |	72 172 |	82 772	91 808	92 909	86 471	85 128	86 267
Belarus	61 611	67 226	71 893	..	..	..	..	..
Belgium	62 149	60 733 e	57 021 e	50 657	50 925 e	50 506 e	..	..
Bosnia-Herzegovina	..	2 736	3 115	2 703	..	2 736	3 460	3 901
Bulgaria	20 947	21 996	22 370	23 116	24 746	26 406	29 267	32 312
Canada	520 856	523 534	513 022	479 449	522 179	559 212	..	..
China	4 616 828	5 261 653	7 733 020	8 248 308	9 565 952	10 979 481	12 019 472	..
Croatia	16 050	16 893	16 874	14 594	14 042	13 534	12 969	13 475
Czech Republic	69 206	67 422	69 492	60 542	68 473	71 795	68 070	71 484
Denmark	18 251	18 203	16 790	15 593	16 360	17 904	17 648	17 409
Estonia	19 275	19 090	14 222	12 224	12 624	12 828 e	..	..
Finland	40 867	40 353	41 892	36 590	40 163	36 402	34 857	34 023
France	270 160 |	278 324	264 373	225 085	230 041	237 309	221 236	216 392
FYROM[1]	9 083	6 880	4 885	4 676	4 883	9 510 |	9 425	7 887
Georgia	..	..	..	..	..	..	..	..
Germany	516 835	538 594	536 933	474 856	498 951	507 815	491 866	496 644
Greece	17 172 e	18 194 e	17 746 e	17 477 e	20 747 e	20 778 e	20 699 e	19 441 p
Hungary	48 354	53 876	53 505	50 139	50 545	51 068	50 749	53 157
Iceland	786 e	825 e	805 e	813 e	806 e	777 e	786	808
India	1 335 467	1 471 476	1 581 630	1 739 618	1 881 090	2 018 600	2 092 723	..
Ireland	17 893	19 275	17 393	12 147	11 016	10 046	9 986	9 237
Italy	189 856	187 168	198 696	182 138 |	173 198	..	..	..
Japan	369 726	378 134	368 676	355 229	266 573 |	253 954 e	230 427	..
Korea	119 562	116 149	113 003	108 362	112 260	114 474 e	118 636 e	..
Latvia	31 398	34 166 |	34 022	28 413	30 119	35 980	36 676	34 627
Liechtenstein	..	358	347	274	316	322	291	327
Lithuania	33 703	35 694	35 707	30 059	33 412	37 195	38 255	40 246
Luxembourg	9 696 e	9 854 e	10 212 e	8 880 e	9 326 e	9 413 e	7 207 e	7 745 e
Malta	..	..	..	..	..	..	..	..
Mexico	283 118	299 560	301 872	280 785	299 056	306 629	312 817	313 144
Moldova, Republic of	6 224	5 836	5 840	3 773	4 192	4 794	4 915	4 838
Montenegro, Republic of	255	277	321	280	318	238	149	172
Netherlands	89 111	90 703	91 741	80 480	94 277	95 012	..	..
New Zealand	23 179	23 781	25 454	21 575	23 969	24 712	25 525	25 871
Norway	23 888	24 085	25 219	23 605	24 272	23 806	24 297	25 273
Poland	216 742	238 631	248 787	258 966	288 186	297 004	305 353	331 469
Portugal	20 574	21 438	19 767	16 556	15 250	15 524	12 059	..
Romania	83 254	85 318	82 020	58 361 |	53 571	53 354	56 439	60 038
Russian Federation	3 390 146	3 523 107	3 509 073	3 220 929	3 387 568	3 529 942	3 739 640	3 750 303
Serbia, Republic of	7 140	7 748	7 282	5 668	6 467	6 792	6 143	6 928
Slovak Republic	33 038	37 701	39 494	35 347	36 705	37 936	38 081	39 505
Slovenia	5 652	6 175	6 155	4 944	5 710	5 928	5 319	5 688
Spain	262 581	278 929	262 406	227 514	226 118	223 459	215 582	208 679
Sweden	57 726	59 626	60 857	52 507 |	56 202	56 281	52 410	51 471
Switzerland	29 052	29 162	29 775	27 722	28 349	29 235	28 482	29 278
Turkey	192 916	204 145 |	229 076	231 892	241 463	259 439	265 155	261 939
Ukraine	288 053	318 707	313 425	260 382	275 007	298 972	289 028	..
United Kingdom	200 035	204 714	193 017	170 343	182 839	..	..	..
United States	7 489 325	7 516 284	7 882 850	7 122 482	7 441 364	7 730 254	..	..
European Union (EU27)	**2 346 813**	**2 433 773**	**2 402 186**	**2 138 975**	**2 237 337**	**2 268 162**	**2 208 085**	**..**
OECD	**11 287 872**	**11 429 694**	**11 800 421**	**10 776 801**	**11 189 038**	**11 552 551 p**	**11 867 911 p**	**..**

.. Not available; | Break in series; e Estimated value; p Provisional data

Note: Detailed metadata at: http://metalinks.oecd.org/transport/20141023/e865.

Area totals include only those countries shown in the table.

1. FYROM: the Former Yugoslav Republic of Macedonia

Source: ITF Transport statistics

Coastal shipping

Million tonne-kilometres

	2006	2007	2008	2009	2010	2011	2012	2013
Albania	..	..	..	..	..	..	..	..
Armenia	x	x	x	x	x	x	..	..
Australia	122 260	126 046	125 511	107 607	114 767	110 945	100 857	96 867
Austria	x	x	x	x	x	x	x	x
Azerbaijan	8 043	5 989	6 076	6 173	4 859	5 186	5 062	4 632
Belarus	x	x	x	x	x	..	..	..
Belgium	..	..	..	..	..	..	..	..
Bosnia-Herzegovina	..	..	..	..	..	..	..	..
Bulgaria	..	..	..	..	..	..	..	..
Canada	24 881	29 388	27 852	26 678	29 547	31 735	x	x
China	42 577	48 686	32 851	39 524	45 999	49 355	53 412	..
Croatia	237	289	248	214	210	217	222	211
Czech Republic	x	x	x	x	x	x	x	x
Denmark	..	..	..	..	..	..	..	..
Estonia	..	..	..	..	..	..	..	..
Finland	2 679	2 892	2 937	2 513	3 621	3 966	2 840	2 964
France	..	..	..	..	..	..	..	..
FYROM[1]	x	x	x	x	x	x	x	x
Georgia	..	..	..	..	..	..	..	..
Germany	..	..	..	..	..	..	..	..
Greece	x	x	x	x	x	x	x	..
Hungary	x	x	x	x	x	x	x	x
Iceland	114	105	48	57	47	43	12	48
India	649	726	744	850	885	914	934	..
Ireland	..	..	..	..	..	..	..	..
Italy	46 594	52 211	47 017	49 173	48 844	..	..	..
Japan	207 849	202 962	187 859	167 135	179 898	174 900	177 791	184 860
Korea	26 478	27 998	29 590	25 249	23 281	27 220	..	..
Latvia	..	..	..	..	..	..	..	..
Liechtenstein	x	x	x	x	x	x	x	x
Lithuania	..	..	..	..	..	..	..	..
Luxembourg	x	x	x	x	x	x	..	..
Malta	..	..	..	..	..	..	..	..
Mexico	..	..	..	..	..	..	..	..
Moldova, Republic of	x	x	x	x	x	x	x	x
Montenegro, Republic of	..	..	..	..	..	..	..	..
Netherlands	..	..	..	..	..	..	..	..
New Zealand	..	..	..	..	..	..	..	..
Norway	24 342	23 690	22 860	22 512	19 077	20 100	18 824	20 237
Poland	..	..	..	..	..	..	..	..
Portugal	..	..	..	..	..	..	..	..
Romania	..	..	..	..	..	..	..	..
Russian Federation	7 591	11 702	12 450	12 042	12 640	13 239	12 138 |	12 133
Serbia, Republic of	..	..	..	..	..	..	..	..
Slovak Republic	x	x	x	x	x	x	x	x
Slovenia	..	..	..	..	..	..	..	..
Spain	47 383	49 446	45 396	40 040	41 666	42 811	41 761	44 430 p
Sweden	7 192	7 866	8 255	6 504	7 851 |	7 794	6 965	6 841
Switzerland	x	x	x	x	x	x	x	x
Turkey	7 084	9 571	11 114	11 397	12 569	15 961	17 158	19 725
Ukraine	474	770	..	..	..	2 747	1 702	..
United Kingdom	50 600	49 500	48 400	47 600	40 800	..	34 000	..
United States	331 640	332 950	303 495	286 578	280 822	263 105	280 822	..

.. Not available; | Break in series; x Not applicable; p Provisional data

Note: Detailed metadata at: http://metalinks.oecd.org/transport/20141023/e865.

1. FYROM: the Former Yugoslav Republic of Macedonia

Source: ITF Transport statistics

Rail container transport

Twenty-foot equivalent unit (TEU)

	2006	2007	2008	2009	2010	2011	2012	2013
Albania	..	..	..	..	..	x	x	x
Armenia	..	..	..	..	..	..	..	..
Australia	..	..	..	..	..	..	..	..
Austria	1 104 894	1 356 087	1 358 667	1 104 894	1 310 989	1 356 994	1 278 267	1 148 801
Azerbaijan	16 431	13 226	13 553	13 851	13 582	16 797	19 264	17 396
Belarus	..	..	..	..	..	..	..	..
Belgium	816 649	911 512	864 031	749 417	..	..	..	..
Bosnia-Herzegovina	..	..	..	..	..	..	..	..
Bulgaria	72 390 |	75 527	102 211	109 818	57 297	51 387	53 272	63 725
Canada	..	..	3 205 834	2 952 584	3 235 761	3 315 391	3 559 595	..
China	..	..	..	..	..	..	..	..
Croatia	59 226	91 234	96 577	64 786	69 583	44 214	37 744	41 299
Czech Republic	673 864	868 326	997 974	876 747	1 051 439	1 111 464	1 157 228	1 274 125
Denmark	252 483	218 047 |	210 925	161 827	197 945	198 763	157 306	154 128
Estonia	16 170	16 309	21 190	17 355	22 484	..	..	..
Finland	127 520	118 818	133 644	89 318	70 204	60 174	43 105	42 211
France	..	..	..	..	..	..	..	..
FYROM[1]	..	..	..	..	..	..	..	..
Georgia	34 525	35 872	40 117	30 727	45 923	43 856	55 798	48 083
Germany	4 833 220	5 603 297	6 023 299	5 078 291	5 614 553	5 921 037	6 228 484	6 456 060
Greece	55 781	107 038 |	88 473	56 550	51 009	65 175	..	..
Hungary	469 928	439 827	447 944	452 273	568 685	520 752	386 746	519 480
Iceland	x	x	x	x	x	x	x	x
India	..	21 130	30 340	34 950	37 590	38 000	41 000	..
Ireland	7 404	3 312	4 896	4 340	13 472	14 280	13 776	14 784
Italy	1 400 489	1 381 261	1 291 673	864 525	649 259	563 196	..	..
Japan	..	..	..	..	..	..	..	..
Korea	..	..	..	..	..	..	..	..
Latvia	32 657	55 334	52 759	71 142	98 223	101 099	111 117	97 710
Liechtenstein	x	x	x	x	x	x	x	x
Lithuania	58 444	95 214	101 711	70 247	78 188	102 297	104 171	103 952
Luxembourg	217 148	29 945 |	26 967	33 892	..	..	..	..
Malta	x	x	x	x	x	x	x	x
Mexico	..	..	..	..	..	..	..	..
Moldova, Republic of	3 426	3 313	3 525	1 922	1 914	1 774	1 463	2 015
Montenegro, Republic of	..	..	..	..	..	..	..	..
Netherlands	681 993	968 534	1 077 777	1 026 295	921 108	939 808	1 539 810	1 282 693
New Zealand	..	..	..	..	..	..	..	..
Norway	..	..	552 003	519 954	493 386	412 043	386 620	332 653
Poland	409 933	547 461	706 804	426 619	569 759	783 338	1 026 181	1 091 888
Portugal	67 154	82 043	82 664	88 032	171 146	185 456	191 895	183 583
Romania	249 461	190 240	230 829	145 065	196 328	125 372	91 465	61 474
Russian Federation	..	..	..	..	..	..	..	..
Serbia, Republic of	..	..	..	..	..	..	..	..
Slovak Republic	165 816	263 369	374 672	314 700	449 429	713 921 |	710 100	593 281
Slovenia	148 512	206 225	256 449	222 740	325 556	385 194	395 945	390 507
Spain	..	..	..	..	..	..	..	..
Sweden	336 766	384 609	416 973	533 876 |	536 934	486 271	450 303	402 224
Switzerland	..	..	..	..	..	..	..	..
Turkey	193 424	220 657	319 583	439 936	451 710	659 004	707 989	814 981
Ukraine	92 609	116 521	255 014	109 217	167 535	214 634	262 455	..
United Kingdom	..	..	..	..	..	..	..	..
United States	..	..	..	..	..	..	..	..

.. Not available; | Break in series; x Not applicable

Note: Detailed metadata at: http://metalinks.oecd.org/transport/20141023/e865.

1. FYROM: the Former Yugoslav Republic of Macedonia

Source: ITF Transport statistics

Maritime container transport

Twenty-foot equivalent unit (TEU)

	2006	2007	2008	2009	2010	2011	2012	2013
Albania	21 879	33 127	46 798	68 622	71 614	80 744	87 909	109 054
Armenia	x	x	x	x	x	x	..	..
Australia	5 311 094	5 828 947	6 312 647	6 102 990	6 329 135	6 788 836	7 060 177	7 164 877
Austria	x	x	x	x	x	x	x	x
Azerbaijan	834	1 209	3 025	3 768	13 306	9 712	4 459	2 276
Belarus	x	x	x	x	x	x	..	..
Belgium	8 424 693	9 841 397	10 478 990	9 185 866	10 431 840	10 253 280	9 915 814	..
Bosnia-Herzegovina	..	..	..	..	..	..	..	..
Bulgaria	120 471	131 570	200 863	168 339	170 835	179 167	212 369	218 999
Canada	3 990 469	4 235 611	4 447 910	3 924 200	4 520 000	4 557 000	4 935 000	..
China	..	..	..	..	..	..	..	..
Croatia	114 301	182 606	210 729	151 926	144 649	154 451	144 041	130 236
Czech Republic	x	x	x	x	x	x	x	x
Denmark	684 000	790 000	747 000	637 000	734 000	782 000	763 000	747 000
Estonia	153 004	182 328	182 065	131 278	152 060	..	..	..
Finland	1 393 690	1 554 176	1 594 686	1 104 755	1 219 575	1 398 630	1 449 596	1 472 143
France	3 648 069	4 234 692	3 940 558	3 719 061	3 921 094	3 890 854	4 073 475	4 276 201
FYROM[1]	x	x	x	x	x	x	x	x
Georgia	129 100	184 792	253 811	181 613	226 115	299 461	357 654	403 447
Germany	13 801 570	15 257 000	15 667 000	11 915 000	13 096 000	15 271 000	15 325 000	15 552 000
Greece	1 796 409	1 873 219	1 036 980	1 025 729	1 187 487	2 054 064	3 220 371	3 620 126
Hungary	x	x	x	x	x	x	x	x
Iceland	..	..	..	..	..	..	..	..
India	5 537 000	6 704 000	6 578 000	6 863 000	7 561 000	7 651 000	7 714 000	7 456 000
Ireland	1 100 320	1 173 301	1 043 809	823 218	772 548	744 056	732 316	726 019
Italy	7 842 333	8 483 074	7 896 531	6 605 651	8 644 600	..	..	..
Japan	20 047 681	20 821 901	20 705 861	18 015 533	20 533 734	21 135 704	21 225 537	..
Korea	15 964 896	17 543 923	17 926 748	16 341 378	19 368 960	21 610 502	22 550 275	..
Latvia	149 930	175 616	167 491	145 415	208 508	246 590	366 824	385 665
Liechtenstein	x	x	x	x	x	x	x	x
Lithuania	231 603	321 432	373 263	247 995	295 226	382 194	381 371	402 733
Luxembourg	x	x	x	x	x	x	..	..
Malta	..	..	..	..	..	..	..	..
Mexico	2 676 774	3 062 442	3 316 087	2 884 487	3 691 374 |	4 223 631	4 878 097	4 875 281
Moldova, Republic of	x	x	x	x	x	x	x	x
Montenegro, Republic of	..	..	..	..	..	..	..	..
Netherlands	10 103 160	11 301 690	11 206 050	9 955 769	11 242 400	11 772 958 p	11 738 628 p	11 373 007 p
New Zealand	..	..	..	..	..	..	..	..
Norway	599 270	635 863	624 762	585 647	656 244	691 172	714 565	729 947
Poland	455 829	576 336	635 387	660 594	1 041 690	1 330 746	1 648 886	1 975 030
Portugal	1 313 909	1 439 111	1 548 388	1 508 678	1 690 073	1 791 644	1 994 327	2 418 743
Romania	670 690	948 100	1 405 333	607 483	548 094	653 306	675 414	659 375
Russian Federation	..	..	2 486 200	1 786 500	2 454 800	3 028 300	3 371 000	3 500 900
Serbia, Republic of	..	..	..	..	..	..	..	..
Slovak Republic	x	x	x	x	x	x	x	x
Slovenia	218 970	305 648	353 880	334 316 |	480 981	586 915	556 392	596 429
Spain	11 969 810	13 187 295	13 314 317	11 719 125	12 505 803	13 849 935	13 999 337	13 709 523
Sweden	995 644	1 087 072	1 081 549	996 444	1 071 238	1 165 087	1 150 775	1 147 065
Switzerland	x	x	x	x	x	x	x	x
Turkey	3 673 132 |	4 461 841 |	5 091 621	4 404 442	5 743 455	6 523 506	7 192 396	7 899 933
Ukraine	..	532 766	..	516 712	659 690	729 523	693 210	..
United Kingdom	8 029 000	8 903 000	8 764 000	7 415 000	8 254 000	8 176 000	8 013 000	8 273 000
United States	27 631 490	29 020 340	28 308 780	24 746 418	27 581 971	28 753 713	29 132 700	..

.. Not available; | Break in series; x Not applicable; p Provisional data

Note: Detailed metadata at: http://metalinks.oecd.org/transport/20141023/e865.

1. FYROM: the Former Yugoslav Republic of Macedonia

Source: ITF Transport statistics

Passenger transport by rail

Million passenger-kilometres

	2006	2007	2008	2009	2010	2011	2012	2013
Albania	80	51	41	32	19	18	16	12
Armenia	28	24	24 e	..	..	..	..	..
Australia	12 355	13 001	14 012	14 777	14 742	14 968	15 191	15 237
Austria	9 296 |	9 580	10 837	10 653	10 737	10 899	11 323	11 915
Azerbaijan	964	1 108	1 049	1 024	917	660	591	457
Belarus	9 968	9 366	8 188	7 401	7 578	7 941 e	8 977 e	8 998 e
Belgium	9 607	9 932	10 406	10 427	10 403	11 003	..	..
Bosnia-Herzegovina	36	61	78	61	59	100	54	40
Bulgaria	2 422	2 424	2 335	2 144	2 100	2 068	1 876	1 826
Canada	1 450	1 453	1 574	1 413	1 404	1 404	1 367	1 363 e
China	662 212	721 631	777 860	787 889	876 218	961 229	981 233	..
Croatia	1 362	1 611	1 810	1 835	1 742	1 486	1 104	858
Czech Republic	6 922	6 900	6 803	6 503	6 591	6 714	7 265	7 601
Denmark	6 274	6 353 |	6 475	6 367	6 577	6 890	7 020	7 076
Estonia	257	274	274	249	247	243 e	235 e	225 e
Finland	3 540	3 778	4 052	3 876	3 959	3 882	4 035	4 053
France	79 276	81 293	86 339	85 612	85 602	88 732	88 789	92 440
FYROM[1]	105	109	148	154	155	145	99	80
Georgia	808	773	674	626	654	641	625	585
Germany	78 995	79 107	82 539	82 253	83 886	85 414	88 796	86 718 e
Greece	1 811	1 930	1 657	1 414	1 337	958	832 e	755 e
Hungary	9 584	8 752	8 293	8 073	7 692	7 806	7 806	7 843
Iceland	x	x	x	x	x	x	x	x
India	694 800	769 960	838 030	903 460	978 510	1 046 520	1 098 100	1 171 670 e
Ireland	1 872	2 007	1 976	1 683	1 678	1 638	1 578	1 569
Italy	50 185	49 780	49 524	48 124	47 172	49 993 e	50 003 e	52 153 e
Japan	395 908	405 544	404 585	393 765	393 466	395 067	404 396	408 716 e
Korea	56 067	55 762	56 799	55 489	58 381	63 044	64 995	..
Latvia	992	983	951	756	749	741	725	729
Liechtenstein	x	x	x	x	x	x	x	x
Lithuania	431	409	398	357	373	389	403	391
Luxembourg	298	316	345	333	347	349	373 e	385 e
Malta	x	x	x	x	x	x	x	x
Mexico	76	84	178 |	449	844 |	891	970	1 036
Moldova, Republic of	471	468	486	423	399	363	347	330
Montenegro, Republic of	132	110	125	99	91	65	62	73
Netherlands	15 889	15 546	15 313	15 400	15 400	16 808	17 771	17 669
New Zealand	..	..	..	..	..	..	..	..
Norway	3 099	3 065	3 107	3 080	3 134	3 076	3 092	3 260
Poland	18 552	19 859	20 195	18 637	17 921	18 177	17 826	16 797
Portugal	3 876	3 987	4 213	4 152	4 111	4 143	3 803	3 649
Romania	8 092	7 476	6 958	6 128	5 438	5 073	4 571	4 411
Russian Federation	177 838	174 085	175 872	151 467	138 885	139 742	144 612	138 517
Serbia, Republic of	684	687	583	522	522	541	540	612
Slovak Republic	2 213	2 165	2 296	2 264	2 309	2 431	2 459	2 485
Slovenia	793	812	834	840	813	773	742	760
Spain	22 105	21 857	23 969	23 137	22 456	22 795	22 476	23 788
Sweden	9 617	10 261	11 146	11 321	11 155	11 378	11 792	11 842
Switzerland	16 578	17 434	17 776	18 571	19 177	19 471	19 262	20 264 e
Turkey	5 277	5 553	5 097	5 374	5 491	5 882	4 598	3 775
Ukraine	53 230	53 089	53 056	48 327	50 248	50 593	49 329	48 881 e
United Kingdom	45 214	48 281	50 626	50 439	53 320	56 059	58 299	59 170
United States	8 706	9 309	9 943	9 518	10 332	10 570	10 949	10 959

.. Not available; | Break in series; e Estimated value; x Not applicable

Note: Detailed metadata at: http://metalinks.oecd.org/transport/20141023/ad01.

1. FYROM: the Former Yugoslav Republic of Macedonia

Source: ITF Transport statistics

Passenger transport by private car

Million passenger-kilometres

	2006	2007	2008	2009	2010	2011	2012	2013
Albania	6 870 e	6 377 e	5 647 e	6 068 e	5 535 e	6 726	6 654	7 587
Armenia	2 344	2 426 e	2 426 e	2 741	2 356	..	..	..
Australia	257 287	260 548	262 063	260 946	262 517	265 181	267 136	267 763
Austria	..	..	..	..	..	..	..	..
Azerbaijan	..	..	..	..	..	..	..	..
Belarus	..	..	..	..	..	..	..	..
Belgium	109 920	112 080	113 010	113 430	114 160	115 540	115 880	..
Bosnia-Herzegovina	..	..	..	..	..	..	..	..
Bulgaria	..	..	..	..	..	..	..	..
Canada	493 000	488 000	477 000	493 000	..	..	..	..
China	1 013 085	1 150 677	1 247 611	1 351 144	1 502 081	1 676 025	1 846 755	..
Croatia	..	..	..	..	..	..	..	..
Czech Republic	69 630 e	71 540 e	72 380 e	72 290 e	63 570 |	65 490 e	64 260 e	64 650 e
Denmark	59 137	60 958	61 009	60 455	59 759	59 759	60 886	61 283
Estonia	..	..	..	..	..	..	..	..
Finland	62 455	63 785	63 400	64 330	64 745	65 490	65 270	65 115
France	801 663	811 976	799 988	802 887	810 793	812 656	814 994	819 442
FYROM[1]	3 806 e	3 974 e	4 215 e	4 244 e	4 683 e	5 322 e	5 116 e	5 964 e
Georgia	5 269	5 416	5 568	5 724	5 885	6 049	6 219	6 393
Germany	863 300	866 500	871 300	881 100	884 800	894 400	895 000	..
Greece	36 240 e	36 324 e	35 895 e	..	..	..	..	..
Hungary	52 315	53 946	54 005	54 396	52 595	52 251	51 793	51 824
Iceland	4 833	5 077	4 948	5 002	4 958	4 776	4 832	4 971
India	4 546 000	4 860 000	5 196 000	5 556 000	5 940 000	6 351 000	6 694 000	7 072 000 e
Ireland	..	..	..	..	..	..	..	..
Italy	676 255	677 056	676 359	719 912	698 390	665 818	..	..
Japan	833 863	835 980	822 076	817 360	..	..	..	..
Korea	145 210	145 916	210 886	216 378	264 281	248 111	249 043	..
Latvia	..	..	..	..	..	..	..	..
Liechtenstein	..	..	..	..	..	..	..	..
Lithuania	39 472	39 119	37 991	36 055	32 569	29 908	34 191	33 325
Luxembourg	..	..	..	..	..	..	..	..
Malta	..	..	..	..	..	..	..	..
Mexico	..	..	..	..	..	..	..	..
Moldova, Republic of	..	..	..	..	..	..	..	..
Montenegro, Republic of	115	141	123	102	81	80	111	109
Netherlands	148 000	150 500	147 044 e	..	144 200	144 400	139 700	145 400
New Zealand	..	..	..	..	..	..	..	..
Norway	53 302	54 866	55 956	56 536	57 037	58 029	58 701	59 407
Poland	156 635 e	162 280 e	172 620 e	182 758 e	188 810 e	197 835 e	208 501 e	..
Portugal	86 645 e	86 844 e	85 819 e	..	..	..	..	..
Romania	..	..	..	..	..	..	..	..
Russian Federation	121	132	123	109	135	79	105	64
Serbia, Republic of	..	..	..	..	..	..	..	..
Slovak Republic	25 920	25 994	26 395	26 420	26 879	26 887	26 935	27 155
Slovenia	23 006	24 355	24 878	25 775	25 636	..	..	x
Spain	340 937	343 293	342 611	350 401	341 629	334 021	321 045	316 539
Sweden	107 100	109 500	108 200	108 300	108 000	109 200	109 600	107 600
Switzerland	78 394	79 261	80 689	82 459	83 775	84 889	86 651	..
Turkey	..	..	..	..	..	..	..	..
Ukraine	..	..	..	..	..	..	..	..
United Kingdom	672 340	673 732	665 890	661 052	643 869	641 465	642 655	..
United States	4 298 629	5 351 032 |	5 147 478	4 507 134 |	4 529 563	4 575 486	4 613 663	..

.. Not available; | Break in series; e Estimated value; x Not applicable

Note: Detailed metadata at: http://metalinks.oecd.org/transport/20141023/ad01.

1. FYROM: the Former Yugoslav Republic of Macedonia

Source: ITF Transport statistics

Passenger transport by bus and coach

Million passenger-kilometres

	2006	2007	2008	2009	2010	2011	2012	2013
Albania	480 e	663 e	790 e	1 302 e	2 370 e	1 254 e	983 e	1 063 e
Armenia	92 e	95 e	95 e	..	..	..	..	..
Australia	18 224	18 492	18 835	19 295	19 804	20 288	21 092	21 397
Austria	..	..	..	..	..	..	..	..
Azerbaijan	11 786	12 893	14 041	15 291	16 633	18 264	20 034	21 880
Belarus	9 343	9 353	8 220	..	..	..	..	..
Belgium	18 070	18 730	17 610	17 630	17 380	17 670	17 910	..
Bosnia-Herzegovina	..	2 038	2 113	1 951	..	1 454	1 926	1 764
Bulgaria	12 039	12 209	12 305	10 073	9 924	9 766	9 233	8 916
Canada	17 103	15 471	15 471 e	..	..	..	..	..
China	..	..	..	..	..	..	..	..
Croatia	3 537	3 808	4 093	3 438	3 284	3 145	3 249	3 507
Czech Republic	9 501	9 519	9 369	9 494	10 816	9 267	9 015	8 996
Denmark	7 054	6 857	6 782	6 781	6 853	6 853	6 737	6 450
Estonia	3 112	2 909	2 676	2 336	2 241	..	..	..
Finland	7 540	7 540	7 540	7 540	7 540	7 540	7 540	7 540
France	43 265	45 333	48 430	48 778	49 852	51 068	51 589	52 311
FYROM[1]	1 016	1 027	1 239	1 213	1 441	1 640	1 403	1 395
Georgia	..	..	..	..	..	..	..	..
Germany	81 752	81 307	79 582	78 594	78 092	77 957	76 019	..
Greece	6 069 e	6 253 e	6 287 e	..	..	..	..	..
Hungary	17 315	16 501	16 979	16 081	16 250	16 259	16 868	16 964
Iceland	622	653	637	644	638	615	622	640
India	..	..	..	..	..	..	..	..
Ireland	..	..	..	..	..	..	..	..
Italy	103 049	102 657	102 438	101 706	102 225	103 238	..	..
Japan	84 075	83 082	83 831	81 360	77 750 |	73 988	75 668	..
Korea	59 129	59 242	96 614	94 409	114 582	115 207	107 131	..
Latvia	2 800	2 644	2 517	2 143	2 311	2 412	2 358	2 319
Liechtenstein	..	..	..	..	..	..	..	..
Lithuania	3 283	3 170	2 952	2 382	2 348	2 400	2 387	2 521
Luxembourg	..	..	..	..	..	..	..	..
Malta	..	..	..	..	..	..	..	..
Mexico	436 999	449 917	463 865	436 900	452 033 |	465 600	480 690	484 776
Moldova, Republic of	2 206	2 475	2 599	2 300	2 417	2 733	2 835	3 000
Montenegro, Republic of	..	..	..	..	..	..	..	..
Netherlands	15 630 e	16 105 e	16 192 e	..	..	..	..	..
New Zealand	..	..	..	..	..	..	..	..
Norway	5 894	6 077	6 147	6 208	5 631 |	5 672	5 791	5 844
Poland	48 654 e	47 679 e	47 723 e	43 903 e	41 651 e	40 126 e	39 419 e	..
Portugal	10 557 e	10 878 e	10 937 e	..	..	6 231 |	6 083	..
Romania	11 735	12 156	13 881 |	12 805	11 955	11 773	12 584	12 923
Russian Federation	135 590	149 542	151 774	141 191	140 333	138 284	132 968	124 690
Serbia, Republic of	5 480	4 456	4 719	4 582	4 653	4 652	4 640	4 612
Slovak Republic	7 816	7 737	6 567	4 673	4 509	4 681	4 636	4 388
Slovenia	3 133	3 235	3 146	3 196	3 183	..	..	x
Spain	49 369	59 163	60 864	57 043	50 902	55 742	54 531	51 834
Sweden	9 206	9 270	9 049	9 046	9 109	9 345	9 227	9 242
Switzerland	6 389	6 496	6 247	6 370	6 504	6 695	6 855	..
Turkey	..	..	..	..	..	..	..	..
Ukraine	53 343	55 446	60 671	54 631	51 463	50 881	49 704	..
United Kingdom	40 300	40 500	42 900	43 900	44 400	42 200	41 900	..
United States	231 449	495 280	505 782	490 873	469 790	471 081	503 398	..

.. Not available; | Break in series; e Estimated value; x Not applicable
Note: Detailed metadata at: http://metalinks.oecd.org/transport/20141023/ad01.
1. FYROM: the Former Yugoslav Republic of Macedonia
Source: ITF Transport statistics

Total passenger transport by road

Million passenger-kilometres

	2006	2007	2008	2009	2010	2011	2012	2013
Albania	7 350 e	7 040 e	6 437 e	7 370 e	7 905 e	7 980 e	7 637 e	8 650 e
Armenia	2 436 e	2 521 e	2 521 e	..	..	..	..	..
Australia	275 511	279 040	280 898	280 241	282 321	285 469	288 228	289 160
Austria	..	..	..	..	..	..	..	..
Azerbaijan	11 786	12 893	14 041	15 291	16 633	18 264	20 034	21 880
Belarus	..	..	..	..	..	..	..	..
Belgium	127 990	130 810	130 620	131 060	131 540	133 210	133 790	..
Bosnia-Herzegovina	..	2 038	2 113	1 951	..	1 454	1 926	1 764
Bulgaria	12 039	12 209	12 305	10 073	9 924	9 766	9 233	8 916
Canada	510 103	503 471	492 471 e	..	..	..	..	..
China	..	..	..	..	..	..	..	..
Croatia	3 537	3 808	4 093	3 438	3 284	3 145	3 249	3 507
Czech Republic	79 131	81 059	81 749	81 784	74 386 |	74 757	73 275	73 646
Denmark	66 191	67 815	67 791	67 236	66 612	66 612	67 623	67 733
Estonia	3 112	2 909	2 676	2 336	2 241	..	..	..
Finland	69 995	71 325	70 940	71 870	72 285	73 030	72 810	72 655
France	844 928	857 309	848 418	851 665	860 645	863 724	866 584	871 753
FYROM[1]	4 822	5 001	5 454	5 457	6 124	6 962	6 519	7 359
Georgia	5 269	5 416	5 568	5 724	5 885	6 049	6 219	6 393
Germany	945 052	947 807	950 882	959 694	962 892	972 357	971 019	..
Greece	42 309 e	42 577 e	42 182 e	..	..	..	..	..
Hungary	69 630	70 447	70 984	70 477	68 845	68 510	68 661	68 788
Iceland	5 455	5 730	5 585	5 646	5 596	5 391	5 454	5 611
India	4 546 000	4 860 000	5 196 000	5 556 000	5 940 000	6 351 000	6 694 000	7 072 000 e
Ireland	..	..	..	..	..	..	..	..
Italy	779 304	779 713	778 797	821 618	800 615	769 056	..	..
Japan	917 938	919 062	905 907	898 720	..	..	..	..
Korea	204 339	205 158	307 500	310 787	378 863	363 318	356 174	..
Latvia	2 800	2 644	2 517	2 143	2 311	2 412	2 358	2 319
Liechtenstein	..	..	..	..	..	..	..	..
Lithuania	42 755	42 289	40 943	38 437	34 917	32 308	36 578	35 846
Luxembourg	..	..	..	..	..	..	..	..
Malta	..	..	..	..	..	..	..	..
Mexico	436 999	449 917	463 865	436 900	452 033	465 600	480 690	484 776
Moldova, Republic of	..	..	..	..	..	..	..	..
Montenegro, Republic of	115	141	123	102	81	80	111	109
Netherlands	163 630 e	166 605 e	163 236 e	..	..	..	..	..
New Zealand	..	..	..	..	..	..	..	..
Norway	59 196	60 943	62 103	62 744	62 668 |	63 701	64 492	65 251
Poland	205 289 e	209 959 e	220 343 e	226 661 e	230 461 e	237 961 e	247 920 e	..
Portugal	97 202 e	97 722 e	96 756 e	..	..	..	..	..
Romania	11 735	12 156	13 881	12 805	11 955	11 773	12 584	12 923
Russian Federation	135 711	149 674	151 897	141 300	140 468	138 363	133 073	124 754
Serbia, Republic of	..	..	..	..	..	..	..	..
Slovak Republic	33 736	33 731	32 962	31 093	31 388	31 568	31 571	31 543
Slovenia	26 139	27 590	28 024	28 971	28 819	x	x	x
Spain	390 306	402 456	403 475	407 444	392 531	389 763	375 576	368 373
Sweden	116 306	118 770	117 249	117 346	117 109	118 545	118 827	116 842
Switzerland	84 783	85 757	86 936	88 829	90 279	91 584	93 506	..
Turkey	187 593	209 115	206 098	212 464	226 913	242 265	258 874	268 179
Ukraine	..	..	..	..	..	..	..	..
United Kingdom	712 640	714 232	708 790	704 952	688 269	683 665	684 555	..
United States	4 530 078	5 846 312 |	5 653 260	4 998 007 |	4 999 353	5 046 567	5 117 061	..

.. Not available; | Break in series; e Estimated value; x Not applicable

Note: Detailed metadata at: http://metalinks.oecd.org/transport/20141023/ad01.

1. FYROM: the Former Yugoslav Republic of Macedonia

Source: ITF Transport statistics

Total inland passenger transport

Million passenger-kilometres

	2006	2007	2008	2009	2010	2011	2012	2013
Albania	7 430	7 091	6 478	7 402	7 924	7 998	7 653	8 662
Armenia	2 464 e	2 545 e	2 545 e	2 741	2 356	..	..	..
Australia	287 866	292 041	294 910	295 018	297 063	300 437	303 419	304 396
Austria	9 296 |	9 580	10 837	10 653	10 306	10 876	11 323	11 915
Azerbaijan	12 750	14 001	15 090	16 315	17 550	18 924	20 694	22 337
Belarus	19 311	18 719	16 408	7 401	7 578	..	..	..
Belgium	137 597	140 742	139 146	140 567	140 303	..	..	..
Bosnia-Herzegovina	..	2 099	2 191	2 012	..	1 554	1 980	1 804
Bulgaria	14 461	14 633	14 640	12 217	12 024	11 834	11 109	10 742
Canada	511 553	504 924	494 045 e	..	..	..	..	..
China	1 675 297	1 872 308	2 025 471	2 139 033	2 378 299	2 637 254	2 827 988	..
Croatia	4 899	5 419	5 903	5 273	5 026	4 631	4 353	4 365
Czech Republic	86 053	87 959	88 552	88 287	80 977 |	81 471	80 540	81 247
Denmark	72 465	74 168	74 266	73 603	73 189	73 502	74 643	74 809
Estonia	3 369	3 183	2 950	2 585	2 488	..	..	..
Finland	73 535	75 103	74 992	75 746	76 244	76 912	76 845	76 708
France	924 203	938 602	934 757	937 278	946 247	952 456	955 373	964 193
FYROM[1]	4 927	5 110	5 602	5 611	6 279	7 107	6 618	7 439
Georgia	6 077	6 189	6 242	6 350	6 539	6 690	6 844	6 978
Germany	1 024 047	1 026 914	1 033 421	1 041 947	1 046 778	1 057 771	1 059 815	..
Greece	44 120 e	44 507 e	43 839 e	..	..	..	..	..
Hungary	79 214	79 199	79 277	78 550	76 537	76 316	76 467	76 631
Iceland	5 455	5 730	5 585	5 646	5 596	5 391	5 454	5 611
India	5 240 800	5 629 960	6 034 030	6 459 460	6 918 510	7 397 520	14 486 100 e	15 315 670 e
Ireland	..	..	..	..	..	..	..	..
Italy	829 489	829 493	828 321	869 742	847 787	..	..	..
Japan	1 313 558	1 324 606	1 310 492	1 292 485	..	..	..	..
Korea	260 406	260 920	364 299	366 276	437 244	426 362	421 169	..
Latvia	3 792	3 627	3 468	2 899	3 060	3 153	3 083	3 048
Liechtenstein	..	..	..	..	..	..	..	..
Lithuania	43 186	42 698	41 341	38 794	35 290	32 697	36 981	36 237
Luxembourg	..	..	..	..	..	..	..	..
Malta	..	..	..	..	..	..	..	..
Mexico	437 075	450 001	464 043	437 349	452 877	466 491	481 660	485 812
Moldova, Republic of	2 677	2 943	3 085	2 723	2 816	3 096	3 182	3 330
Montenegro, Republic of	247	251	248	201	172	145	173	182
Netherlands	179 519 e	182 151 e	178 549 e	..	..	..	..	..
New Zealand	..	..	..	..	..	..	..	..
Norway	62 295	64 008	65 221	65 809	65 786 |	66 766	67 678	68 465
Poland	223 841 e	229 818 e	240 538 e	245 298 e	248 382 e	256 138 e	265 746 e	..
Portugal	101 078 e	101 709 e	100 969 e	..	..	..	..	..
Romania	19 827	19 632	20 839	18 933	17 393	16 846	17 155	17 334
Russian Federation	313 549	323 759	327 769	292 767	279 353	278 105	277 685	263 271
Serbia, Republic of	..	..	..	..	..	..	..	..
Slovak Republic	35 949	35 896	35 258	33 357	33 697	33 999	34 030	34 028
Slovenia	26 932	28 402	28 858	29 811	29 632	..	..	x
Spain	412 411	424 313	427 444	430 581	414 987	412 558	398 052	392 161
Sweden	125 923	129 031	128 395	128 667	128 264	129 923	130 619	128 684
Switzerland	101 361	103 191	104 712	107 400	109 456	111 055	112 768	..
Turkey	192 870	214 668	211 195	217 838	232 404	248 147	263 472	271 954
Ukraine	106 573	108 535	113 727	102 958	101 711	101 474	99 033	..
United Kingdom	757 854	762 513	759 416	755 391	741 589	739 724	742 854	..
United States	4 538 784	5 855 621 |	5 663 203	5 007 525 |	5 009 557	5 057 137	5 128 010	..
European Union (EU27)	**5 131 982**	**5 187 583**	**5 195 007**	**5 236 438**	**5 180 410**	**..**	**5 092 487**	**..**
OECD	**12 757 040**	**14 177 284**	**14 086 521**	**..**	**13 312 661**	**..**	**13 262 493**	**..**

.. Not available; | Break in series; e Estimated value; x Not applicable

Note: Detailed metadata at: http://metalinks.oecd.org/transport/20141023/ad01.
Area totals include only those countries shown in the table.

1. FYROM: the Former Yugoslav Republic of Macedonia

Source: ITF Transport statistics

Road traffic injury accidents

Number of accidents

	2006	2007	2008	2009	2010	2011	2012	2013
Albania	1 015	1 254	1 208	1 465	1 564	1 876	1 870	2 075
Armenia	1 574	1 943	2 202	2 002	..	..	..	..
Australia	..	..	..	..	..	..	..	..
Austria	39 884	41 096	39 173	37 925	35 348	35 129	40 831 |	38 502
Azerbaijan	3 197	3 104	2 970	2 792	2 721	2 890	2 892	2 846
Belarus	8 283	7 501	7 238	6 739	..	..	..	..
Belgium	49 171	49 794	48 827	47 798	45 918	47 945	44 234	41 279
Bosnia-Herzegovina	36 090	39 899	40 859	40 237	..	37 928	34 884	35 725
Bulgaria	8 222	8 010	8 045	7 068	6 609	6 639	6 717	7 015
Canada	145 103	141 070	129 869	125 575	125 161	122 966	122 450	122 000 e
China	378 781	327 209	265 204	238 351	219 521	210 812	..	..
Croatia	16 706	18 029	16 283	15 730	13 272	13 228	11 773	11 225
Czech Republic	22 115	23 060	22 481	21 706	19 676	20 487	20 504	20 342
Denmark	5 403	5 549	5 020	4 174	3 498	3 525	3 124	2 984
Estonia	2 585	2 450	1 869	1 505	1 346	1 494 e	1 383 e	..
Finland	6 740	6 657	6 881	6 414	6 072	6 408	5 725	5 334
France	80 309	81 272	74 487	72 315	67 288	65 024	60 437	56 812
FYROM[1]	3 313	4 037	4 403	4 353	4 223	4 462	4 108	4 230
Georgia	4 795	4 946	6 015	5 482	5 099	4 486	5 359	5 510
Germany	327 984	335 845	320 614	310 806	288 297	306 266	299 637	291 105
Greece	16 019	15 499	15 083	14 789	15 032	13 849	12 398	12 072 p
Hungary	20 977	20 635	19 174	17 864	16 308	15 827	15 174	15 691
Iceland	915	1 147	1 085	893	876	837	733	808
India	460 920	479 216	484 704	486 384	499 628	497 686	490 383	486 475
Ireland	6 018	5 158	5 580	6 615	5 780	5 230	5 376	..
Italy	238 124	230 871	218 963	215 405	211 404	205 000	186 726 e	..
Japan	887 257	832 691	766 382	737 628	725 903	692 056	665 138	629 021
Korea	213 745	211 662	215 822	231 990	226 878	221 711	223 656	215 354
Latvia	4 302	4 781	4 196	3 160	3 193	3 386	3 358	3 489
Liechtenstein	448	420	402	358	366	327	403	468
Lithuania	6 588	6 448	4 796	3 805	3 530	3 266	3 391	3 391
Luxembourg	805	954	927	869	787	962 e	1 019 e	..
Malta	15 549	16 138	15 007	14 877	13 727	14 624	14 546	..
Mexico	29 030	30 551	30 379	16 011 |	14 581	11 473	12 888	..
Moldova, Republic of	2 298	2 437	2 869	2 729	2 921	2 825	2 713	2 603
Montenegro, Republic of	1 554	1 874	1 760	1 718	1 520	1 451 |	1 217	1 266
Netherlands	8 717	9 228	8 897	6 927	3 853 e	..	..	..
New Zealand	11 293	12 042	11 647	11 125	10 886	9 804	9 604	9 348
Norway	7 925	8 182	7 726	6 922	6 434	6 079	6 154	5 241
Poland	46 876	49 536	49 054	44 196	38 832	40 065	37 062	35 847
Portugal	35 680	35 311	33 613	35 484	35 426	32 541	29 867	..
Romania	21 904 |	24 662	29 861	28 612	25 996	26 648	26 928	24 827
Russian Federation	229 140	233 809	218 322	203 603	199 431	199 868	203 597	204 068
Serbia, Republic of	13 912	16 585	16 651	15 807	14 179	14 119	13 333	13 522
Slovak Republic	7 988	8 500	8 343	6 465	6 570	5 775	5 370	5 113
Slovenia	11 223	11 414	8 938	8 589	7 560	7 218	6 864	6 542
Spain	99 797	100 508	93 161	88 251	85 503	83 027	83 115	89 519
Sweden	18 213	18 548	18 462	17 858	16 500	16 119	16 458	14 816
Switzerland	21 491	21 911	20 736	20 506	19 609	18 990	18 148	17 473
Turkey	96 128	106 994	104 212	111 121	116 804	131 845	153 552	161 306
Ukraine	49 491	63 554	51 279	37 049	31 914	31 281	30 699	..
United Kingdom	204 363	188 105	176 814	169 805	160 080	157 068	151 346	144 426
United States	1 785 000	1 748 000	1 664 000	1 548 000	1 572 000	1 530 000	1 634 000	..

.. Not available; | Break in series; e Estimated value; p Provisional data

Note: Detailed metadata at: http://metalinks.oecd.org/transport/20141023/9344.

1. FYROM: the Former Yugoslav Republic of Macedonia

Source: ITF Transport statistics

Road traffic injuries

Number

	2006	2007	2008	2009	2010	2011	2012	2013
Albania	1 065	1 344	1 251	1 455	1 716	2 150	2 235	3 840
Armenia	2 089	2 720	3 145 e	2 804 e	..	..	..	..
Australia	32 288	32 552	33 524	33 692	32 775	34 082	..	..
Austria	51 930	53 211	50 521	49 158	45 858	45 025	50 895 |	48 044
Azerbaijan	3 606	3 432	3 232	3 044	2 871	3 031	2 997	2 948
Belarus	8 832	8 037 e	7 494 e	7 283 e	..	..	..	..
Belgium	65 297	65 850	64 437	62 720	60 363	62 861	57 763	53 967
Bosnia-Herzegovina	9 994	11 890	11 884	11 052	..	10 039	9 175	9 718
Bulgaria	10 215	9 827	9 952	8 674	8 078	8 301	8 193	8 775
Canada	199 976	192 745	176 512	170 912	170 629	166 725	168 513 e	169 000 e
China	431 139	380 442	304 919	275 125	254 074	237 421	..	..
Croatia	23 136	25 092	22 395	21 923	18 333	18 065	16 010	15 274
Czech Republic	28 114	29 243	28 501	27 244	24 384	25 549	25 515	25 288
Denmark	6 515	6 656	5 923	4 947	4 153	4 039	3 611	3 394
Estonia	3 508	3 271	2 398	1 931	1 719	1 879 e	1 707 e	..
Finland	8 580	8 446	8 513	8 057	7 673	7 931	7 088	6 681
France	102 125	103 201	93 798	90 934	84 461	81 251	75 851	70 607
FYROM[1]	4 936	6 133	6 724	6 731	6 195	6 853	6 149	6 484
Georgia	7 084	7 349	9 063	8 261	7 560	6 638	7 734	8 045
Germany	422 337	431 419	409 047	397 671	371 170	392 365	384 378	374 142
Greece	20 675	19 766	19 010	18 641	19 108	17 259	15 640	14 812 p
Hungary	27 977	27 452	25 369	23 274	20 917	20 172	18 979	20 090
Iceland	1 327	1 658	1 573	1 282	1 253	1 205	1 035	1 217
India	496 481	513 340	523 193	515 458	527 512	511 412	509 667	494 893
Ireland	8 575	7 806	7 921	9 742	8 270	7 235	7 597	..
Italy	338 624	330 981	315 470	307 258	302 735	292 000	264 716 e	..
Japan	1 097 643	1 033 754	944 833	910 352	895 410	853 766	824 570	780 715
Korea	340 229	335 906	338 962	361 875	352 458	341 391	344 565	328 711
Latvia	5 404	6 088	5 408	3 930	4 023	4 224	4 179	4 338
Liechtenstein	97	116	109	111	114	105	108	111
Lithuania	8 252	8 043	5 818	4 426	4 230	3 919	3 951	4 007
Luxembourg	1 089	1 326	1 239	1 156	1 059	1 308 e	1 378 e	..
Malta	1 186	1 195	1 157	1 048	1 064	1 560	1 590	1 564
Mexico	33 168	33 580	32 769	31 656	28 617	26 045	24 736	..
Moldova, Republic of	2 807	2 984	3 494	2 801	3 735	3 543	3 510	3 221
Montenegro, Republic of	2 257	2 796	2 473	2 478	2 099	2 075	1 722	1 812
Netherlands	9 051	9 683	8 750 e	6 956 e	3 651 e	..	..	..
New Zealand	15 174	16 013	15 174	14 540	14 031	12 574	12 122	11 781
Norway	11 126	12 082	10 868	9 844	9 130	8 363	8 195	6 842
Poland	59 123	63 224	62 097	56 046	48 952	49 501	45 792	44 059
Portugal	47 018	46 198	43 824	46 414	46 365	41 960	38 105	..
Romania	26 124 |	29 604	36 931	35 523	32 414	33 491	34 209	31 464
Russian Federation	285 362	292 206	270 883	255 484	250 635	251 848	258 618	258 437
Serbia, Republic of	18 405	22 201	22 275	21 512	19 326	19 312	18 406	18 472
Slovak Republic	10 692	11 310	11 040	8 534	8 150	7 057	6 438	6 311
Slovenia	16 075	16 037	12 409	12 114	10 316	9 673	9 148	8 742
Spain	143 450	142 521	130 947	124 966	120 345	115 627	115 890	124 720
Sweden	26 636	26 749	26 248	25 281	23 305 |	22 360	22 825	20 259
Switzerland	26 718	27 132	25 556	25 130	24 237	23 242	22 218	21 379
Turkey	169 080	189 057	184 468	201 380	211 496	238 074	268 079	274 829
Ukraine	60 018	78 528	63 254	45 675	38 975	38 178	37 519	..
United Kingdom	264 288	254 157	237 811	229 576	215 700	210 750	202 931	190 923
United States	2 575 000	2 491 000	2 346 000	2 217 000	2 239 000	2 217 000	2 362 000	..

.. Not available; | Break in series; e Estimated value; p Provisional data

Note: Detailed metadata at: http://metalinks.oecd.org/transport/20141023/9344.

1. FYROM: the Former Yugoslav Republic of Macedonia

Source: ITF Transport statistics

Road traffic fatalities

Number

	2006	2007	2008	2009	2010	2011	2012	2013
Albania	277	384	303	378	353	322	334	593
Armenia	332	371	407	325	..	..	..	..
Australia	1 598	1 603	1 437	1 491	1 353	1 277	1 299	1 192
Austria	730	691	679	633	552	523	531 |	455
Azerbaijan	1 027	1 107	1 052	930	925	1 016	1 168	1 164
Belarus	1 726	1 518	1 564	1 322	..	..	..	..
Belgium	1 069	1 067	944	943	841	862	770	724
Bosnia-Herzegovina	403	430	434	382	..	356	303	334
Bulgaria	1 043	1 006	1 061	901	776	657	601	601
Canada	2 871	2 753	2 436	2 223	2 237	2 006	2 104	2 150 e
China	89 455	81 649	73 484	67 759	65 225	62 387	..	..
Croatia	614	619	664	548	426	418	393	368
Czech Republic	1 063	1 222	1 076	901	802	773	742	654
Denmark	306	406	406	303	255	220	167	191
Estonia	204	196	132	100	78	101 e	87 e	81 p
Finland	336	380	344	279	272	292	255	258
France	4 709	4 620	4 275	4 273	3 992	3 963	3 653	3 268
FYROM[1]	140	173	162	160	162	172	132	198
Georgia	675	737	867	738	685	526	605	514
Germany	5 091	4 949	4 477	4 152	3 648	4 009	3 600	3 339
Greece	1 657	1 612	1 553	1 456	1 258	1 141	988	874 p
Hungary	1 303	1 232	996	822	740	638	605	591
Iceland	31	15	12	17	8	12	9	15
India	105 749	114 444	119 860	125 660	134 513	142 485	138 258	137 572
Ireland	365	338	279	238	212	186	162	189 p
Italy	5 669	5 131	4 731	4 237	4 090	3 800	3 653 e	..
Japan	7 326	6 681	6 067	5 831	5 806	5 507	5 237	5 152
Korea	6 327	6 166	5 870	5 838	5 505	5 229	5 392	5 092
Latvia	407	419	316	254	218	179	177	179
Liechtenstein	0	0	1	1	0	2	1	2
Lithuania	760	740	499	370	299	296	302	256
Luxembourg	43	46	35	48	32	33 e	34 e	45 p
Malta	10	14	15	21	15	17	9	18
Mexico	4 908	5 398	5 379	4 869	5 032	4 406	4 539	..
Moldova, Republic of	382	464	500	487	452	433	442	295
Montenegro, Republic of	85	122	112	100	95	58	46	74
Netherlands	811	791	750	720	640	661	650	570
New Zealand	393	421	366	385	375	284	308	254
Norway	242	233	255	212	208	168	145	187
Poland	5 243	5 583	5 437	4 572	3 907	4 189	3 577	3 357
Portugal	969	974	885	737	937	891	718	..
Romania	2 587	2 800	3 065	2 797	2 377	2 018	2 042	1 861
Russian Federation	32 724	33 308	29 936	27 659	26 567	27 953	27 991	27 025
Serbia, Republic of	900	962	897	808	656	728	684	646
Slovak Republic	608	661	606	384	353	325	352	251
Slovenia	262	293	214	171	138	141	130	125
Spain	4 104	3 823	3 100	2 714	2 478	2 060	1 903	1 680
Sweden	445	471	397	358	266 |	319	285	260
Switzerland	370	384	357	349	327	320	339	269
Turkey	4 633	5 007	4 236	4 324	4 045	3 835	3 750	3 685
Ukraine	7 592	9 574	7 718	5 348	4 875	4 908	5 131	4 824 p
United Kingdom	3 298	3 059	2 645	2 337	1 905	1 960	1 802	1 766
United States	42 708	41 259	37 423	33 883	32 999	32 479	33 561	..
European Union (EU27)	**43 706**	**43 143**	**39 581**	**35 372**	**31 507**	**30 620 p**	**28 211 p**	**..**
OECD	**109 754**	**107 466**	**97 846**	**89 945**	**85 329**	**82 483 p**	**81 347 p**	**..**

.. Not available; | Break in series; e Estimated value; p Provisional data

Note: Detailed metadata at: http://metalinks.oecd.org/transport/20141023/9344.

Area totals include only those countries shown in the table.

1. FYROM: the Former Yugoslav Republic of Macedonia

Source: ITF Transport statistics

Road traffic fatalities, per million inhabitants

Number

	2006	2007	2008	2009	2010	2011	2012	2013
Albania	87	121	96	120	112	102	106	187
Armenia	111	124	137	109	..	..	..	..
Australia	77	75	66	68	60	56	56	51
Austria	88	83	81	76	66	62	63 |	54
Azerbaijan	119	126	118	103	102	110	125	123
Belarus	179	158	164	139	..	..	..	..
Belgium	101	100	88	87	77	78	70	65
Bosnia-Herzegovina	104	111	112	99	..	93	79	87
Bulgaria	137	133	141	121	105	90	83	83
Canada	88	83	73	66	66	58	60	61 e
China	67	61	55	50	48	46	..	..
Croatia	140	142	152	126	98	97	91	86
Czech Republic	103	118	103	86	76	73	70	61
Denmark	56	74	74	55	46	39	30	34
Estonia	155	149	101	77	60	78 e	67 e	63 p
Finland	64	72	65	52	51	54	47	48
France	76	74	68	68	63	62	57	51
FYROM[1]	67	83	77	76	77	82	63	94
Georgia	152	167	196	168	156	120	139	118
Germany	61	59	54	50	44	48	43	40
Greece	150	146	140	131	113	103	89	79 p
Hungary	129	122	99	82	74	64	61	59
Iceland	103	49	39	54	25	37	28	45
India	92	99	102	106	112	117	112	110
Ireland	86	79	64	54	47	41	35	41 p
Italy	96	86	79	70	68	63	60 e	..
Japan	58	53	48	46	46	43	41	41
Korea	134	130	123	121	114	107	110	104
Latvia	185	193	148	120	104	86	86	87
Liechtenstein	0	0	28	28	0	55	27	54
Lithuania	235	232	159	119	97	97	100	85
Luxembourg	92	97	72	96	63	64 e	65 e	85 p
Malta	24	33	36	50	35	40	21	42
Mexico	44	48	47	42	43	37	37	..
Moldova, Republic of	103	126	137	135	127	122	126	85
Montenegro, Republic of	138	197	181	161	153	93	74	119
Netherlands	50	48	45	43	39	40	39	34
New Zealand	94	99	86	89	86	64	69	56
Norway	52	49	53	44	43	34	29	37
Poland	137	146	142	120	102	110	94	88
Portugal	92	92	84	70	88	84	68	..
Romania	117	127	140	128	109	93	94	86
Russian Federation	228	232	208	192	185	195	196	190
Serbia, Republic of	91	98	92	83	68	76	72	68
Slovak Republic	113	122	112	71	65	60	65	46
Slovenia	130	145	105	84	67	68	63	60
Spain	93	86	69	59	54	44	41	36
Sweden	49	51	43	38	28 |	34	30	27
Switzerland	49	51	47	45	42	40	42	33
Turkey	68	72	60	61	56	52	51	49
Ukraine	162	205	166	116	106	107	113	107 p
United Kingdom	54	50	43	38	31	31	29	28
United States	142	136	122	109	106	103	106	..
European Union (EU27)	**88**	**87**	**79**	**71**	**63**	**61 p**	**56 p**	**..**
OECD	**91**	**89**	**80**	**73**	**69**	**66 p**	**65 p**	**..**

.. Not available; | Break in series; e Estimated value; p Provisional data

Note: Detailed metadata at: http://metalinks.oecd.org/transport/20141023/9344.

Area totals include only those countries shown in the table.

1. FYROM: the Former Yugoslav Republic of Macedonia

Source: ITF Transport statistics

Road traffic casualties (injuries plus fatalities)

Number

	2006	2007	2008	2009	2010	2011	2012	2013
Albania	1 342	1 728	1 554	1 833	2 069	2 472	2 569	4 433
Armenia	2 421	3 091	3 552 e	3 129 e	..	..	..	..
Australia	33 886	34 155	34 961	35 183	34 128	35 359	..	..
Austria	52 660	53 902	51 200	49 791	46 410	45 548	51 426 |	48 499
Azerbaijan	4 633	4 539	4 284	3 974	3 796	4 047	4 165	4 112
Belarus	10 558	9 555 e	9 058 e	8 605 e	..	..	..	..
Belgium	66 366	66 917	65 381	63 663	61 203	63 723	58 533	54 691
Bosnia-Herzegovina	10 397	12 320	12 318	11 434	..	10 395	9 478	10 052
Bulgaria	11 258	10 833	11 013	9 575	8 854	8 958	8 794	9 376
Canada	202 847	195 498	178 948	173 135	172 866	168 731	170 617	293 150 e
China	520 594	462 091	378 403	342 884	319 299	299 808	..	..
Croatia	23 750	25 711	23 059	22 471	18 759	18 483	16 403	15 642
Czech Republic	29 177	30 465	29 577	28 145	25 186	26 323	26 257	25 942
Denmark	6 821	7 062	6 329	5 250	4 408	4 259	3 778	3 585
Estonia	3 712	3 467	2 530	2 031	1 797	2 081 e	1 794 e	..
Finland	8 916	8 826	8 857	8 336	7 945	8 223	7 343	6 939
France	106 834	107 821	98 073	95 207	88 453	85 214	79 504	73 875
FYROM[1]	5 076	6 306	6 886	6 891	6 357	7 025	6 281	6 682
Georgia	7 759	8 086	9 930	8 999	8 245	7 164	8 339	8 559
Germany	427 428	436 368	413 524	401 823	374 818	396 374	387 978	377 481
Greece	22 332	21 378	20 563	20 097	20 366	18 400	16 628	15 686 p
Hungary	29 280	28 684	26 365	24 096	21 657	20 810	19 584	20 681
Iceland	1 358	1 673	1 585	1 299	1 261	1 217	1 044	1 232
India	602 230	627 784	643 053	641 118	662 025	653 897	647 925	632 465
Ireland	8 940	8 144	8 200	9 980	8 482	7 421	7 759	..
Italy	344 293	336 112	320 201	311 495	306 825	295 800	268 369 e	..
Japan	1 104 969	1 040 435	950 900	916 183	901 216	859 273	829 807	785 867
Korea	346 556	342 072	344 832	367 713	357 963	346 620	349 957	333 803
Latvia	5 811	6 507	5 724	4 184	4 241	4 403	4 356	4 517
Liechtenstein	97	116	110	112	114	107	109	113
Lithuania	9 012	8 783	6 317	4 796	4 529	4 215	4 253	4 263
Luxembourg	1 132	1 372	1 274	1 204	1 091	1 341 e	1 412 e	..
Malta	1 196	1 209	1 172	1 069	1 079	1 577	1 599	1 582
Mexico	38 076	38 978	38 148	36 525	33 649	30 451	29 275	..
Moldova, Republic of	3 189	3 448	3 994	3 288	4 187	3 976	3 952	3 516
Montenegro, Republic of	2 342	2 918	2 585	2 578	2 194	2 133	1 768	1 886
Netherlands	9 862	10 474	9 500 e	7 676 e	4 291 e	..	..	..
New Zealand	15 567	16 434	15 540	14 925	14 406	12 858	12 430	12 035
Norway	11 368	12 315	11 123	10 056	9 338	8 531	8 340	7 029
Poland	64 366	68 807	67 534	60 618	52 859	53 690	49 369	47 416
Portugal	47 987	47 172	44 709	47 151	47 302	42 851	38 823	..
Romania	28 711 |	32 404	39 996	38 320	34 791	35 509	36 251	33 325
Russian Federation	318 086	325 514	300 819	283 143	277 202	279 801	286 609	285 462
Serbia, Republic of	19 305	23 163	23 172	22 320	19 982	20 040	19 090	19 118
Slovak Republic	11 300	11 971	11 646	8 918	8 503	7 382	6 790	6 562
Slovenia	16 337	16 330	12 623	12 285	10 454	9 814	9 278	8 867
Spain	147 554	146 344	134 047	127 680	122 823	117 687	117 793	126 400
Sweden	27 081	27 220	26 645	25 639	23 571 |	22 679	23 110	20 519
Switzerland	27 088	27 516	25 913	25 479	24 564	23 562	22 557	21 648
Turkey	173 713	194 064	188 704	205 704	215 541	241 909	271 829	278 514
Ukraine	67 610	88 102	70 972	51 023	43 850	43 086	42 650	..
United Kingdom	267 586	257 216	240 456	231 913	217 605	212 710	204 733	192 689
United States	2 575 000	2 532 000	2 383 000	2 251 000	2 272 000	2 249 000	2 396 000	..

.. Not available; | Break in series; e Estimated value; p Provisional data

Note: Detailed metadata at: http://metalinks.oecd.org/transport/20141023/9344.

1. FYROM: the Former Yugoslav Republic of Macedonia

Source: ITF Transport statistics

Investment in rail transport infrastructure

Million euros

	2004	2005	2006	2007	2008	2009	2010	2011
Albania	2.1	2.3	1.2	0.6	1.4	0.1	0.3	0.9
Armenia	..	..	..	..	..	..	..	..
Australia	1 105.8	1 492.5	1 251.7	1 962.0	1 727.2	2 285.0	3 611.5	5 492.2
Austria	1 334.7	1 330.1	1 489.1	1 505.2	1 683.3	2 061.5	1 936.0	2 143.1
Azerbaijan	7.0	19.1	11.8	3.7	11.1	2.4	3.2	2.8
Belarus	..	..	..	..	..	..	..	..
Belgium	976.4	915.8	1 011.6	1 009.2	1 222.6	1 222.6	..	..
Bosnia-Herzegovina	..	..	..	..	..	..	..	..
Bulgaria	31.2	45.5	39.4	44.5	71.6	49.6	129.9	90.0
Canada	356.5	572.5	598.5	646.1	617.0	493.4	698.8	841.5
China	..	..	..	..	..	..	..	..
Croatia	128.2	93.8	121.5	92.3	125.7	98.2	83.4	80.5
Czech Republic	411.5	484.6	464.8	612.2	1 216.7	740.3	563.7	447.3
Denmark	341.5	240.9	178.2	232.1	373.0	356.7	396.4	863.0
Estonia	20.0	20.0	21.0	30.3	22.7	37.5	35.1	94.0
Finland	328.3	281.2	234.0	211.0	327.0	361.0	288.0	355.0
France	3 680.5	4 117.8	4 214.1	4 505.0	5 119.4	5 046.9	4 914.8	5 148.2
FYROM[1]	0.1	1.4	1.1	0.7	1.6	3.6	2.3	0.5
Georgia	11.1	14.2	61.9	212.0	48.2	80.3	77.5	249.2
Germany	6 404.0	3 411.0	3 971.0	3 836.0	3 816.0	3 412.0	3 807.0	3 920.0
Greece	1 786.0	278.0	239.0	253.0	..	..	..	..
Hungary	154.5	170.7	91.4	376.4	297.7	317.4	275.2	..
Iceland	x	x	x	x	x	x	x	x
India	1 504.0	1 425.2	1 328.4	1 437.1	1 500.7	2 514.7	2 994.2	3 079.9
Ireland	184.0	184.0	172.0	244.0	..	..	..	..
Italy	8 809.0	10 174.8	8 969.7	7 701.9	7 109.0	5 687.0	4 773.0	..
Japan	6 217.3	6 057.1	6 735.6	6 882.6	7 367.1	9 601.9	11 308.3	10 197.7
Korea	29.8	38.5	38.4	37.3	..	..	..	..
Latvia	33.1	40.2	33.0	37.1	61.2	63.8	77.6	53.8
Liechtenstein	x	x	x	x	x	x	x	x
Lithuania	70.4	68.1	50.4	75.9	85.4	67.2	107.2	116.1
Luxembourg	106.9	126.5	103.9	138.5	149.7	172.3	156.5	150.4
Malta	x	x	x	x	x	x	x	x
Mexico	192.0	222.7	370.5	562.7	497.9	437.9	434.9	649.2
Moldova, Republic of	5.6	9.4	6.4	10.5	24.5	8.4	7.2	7.4
Montenegro, Republic of	..	..	..	..	..	..	..	..
Netherlands	1 051.2	1 100.5	702.8	845.2	820.1	778.2	1 096.6	1 135.6
New Zealand	..	..	..	..	..	..	..	..
Norway	221.9	193.4	258.1	310.0	286.4	358.2	479.3	527.6 e
Poland	220.2	236.1	353.2	646.7	904.3	650.2	690.2	924.9
Portugal	484.0	415.0	307.0	329.0	392.0	360.0	403.0	333.0
Romania	57.8	109.1	101.8	310.9	316.4	177.4	168.8	161.4
Russian Federation	3 647.6	4 021.1	4 167.6	5 435.8	9 506.7	6 574.6	9 065.8	9 860.5
Serbia, Republic of	4.4	4.4	3.9	2.2	2.4	5.7	12.2	7.0
Slovak Republic	90.6	159.9	225.5	287.3	214.6	175.3	273.4	293.0
Slovenia	58.9	42.4	12.8	53.5	128.7	100.1	131.0	105.7
Spain	4 368.4	5 764.1	6 335.9	8 345.0	8 981.0	9 780.0	8 255.0	7 581.0
Sweden	942.6	1 124.2	1 061.0	1 253.5	1 319.4	1 318.6	1 433.6	1 400.3
Switzerland	2 116.2	2 191.4	2 351.1	2 329.0	2 621.7	2 888.1	3 036.3	3 413.9
Turkey	222.1	226.3	450.8	498.6	671.8	756.3	1 493.3	1 470.1
Ukraine	..	..	..	..	..	..	..	..
United Kingdom	5 450.1	5 757.5	7 940.4	7 733.5	7 562.5	6 341.9	6 387.3	6 651.7
United States	..	..	..	..	..	..	..	..

.. Not available; e Estimated value; x Not applicable

Note: Detailed metadata at: http://metalinks.oecd.org/transport/20141023/69a5.

1. FYROM: the Former Yugoslav Republic of Macedonia

Source: ITF Transport statistics

Investment in road transport infrastructure

Million euros

	2004	2005	2006	2007	2008	2009	2010	2011
Albania	91.1	68.1	175.2	253.3	499.6	486.9	241.9	210.2
Armenia	..	..	..	..	..	..	..	..
Australia	5 194.1	6 736.2	6 972.9	8 025.4	9 263.1	9 196.1	11 200.3	13 792.2
Austria	719.7	687.0	802.0	869.9	874.5	665.0	390.0	303.0
Azerbaijan	48.1	82.4	260.0	374.0	1 327.5	1 271.7	1 545.3	1 561.7
Belarus	..	..	..	..	..	..	..	..
Belgium	1 431.7	1 561.8	1 508.4	1 281.1	1 431.9	1 431.9	..	..
Bosnia-Herzegovina	..	..	..	..	..	..	..	..
Bulgaria	..	272.2	166.2	134.0	168.7	101.2	281.2	344.1
Canada	4 173.9	5 496.8	6 780.2	7 810.3	8 751.4	10 891.5	15 394.5	15 060.7
China	..	..	..	..	..	..	..	..
Croatia	876.7	750.3	875.0	1 066.0	1 101.3	909.3	515.3	465.7
Czech Republic	1 030.6	1 415.4	1 491.0	1 492.8	2 041.0	1 984.6	1 721.2	1 294.5
Denmark	727.8	927.7	1 190.8	1 028.9	935.6	713.8	936.6	..
Estonia	56.0	102.0	130.0	126.0	142.0	119.0	137.0	158.0
Finland	599.4	594.8	650.0	802.0	973.0	921.8	890.0	932.0
France	11 271.3	11 354.7	12 099.2	12 489.1	12 623.4	12 648.1	11 942.4	11 875.7
FYROM[1]	27.9	23.1	23.3	39.0	45.0	42.6	31.7	38.2
Georgia	40.0	62.5	90.9	122.2	124.3	218.8	232.4	215.7
Germany	10 710.0	10 200.0	10 730.0	10 845.0	11 410.0	12 160.0	11 710.0	11 610.0
Greece	1 507.0	1 592.0	1 845.0	1 946.0	..	..	..	..
Hungary	1 426.9	1 703.6	583.8	645.9	976.3	1 564.3	840.7	..
Iceland	142.8	151.5	210.6	186.5	241.6	121.4	79.5	38.7
India	2 331.8	3 831.5	4 606.1	5 403.2	5 816.7	6 235.5	..	..
Ireland	1 190.0	1 153.0	1 495.0	1 425.0	1 319.0	1 173.0	841.0	463.0
Italy	7 571.7	9 168.6	14 279.9	13 663.5	13 051.0	5 641.0	3 389.0	..
Japan	43 290.3	40 103.4	36 584.8	31 560.4	31 861.2	37 206.8	35 774.0	..
Korea	56.7	60.2	61.4	57.8	19.3	..	..	..
Latvia	63.1	160.9	181.0	241.4	264.7	134.6	139.7	223.7
Liechtenstein	26.2	27.3	..	..	..	..	..	..
Lithuania	136.7	165.4	242.4	311.9	437.3	448.0	422.3	343.5
Luxembourg	135.2	127.7	175.9	157.4	137.8	148.5	182.6	220.2
Malta	10.1	8.2	..	..	..	..	..	..
Mexico	1 998.9	2 853.8	2 542.0	2 164.2	2 544.8	3 022.7	3 938.4	3 911.5
Moldova, Republic of	4.0	2.4	6.5	27.7	26.0	13.4	13.8	..
Montenegro, Republic of	3.9	3.1	37.2	50.8	10.9	23.2	17.8	14.8
Netherlands	2 333.9	1 635.8	1 654.0	1 680.0	2 194.3	2 362.6	2 299.7	2 287.4
New Zealand	269.4	347.3	395.8	487.3	511.6	579.1	731.7	839.9
Norway	1 138.3	1 462.6	1 473.8	1 718.4	1 984.9	2 395.7	2 621.7	2 724.4 e
Poland	1 236.9	1 874.7	2 604.8	3 443.5	4 508.4	5 340.4	6 510.1	8 319.4
Portugal	1 932.9	2 111.8	1 940.3	1 453.0	1 366.3	951.4	1 510.5	..
Romania	1 095.3	1 331.4	1 949.9	2 806.0	3 891.3	3 105.0	2 850.1	3 283.2
Russian Federation	3 182.0	3 790.2	4 872.4	7 299.1	9 899.0	6 240.3	6 209.9	8 413.8
Serbia, Republic of	184.8	174.0	351.4	406.0	378.6	251.5	228.8	339.0
Slovak Republic	240.0	360.2	411.0	520.0	566.7	661.6	342.1	432.0
Slovenia	496.3	450.1	573.2	666.5	694.4	406.2	220.8	128.4
Spain	7 244.5	8 580.0	8 411.0	8 077.0	8 522.0	8 588.0	7 818.0	5 911.0
Sweden	1 443.2	1 297.6	1 407.1	1 423.0	1 604.3	1 573.7	1 653.0	1 871.0
Switzerland	2 729.6	2 766.3	2 710.9	2 674.3	2 839.9	2 996.7	3 388.4	..
Turkey	633.9	920.6	1 966.9	1 947.2	2 233.4	2 918.0	5 419.5	5 180.5
Ukraine	..	..	..	..	..	..	..	..
United Kingdom	4 949.2	5 631.8	6 341.5	6 202.0	6 042.9	6 583.2	6 472.4	5 146.9
United States	48 958.9	52 889.6	58 537.8	54 359.7	53 576.3	56 710.6	59 892.9	55 531.6

.. Not available; e Estimated value

Note: Detailed metadata at: http://metalinks.oecd.org/transport/20141023/69a5.

1. FYROM: the Former Yugoslav Republic of Macedonia

Source: ITF Transport statistics

Investment in inland waterway transport infrastructure

Million euros

	2004	2005	2006	2007	2008	2009	2010	2011
Albania	0.0	0.1	0.1	0.1	0.2	0.3	0.2	0.1
Armenia	..	..	..	..	..	..	..	..
Australia	x	x	x	x	x	x	x	x
Austria	11.6	6.5	6.6	3.8	2.5	5.0	11.3	8.1 e
Azerbaijan	..	..	..	..	..	..	..	..
Belarus	..	..	..	..	..	..	..	..
Belgium	153.4	156.4	161.8	178.4	188.4	188.4	..	..
Bosnia-Herzegovina	..	..	..	..	..	..	..	..
Bulgaria	25.6	85.4	196.9	405.5	0.0	0.0	0.0	0.0
Canada	..	..	..	..	..	..	..	..
China	..	..	..	..	..	..	..	..
Croatia	3.3	1.9	1.2	2.0	1.9	3.5	2.6	3.5
Czech Republic	11.5	10.2	18.6	14.0	21.5	58.8	57.9	22.3
Denmark	x	x	x	x	x	x	x	x
Estonia	x	x	x	x	x	x	x	x
Finland	3.9	0.9	2.0	5.4	2.1	2.1	2.0	1.0
France	109.1	107.7	162.0	167.6	140.7	182.2	188.2	197.3
FYROM[1]	x	x	x	x	x	x	x	x
Georgia	x	x	x	x	x	x	x	x
Germany	790.0	790.0	800.0	820.0	905.0	1 180.0	1 100.0	1 040.0
Greece	x	x	x	x	x	x	x	x
Hungary	0.8	1.6	3.9	4.1	0.4	3.1	0.7	..
Iceland	x	x	x	x	x	x	x	x
India	..	..	..	..	..	..	..	..
Ireland	x	x	x	x	x	x	x	x
Italy	50.8	53.0	55.5	29.1	34.0	27.0	42.0	..
Japan	x	x	x	x	x	x	x	x
Korea	x	x	x	x	x	x	x	x
Latvia	x	x	x	x	x	x	x	x
Liechtenstein	x	x	x	x	x	x	x	x
Lithuania	0.0	0.3	1.7	3.5	3.8	0.6	0.9	2.3
Luxembourg	1.3	0.3	0.7	0.2	0.5	0.3	1.0	1.3
Malta	x	x	x	x	x	x	x	x
Mexico	x	x	x	x	x	x	x	x
Moldova, Republic of	..	..	..	..	..	..	..	..
Montenegro, Republic of	x	x	x	x	x	x	x	x
Netherlands	486.2	284.5	311.7	263.4	269.6	361.0	251.6	263.2
New Zealand	x	x	x	x	x	x	x	x
Norway	x	x	x	x	x	x	x	x
Poland	14.1	7.0	6.7	12.7	20.8	25.2	24.8	29.1
Portugal	7.9	19.8	13.0	10.0	7.0	4.8	1.0	0.8
Romania	190.6	139.7	213.0	358.9	490.1	536.1	423.3	519.0
Russian Federation	140.5	72.8	51.4	57.7	102.0	58.8	68.3	301.4
Serbia, Republic of	18.7	14.7	29.5	23.6	36.3	19.3	21.1	25.8
Slovak Republic	1.2	0.9	1.3	0.4	0.9	1.5	2.9	1.0
Slovenia	x	x	x	x	x	x	x	x
Spain	x	x	x	x	x	x	x	x
Sweden	x	x	x	x	x	x	x	x
Switzerland	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Turkey	x	x	x	x	x	x	x	x
Ukraine	..	..	..	..	..	..	..	..
United Kingdom	..	..	..	..	..	..	..	..
United States	..	..	..	..	..	..	..	..

.. Not available; e Estimated value; x Not applicable

Note: Detailed metadata at: http://metalinks.oecd.org/transport/20141023/69a5.

1. FYROM: the Former Yugoslav Republic of Macedonia

Source: ITF Transport statistics

Total investment in inland transport infrastructure

Million euros

	2004	2005	2006	2007	2008	2009	2010	2011
Albania	93.2	70.6	176.6	254.0	501.2	487.3	242.4	211.1
Armenia	..	..	..	..	..	..	..	..
Australia	6 299.9	8 228.7	8 224.5	9 987.4	10 990.2	11 481.1	14 811.9	19 284.4
Austria	2 066.0	2 023.6	2 297.6	2 378.9	2 560.4	2 731.5	2 337.3	2 454.2 e
Azerbaijan	55.1	101.5	271.7	377.7	1 338.6	1 274.1	1 548.5	1 564.5
Belarus	..	..	..	..	..	..	..	..
Belgium	2 561.5	2 634.0	2 681.8	2 468.7	2 842.9	2 842.9	..	..
Bosnia-Herzegovina	..	..	..	..	..	..	..	..
Bulgaria	..	403.1	402.4	583.9	240.3	150.8	411.1	434.1
Canada	4 530.4	6 069.2	7 378.8	8 456.4	9 368.5	11 384.9	16 093.3	15 902.2
China	..	..	..	..	..	..	..	..
Croatia	1 008.2	846.0	997.7	1 160.3	1 229.0	1 011.0	601.3	549.7
Czech Republic	1 453.6	1 910.2	1 974.4	2 118.9	3 279.3	2 783.7	2 342.8	1 764.1
Denmark	1 069.4	1 168.6	1 368.9	1 261.0	1 308.6	1 070.5	1 333.0	..
Estonia	76.0	122.0	151.0	156.3	164.7	156.5	172.1	252.0
Finland	931.6	876.9	886.0	1 018.4	1 302.1	1 284.9	1 180.0	1 288.0
France	15 060.9	15 580.2	16 475.3	17 161.7	17 883.6	17 877.3	17 045.4	17 221.2
FYROM[1]	28.0	24.5	24.3	39.6	46.6	46.2	34.0	38.7
Georgia	51.1	76.6	152.8	334.2	172.6	299.1	310.0	464.9
Germany	17 904.0	14 401.0	15 501.0	15 501.0	16 131.0	16 752.0	16 617.0	16 570.0
Greece	3 293.0	1 870.0	2 084.0	2 199.0	..	..	..	..
Hungary	1 582.2	1 875.9	679.1	1 026.5	1 274.3	1 884.7	1 116.7	..
Iceland	142.8	151.5	210.6	186.5	241.6	121.4	79.5	38.7
India	3 835.8	5 256.8	5 934.4	6 840.3	7 317.4	8 750.2	2 994.2	3 079.9
Ireland	1 374.0	1 337.0	1 667.0	1 669.0	..	..	..	..
Italy	16 431.5	19 396.4	23 305.2	21 394.6	20 194.0	11 355.0	8 204.0	..
Japan	49 507.6	46 160.5	43 320.4	38 442.9	39 228.3	46 808.7	47 082.3	..
Korea	86.5	98.7	99.8	95.1	19.3	..	..	..
Latvia	96.2	201.1	214.0	278.5	325.9	198.4	217.3	277.5
Liechtenstein	26.2	27.3	..	..	..	..	..	..
Lithuania	207.1	233.7	294.5	391.3	526.5	515.8	530.3	461.9
Luxembourg	243.4	254.5	280.4	296.1	288.0	321.2	340.1	371.9
Malta	10.1	8.2	..	..	..	..	..	..
Mexico	2 190.9	3 076.5	2 912.5	2 727.0	3 042.7	3 460.6	4 373.3	4 560.7
Moldova, Republic of	9.6	11.8	12.9	38.2	50.5	21.9	21.0	7.4
Montenegro, Republic of	3.9	3.1	37.2	50.8	10.9	23.2	17.8	14.8
Netherlands	3 871.3	3 020.8	2 668.5	2 788.6	3 284.0	3 501.8	3 647.9	3 686.2
New Zealand	269.4	347.3	395.8	487.3	511.6	579.1	731.7	839.9
Norway	1 360.2	1 656.0	1 731.9	2 028.4	2 271.3	2 753.9	3 101.0	3 252.1 e
Poland	1 471.2	2 117.8	2 964.7	4 102.9	5 433.5	6 015.8	7 225.1	9 273.4
Portugal	2 424.8	2 546.6	2 260.3	1 792.0	1 765.3	1 316.2	1 914.5	..
Romania	1 343.6	1 580.3	2 264.7	3 475.8	4 697.8	3 818.5	3 442.1	3 963.6
Russian Federation	6 970.1	7 884.2	9 091.4	12 792.5	19 507.7	12 873.7	15 343.9	18 575.7
Serbia, Republic of	207.9	193.0	384.8	431.8	417.3	276.5	262.2	371.8
Slovak Republic	331.9	521.0	637.7	807.7	782.1	838.4	618.4	726.0
Slovenia	555.3	492.4	586.1	719.9	823.0	506.3	351.9	234.1
Spain	11 612.9	14 344.1	14 746.9	16 422.0	17 503.0	18 368.0	16 073.0	13 492.0
Sweden	2 385.8	2 421.8	2 468.1	2 676.5	2 923.7	2 892.2	3 086.6	3 271.3
Switzerland	4 847.1	4 957.7	5 062.0	5 003.3	5 461.6	5 884.8	6 424.7	..
Turkey	856.0	1 146.9	2 417.7	2 445.8	2 905.3	3 674.3	6 912.7	6 650.6
Ukraine	..	..	..	..	..	..	..	..
United Kingdom	10 399.3	11 389.3	14 281.9	13 935.4	13 605.4	12 925.1	12 859.6	11 798.6
United States	..	..	..	..	..	..	..	..

.. Not available; e Estimated value

Note: Detailed metadata at: http://metalinks.oecd.org/transport/20141023/69a5.

1. FYROM: the Former Yugoslav Republic of Macedonia

Source: ITF Transport statistics

Investment in sea port infrastructure

Million euros

	2004	2005	2006	2007	2008	2009	2010	2011
Albania	7.9	10.7	6.0	1.0	3.1	2.8	3.9	9.9
Armenia	..	..	..	..	..	..	..	..
Australia	418.9	576.9	700.8	701.9	1 056.9	1 170.6	1 765.2	3 256.3
Austria	x	x	x	x	x	x	x	x
Azerbaijan	..	..	..	..	..	..	..	59.0
Belarus	x	x	x	x	x	x	x	x
Belgium	260.3	184.4	158.6	202.5	219.2	219.2	..	..
Bosnia-Herzegovina	..	..	..	..	..	..	..	..
Bulgaria	1.0	4.7	8.3	46.0	6.9	8.2	5.1	4.6
Canada	119.0	108.2	160.1	175.3	183.6	298.9	319.6	249.4
China	..	..	..	..	..	..	..	..
Croatia	9.3	16.6	13.5	17.4	51.9	76.7	51.4	62.6
Czech Republic	x	x	x	x	x	x	x	x
Denmark	101.7	67.5	104.6	67.1	70.7	66.2	49.4	..
Estonia	66.0	24.0	31.0	56.5	40.8	74.9	38.6	18.5
Finland	118.3	135.7	195.1	221.0	238.0	100.1	69.0	76.0
France	377.5	282.6	261.3	226.0	410.0	394.2	228.9	218.0
FYROM[1]	x	x	x	x	x	x	x	x
Georgia	..	..	..	..	29.7	23.6	24.0	13.4
Germany	430.0	570.0	580.0	640.0	630.0	685.0	965.0	925.0
Greece	86.0	61.0	75.0	60.0	..	..	..	..
Hungary	x	x	x	x	x	x	x	x
Iceland	34.4	22.8	34.3	36.7	23.2	20.0	14.5	16.9
India	17.4	28.5	56.2	65.6	55.1	65.4	73.9	97.8
Ireland	..	..	..	..	..	..	..	..
Italy	2 447.4	2 062.3	848.3	1 179.1	940.0	1 278.0	1 345.0	..
Japan	3 600.6	3 207.6	2 800.5	2 505.5	2 848.7	4 655.6	2 168.9	2 423.2
Korea	15.5	20.8	23.7	23.5	1.9	..	..	..
Latvia	97.7	61.8	90.5	148.6	261.8	..	..	..
Liechtenstein	x	x	x	x	x	x	x	x
Lithuania	16.2	29.8	29.5	25.8	42.3	15.6	20.6	27.2
Luxembourg	x	x	x	x	x	x	x	x
Malta	..	..	..	..	..	..	..	..
Mexico	527.3	565.4	512.7	437.6	578.8	383.1	486.7	542.2
Moldova, Republic of	x	x	x	x	x	x	x	x
Montenegro, Republic of	0.2	1.4	0.6	2.1	2.6	1.7	2.6	2.5
Netherlands	..	..	..	..	..	..	..	..
New Zealand	..	..	..	..	..	..	..	..
Norway	72.3	99.6	73.0	123.4	8.6	81.0	19.0	..
Poland	13.7	9.4	13.9	17.4	29.6	4.2	27.0	63.6
Portugal	84.0	44.0	114.0	157.0	128.0	100.0	112.0	83.0
Romania	..	..	..	..	..	..	..	..
Russian Federation	300.2	278.6	235.9	197.3	413.3	182.6	115.3	326.3
Serbia, Republic of	x	x	x	x	x	x	x	x
Slovak Republic	x	x	x	x	x	x	x	x
Slovenia	4.2	1.6	2.9	6.5	10.0	53.7	12.7	5.9
Spain	1 942.3	2 257.8	2 431.8	2 573.3	2 871.0	2 507.7	2 247.0	1 902.0
Sweden	76.4	37.2	42.7	80.6	60.3	72.4	107.4	..
Switzerland	x	x	x	x	x	x	x	x
Turkey	6.8	10.1	13.7	22.8	30.2	20.2	16.0	34.0
Ukraine	..	..	..	..	..	..	..	..
United Kingdom	297.6	336.4	..	..	..	..	..	..
United States	..	..	..	..	..	..	..	..

.. Not available; x Not applicable

Note: Detailed metadata at: http://metalinks.oecd.org/transport/20141023/69a5.

1. FYROM: the Former Yugoslav Republic of Macedonia

Source: ITF Transport statistics

Investment in airport infrastructure

Million euros

	2004	2005	2006	2007	2008	2009	2010	2011
Albania	6.4	6.6	1.4	1.8	0.1	0.0	0.0	0.0
Armenia	..	..	..	..	..	..	..	..
Australia	..	..	..	..	..	..	..	..
Austria	240.1	361.5	217.1	187.2	305.6	221.1	174.4	..
Azerbaijan	9.4	100.2	96.0	70.6	82.5	28.5	201.0	164.2
Belarus	..	..	..	..	..	..	..	..
Belgium	46.6	67.6	88.0	134.5	115.5	115.5	..	..
Bosnia-Herzegovina	..	..	..	..	..	..	..	..
Bulgaria	3.4	1.9	2.4	2.4	3.6	1.0	1.5	1.5
Canada	777.1	785.9	828.8	741.0	810.4	731.2	607.9	612.9
China	..	..	..	..	..	..	..	..
Croatia	11.9	19.1	24.3	19.9	20.6	27.9	28.1	18.6
Czech Republic	150.5	236.7	71.0	76.9	324.7	92.2	81.5	40.0
Denmark	26.6	35.0	37.1	64.2	20.1	92.3	..	..
Estonia	6.3	4.3	9.9	30.7	55.7	18.9	2.9	6.0
Finland	48.2	48.2	60.0	74.0	108.0	76.2	45.0	44.0
France	837.6	860.2	978.0	1 052.4	819.6	738.8	776.5	998.7
FYROM[1]	0.1	0.2	2.0	0.3	1.5	0.0	0.1	101.6
Georgia	..	..	..	27.4	0.1	0.1	0.2	0.9
Germany	540.0	700.0	720.0	1 620.0	1 140.0	1 510.0	1 480.0	1 815.0
Greece	94.0	68.0	52.0	34.0	..	..	..	..
Hungary	20.4	115.1	9.2	2.5	..	10.7	50.3	..
Iceland	2.8	7.3	5.0	5.0	11.6	5.3	1.9	1.7
India	4.1	63.4	3.9	17.0	21.5	132.6	213.0	212.9
Ireland	80.0	105.0	147.0	271.0	403.0	509.0	243.0	83.0
Italy	307.0	806.2	234.2	123.5	126.0	117.0	634.0	..
Japan	2 027.3	2 154.5	2 547.8	2 277.9	2 265.2	2 537.8	2 361.6	1 326.8
Korea	2.5	3.2	3.3	2.6	0.9	..	..	..
Latvia	4.5	17.2	20.1	17.1	18.5	2.8	2.8	5.7
Liechtenstein	x	x	x	x	x	x	x	x
Lithuania	2.9	4.3	18.2	53.3	11.3	28.7	8.1	14.6
Luxembourg	23.5	26.3	70.6	64.2	46.6	18.8	6.7	12.5
Malta	..	..	..	..	..	..	..	..
Mexico	167.2	602.2	344.9	191.3	325.7	179.1	270.8	226.0
Moldova, Republic of	1.1	1.2	1.7	3.7	11.8	3.6	0.0	1.8
Montenegro, Republic of	3.6	3.0	0.6	3.9	0.4	1.6	28.4	3.8
Netherlands	..	..	..	..	..	..	..	..
New Zealand	..	..	..	..	..	..	..	..
Norway	103.8	21.4	153.9	237.5	205.3	251.4	203.1	..
Poland	48.8	131.0	133.0	84.8	79.4	63.3	131.9	205.6
Portugal	170.0	133.8	102.6	82.0	134.8	151.4	126.9	102.0
Romania	2.2	1.9	15.0	42.0	9.2	6.1	0.9	2.1
Russian Federation	683.8	268.2	397.7	435.5	441.4	268.6	470.7	434.5
Serbia, Republic of	0.8	0.1	0.7	0.0	0.1	1.2	0.7	0.3
Slovak Republic	11.4	32.2	13.5	16.1	29.6	56.4	70.1	33.0
Slovenia	3.2	1.3	11.0	23.8	5.1	13.3	7.3	2.9
Spain	2 020.2	1 512.4	1 828.8	2 163.8	2 132.2	1 773.0	1 744.0	1 235.0
Sweden	80.6	84.6	87.7	117.6	107.9	86.9	78.8	126.4
Switzerland	158.7	104.0	..	..	..	168.9	210.8	327.0
Turkey	92.8	217.7	631.7	175.0	138.3	569.0	520.1	426.1
Ukraine	..	..	..	..	..	..	..	..
United Kingdom	2 202.7	2 601.6	..	..	..	..	..	..
United States	..	..	..	..	..	..	..	..

.. Not available; x Not applicable

Note: Detailed metadata at: http://metalinks.oecd.org/transport/20141023/69a5.

1. FYROM: the Former Yugoslav Republic of Macedonia

Source: ITF Transport statistics

Rail infrastructure maintenance expenditure

Million euros

	2004	2005	2006	2007	2008	2009	2010	2011
Albania	..	..	..	..	..	..	..	..
Armenia	..	..	..	..	..	..	..	..
Australia	..	..	..	..	..	..	..	..
Austria	341.0	302.0	362.0	325.0	355.5	347.6	344.2	450.6
Azerbaijan	12.0	5.9	8.5	12.1	20.7	29.6	22.2	18.9
Belarus	..	..	..	..	..	..	..	..
Belgium	..	..	..	..	..	..	..	..
Bosnia-Herzegovina	..	..	..	..	..	..	..	..
Bulgaria	5.6	30.7	29.1	30.2	57.8	38.3	35.8	32.7
Canada	..	..	..	..	..	..	..	..
China	..	..	..	..	..	..	..	..
Croatia	113.4	106.6	107.7	112.2	105.8	76.4	89.9	86.8
Czech Republic	212.9	235.9	255.9	252.6	353.1	372.0	359.4	364.9
Denmark	..	..	..	..	..	..	..	..
Estonia	..	..	..	..	..	..	..	..
Finland	155.4	156.2	156.0	167.0	180.0	195.8	195.0	197.0
France	3 591.7	3 567.9	3 225.0	3 376.5	3 672.0	3 730.0	3 770.0	3 804.0
FYROM[1]	10.7	9.5	10.4	0.4	5.0	2.6	2.2	1.9
Georgia	90.7	100.9	94.4	133.3	132.9	131.9	138.0	22.9
Germany	..	..	..	..	..	..	..	..
Greece	..	..	..	..	..	..	..	..
Hungary	211.2	234.0	1 237.4	1 287.8	457.2	398.2	..	..
Iceland	x	x	x	x	x	x	x	x
India	7 774.4	8 814.3	8 850.7	9 706.5	11 395.8	12 444.4	14 916.4	..
Ireland	121.0	127.0	135.0	144.0	..	..	..	..
Italy	7 807.3	8 919.0	9 492.0	8 282.0	8 036.0	7 832.0	7 829.0	..
Japan	..	..	..	..	..	..	..	..
Korea	1.0	8.0	9.1	14.7	..	..	..	..
Latvia	55.6	60.3	70.4	88.6	125.2	136.0	104.4	110.4
Liechtenstein	x	x	x	x	x	x	x	x
Lithuania	95.6	105.4	105.4	114.7	165.7	132.4	142.8	151.2
Luxembourg	114.9	112.2	127.4	108.3	115.0	125.5	120.0	124.4
Malta	x	x	x	x	x	x	x	x
Mexico	..	..	..	..	..	..	..	..
Moldova, Republic of	..	..	..	..	..	..	..	..
Montenegro, Republic of	..	..	..	..	..	..	..	..
Netherlands	1 037.0	1 117.7	1 547.4	1 367.4	1 174.5	1 410.3	1 690.0	1 797.9
New Zealand	..	..	..	..	..	..	..	..
Norway	353.0	359.9	403.9	421.7	447.2	534.1	676.2	728.6
Poland	76.9	82.3	66.7	100.4	35.6	157.1	212.8	238.6
Portugal	91.0	100.0	115.0	122.0	122.0	127.0	135.0	..
Romania	20.2	57.7	38.3	96.2	..	..	..	..
Russian Federation	..	..	..	..	..	..	..	..
Serbia, Republic of	22.1	22.4	18.1	20.2	20.9	15.8	13.5	17.4
Slovak Republic	9.1	9.6	9.7	15.1	14.0	15.0	12.4	6.0
Slovenia	3.0	7.5	8.3	8.1	9.4	0.7	1.0	7.5
Spain	..	..	..	..	..	..	..	..
Sweden	467.3	490.3	509.4	540.0	598.3	589.9	723.9	701.3
Switzerland	862.2	683.3	701.9	847.4	475.0	534.4	587.6	670.9
Turkey	136.9	164.1	180.3	191.5	206.5	177.5	222.9	194.6
Ukraine	..	..	..	..	..	..	..	..
United Kingdom	..	..	..	..	..	..	..	..
United States	..	..	..	..	..	..	..	..

.. Not available; x Not applicable

Note: Detailed metadata at: http://metalinks.oecd.org/transport/20141023/69a5.

1. FYROM: the Former Yugoslav Republic of Macedonia

Source: ITF Transport statistics

Road infrastructure maintenance expenditure

Million euros

	2004	2005	2006	2007	2008	2009	2010	2011
Albania	6.8	7.1	5.7	6.0	8.1	8.7	6.9	7.7
Armenia	..	..	..	..	..	..	..	..
Australia	2 623.9	2 893.1	2 239.2	2 720.2	3 237.4	3 192.0	4 471.5	..
Austria	457.8	443.3	495.0	485.9	467.4	516.2	558.8	494.3
Azerbaijan	34.7	32.8	54.6	31.3	34.7	24.7	23.4	26.5
Belarus	..	..	..	..	..	..	..	..
Belgium	490.5	469.7	492.3	458.0	499.1	522.9	..	..
Bosnia-Herzegovina	..	..	..	..	..	..	..	..
Bulgaria	..	..	107.9	215.3	203.0	69.0	99.7	70.6
Canada	5 402.5	5 245.7	5 413.0	6 879.5	6 947.6	6 551.4	8 702.7	5 816.4
China	..	..	..	..	..	..	..	..
Croatia	243.8	242.3	154.5	158.1	168.3	143.9	194.9	212.1
Czech Republic	296.4	350.5	544.1	589.4	611.0	578.1	670.5	570.3
Denmark	736.7	767.3	705.3	728.5	715.7	866.3	1 058.0	..
Estonia	22.5	25.1	27.9	32.3	37.7	39.1	37.8	38.6
Finland	587.2	599.7	612.0	611.0	673.0	684.0	667.0	658.0
France	239.4	2 189.2 |	2 235.4	2 294.0	2 285.9	2 601.0	2 431.0	2 746.0
FYROM[1]	6.7	6.3	3.7	13.6	13.5	12.2	15.6	14.7
Georgia	6.3	6.2	9.8	11.1	11.6	11.1	9.3	13.4
Germany	..	..	..	..	..	..	..	..
Greece	..	..	..	..	..	..	..	..
Hungary	254.5	283.5	1 255.7	1 367.0	443.5	453.7	..	..
Iceland	26.5	33.6	32.3	35.5	52.1	30.1	28.9	29.0
India	2 379.3	3 773.6	5 155.8	5 381.7	5 296.1	6 254.6	9 311.9	8 830.5
Ireland	51.0	53.0	54.0	50.0	55.0	45.0	42.0	35.0
Italy	11 241.2	12 549.0	13 452.0	9 764.0	10 756.0	6 008.0	6 437.0	..
Japan	14 630.2	14 029.9	11 773.0	11 372.9	10 875.4	13 528.9	13 965.9	..
Korea	11.5	13.5	17.9	15.3	..	..	..	..
Latvia	70.7	80.4	129.3	211.4	224.8	133.2	119.9	126.0
Liechtenstein	4.1	4.1	..	..	..	..	..	..
Lithuania	121.9	125.1	161.0	124.8	133.5	124.8	160.2	152.9
Luxembourg	32.0	34.9	24.2	23.1	26.8	29.6	33.8	36.2
Malta	2.3	3.0	..	..	..	..	..	..
Mexico	376.7	478.3	471.5	464.6	690.3	671.8	802.1	820.6
Moldova, Republic of	10.1	8.4	11.0	11.3	18.1	17.3	37.0	675.9
Montenegro, Republic of	..	..	..	..	..	..	..	..
Netherlands	610.8	725.2	1 039.9	1 090.9	1 230.5	827.2	1 209.4	323.0
New Zealand	481.8	570.1	542.9	616.2	579.3	607.2	719.8	787.0
Norway	906.2	992.8	1 053.6	1 109.0	1 149.2	1 222.6	1 499.0	1 669.8
Poland	1 055.3	1 263.5	1 670.0	1 515.2	2 005.6	2 341.0	2 636.5	2 678.3
Portugal	233.0	176.9	202.7	192.2	140.9	124.0	102.0	..
Romania	379.4	425.6	1 040.6	1 336.6	..	..	..	..
Russian Federation	..	..	..	..	..	..	..	..
Serbia, Republic of	183.8	259.4	259.7	300.4	331.0	258.9	229.0	205.4
Slovak Republic	82.1	100.3	130.5	155.6	161.4	192.4	174.7	160.0
Slovenia	76.5	99.2	139.8	138.6	147.8	151.0	137.2	121.8
Spain	..	..	..	..	..	..	..	..
Sweden	758.4	787.5	809.3	836.3	858.6	786.8	982.8	925.2
Switzerland	1 476.2	1 520.4	1 534.1	1 409.9	1 610.8	1 817.2	2 035.8	..
Turkey	71.1	88.7	156.9	278.0	308.8	410.5	360.1	673.7
Ukraine	..	..	..	..	..	..	..	..
United Kingdom	5 450.1	5 662.5	5 857.4	5 639.3	5 057.1	4 409.0	3 989.3	3 719.3
United States	21 037.1	23 568.8	25 004.0	22 513.0	22 642.1	23 087.9	..	..

.. Not available; | Break in series

Note: Detailed metadata at: http://metalinks.oecd.org/transport/20141023/69a5.

1. FYROM: the Former Yugoslav Republic of Macedonia

Source: ITF Transport statistics

Inland waterway infrastructure maintenance expenditure

Million euros

	2004	2005	2006	2007	2008	2009	2010	2011
Albania	..	..	..	..	..	..	..	..
Armenia	..	..	..	..	..	..	..	..
Australia	x	x	x	x	x	x	x	x
Austria	..	..	..	..	..	..	..	..
Azerbaijan	..	..	..	..	..	..	..	..
Belarus	..	..	..	..	..	..	..	..
Belgium	61.0	66.0	67.1	76.0	87.0	131.0	..	..
Bosnia-Herzegovina	..	..	..	..	..	..	..	..
Bulgaria	292.8	507.2	619.2	787.9	1.5	1.0	1.0	1.5
Canada	..	..	..	..	..	..	..	..
China	..	..	..	..	..	..	..	..
Croatia	4.4	3.8	1.2	1.9	2.6	1.2	0.7	0.8
Czech Republic	10.5	2.2	1.0	2.9	1.9	1.8	1.5	1.8
Denmark	x	x	x	x	x	x	x	x
Estonia	x	x	x	x	x	x	x	x
Finland	14.3	15.3	14.9	15.8	17.0	26.1	17.0	14.0
France	43.3	55.0	60.9	58.2	60.0	61.3	60.5	61.5
FYROM[1]	x	x	x	x	x	x	x	x
Georgia	x	x	x	x	x	x	x	x
Germany	..	..	..	..	..	..	..	..
Greece	x	x	x	x	x	x	x	x
Hungary	1.0	1.3	24.5	33.1	1.6	0.9	..	..
Iceland	x	x	x	x	x	x	x	x
India	..	..	..	..	..	..	..	..
Ireland	x	x	x	x	x	x	x	x
Italy	120.9	481.0	498.0	98.0	83.0	82.0	81.0	..
Japan	x	x	x	x	x	x	x	x
Korea	x	x	x	x	x	x	x	x
Latvia	x	x	x	x	x	x	x	x
Liechtenstein	x	x	x	x	x	x	x	x
Lithuania	1.4	1.7	2.0	2.3	2.6	1.4	1.2	1.2
Luxembourg	0.9	0.5	0.7	0.5	0.4	0.2	0.3	0.2
Malta	x	x	x	x	x	x	x	x
Mexico	x	x	x	x	x	x	x	x
Moldova, Republic of	0.0	0.0	0.0	0.0	3.8	0.6	0.0	..
Montenegro, Republic of	x	x	x	x	x	x	x	x
Netherlands	288.8	603.5	377.1	492.4	583.3	693.4	543.9	343.2
New Zealand	x	x	x	x	x	x	x	x
Norway	x	x	x	x	x	x	x	x
Poland	8.6	14.4	7.7	2.1	2.3	3.0	7.8	16.5
Portugal	..	..	..	..	..	..	..	..
Romania	7.7	6.1	17.4	28.5	..	..	..	..
Russian Federation	..	..	..	..	..	..	..	..
Serbia, Republic of	6.1	6.0	7.2	11.3	13.5	10.5	13.2	23.0
Slovak Republic	1.5	2.1	0.8	1.1	3.7	2.3	2.1	2.0
Slovenia	x	x	x	x	x	x	x	x
Spain	x	x	x	x	x	x	x	x
Sweden	x	x	x	x	x	x	x	x
Switzerland	..	..	..	..	..	..	..	..
Turkey	x	x	x	x	x	x	x	x
Ukraine	..	..	..	..	..	..	..	..
United Kingdom	..	..	..	..	..	..	..	..
United States	..	..	..	..	..	..	..	..

.. Not available; x Not applicable

Note: Detailed metadata at: http://metalinks.oecd.org/transport/20141023/69a5.

1. FYROM: the Former Yugoslav Republic of Macedonia

Source: ITF Transport statistics

Sea port infrastructure maintenance expenditure

Million euros

	2004	2005	2006	2007	2008	2009	2010	2011
Albania	..	..	..	..	..	..	..	..
Armenia	..	..	..	..	..	..	..	..
Australia	..	..	..	..	..	..	..	..
Austria	x	x	x	x	x	x	x	x
Azerbaijan	..	..	..	..	..	..	..	..
Belarus	x	x	x	x	x	x	x	x
Belgium	130.0	130.0	130.0	130.0	130.0	135.0	..	..
Bosnia-Herzegovina	..	..	..	..	..	..	..	..
Bulgaria	1.0	4.7	0.0	27.3	0.0	4.6	1.0	0.5
Canada	72.9	92.5	110.0	114.4	128.4	138.3	150.6	26.1
China	..	..	..	..	..	..	..	..
Croatia	5.5	3.8	4.8	7.8	5.4	3.7	2.7	3.4
Czech Republic	x	x	x	x	x	x	x	x
Denmark	..	..	..	..	..	..	..	..
Estonia	..	..	..	..	..	..	..	..
Finland	87.9	92.9	88.1	89.3	82.0	107.2	106.0	134.0
France	50.4	49.9	50.1	44.0	48.0	47.8	52.5	53.0
FYROM[1]	x	x	x	x	x	x	x	x
Georgia	..	..	..	..	0.1	0.0	0.6	1.8
Germany	..	..	..	..	..	..	..	..
Greece	..	..	..	..	..	..	..	..
Hungary	x	x	x	x	x	x	x	x
Iceland	..	..	..	..	..	..	..	..
India	105.1	115.7	135.2	170.7	157.6	131.6	193.8	167.8
Ireland	..	..	..	..	..	..	..	..
Italy	1 243.9	3 074.0	2 469.0	1 394.0	1 163.0	1 287.0	1 098.0	..
Japan	..	..	..	..	..	..	..	..
Korea	2.2	2.7	2.9	2.7	..	..	..	..
Latvia	7.5	28.7	34.5	54.3	58.3	..	..	..
Liechtenstein	x	x	x	x	x	x	x	x
Lithuania	3.2	5.2	2.9	3.8	6.1	2.0	7.0	2.3
Luxembourg	x	x	x	x	x	x	x	x
Malta	..	..	..	..	..	..	..	..
Mexico	..	..	..	..	..	..	..	..
Moldova, Republic of	x	x	x	x	x	x	x	x
Montenegro, Republic of	..	..	..	..	..	..	..	..
Netherlands	..	..	..	..	..	..	..	..
New Zealand	..	..	..	..	..	..	..	..
Norway	..	..	..	..	..	..	..	..
Poland	5.1	8.9	2.8	5.6	6.3	9.7	9.5	15.3
Portugal	2.0	2.0	1.2	0.7	0.6	1.3	1.3	4.3
Romania	..	..	..	..	..	..	..	..
Russian Federation	..	..	..	..	..	..	..	..
Serbia, Republic of	x	x	x	x	x	x	x	x
Slovak Republic	x	x	x	x	x	x	x	x
Slovenia	1.4	1.3	2.3	1.4	1.2	2.1	1.9	2.6
Spain	..	..	..	..	..	..	..	..
Sweden	12.4	12.6	21.4	27.8	0.9	22.8	27.5	..
Switzerland	x	x	x	x	x	x	x	x
Turkey	..	..	..	..	..	..	..	..
Ukraine	..	..	..	..	..	..	..	..
United Kingdom	..	..	..	..	..	..	..	..
United States	..	..	..	..	..	..	..	..

.. Not available; x Not applicable

Note: Detailed metadata at: http://metalinks.oecd.org/transport/20141023/69a5.

1. FYROM: the Former Yugoslav Republic of Macedonia

Source: ITF Transport statistics

Airport infrastructure maintenance expenditure

Million euros

	2004	2005	2006	2007	2008	2009	2010	2011
Albania	..	..	..	..	..	..	..	..
Armenia	..	..	..	..	..	..	..	..
Australia	..	..	..	..	..	..	..	..
Austria	..	..	..	..	..	..	..	..
Azerbaijan	7.1	43.8	10.7	10.2	7.4	10.6	3.7	6.9
Belarus	..	..	..	..	..	..	..	..
Belgium	..	..	..	..	..	..	..	..
Bosnia-Herzegovina	..	..	..	..	..	..	..	..
Bulgaria	3.4	1.9	2.4	2.4	0.0	1.0	1.5	1.5
Canada	490.8	548.3	603.2	629.9	630.3	600.0	707.1	699.1
China	..	..	..	..	..	..	..	..
Croatia	0.7	0.7	1.6	1.9	1.8	3.4	2.3	3.5
Czech Republic	13.7	14.5	8.2	13.0	12.3	12.5	13.8	7.0
Denmark	..	..	..	..	..	..	..	..
Estonia	..	..	..	..	..	..	..	..
Finland	181.3	180.7	203.0	218.0	232.0	230.1	240.0	267.0
France	..	..	..	..	..	..	..	..
FYROM[1]	..	..	..	..	..	..	..	..
Georgia	0.0	0.0	0.2	0.1	1.5	0.3	0.3	0.4
Germany	..	..	..	..	..	..	..	..
Greece	..	..	..	..	..	..	..	..
Hungary	..	..	646.0	658.9	..	..	..	..
Iceland	..	..	..	..	..	..	..	..
India	64.3	76.9	85.0	210.7	116.6	167.5	230.5	166.9
Ireland	30.0	33.0	35.0	37.0	37.0	33.0	34.0	29.0
Italy	189.5	178.0	197.0	113.0	98.0	100.0	102.0	..
Japan	..	..	..	..	..	..	..	..
Korea	0.1	0.2	0.3	0.3	..	..	..	..
Latvia	..	..	..	..	..	..	..	..
Liechtenstein	x	x	x	x	x	x	x	x
Lithuania	2.6	2.9	3.5	3.8	12.5	1.7	1.2	1.3
Luxembourg	3.4	3.5	4.2	5.6	3.5	4.8	7.5	7.0
Malta	..	..	..	..	..	..	..	..
Mexico	..	..	..	..	..	..	..	..
Moldova, Republic of	..	..	..	..	..	..	..	..
Montenegro, Republic of	..	..	..	..	..	..	..	..
Netherlands	..	..	..	..	..	..	..	..
New Zealand	..	..	..	..	..	..	..	..
Norway	..	..	..	..	..	..	..	..
Poland	1.3	2.0	4.1	5.6	19.9	4.4	5.0	20.6
Portugal	4.3	4.4	4.7	5.0	17.9	13.7	9.0	15.8
Romania	1.2	0.0	1.0	1.8	..	..	..	..
Russian Federation	..	..	..	..	..	..	..	..
Serbia, Republic of	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0
Slovak Republic	1.8	2.0	1.4	1.6	2.5	2.7	4.6	2.0
Slovenia	..	..	..	..	..	..	..	..
Spain	..	..	..	..	..	..	..	..
Sweden	36.9	34.3	35.9	32.3	33.6	30.9	26.4	17.3
Switzerland	..	..	..	..	..	..	..	..
Turkey	10.7	2.7	1.9	1.9	3.0	4.5	6.7	2.4
Ukraine	..	..	..	..	..	..	..	..
United Kingdom	..	..	..	..	..	..	..	..
United States	..	..	..	..	..	..	..	..

.. Not available; x Not applicable

Note: Detailed metadata at: http://metalinks.oecd.org/transport/20141023/69a5.

1. FYROM: the Former Yugoslav Republic of Macedonia

Source: ITF Transport statistics

Total spending on road infrastructure investment and maintenance

Million euros

	2004	2005	2006	2007	2008	2009	2010	2011
Albania	97.9	75.2	180.9	259.3	507.6	495.7	248.8	217.9
Armenia	..	..	..	..	..	..	..	..
Australia	7 818.0	9 629.3	9 212.1	10 745.6	12 500.5	12 388.0	15 671.8	..
Austria	1 177.5	1 130.3	1 297.0	1 355.8	1 341.9	1 181.2	948.8	797.3
Azerbaijan	82.8	115.2	314.5	405.3	1 362.2	1 296.4	1 568.6	1 588.2
Belarus	..	..	..	..	..	..	..	..
Belgium	1 922.2	2 031.5	2 000.7	1 739.1	1 931.0	1 954.8	..	..
Bosnia-Herzegovina	..	..	..	..	..	..	..	..
Bulgaria	..	..	274.1	349.2	371.7	170.3	380.9	414.7
Canada	9 576.5	10 742.5	12 193.3	14 689.8	15 699.0	17 442.9	24 097.1	20 877.1
China	..	..	..	..	..	..	..	..
Croatia	1 120.5	992.6	1 029.5	1 224.1	1 269.7	1 053.1	710.2	677.8
Czech Republic	1 327.0	1 765.9	2 035.1	2 082.1	2 652.1	2 562.7	2 391.7	1 864.8
Denmark	1 464.5	1 695.0	1 896.1	1 757.4	1 651.3	1 580.1	1 994.5	..
Estonia	78.5	127.1	157.9	158.3	179.7	158.1	174.8	196.6
Finland	1 186.6	1 194.5	1 262.0	1 413.0	1 646.0	1 605.8	1 557.0	1 590.0
France	11 510.7	13 543.8	14 334.6	14 783.1	14 909.4	15 249.1	14 373.4	14 621.7
FYROM[1]	34.6	29.5	26.9	52.6	58.4	54.8	47.4	52.9
Georgia	46.3	68.7	100.8	133.3	136.0	229.9	241.8	229.0
Germany	..	..	..	..	..	..	..	..
Greece	..	..	..	..	..	..	..	..
Hungary	1 681.4	1 987.1	1 839.5	2 012.9	1 419.8	2 017.9	..	..
Iceland	169.3	185.1	242.9	222.0	293.7	151.6	108.4	67.7
India	4 711.2	7 605.2	9 761.9	10 784.8	11 112.8	12 490.1	..	..
Ireland	1 241.0	1 206.0	1 549.0	1 475.0	1 374.0	1 218.0	883.0	498.0
Italy	18 812.9	21 717.6	27 731.9	23 427.5	23 807.0	11 649.0	9 826.0	..
Japan	57 920.6	54 133.2	48 357.9	42 933.3	42 736.6	50 735.8	49 739.9	..
Korea	68.2	73.7	79.3	73.1	..	..	..	..
Latvia	133.8	241.3	310.3	452.8	489.5	267.8	259.6	349.7
Liechtenstein	30.3	31.4	..	..	..	..	..	..
Lithuania	258.6	290.5	403.4	436.7	570.8	572.9	582.4	496.4
Luxembourg	167.3	162.6	200.1	180.5	164.5	178.1	216.4	256.4
Malta	12.4	11.3	..	..	..	..	..	..
Mexico	2 375.6	3 332.0	3 013.5	2 628.8	3 235.1	3 694.5	4 740.5	4 732.2
Moldova, Republic of	14.1	10.8	17.5	39.0	44.1	30.7	50.8	..
Montenegro, Republic of	..	..	..	..	..	..	..	..
Netherlands	2 944.7	2 361.0	2 693.9	2 770.9	3 424.8	3 189.8	3 509.1	2 610.4
New Zealand	751.2	917.4	938.6	1 103.5	1 090.8	1 186.3	1 451.5	1 626.9
Norway	2 044.5	2 455.4	2 527.4	2 827.4	3 134.0	3 618.3	4 120.7	4 394.3
Poland	2 292.1	3 138.2	4 274.8	4 958.6	6 514.1	7 681.4	9 146.6	10 997.7
Portugal	2 165.9	2 288.7	2 142.9	1 645.2	1 507.2	1 075.4	1 612.5	..
Romania	1 474.7	1 757.0	2 990.5	4 142.7	..	..	..	..
Russian Federation	..	..	..	..	..	..	..	..
Serbia, Republic of	368.5	433.3	611.1	706.4	709.6	510.4	457.8	544.4
Slovak Republic	322.1	460.5	541.4	675.6	728.0	854.0	516.8	592.0
Slovenia	572.9	549.3	713.1	805.1	842.2	557.2	358.1	250.2
Spain	..	..	..	..	..	..	..	..
Sweden	2 201.6	2 085.2	2 216.5	2 259.3	2 463.0	2 360.5	2 635.8	2 796.2
Switzerland	4 205.9	4 286.6	4 245.0	4 084.1	4 450.7	4 813.9	5 424.2	..
Turkey	705.0	1 009.3	2 123.8	2 225.3	2 542.2	3 328.6	5 779.6	5 854.2
Ukraine	..	..	..	..	..	..	..	..
United Kingdom	10 399.3	11 294.2	12 198.9	11 841.3	11 100.1	10 992.3	10 461.6	8 866.2
United States	69 996.1	76 458.5	83 541.7	76 872.7	76 218.4	79 798.5	..	..

.. Not available

Note: Detailed metadata at: http://metalinks.oecd.org/transport/20141023/69a5.

1. FYROM: the Former Yugoslav Republic of Macedonia

Source: ITF Transport statistics

Total inland transport infrastructure investment as a percentage of GDP

Percentage

	2004	2005	2006	2007	2008	2009	2010	2011
Albania	1.6	1.1	2.5	3.2	5.7	5.6	2.7	2.3
Armenia	..	..	..	..	..	..	..	..
Australia	1.2	1.3	1.3	1.4	1.5	1.6	1.5	1.8
Austria	0.9	0.8	0.9	0.9	0.9	1.0	0.8	0.8 e
Azerbaijan	0.8	1.0	1.6	1.6	4.0	4.0	3.9	3.4
Belarus	..	..	..	..	..	..	..	..
Belgium	0.9	0.9	0.8	0.7	0.8	0.8	..	..
Bosnia-Herzegovina	..	..	..	..	..	..	..	..
Bulgaria	..	1.7	1.5	1.9	0.7	0.4	1.1	1.1
Canada	0.6	0.7	0.7	0.8	0.9	1.2	1.4	1.3
China	..	..	..	..	..	..	..	..
Croatia	3.1	2.3	2.5	2.7	2.6	2.3	1.3	1.2
Czech Republic	1.6	1.8	1.7	1.6	2.1	2.0	1.6	1.1
Denmark	0.5	0.6	0.6	0.6	0.6	0.5	0.6	..
Estonia	0.8	1.1	1.1	1.0	1.0	1.1	1.2	1.6
Finland	0.6	0.6	0.5	0.6	0.7	0.7	0.7	0.7
France	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
FYROM[1]	0.6	0.5	0.5	0.7	0.7	0.7	0.5	0.5
Georgia	1.2	1.5	2.5	4.5	2.0	3.9	3.5	4.5
Germany	0.8	0.6	0.7	0.6	0.7	0.7	0.7	0.6
Greece	1.8	1.0	1.0	1.0	..	..	..	..
Hungary	1.9	2.1	0.8	1.0	1.2	2.1	1.2	..
Iceland	1.3	1.2	1.6	1.3	2.1	1.4	0.8	0.4
India	0.7	0.8	0.8	0.8	0.8	0.9	0.2	0.2
Ireland	0.9	0.8	0.9	0.9	..	..	..	..
Italy	1.2	1.4	1.6	1.4	1.3	0.7	0.5	..
Japan	1.3	1.3	1.2	1.2	1.2	1.3	1.1	..
Korea	0.0	0.0	0.0	0.0	0.0	..	..	..
Latvia	0.9	1.6	1.3	1.3	1.4	1.1	1.2	1.4
Liechtenstein	0.9	0.9	..	..	..	..	..	..
Lithuania	1.1	1.1	1.2	1.4	1.6	1.9	1.9	1.5
Luxembourg	0.9	0.8	0.8	0.8	0.7	0.9	0.8	0.9
Malta	0.1	0.1	..	..	..	..	..	..
Mexico	0.4	0.5	0.4	0.4	0.4	0.5	0.6	0.5
Moldova, Republic of	0.5	0.5	0.5	1.2	1.2	0.6	0.5	0.1
Montenegro, Republic of	0.2	0.2	1.7	1.9	0.4	0.8	0.6	0.5
Netherlands	0.8	0.6	0.5	0.5	0.6	0.6	0.6	0.6
New Zealand	0.3	0.4	0.5	0.5	0.6	0.7	0.7	0.7
Norway	0.6	0.7	0.6	0.7	0.7	1.0	1.0	0.9 e
Poland	0.7	0.9	1.1	1.3	1.5	1.9	2.0	2.5
Portugal	1.6	1.7	1.4	1.1	1.0	0.8	1.1	..
Romania	2.2	2.0	2.3	2.8	3.4	3.2	2.8	2.9
Russian Federation	1.5	1.3	1.2	1.3	1.7	1.5	1.4	1.4
Serbia, Republic of	1.1	1.0	1.7	1.5	1.3	1.0	0.9	1.2
Slovak Republic	0.7	1.1	1.2	1.3	1.2	1.3	0.9	1.1
Slovenia	2.0	1.7	1.9	2.1	2.2	1.4	1.0	0.6
Spain	1.4	1.6	1.5	1.6	1.6	1.8	1.5	1.3
Sweden	0.8	0.8	0.8	0.8	0.9	1.0	0.9	0.8
Switzerland	1.6	1.6	1.6	1.5	1.5	1.6	1.5	..
Turkey	0.3	0.3	0.6	0.5	0.6	0.8	1.3	1.2
Ukraine	..	..	..	..	..	..	..	..
United Kingdom	0.6	0.6	0.7	0.7	0.8	0.8	0.8	0.7
United States	..	..	..	..	..	..	..	..

.. Not available; e Estimated value

Note: Detailed metadata at: http://metalinks.oecd.org/transport/20141023/69a5.

1. FYROM: the Former Yugoslav Republic of Macedonia

Source: ITF Transport statistics

INTERNATIONAL TRANSPORT FORUM

The International Transport Forum at the OECD is an intergovernmental organisation with 54 member countries. It acts as a strategic think tank with the objective of helping shape the transport policy agenda on a global level and ensuring that it contributes to economic growth, environmental protection, social inclusion and the preservation of human life and well-being. The International Transport Forum organises an Annual Summit of ministers along with leading representatives from industry, civil society and academia.

The International Transport Forum was created under a Declaration issued by the Council of Ministers of the ECMT (European Conference of Ministers of Transport) at its Ministerial Session in May 2006 under the legal authority of the Protocol of the ECMT, signed in Brussels on 17 October 1953, and legal instruments of the OECD.

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The International Transport Forum's Research Centre gathers statistics and conducts co-operative research programmes addressing all modes of transport. Its findings are widely disseminated and support policy making in Member countries as well as contributing to the annual summit.

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