Chapter 1. How transport demand will change by 2050

This chapter examines past trends in transport demand and offers projections of future transport activity to 2050. It first reviews the key drivers for recent trends in transport demand and for expected developments. Demand projections for passenger transport are broken down for urban, domestic and international transport by mode. Freight projections are presented for maritime, surface, and air freight transport.

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

Note 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 recognises the Turkish Republic of Northern Cyprus (TRNC). Until a lasting and equitable solution is found within the context of the United Nations, Turkey shall preserve its position concerning the "Cyprus issue".

Note by all the European Union Member States of the OECD and the European Union:
The Republic of Cyprus is recognised 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.

Increasing uncertainty about the drivers of transport demand

Uncertainty is a defining feature of the current economic climate and impacts the ability to make robust projections. Among the unpredictable factors are the potential for increasingly bilateral international trade relationships, supply-driven disruptions in oil prices, and tighter financial conditions in emerging economies (OECD, 2018[1]). The combined downside impact of these factors could reduce the level of global output by over 0.5% in 2020 relative to baseline projections of the Organisation for Economic Cooperation and Development (OECD, 2018[1]). This would certainly attenuate growth in demand for transport, especially freight.

Transport demand is nevertheless expected to grow significantly in the coming years. This will be the case especially in developing countries. Population, gross domestic product (GDP) and international trade activity have been strongly correlated historically with global transport demand and will continue to determine demand.

Population growth drives transport demand because more passengers require more mobility. A larger population also implies increased production and consumption of goods, thus raising the demand for freight transport. Shifting population densities also affect transport demand by changing its distribution. Populations around the globe are becoming increasingly urbanised, even as overall demographic growth decelerates in most regions.

The average distance travelled by both people and freight rises as disposable income grows, and this increases the demand for passenger and freight transport respectively. The reciprocal relationship between economic activity and transport activity has resulted in a strong statistical correlation between GDP and transport demand (Banister and Stead, 2002[2]). For instance, growing per capita GDP tends to increase private vehicle ownership, an effect that is strongest for middle income ranges and weaker at the lowest and highest income levels (Dargay, Gately and Sommer, 2007[3]). Increasing sub-urbanisation in the wake of expanding urban populations also boosts private vehicle ownership. Although transport demand remains relatively closely linked with GDP, some work suggests that a decoupling of passenger transport from GDP has begun in developed countries (IPCC, 2014[4]); (IEA, 2018[5]); (Girod, van Vuuren and Hertwich, 2013[6]).

Freight transport enables the movement of intermediate and finished goods and thus strongly correlates with levels of international trade. To the extent that manufacturing and trade activity are sensitive to freight costs, oil prices also play an important role for determining freight demand. International trade has continued to grow modestly compared to growth rates prior to the 2008 economic downturn. This trend can be partly explained by cyclical factors in the wake of the downturn, but structural factors also play a role. Trade in services, for instance, increased from 23% to 30% between 2005 and 2017 (UNCTAD, 2018[7]), the elasticity of trade to GDP has declined (WTO, 2018[8]) and the expansion of global value chains has begun to slow (WTO, 2017[9]).

Trade liberalisation has also been slower since 2007 (OECD, 2016[10]). Growth in international trade nevertheless picked up in 2017 mainly due to increased consumption and investment spending and because the elasticity of trade to GDP rebounded towards pre-crisis levels. The current outlook for international trade is broadly positive, but a range of downside risks could undermine this development (WTO, 2018[11]). Notably, recent political developments have led to increased protectionism in 2018. An ever-higher proportion of value-added activity coming from financial capital flows and the increased

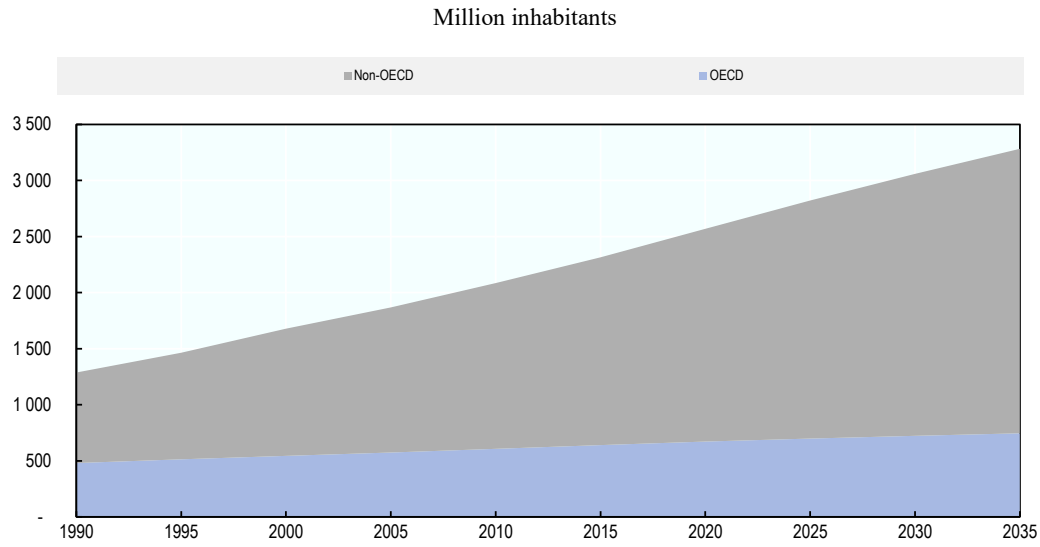
concentration of trade activity carried out by large corporations heightens exposure of the world economy to future economic downturns (UNCTAD, 2018[7]).

A changing world demographic

Freight and passenger mobility demand will grow as the global population continues to expand, particularly in cities. Today's world population of 7.7 billion people (as of January 2019) is predicted to grow to 8.5 billion by 2030 and 9.7 billion by 2050 (Bank, 2017[12]). In 2018, 54% of the global population resided in urban areas. By 2050, this figure is expected to rise to 68%, and as many as ten new mega-cities of more than 10 million people are expected to appear in the next twenty years (UN DESA, 2018[13]).

Urbanisation rates will be particularly high in emerging and developing economies. Much of the anticipated increase in the global population by 2050 is projected to occur in Africa and in countries with large populations such as India, Pakistan, and Indonesia (Bank, 2017[12]). By 2100, Africa will be home to as much as 40% of the world population.

Figure 1.1. Population of cities with over 300 000 inhabitants



Source: UN DESA (2018[13])

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Slowing economic growth

Economic growth plays a central role for the development of transport demand. The latest composite leading indicators of global GDP growth rates show a slowing momentum (OECD, 2018[14]). Previous optimistic projections for GDP growth have been revised downwards in light of political and economic developments. Global GDP growth is now projected at 3.5% in 2019 and 2020 (Table 1.1). The estimated compound annual GDP growth rate for 2015 to 2030 is 3.3%, with slightly slower growth of 2.9% projected for longer term scenario of 2015 to 2050.

Trends diverge between world regions. One the one hand, developing economies will continue to grow at high rates, despite the expected deceleration of the global economy.

This will make them the main drivers of growth for future transport demand. GDP growth rates of emerging market and developing economies will stabilise at 4.7% in 2019/20. China's growth rate will decline from nearly 7% in 2017 to 6% by 2020, and India's GDP growth rate should fluctuate around 7.4% in the next couple of years – making it the country with the highest growth rates world-wide for 2018-20 (OECD, 2018[1]). GDP growth rate for OECD countries, on the other hand, will decrease gradually over the coming years, reaching 1.9% by 2020. In the United States, the 2018 GDP growth rate was nearly 3%, partly supported by the recent fiscal stimulus packages (OECD, 2018[1]).

Factors contributing to the slower economic expansion include geopolitical instability, increased protectionism, as well as the ramifications of trade tensions on employment and business confidence. Inflation could increase steeply with rising oil prices and new trade tariffs. High levels of public and private debt increase the financial vulnerability of many countries and could further hinder economic growth. The downward trend in productivity levels and a shrinking workforce due to aging populations can constrain expansion in advanced economies (IMF, 2018[15]); (OECD, 2018[1]).

Business-level data supports predictions of lower growth. The year-on-year global growth rates of both industrial production and retail sales volume have declined noticeably in the first three quarters of 2018, according to preliminary data. Manufacturing export orders have been decreasing steeply throughout the year (OECD, 2018[1]).

Table 1.1.GDP growth in world regions

Percentage change over previous year

						Compound Annual Growth Rate	
	2016	2017	2018*	2019*	2020*	2015-2030*	2015-2050*
OECD							
World	3.1	3.6	3.7	3.5	3.5	3.3	2.9
OECD countries	1.8	2.5	2.4	2.1	1.9	2.0	1.9
Euro Area	1.9	2.5	1.9	1.8	1.6	1.5	1.6
United States	1.6	2.2	2.9	2.7	2.1	1.8	1.9
Japan	1.0	1.7	0.9	1.0	0.7	1.0	1.1
Non-OECD countries	4.2	4.6	4.7	4.7	4.7	4.2	3.5
Brazil	-3.4	1.0	1.2	2.1	2.4	2.2	1.9
China	6.7	6.9	6.6	6.3	6.0	4.8	3.2
India	7.1	6.7	7.5	7.3	7.4	6.5	5.2
World Bank							
World	2.4	3.1	3.1	3.0	2.9	—	—
Advanced economies	1.7	2.3	2.2	2.0	1.7	—	—
Emerging market and developing economies	3.7	4.3	4.5	4.7	4.7	—	—
IMF							
World	3.7	3.7	3.7	3.7	—	—	—
Advanced economies	1.7	2.3	2.4	2.1	—	—	—
Emerging market and developing economies	4.4	4.7	4.7	4.7	—	—	—

Note: * Figures for 2018 onwards are predictions. World Bank figures for 2017 are estimates.
Source: OECD (2018[16]); World Bank (2019[17]); and IMF (2018[18]). Estimates for 2015-2030 and 2015-2050 are based on OECD ENV-Linkages model.

International trade faces uncertainties

Trade is a main determinant of freight demand. Current estimates show global trade growing slightly stronger than GDP, but on a downward path. The OECD ENV Linkages model projects 3.4% annual growth through 2030 and 3.2% through 2050 (Table 1.2) Global merchandise trade volumes are expected to grow at gradually descending growth rates from 2017 onwards, reaching 3.7% in 2019. The figures for merchandise trade growth reflect the risks of gowing protectionism that will not only reduce trade flows, but diminish the exchange of information and new technologies - with important impacts on productivity and long-term growth (WTO, 2018[11]); (IMF, 2018[15]).

Growth in trade will be impacted by the trend of global value chains becoming more consolidated (ITF, 2017[19]). Trade in emerging economies is also likely to be affected by market disturbances such as rising interest rates in developed economies (WTO, 2018[11]). Nevertheless, exports and imports will grow faster in emerging economies than developed economies. The compound annual growth rate of imports for developing and emerging economies will be 60% higher than that of developed economies for imports and nearly three-quarters higher for exports by 2050. Among the world regions, Asia displays the highest growth rates in merchandise trade. Although they are expected to slow as early as 2019, Asia will also grow fastest in the long-term through 2050 - together with South and Central America, according to OECD projections.

Table 1.2. World merchandise trade

Percentage change over previous year

					Compound Annual Growth Rate	
	2016	2017	2018*	2019*	2015-2030*	2015-2050*
World	1.8	4.7	3.9	3.7	3.4	3.2
Exports						
Developed economies	1.1	3.4	3.5	3.3	2.7	2.3
Developing and emerging economies	2.5	5.3	4.6	4.5	4.2	4.0
North America	0.6	4.2	5.0	3.6	3.5	2.8
South and Central America	2.0	3.3	2.8	2.6	3.1	3.4
Europe	1.2	3.5	2.9	3.2	2.2	2.0
Asia	2.3	6.7	5.5	4.9	4.2	3.8
Other regions	3.4	0.2	2.6	3.6	3.6	4.2
Imports						
Developed economies	2.1	3.0	3.2	3.0	2.7	2.5
Developing and emerging economies	1.6	8.1	4.8	4.5	4.3	4.0
North America	0.0	4.0	4.3	3.6	2.8	2.9
South and Central America	-6.7	4.0	3.6	4.0	4.3	3.9
Europe	3.3	2.5	3.1	3.0	2.4	2.1
Asia	3.5	9.8	5.7	4.9	4.2	3.9
Other regions	-1.7	3.5	0.5	1.4	3.6	3.7

Notes: *Figures for 2018 onwards are projections. Figures for 2015-2030 and 2015-2050 are based on the OECD ENV linkages model
Source: WTO (2018[11])

Uncertainty around oil prices

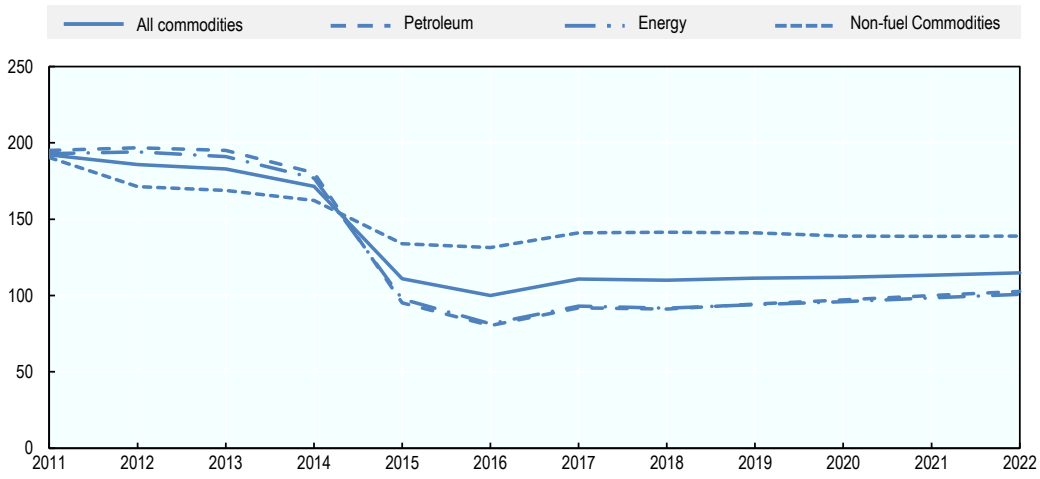
Rising oil prices could attenuate projected economic growth in the next few years by contributing to inflation and reducing disposable household incomes. Oil price fluctuations have a particularly significant impact on the transport sector. They can lead

to shifts in transport behaviour and also in investment in renewables, two determinants of transport demand and transport-related CO_2 emissions. Transport CO_2 emissions in Europe decreased for the first time in 2007, which coincided with a spike in oil prices. As oil has become cheaper since 2012, transport emissions have started to grow again.

Driven mainly by increasing oil and natural gas prices, the International Monetary Fund's Primary Commodities Price Index grew nearly 17% from August 2017 to February 2018 (IMF, 2018[15]). However, the IMF sees fuel price increases to slow in the medium-term, (Figure 1.2). Such price changes do not affect all world regions to the same degree, particularly since a weak USD can counteract high oil prices in some countries. Supply disruptions following natural disasters - notably the hurricanes on the US Gulf Coast and wildfires in Canada - contributed to recent oil prices hikes (EIA, 2017[20]). Political disputes have also led to longer and more severe disruptions in oil supply. Logistics issues, oil quality problems, and growing demand for liquefied natural gas also help to explain why global oil supply in 2017 fell to its lowest level since January 2012 (EIA, 2017[20]); (Lawler and Cooper, 2018[21]).

Figure 1.2. Primary commodity price indices, 2011-22

Constant USD, 2005 =100



Note: Figures for 2017 to 2022 are projections. Petroleum refers to petroleum crude spot: the average spot prices for Brent in the United Kingdom, Dubai and West Texas Intermediate.
Source: IMF (2019[22])

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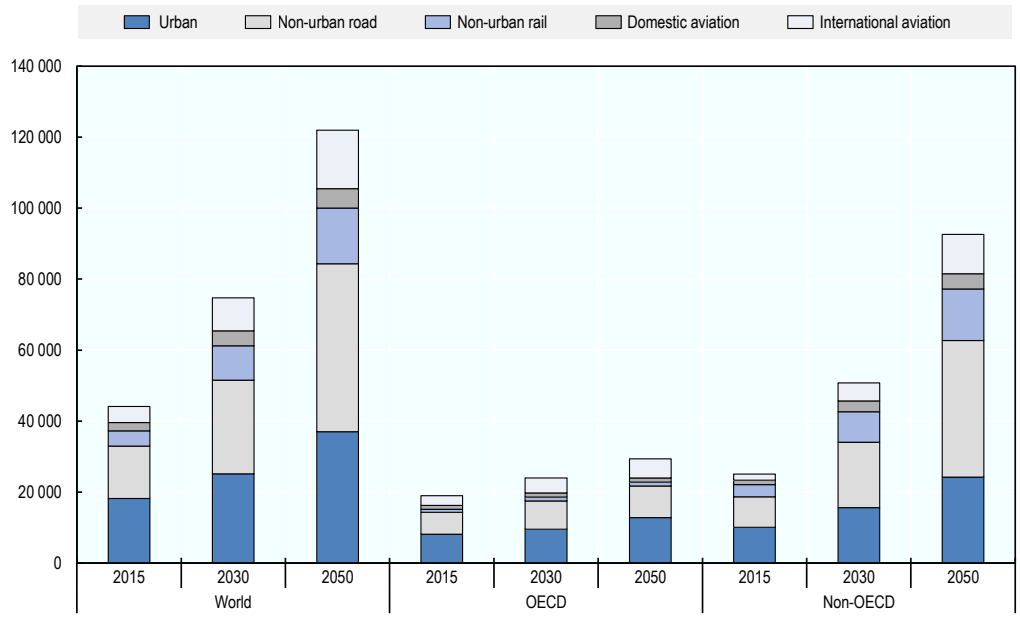
Growing demand for passenger transport

Demand for passenger transport is projected to grow in all world regions. It will increase three-fold between 2015 and 2050, from 44 trillion to 122 trillion passenger-kilometres (p-km), according to ITF projections (Figure 1.3). The distribution of demand will change siginficantly. OECD countries were responsible for 43% of global passenger movements in 2015, but their share will decline to 24% by 2050. The reason is the comparatively faster growth rates of passenger transport demand in other countries. China and India were responsible for a quarter of passenger-kilometres in 2015, but will generate one-third of passenger travel by 2050.

Non-urban rail passenger transport is expected to grow faster than all other mode groups by 2030. It will see a compound annual growth of 5.5%, followed closely by international aviation at 5.0%. Demand for aviation and rail transport will continue to grow strongly through 2050, with compound annual growth rates of 3.8% and 3.7% respectively. Non-urban road passenger transport will more than triple by 2050, generating more passenger-kilometres than any other mode group, namely 47 trillion passenger-kilometres.

Figure 1.3. Demand for passenger transport by type

Current demand pathway, billion passenger-kilometres



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Changing urban mobility patterns

Higher per capita income is typically associated with with an increased demand for passenger transport. By 2050, urban regions are expected to account for 81% of global GDP, up from 60% in 2015. Cities in developing countries will see incomes rise faster than anywhere else. Average GDP per capita will nearly quadruple in China (+296%) by 2050 and more than quintuple in India (+432%). As a result, global demand for urban passenger transport demand will more than double by 2050.

Much of this increase will likely be absorbed by shared mobility and public transport. Projections see shared mobility as the fastest growing transport mode in urban areas, while vehicle use will decline by 2030 (Figure 1.4). The urban passenger transport model used in this *Transport Outlook* has been modified from the 2017 version to include shared mobility (shared bikes, scooters, cars, taxis and buses) in the current ambition scenario, drawing upon the measurable impact that these services have already had on passenger transport movements.

Urban transport demand will grow particularly strong in non-OECD countries. Passenger-kilometres will reach 2.4 times their current levels by 2050 (24 trillion p-km), at which point they will generate twice as many passenger-kilometres as OECD countries. In 2050, the world's cities will generate 10 trillion passenger-kilometres by bus and bus rapid

transit (BRT), 9 trillion p-km by private car, 8 trillion p-km from shared mobility, 4 trillion p-km by motorcycles, 3 trillion p-km by rail and metro, and less than 1 trillion p-km from non-motorised modes.

Shared mobility was only responsible for 1.5% of worldwide urban p-km in 2015, but by 2050 it is likely to cover more than one fifth of urban trips. Demand for shared mobility will be slightly higher in OECD countries (24%) than in non-OECD countries (20%).

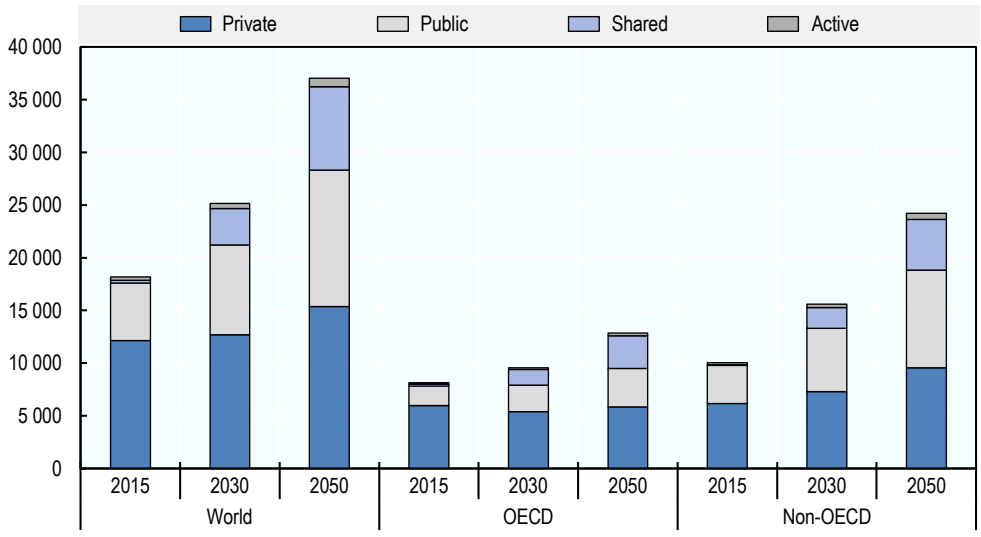
Private vehicles are currently the preferred mode of travel worldwide. However, evidence suggests that travel modes in cities will shift towards public transport and shared mobility over the next 35 years. Private cars, two- and three-wheelers and taxis are currently used for nearly 75% of urban passenger transport in OECD countries and over 60% in non-OECD countries. These shares will decrease to 46% and 39% by 2050. Projections suggest negative composite annual growth rates for private car ridership in cities through 2050 for OECD countries and through 2030 for non-OECD countries.

Public transport will account for 35% of worldwide urban passenger transport by 2050, that is 2.4 times more than in 2015. Public transport ridership will increase through 2030 and 2050 regardless of region. Particularly strong growth is expected for rail and metro in non-OECD countries (4.7% per year). Demand for bus and BRT transport should see an annual compound growth rate of nearly 2%, even if past trends in bus and coach travel diverge among some developed economies (Figure 1.5).

The growing use of public transport in urban areas of developed economies is partly due to the inability of existing road networks to accommodate increased travel demand. Congested roads mean greater levels of pollution and increased infrastructure maintenance. Public transport systems can improve accessibility and reduce CO_2 emissions and thus respond to growing passenger transport demand in urban regions.

Figure 1.4. Urban travel by mode group

Current demand pathway, billion passenger-kilometres



Note: See glossary for further information on mode groupings.

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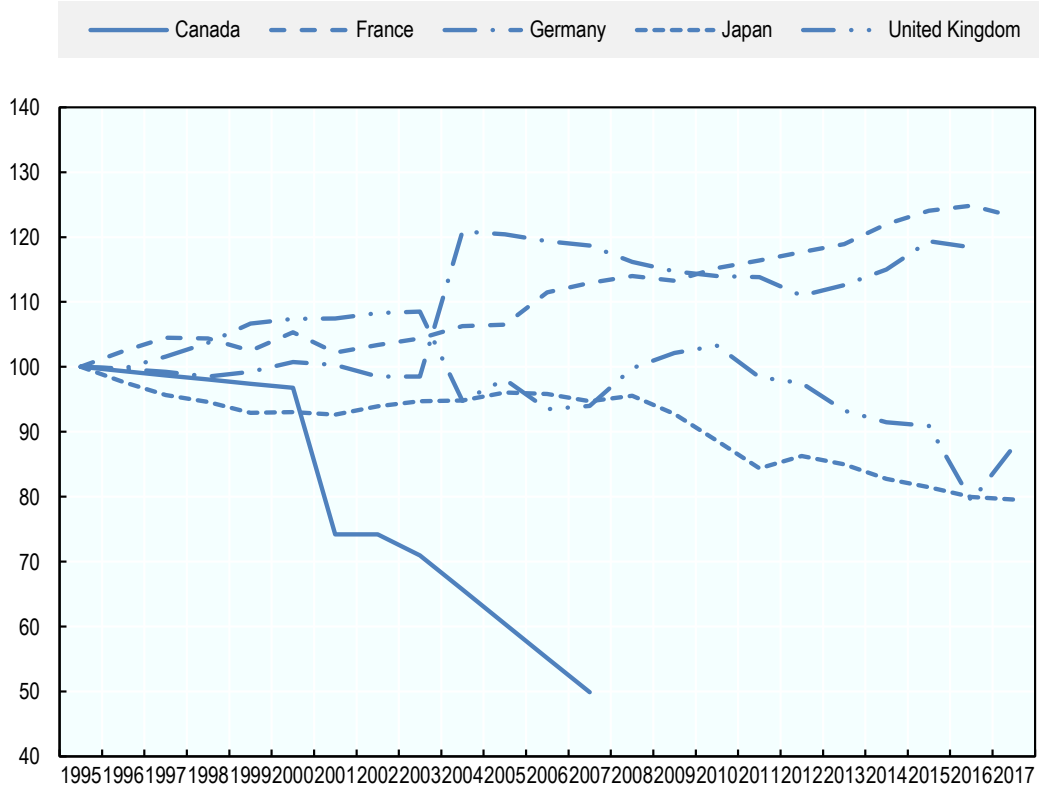
Table 1.3. Urban transport growth by mode

Current demand pathway, compound annual growth rates of passenger-kilometres in percentages

	2015-30	2015-50
OECD urban transport demand		
Private cars	-0.9%	-0.2%
Two and three wheelers	3.0%	2.1%
Bus and BRT	1.7%	1.9%
Rail and metro	2.7%	2.2%
Shared mobility (including all modes)	14.9%	8.4%
Non-OECD urban transport demand		
Private cars	-0.2%	0.4%
Two and three wheelers	3.1%	2.2%
Bus and BRT	3.3%	2.6%
Rail and metro	4.7%	3.6%
Shared mobility (including all modes)	23.8%	12.4%

Figure 1.5. Bus and coach travel in selected countries

Passenger-kilometres, 1995=100



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Car-dominated growth of domestic non-urban transport

Domestic non-urban transport will generate nearly 68 trillion passenger kilometres by 2050, according to projections. This is over three times higher than in 2015. Passenger demand growth will be slightly slower in the long-term compared to the short-term, with

a 4.3% compound annual growth through 2030 and a 3.4% rate through 2050 (Table 1.4). Domestic non-urban rail will see the highest compound annual growth rate of all modes (3.8% through 2050). Yet road passenger transport will grow the most in absolute terms, with an increase of 32 trillion passenger-kilometres. This trend is mainly due to strong growth of per capita GDP in developing economies, which will lead to increases in ownership and use of private vehicles in those countries. While domestic non-urban road transport is expected to grow by 29.8 trillion passenger-kilometres in non-OECD countries by 2050, the increase for OEDC countries will be only 2.7 trillion passenger-kilometres.

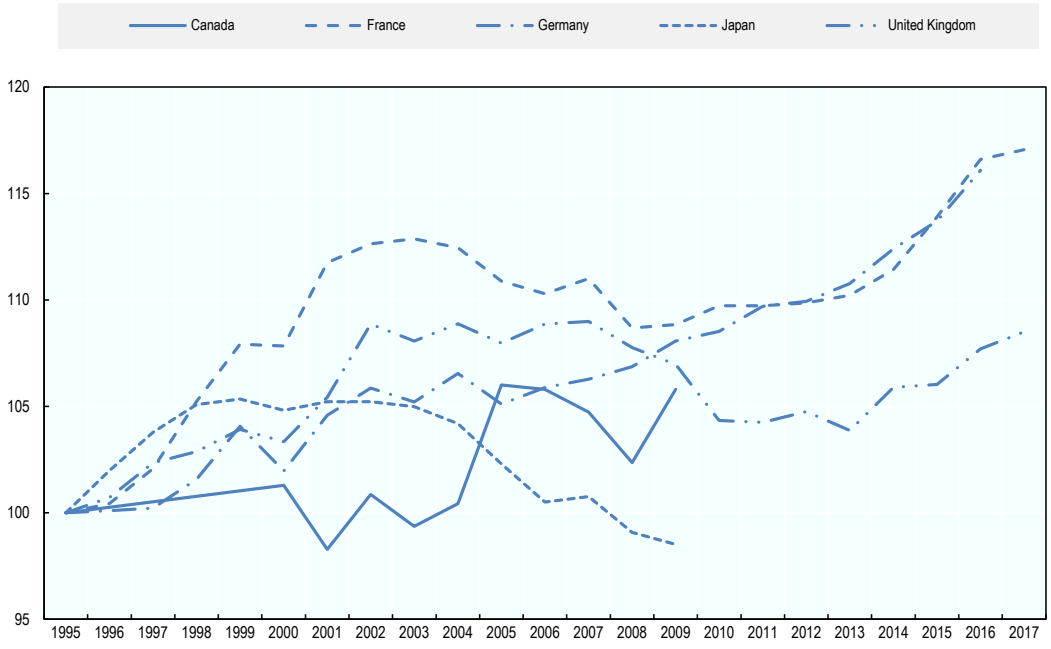
Table 1.4. Growth projections for domestic transport demand by mode, 2015-50

Current demand pathway, global compound annual growth rate in percentages

	2015-2030	2015-2050
Domestic passenger transport demand	4.3	3.4
Domestic non-urban		
Rail	5.5	3.8
Road	4.0	3.4
Aviation	3.6	2.3

Figure 1.6. Travel by private car in selected countries, 1995-2017

Passenger-kilometres,1995=100



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Historic data shows that private car use in many developed economies has increased since the mid-1990s, yet in the long-term future growth will likely be limited. For OECD countries, the compound annual growth rate for non-urban road passenger-kilometres through 2050 is projected to be 1.1%. Some developed economies were already showing little growth or a decline in car use from the early 2000s (Figure 1.6). Then again,

countries like France, Germany and the United Kingdom have seen renewed growth in passenger-kilometres. The latest available data shows that total private car use in these countries increased by 17%, 16%, and 9% respectively since 1995.

Current projections of demand pathways see developing economies as the main factor behind the growth in private vehicle passenger-kilometres. The global stock of passenger cars in 2015 is estimated at just over 1 billion vehicles. By 2030, the number is expected to reach nearly 2 billion vehicles, and 3 billion by 2050 (IEA, 2018[23]). China and India alone will have a combined car fleet of over 1 billion vehicles by 2050, according to these estimates. That will be six times greater than in 2015. The overall passenger car fleet in non-OECD countries grows five-fold by 2050 in the current demand pathyway, while the fleet increases by only 16% in OECD countries.

Although fleet size has historically been an important determinant of vehicle-kilometres travelled, this dynamic may change as consumers have better access to alternative forms of mobility. New policies aimed at limiting passenger car use in response to concerns regarding congestion or emissions could affect these trends.

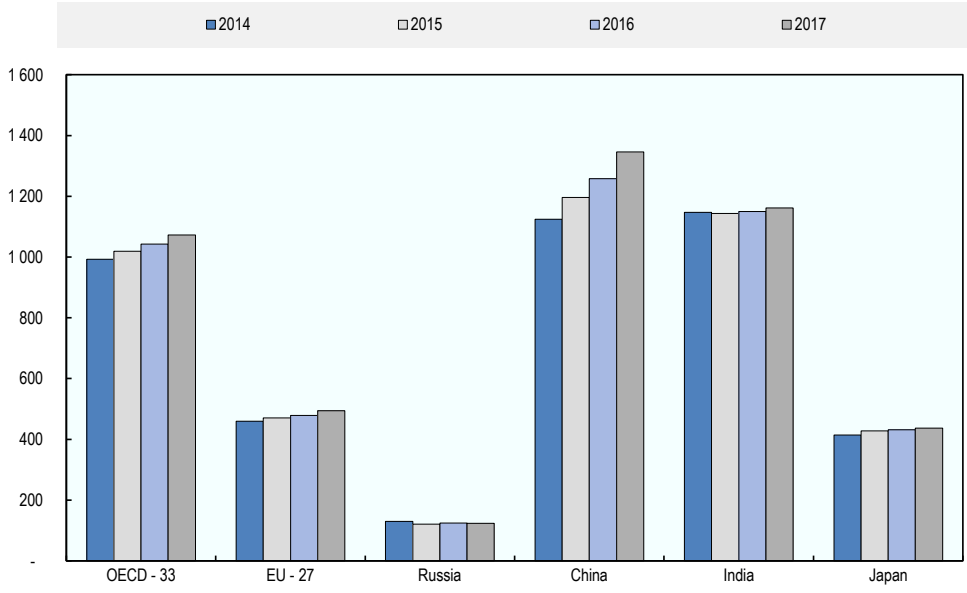
Domestic non-urban rail traffic is predicted to grow by 5.5% annually through 2030, and by 3.8% annually through 2050. The main factor behind this growth are planned rail infrastructure investments in China (Table 1.4). Historical data show strong growth in passenger demand for rail travel in China (Figure 1.7). Global growth of non-urban rail traffic is partly limited by increases in domestic air travel and private car use in developing economies. If shared mobility demand grows significantly, it could also begin to absorb demand for rail travel, particularly due to the cost difference.

High-speed rail can provide a viable alternative to travel by plane or road with regards to cost and efficiency. In particular, many of the developments of high-speed rail within China and Europe have reduced travel demand in aviation for specific routes. Where a new high-speed rail line connects cities that are separated by between 200 and 1 000 kilometres, rail tends to more or less replace aviation (ITF, 2017[19]). Such railway lines are only responsible for a small part of the total domestic inter-urban railway movements, however, and will have a limited impact on total rail traffic.

Nearly all countries have seen growth in rail passenger movements in recent years. China and India each individually generated more rail passenger movements in 2017 than all OECD countries combined (Figure 1.7). China has experienced consistently strong growth in rail passenger traffic, with a total of over 1.3 trillion passenger-kilometres travelled in 2017, which is 7% higher than in 2016. In Japan (1.3%), in OECD countries (2.9%) and in the European Union (3.2%) rail passenger-kilometres continued to grow at a modest pace between 2016 and 2017, while rail traffic in Russia fell by 1.2%.

Figure 1.7. Rail passenger traffic in selected countries and regions, 2014-17

Billion passenger- kilometres



Note: Chile and New Zealand are missing from the OECD aggregate. EU does not include Cyprus. 2017 data has been estimated for Australia and Greece.

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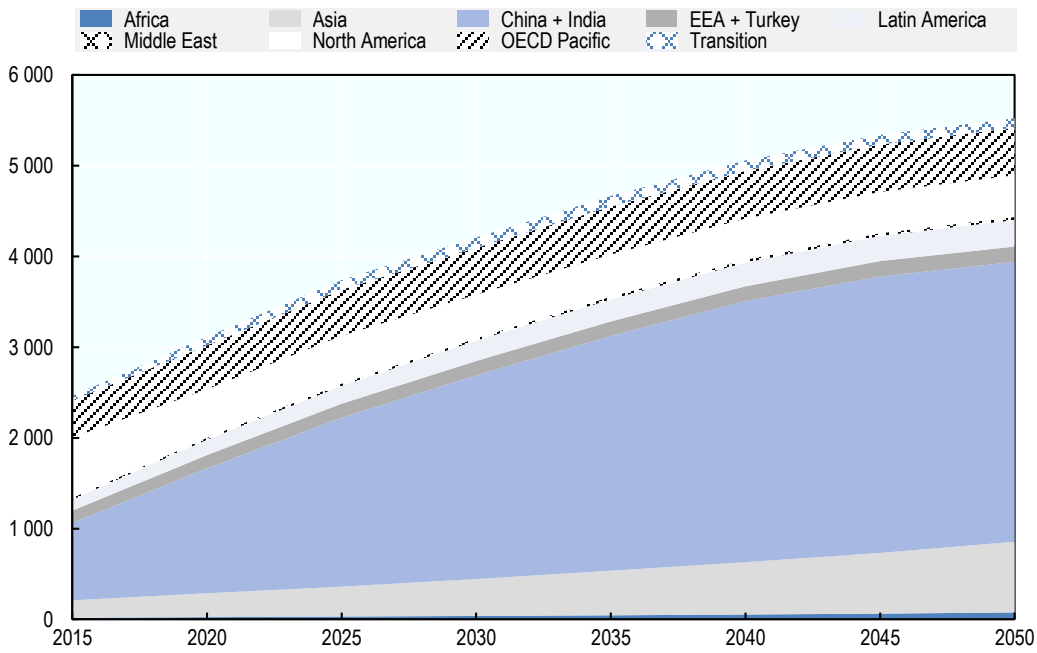
Domestic aviation is expected to experience strong growth through 2030 (3.6% CAGR), driven by increasing demand, especially in China and India (Figure 1.8). By 2050, almost two-thirds of worldwide domestic air passenger-kilometres will come from China, India and the United States. Given the significance of domestic air travel for regional economic development, major markets are likely to encourage its development through fiscal packages and deregulation, as has occurred in the United States (ITF, 2017[19]).

In 2017, more domestic air journeys were undertaken in China than in any other origin-destination market, increasing 14.6% since 2016 to a total of 59 million trips. The fastest growth in domestic aviation occurred in Japan and Korea, where passenger trips increased 26.5% in 2017. India and the United States remained the second and third fastest growing origin-destination markets in 2017, growing 17.6% and 4.7%, respectively (IATA, 2018[24]). Passenger-kilometres in Central and South America grew the most (10%), followed by Asia and Oceania at 9.6%, and Europe at 8.1% (ICAO, 2018[25]).

Figure 1.8. Projected domestic air transport demand by region, 2015-50

Current demand pathway by region of origin, billion passenger-kilometres



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Fast-growing international passenger aviation

Global demand for air travel will continue to increase through 2050, according to the current demand pathway. The main drivers are economic growth in developing economies and improving air connectivity. The projected growth rate for global air passenger-kilometres is 4.5% through 2030 and 3.3% through 2050. Demand for domestic and international air transport combined will rise from 7 trillion passenger-kilometres in 2015 to 22 trillion in 2050 (Figure 1.9). The further rise of low-cost carriers will make air travel less expensive than many trips previously using other modes. However, the future growth of air passenger transport will depend on whether the network is able to keep up with the demand. Given the uncertainty of how air networks will evolve there are notable differences between the projections of the current demand pathway and alternative scenarios (see Chapter 4).

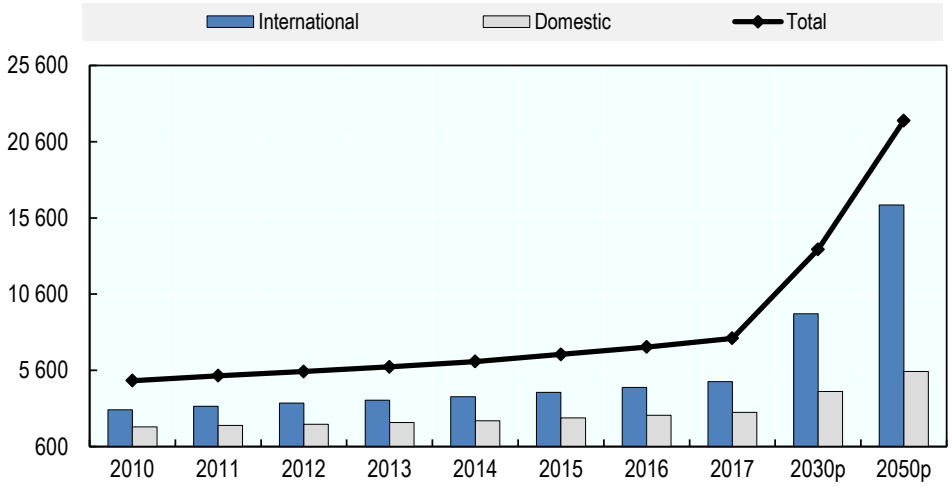
International air passenger traffic reached a record level in 2017 with 4.9 trillion passenger-kilometres, an increase of more than 8% on 2016 (Figure 1.9). Since 2010, international flights, measured in passenger-kilometres, have increased by 61%. More than 4 billion passengers (+7.1%) travelled by plane in 2017. On average, a person flew once every 22 months, twice as frequently as in the year 2000 (IATA, 2018[26]); (ICAO, 2018[25]). Asia and the Pacific region were responsible for 34% of global air passenger-kilometres in 2017, followed by Europe with 27% and North America with 23% (IATA, 2018[27]). Projections see the number of flights and air passengers double in the next 15 years (ICAO, 2018[25]).

International passenger air travel will see its strongest growth primarily in developing economies. It will be particularly strong in Asia; international air passenger-kilometres in

China and India alone are expected to increase more than three-fold by 2030 and almost seven-fold by 2050. At that point these two countries' alone will be responsible for a quarter of worldwide air traffic (Figure 1.10). In Africa, demand for air travel is currently growing faster than capacity which in 2017 rose by 6.7% on the previous year. By 2050, demand is expected to be over nine times the current levels at 1.3 trillion passenger-kilometres.

Figure 1.9. World air passenger traffic, 2010-50

International and domestic, billion passenger-kilometres



Source: ICAO (2018[28]), Annual Report of the Council 2017 for data through 2017. Data for 2030 and 2050 are ITF projections from the current demand pathway using region of origin.

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The number of city pairs with regular air services between them reached a record high of 20 000 in 2017. In 2016, there had been 1 300 fewer pairs. Better air connectivity has helped to lower costs for travellers and shippers alike. It partly explains the boom in air passenger movements between 2014 to 2017 (IATA, 2018[26]). The number of city pairs in the global air network will grow by 2.8% annually through 2050, based on a projection of the current demand pathway. Jet fuel prices increased by 25% in 2017 relative to 2016 but are still much lower than in the previous decade. This has helped airlines' profit margins to remain quite stable (ICAO, 2018[25]). The expansion of tourism also adds to growing demand for air travel. Tourists spent 6% more on air travel in 2017 compared to 2016, amounting to an estimated total of USD 711 billion (IATA, 2018[26]).

The ranking of the world's busiest airports has remained more or less stable. Atlanta's Hartsfield-Jackson International Airport in the United States remains the busiest airport in the world, transporting almost 104 million passengers in 2017 - a slight drop (-0.30%) from 2016. Of the ten highest-volume aviation hubs in 2015, only Dallas-Fort Worth Airport in the United States did not make the 2016 top ten. It was replaced by Shanghai's Pudong Airport in China (which also surpassed the Charles de Gaulle Airport in France) with a passenger volume of 66 million in 2016, nearly three times higher than a decade earlier.

Figure 1.10. Projected international air transport demand by world region, 2015-50

Current demand pathway by region of origin, billion passenger-kilometres

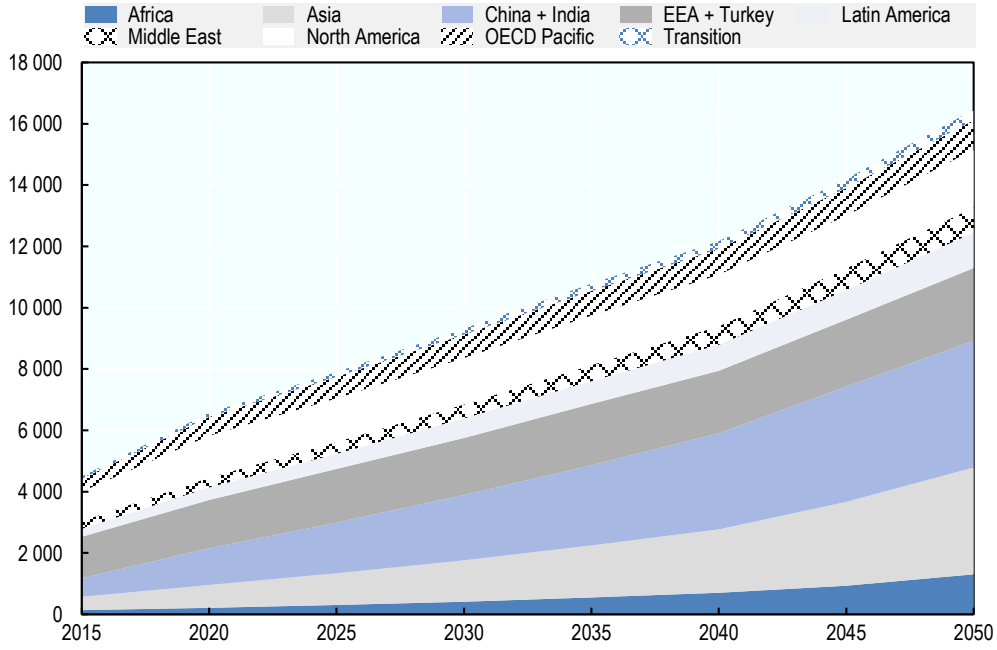

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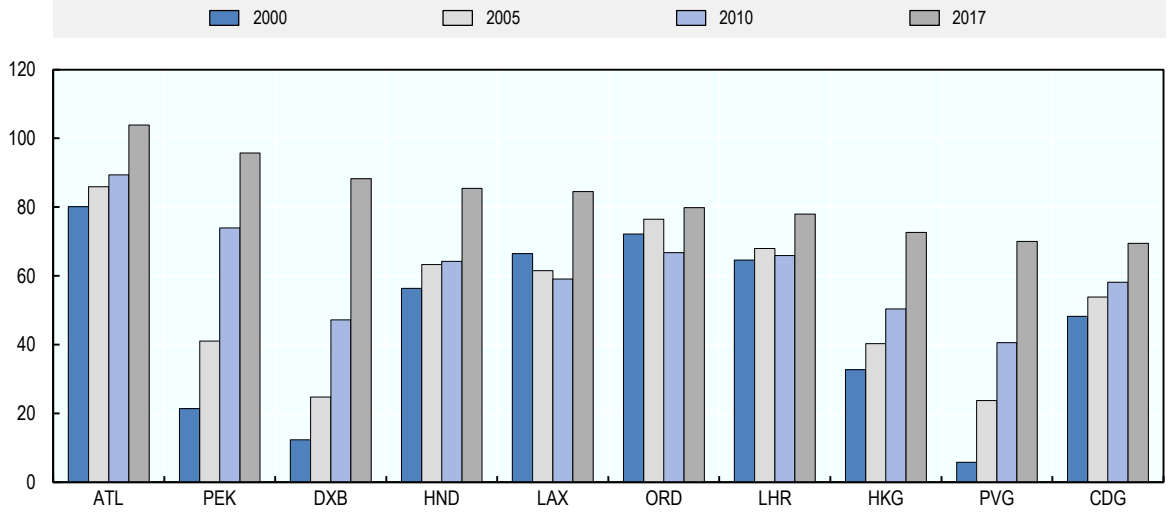
Figure 1.11. Top ten busiest airports in 2017

Million passengers



Note: Airports, from left to right: Atlanta Hartsfield-Jackson, Beijing Capital, Dubai, Tokyo Haneda, Los Angeles, Chicago O'Hare, London Heathrow, Hong-Kong, Shanghai Pudong, Paris Charles de Gaulle
Source: ACI (2019[29])

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Freight transport growth faces uncertainties

Global freight demand will triple between 2015 and 2050, based on the current demand pathway. Of the 108 trillion t-km transported worldwide in 2015, 70% travelled by sea, 18% by road, 9% by rail and 2% by inland waterway. Less than 0.25% of global freight in t-km is transported by air (Figure 1.12). The projected compound annual growth rate of freight through 2030 is 3.1%. Due mainly to downward adjustments in the projections for trade and economic growth, this is a slightly lower figure than in the 2017 edition of the *Transport Outlook* projections (Table 1.5). Freight demand will grow faster over the longer term, at 3.4% through 2050.

Air freight, while representing a marginal share of total freight transport, will have the highest compound annual growth rate of all modes through 2030 (5.5%) and 2050 (4.5%). Its growth is driven by larger shares of high-value goods being transported by air, most notably in China. Maritime shipping will remain the largest contributor to global tonne-kilometres. Ships will carry out more than three-quarters of all goods movements by 2050 (Figure 1.12). The remaining goods will mostly be transported by road (17%) and rail (7%).

Freight demand depends primarily on economic growth and international trade activity. In light of the current instability of the global economy and the rising tensions over trade, the accuracy of growth projections for freight transport in the current demand pathway is uncertain. Projected figures could shift as a result of increased protectionism or a global economic downturn, but also to improvements in freight transport capacity in countries or regions with significant growth potential. In Asia, for instance, capacity will need to increase to accommodate future freight transport demand.

Figure 1.12. Projected freight transport demand by mode

Current demand pathway, billion tonne-kilometres

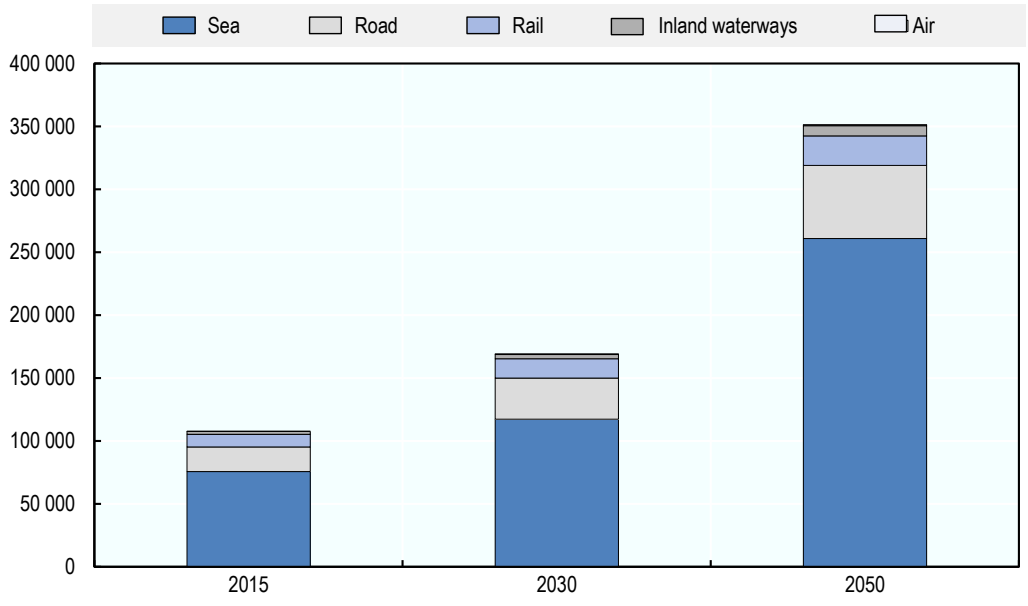

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Table 1.5. Projected growth rates of freight transport demand

Current demand pathway, global compound annual growth rate in percentages

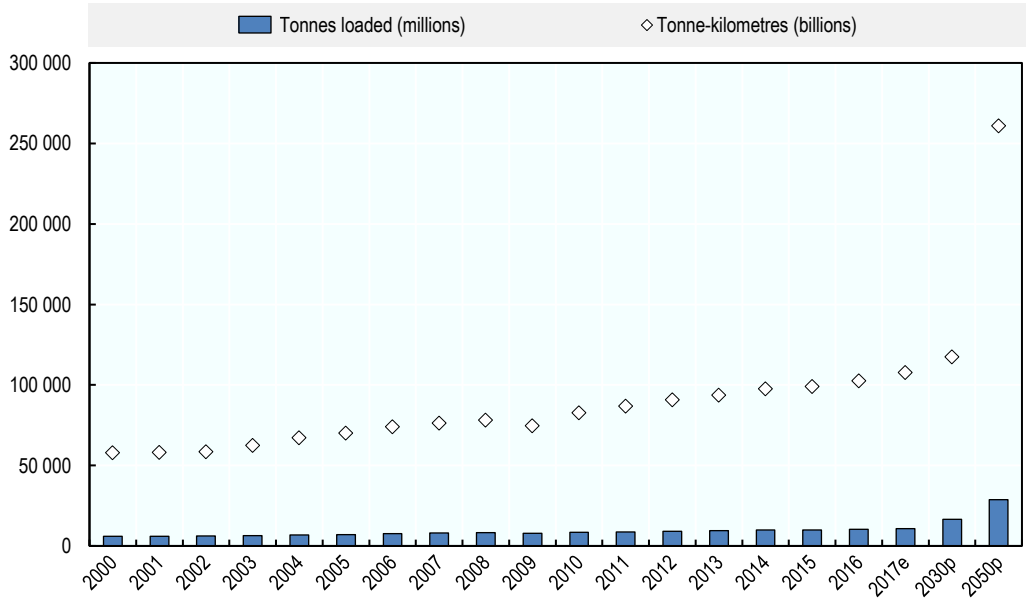
	2015-2030	2015-2050
Freight transport demand	3.1	3.4
Rail	2.7	2.5
Road	3.5	3.2
Inland waterways	3.4	3.8
Aviation	5.5	4.5
Sea	3.0	3.6

Maritime ships carry most of global freight

Maritime shipping covers most of the movement of goods over long distances. This will continue to be the case in the coming years. The current demand pathway projects that maritime freight transport will grow at a compound annual growth rate of 3.6% through 2050 (Table 1.5). This will lead to a near tripling of maritime trade volumes by 2050.

The economic value of freight flows in the North Pacific and Indian Oceans will increase nearly four-fold between 2015 and 2050. Approximately one third of all maritime freight movements in 2050 will take place in these two regions (Figure 1.14). The North Atlantic Ocean will remain the third-busiest maritime corridor, with 15% of maritime freight movements in 2050, equalling 38 trillion tonne-kilometres. A recent trend, particularly strong in China, is the relocation of factories inland. This may impact mode choice for Eurasian freight flows if these relocations significantly increase the time and cost of maritime shipments relative to inland modes. Seaborne trade volumes grew 4% in 2017, the fastest rate since 2012, An estimated 10.7 billion tonnes were transported by sea that year. In terms of tonne-kilometres, global shipping activity amounted to over 58 trillion in 2017, an increase of 5% on 2016. An estimated 752 million twenty-foot equivalent units (TEUs) were shipped through container ports. The size of the global ship fleet also grew +3.3% in 2017, but the growth in capacity was surpassed by increased freight volumes. UNCTAD projects that maritime freight volumes will continue expand through 2023, although this could change depending on the development of international trade agreements (UNCTAD, 2018[30]).

Figure 1.13. Total maritime trade demand, 2000-50



Note: Data for 2017 are estimates; data for 2030 and 2050 are projections.
Source: Data for 2000-17 are from UNCTAD (2018[30]) Review of Maritime Transport (tonnes loaded) and Clarksons Research (tonne-kilometres), as cited in UNCTAD (2018[30]).

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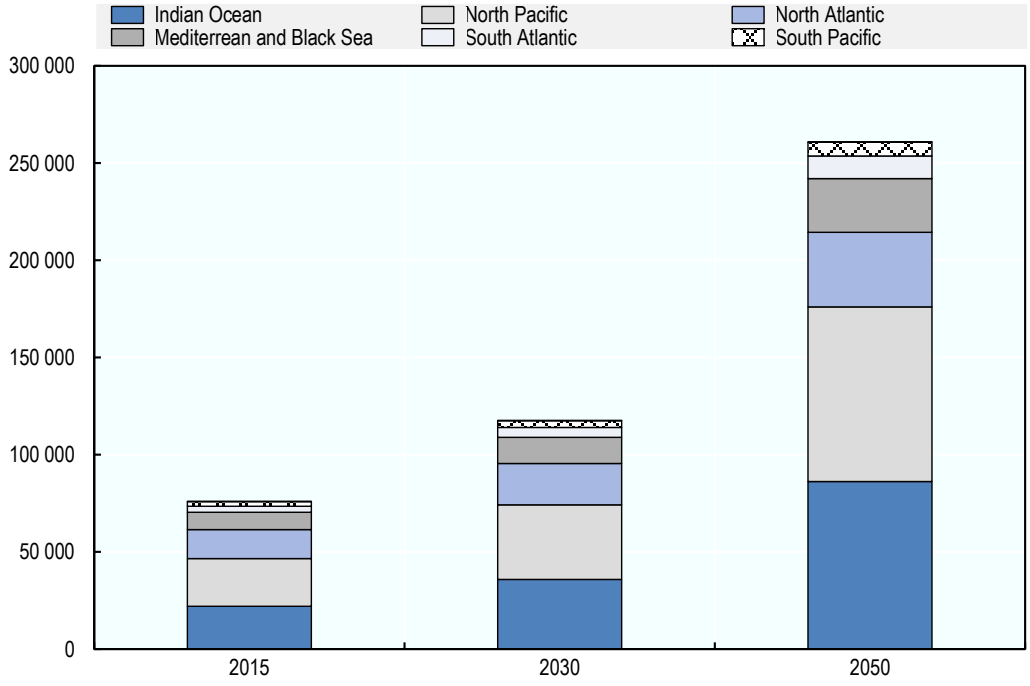
Fuel transport patterns have been shifting as demand for cleaner energy sources such as natural gas is rising, especially in Asia. Growth in crude oil shipments has slowed. In 2016, crude oil shipments grew by 2.4%, down from 4% in 2017 (UNCTAD, 2018[30]). Containerised trade increased globally in 2017 (+6.4%), most notably because of increased shipments from the Atlantic basin to Asia (UNCTAD, 2018[30]). Small island nations have experienced a particularly steep rise in maritime freight costs since 2013. The growth rate of costs in these developing economies is just above the average growth rate in developing economies (UNCTAD, 2017[31]).

The future of the maritime freight sector depends in particular on international trade agreements, the development of transcontinental inland routes, and changes in global energy use. The Economic Partnership Agreement between the European Union (EU) and Japan as well as the Comprehensive Economic and Trade Agreement (CETA) between the EU and Canada will likely lead to further increases in trade volumes. Changing global value chains in rapidly developing economies such as China and India will also determine how freight flows evolve. Growing global e-commerce will also likely contribute to long-term growth in demand for container shipping. Evolutions in the energy sector and a global transition toward cleaner energy will also shape the future of the maritime industry (UNCTAD, 2018[30]).

Figure 1.14. Maritime trade demand projections by region, 2015-50

Current demand pathway, billion tonne-kilometres



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Anticipating bottlenecks and planning necessary land acquisitions for new port capacity and connecting inland corridors will be crucial for accommodating growing maritime freight transport. This presents a formidable challenge, however: Projections for trade trends and mode distributions are beset with uncertainties,while maritime infrastructure investments are costly and have a long lead time. The risk of over-investment in capacity expansion if expected growth in trade flows does not materialise is thus not negligble.

Slower-than-expected growth in international trade has led to overcapacity in certain maritime transport sectors and locations. Since capital investments in the shipping industry cannot be easily recuperated, companies may seek to cut costs in other ways in order to maintain profitability. This could lead to shipping operators concentrating on a limited number of ports and routes, which in turn could strain the capacity of these ports. Current demand pathway projections indicate that scheduled investments in port capacity should be capable of accommodating maritime freight demand through 2030 in most areas of the world except in South Asia.

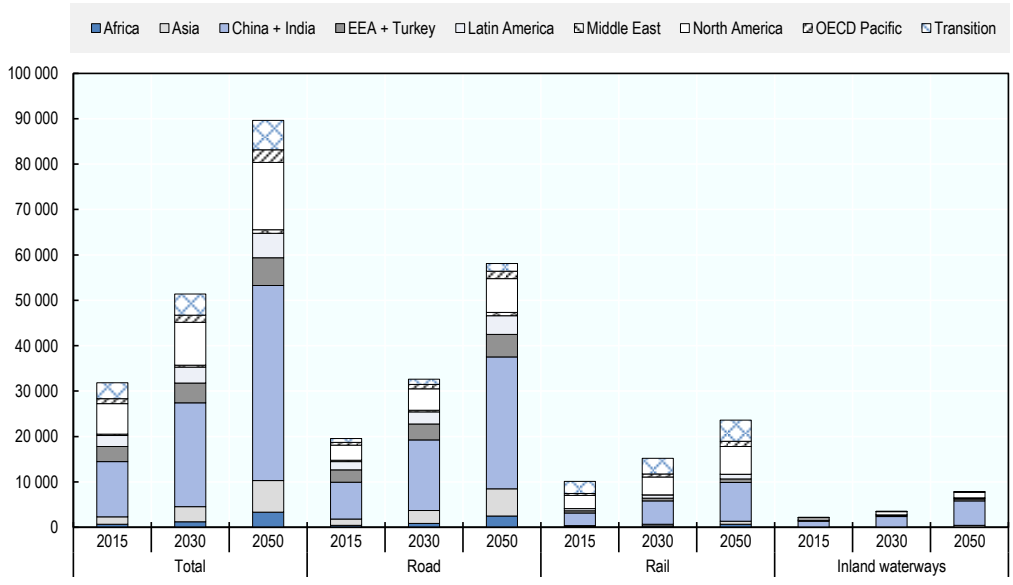
Surface freight demand growth strong in Asia

Global surface freight movements, i.e. transport via road, rail and inland waterways are projected to grow 182% between 2015 and 2050. They will carry 90 trillion t-km or 26% of total freight demand (Figure 1.15). Surface freight flows in China and India taken together made up 38% of total surface freight flows in 2015. By 2050, Asia (including China and India) will be responsible for 56% of global surface freight demand. Africa will see the fastest growth in road and rail tonne-kilometres, with an increase of +394% between 2015 and 2050, followed by the Asian continent with an increase of +261%.

Growth will be less pronounced in the Middle East (+169%), the OECD Pacific countries (+154%), North America (+121%) and Latin America (+120%), In transition economies[1] (+84%), and Europe (+86%) it will be significantly lower. Among the surface modes, road freight will increase exponentially in Africa (+435%) and the Asian continent (+269%) over this period.

Figure 1.15. Projected demand for surface freight transport by region

Current demand pathway, billion tonne-kilometres



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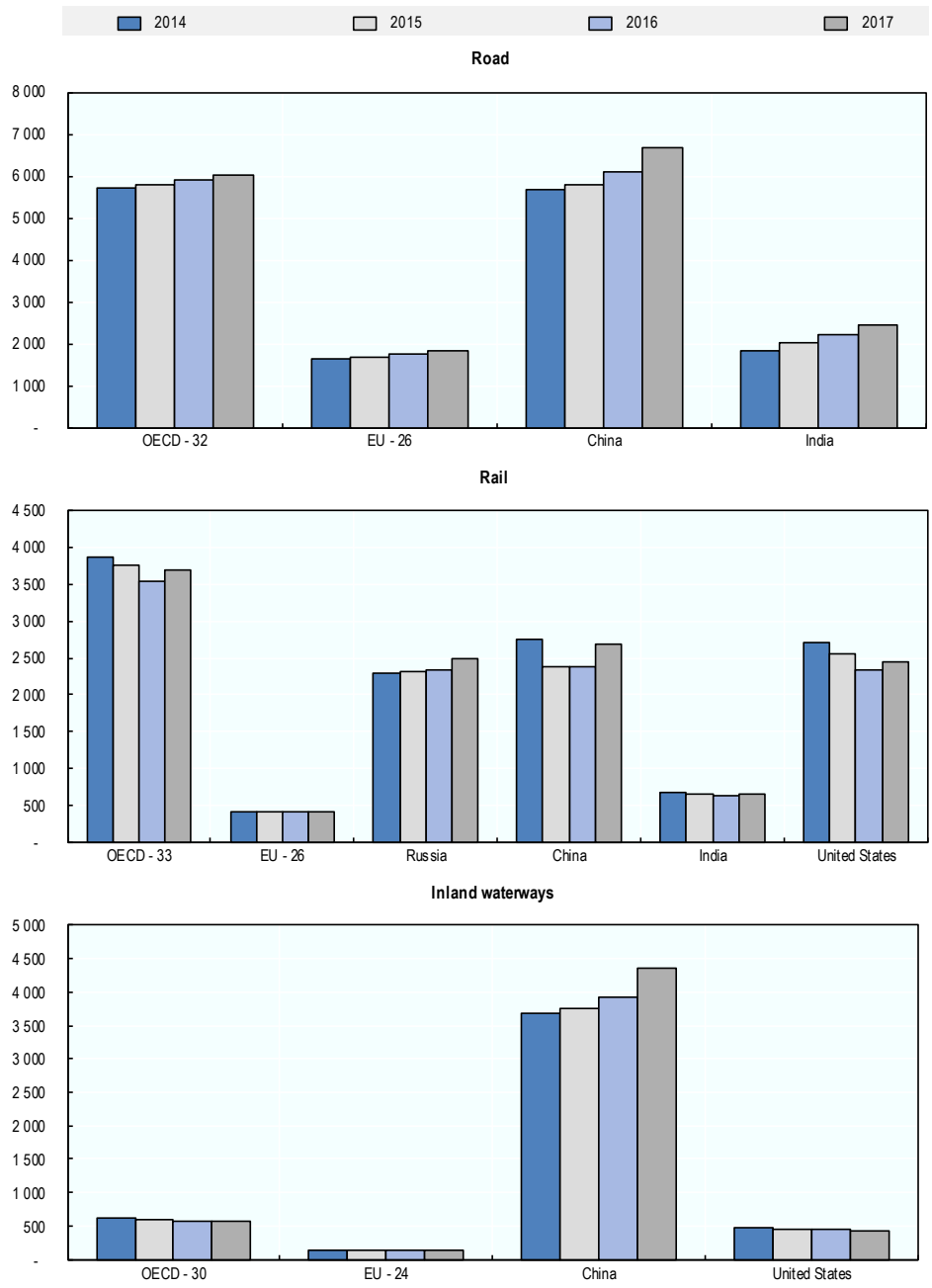
Over the past few years, road freight traffic levels have been growing across the globe, albeit at a more modest rate in the European Union (Figure 1.16). Surface freight volumes showed signs of recovery from the global economic downturn as early as 2011, but this trend is not uniform across modes and regions. China and India saw the fastest growth in road tonne-kilometres since 2016, with increases of 9.3% and 9.4% in 2017 respectively. China alone transported 6.7 trillion tonne-kilometres of road freight in 2017, nearly 700 billion tonne-kilometres more than the total freight traffic of OECD countries.

Global rail freight volumes have declined in recent years, but for many countries 2017 marked a slight reversal in this trend. Rail tonne-kilometres in China grew by 13.3% on the previous year, returning nearly to their 2014 level. Russia also saw a notable increase of 6.4% in rail tonne-kilometres in 2017. Rail freight in India (+5.5%) and the United States (+5.2%) also grew significantly.

Inland waterway freight traffic in China is projected to remain well above that of any other country or even any other continent, with strong growth rates through 2017. The volume of inland waterway freight in China was estimated at 4.4 trillion tonne-kilometres in 2017, a 10.9% increase from 2016.

Figure 1.16. Surface freight traffic by transport mode, 2014-17

Billion tonne-kilometres



Note: Aggregates for road do not include Chile, Cyprus, Israel or Malta. Rail aggregates do not include Belgium, Chile or Cyprus. Inland waterway aggregates do not include Canada, Chile, Greece, Portugal and Sweden. Data for 2017 was estimated for the following countries: the United States for inland waterways, Australia and Greece for rail, Australia, Canada, Iceland, Italy, South Korea, and the United States for road.

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Growth in surface freight volumes has slowed in recent decades. However, planned large-scale infrastructure investments and legislation facilitating greater connectivity and

integration could slightly shift this trend. The European Union will provide a total of EUR 30.6 billion between 2021 and 2027 via the Connecting Europe Facility to improve interoperability and border crossing procedures in Europe (Van Leijen, 2018[32]). There have also been some advances in the European Commission's proposal to increase road charges and coverage so as to be more on par with those of railways (Van Leijen, 2018[33]).

Several initiatives aim to better connect China's economy to markets in Europe, Africa and Asia and are likely to shift freight patterns. A new railway line launched in 2018 now connects the freight hub of Chengdu, the capital of Sechuan, with Vienna in Austria (Van Leijen, 2018[34]). A recently established railway route links China, Kazakhstan, Azerbaijan, Georgia and Turkey (Van Leijen, 2018[35]). China also announced plans in June 2018 to build a railway line between Tibet and Nepal, an initiative endorsed by the Nepali Prime Minister (The Straits Times, 2018[36]).

Technological advances and innovtions in logistics could influence the current demand pathway projections for freight flows. Enforcement of road freight regulations will become with the increased availability of extensive freight transport data. This will improve governments' ability to monitor the effectiveness of their road freight policies and presents opportunities for data-driven regulation and enforcement (ITF, 2017[37]). The use of autonomous trucks could also impact the cost and efficiency of road freight transport. Chapter 5 offers a detailed analysis of these potential developments.

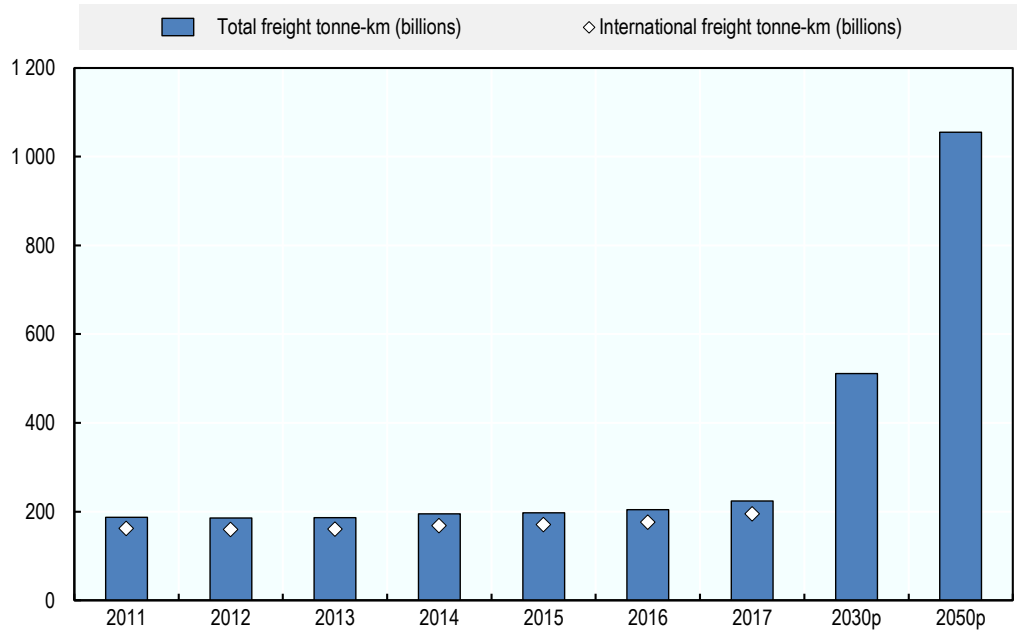
Aviation outpaces growth of other freight modes

Air freight generated 9.5% more tonne-kilometres in 2017 than in 2016, a more than double the growth rate of the previous year. International air freight flows grew even faster with a growth rate of 10.4%. Africa had the highest growth rate (+25.2%), although from a low level as Africa also had the smallest amount of traffic (4 billion t-km) of all regions in 2017. In terms of regional shares, Asia and the Pacific were responsible for nearly 40% of global air freight traffic, followed by Europe with 23%, North America at 20% and a share of 14% for the Middle East (ICAO, 2018[28]).

By 2030, planes will transport 500 billion tonne-kilometres of goods, according to the current demand pathway projection. By 2050, the total volume of air freight could exceed 1 trillion tonne-kilometres (Figure 1.17). Global air freight demand is expected to grow at faster rates than any other mode, with a compound annual rate of 5.5% through 2030 and 4.5% through 2050 (Table 1.5) still, aviation will only account less than 0.25% of global freight movements in 2050 in t-km (Figure 1.12). Yet it is an integral part of global supply chains, as the only mode suitable for transporting certain perishable or time-sensitive goods. This is reflected in the high share of air freight when measured in value terms 35% of the value of global trade, equalling USD 5.6 trillion worth of goods were moved by planes in 2017 (IATA, 2018[26]). Thus, comparatively small air freight flows can have considerable economic significance.

Figure 1.17. World air freight traffic, 2011-50

Billion tonne-kilometres



Note: Data for 2030 and 2050 are ITF predictions from the current demand pathway.
Source: ICAO (2018[28]), Annual Report of the Council 2017 for data 2011 to 2017.

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One reason behind high recent growth in air freight volumes is the global inventory re-stocking cycle, during which unexpected spikes in demand require rapid restocking of inventory. However, evidence suggests that this cycle is ending (IATA, 2018[38]). Despite an easing of growth, demand for air freight continues to experience strong growth overall, which has put significant strain current air freight transport capacity (IATA, 2018[24]). However, recent rises in protectionist trade policies appear to be softening this demand. Most notably, the growth rate for manufactured goods exports has been slowing in late 2018 in China, Germany and the United States (IATA, 2018[38]).

Aviation has become central to e-commerce. Nearly 90% of business-to-consumer e-commerce goods were transported by air in 2017, a steep increase from the 16% of e-commerce goods transported by air in 2010 (IATA, 2018[24]). The aviation industry has also been working to digitalise supply chains (e-freight) for the past decade to improve efficiency. Electronic air waybills (e-AWB) were used for 50% of air freight in 2017. However, methods and procedures for the e-AWB are not yet harmonised throughout the world, with some countries constrained by regulations that do not allow digital data to be shared (IATA, 2018[26]).

Aviation infrastructure is not developing at the pace needed to respond to growing demand for air freight. This could pose a critical problem in the future since infrastructure expansion requires long-term planning and air freight demand is predicted to grow very fast, reaching 4.7 times the 2017 level by 2050.

Notes

[1] Transition economies include former Soviet Union countries and non-EU south-eastern European countries.

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