# 5 Freight transport: Bold action can decarbonise movement of goods

This chapter highlights the significant role freight transport plays in a sustainable transport system and the challenges in decarbonising the sector. It presents estimates for freight activity and emissions for the next 30 years under three scenarios and gives recommendations for policies to set the movement of goods on a sustainable path. It includes a discussion of potential regional imbalances associated with decarbonisation and outlines important considerations for ensuring an equitable transition to cleaner freight transport.

# In Brief

## The carbon footprint from moving goods is as important as that from moving people

Freight transport receives less attention from policy makers than it deserves, given its cross-border complexities and commercial nature. Policy ambition has been relatively low compared to passenger transport, even though freight is responsible for more than 40% of all transport $CO_2$ emissions. Freight transport demand is projected to more than double in the next three decades, even with an ambitious policy agenda. Bold and fast action is crucial to decarbonise the sector.

The return to a pre-pandemic "normal" will mean rising freight emissions and missing climate change mitigation targets. However, with decisive decarbonisation actions, freight transport's $CO_2$ emissions could be 72% lower in 2050 than in 2015. The introduction of low-carbon technologies across all modes, load consolidation, collaboration, and standardisation are among the critical levers to in get us there.

Road freight will be decisive for transport decarbonisation. Trucks currently emit 65% of all freight $CO_2$ and will remain the dominant mode of surface transport. Carbon-neutral solutions for long-haul heavy-duty trucks are not yet commercially available for widespread adoption. Further advances in vehicle technology, supply and distribution infrastructure are needed.

Maritime freight transport accounts for more than 70% of global goods movements. Maritime shipping's carbon intensity is relatively low, but its emissions are not included in the National Determined Contributions of the Paris Agreement. The sector is under the purview of the International Maritime Organization, which has set targets, but not yet agreed on measures that would significantly reduce maritime shipping emissions. Close international co-operation is needed for a clean and equitable transition.

Opportunities for freight decarbonisation arise from the greater emphasis on resilient supply chains in the aftermath of the Covid-19 pandemic. Faster digitalisation and automation can help to optimise logistics and reduce its carbon intensity. Stimulus packages can include investments in alternative fuel production, distribution and supply infrastructure. They can also boost the availability of multimodal solutions and their competitiveness. The renewal of fleets with newer, cleaner vehicles is crucial.

Fossil fuels are being replaced by alternatives at an increasing pace. Historically low fuel prices provide an opportunity to phase out fossil fuel subsidies. Long-term interest rates close to zero in many developed economies mean that the social rate of return of such investments will likely exceed the financial costs of the projects. The world has an unprecedented opportunity to make bold policy choices that will enable a successful and equitable transition to clean freight transport.

### Policy recommendations

- Design stimulus packages that align to support economic recovery, freight decarbonisation and supply chain resilience.
- Align price incentives with freight decarbonisation ambitions for carrier buy-in.
- Scale-up ready-to-adopt freight decarbonisation measures quickly to cut costs and emissions.
- Strengthen international co-operation to combat freight emissions.
- Accelerate standardisation procedures to speed up the adoption of new clean technologies.
- Tailor decarbonisation pathways to regional realities to address gaps in standard solutions.
- Broaden access to privately owned data to improve policy design.

*This chapter covers all freight transport: by air, by sea and by the surface modes road, rail, and inland waterways. The analysis covers both international and domestic movements. Urban freight is covered as part of road freight unless specified otherwise. The chapter outlines the current state of freight transport and highlights challenges and opportunities for freight decarbonisation. It examines the impact of the pandemic on goods transport and reviews the immediate and potential long-term structural changes facing the sector. It also explores policies for a transition to cleaner and more equitable freight transport, based on three different scenarios for the sector's future development. The presentation of detailed results of the Recover, Reshape and Reshape+ scenarios is followed by a discussion about possible regional imbalances associated with decarbonising policies and changes in the structure of freight markets accentuated by the Covid-19 crisis. Policy recommendations are summarised at the end of the chapter.*

**Freight transport keeps the global economy moving but is a major emitter of $CO_2$.** Total freight activity volume amounted to 145 229 billion tonne-kilometres in 2019. This resulted in $CO_2$ emissions of 3 233 million tonnes, according to ITF estimates. In that year, freight was responsible for 42% of all transport emissions. In 2020, freight accounted for 50% because of the much sharper fall in passenger transport due to Covid-19. Even in the most optimistic scenario, projections see freight transport demand more than double over the next three decades. If policies continue as before the pandemic, freight emissions will not be lower by 2050, but 22% higher than the 2015 period. By contrast, ambitious policies can drastically reduce freight emissions over the next 30 years.

**Road freight will continue to dominate surface goods transport and play a decisive role in transport decarbonisation** as it represents 65% of all freight emissions. Carbon-neutral transport solutions in long-haul heavy-duty trucking are not yet commercially available for widespread adoption. Further developments in vehicle technology, supply and distribution infrastructure are needed. This transition requires millions of small companies to renew their truck fleets and switch to vehicles powered by clean energy.

**Maritime transport dominates freight activity with more than 70% of all tonne-kilometres**, while its $CO_2$ emissions account for around 20% of all transport freight emissions due to its high capacity and low carbon intensity. But, it is the second-highest emitter after road freight.

**Freight demand grows at a slower pace than previously estimated**. Previous projections saw freight activity measured in tonne-kilometres more than triple by 2050 (ITF, 2019[1]) (ITF, 2017[2]). The current ITF estimates see freight grow less, but still more than double by 2050 (Figure 5.1). The fall in GDP and drop in trade due to the pandemic are the main drivers of this change. As a result, the annual compound growth rate in freight activity between 2015 and 2050 is 2.7% in the *Recover* scenario, instead of the pre-pandemic 3.4% projection. Even before considering the impacts of Covid-19, the updated GDP and trade projections indicated slower growth than expected at the time of modelling for the 2019 Outlook. Covid-19 introduced a further slowdown. In addition, average distances are also lower than modelled in 2019, including for the *Recover* scenario, where there is less reliance on long-distance trade.

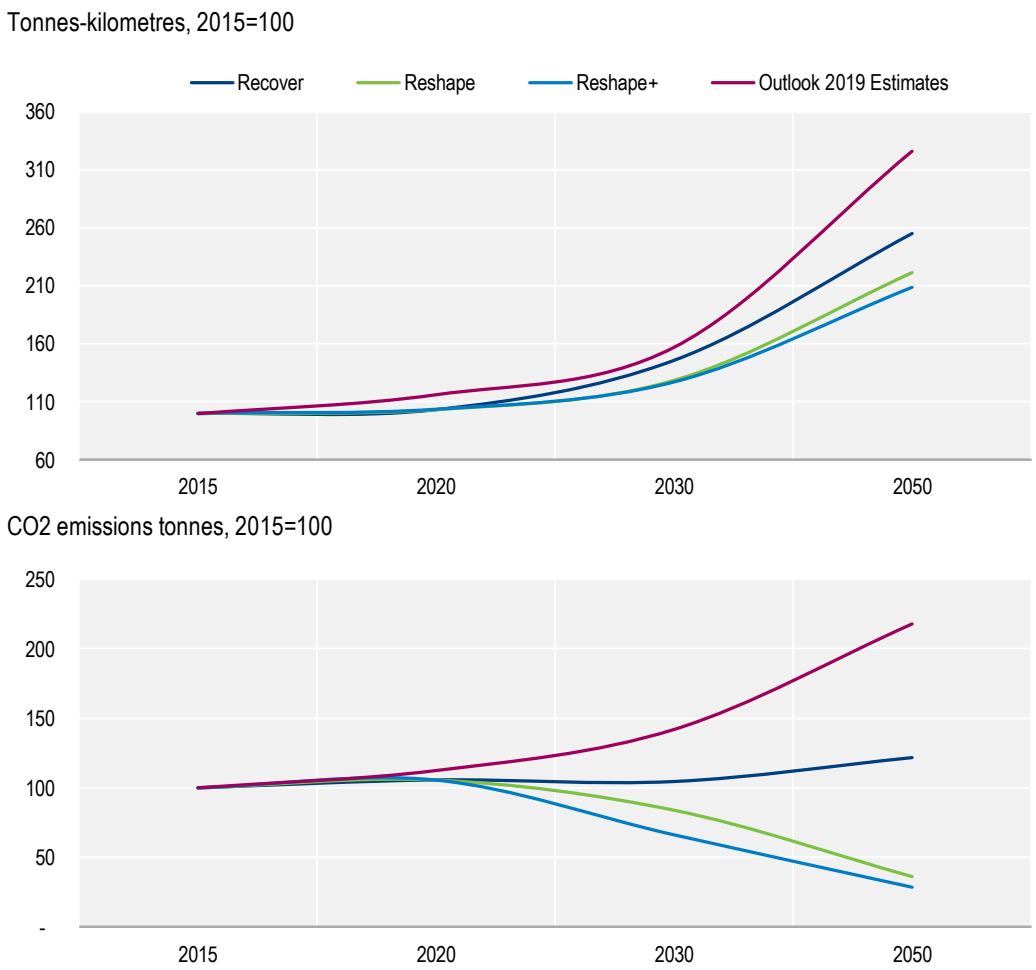
In the *Reshape* scenario, freight demand growth further decreases due to lower fossil-fuel consumption and, to a lesser extent, increasing 3D printing. These trends intensify for *Reshape+*. When coupled with trade regionalisation, this leads to even slower growth. Compared to *Recover*, freight transport activity drops 11% in *Reshape* and 18% in *Reshape+* by 2050. Transport activity still doubles between 2015 and 2050 in *Reshape+*, however.

**Substantial emission reductions are within reach but require bold action**. In the *Recover* scenario, carbon emissions will grow in the long-term, rising by 22% by 2050 compared to 2015, even considering that this scenario does include stated policies by countries and does not follow a do-nothing approach. Still, the drop in this scenario compared to the 2019 edition of the *Transport Outlook* is substantial, both due to lower demand and new mitigation commitments made since 2019.

Freight currently accounts for about 42% of total transport emissions and will be responsible for 44% of emissions by 2050. More ambitious policies will make reductions possible. Freight can remain in lockstep with other transport sectors to reduce emissions and contribute to achieving climate targets. In the *Reshape* scenario, emissions from goods transport would be 70% less by 2050 than in *Recover,* and 64% less than in 2015. The reductions in *Reshape+* are even greater, 77% below *Recover* in 2050 and 72% less than in 2015. The share of freight in total transport emissions will remain stable in *Reshape,* but drops to below 37% in *Reshape+* (see Figure 2.8 in Chapter 2).

*Reshape* envisages significantly stronger leadership and accelerated technological transitions. A wide array of economic, regulatory, technological and operational measures must converge for freight transport carbon intensity to drop by 84% between 2015 and 2050. Even then, this pathway's success also relies on a slowdown in freight transport demand growth caused by exogenous factors. The Covid-19 pandemic was a shock, economically and socially. The *Reshape+* scenario assumes policy makers leverage it as an opportunity to "build back better" by reinforcing the positive trends and measures emerging from the pandemic to push emissions down further.

## Figure 5.1. Freight transport demand and emission trends

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## Decarbonising freight transport: The state of play

Most freight transport activity takes place at sea. The maritime sector accounts for more than 70% of freight activity and around one-fifth of freight emissions. Demand for maritime freight has approximately doubled over the last two decades, growing 3.7% annually on average (Figure 5.2).

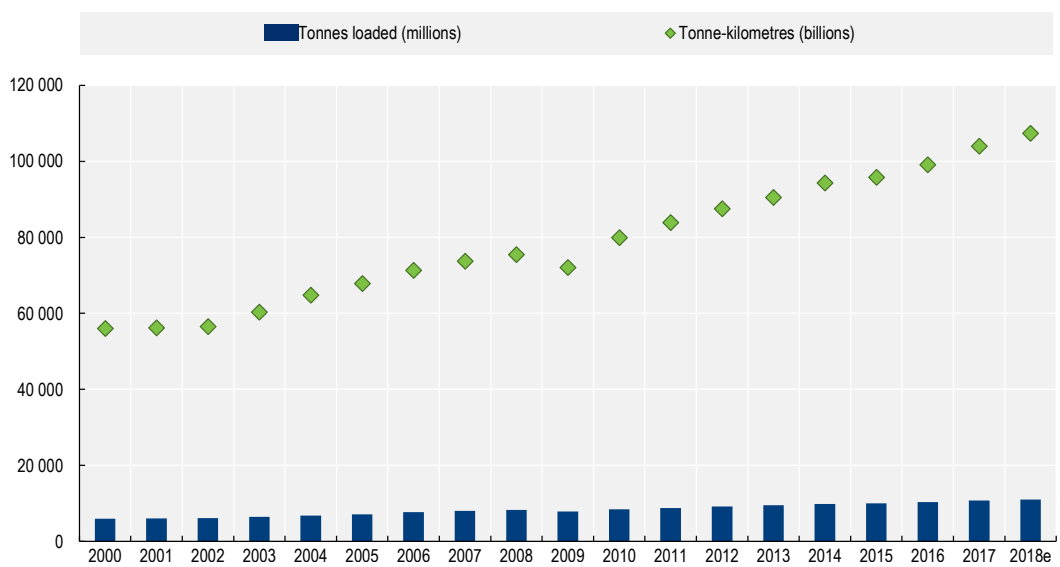
Road freight represents 15% of total freight activity but emits 44% of the sector´s $CO_2$ (see Figure 5.8 and Figure 5.11). It is the predominant surface mode with 60% of global activity for road, rail, and inland waterways combined. Road freight will retain this position in the future, even though its share will tend to fall.

> Urban delivery trips account for around 20% of all freight emissions – the same as maritime shipping. But shipping covers 70% of all freight activity, urban deliveries only 3%.

Urban freight transport covers short distances, involves many trips and small loads. These movements represent only about 3% of total freight activity but are very carbon-intensive. Urban delivery trips account for roughly the same emissions as global maritime shipping, with around 20% of all freight emissions.

Rail and inland waterways are the least carbon-intensive surface modes. Rail accounted for 30% of the global surface transport in 2015, with ambitious decarbonisation policies it will be around 35% by 2050. However, rail freight demand fell in the OECD, the European Union countries and the United States in 2019, after growing for three consecutive years (Figure 5.4). China has seen growth in all surface freight modes and makes far more use of inland waterways than any other country

### Figure 5.2. Development of total maritime freight demand, 2000-18




Note: Data for 2018 are estimates.
Source: Data on tonnes for 2000 to 2018 are from UNCTAD (2020[3]), *World seaborne trade database*, http://stats.unctad.org/seabornetrade(accessed 7 August 2020). Data on tonne-kilometres are from UNCTAD (2020[4]) *Review of Maritime Transport 2019*, https://unctad.org/system/files/official-document/rmt2019_en.pdf, based on data from Clarksons Research Services.

StatLink https://doi.org/10.1787/888934239002

Airfreight accounts for less than 1% of global freight activity measured in tonne-kilometres. The reason is that most goods moved by air are high-value and lightweight. Air cargo is by far the most carbon-intensive freight mode: it emits 20 times more than the freight sector average per tonne-kilometre, according to ITF estimates based on International Energy Agency (IEA) data. Airfreight demand remained relatively steady between 2011 and 2016, increasing by 9% in 2016/17 (Figure 5.3).

## Figure 5.3. Development of global airfreight traffic 2011-17

Source: Data from the ICAO (2018[5]) *ICAO Annual Report of the Council 2017*, https://www.icao.int/annual-report-2017/Pages/default.aspx.

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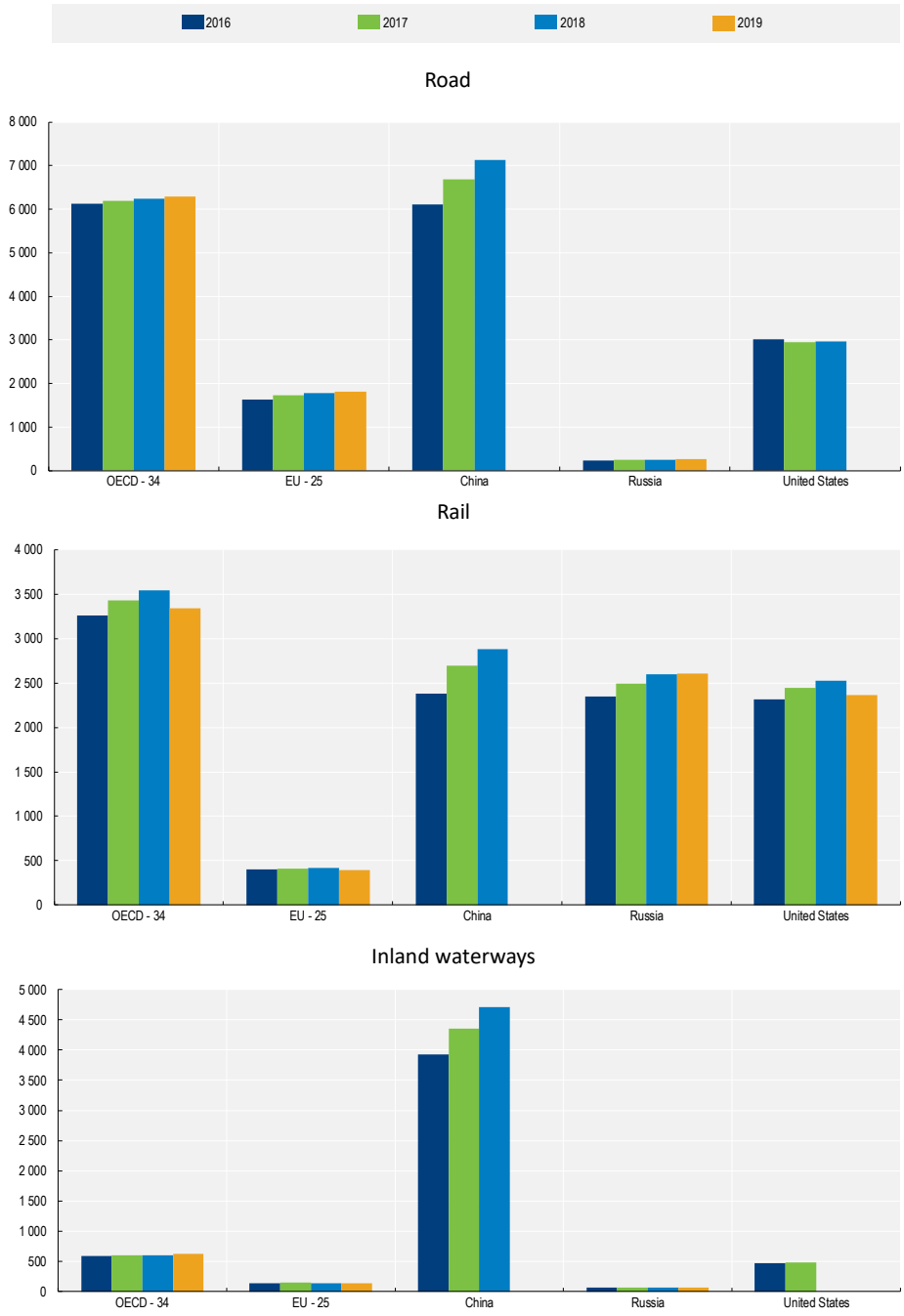
## Figure 5.4. Surface freight demand by transport mode, 2016-19

Billion tonne-kilometres




Note: Aggregates for road do not include Chile, Columbia, Cyprus, Israel or Malta. Rail aggregates do not include Australia, Belgium, Columbia or Cyprus. Inland waterway aggregates do not include Canada, Chile, Columbia, Cyprus, Estonia, Latvia, or Portugal. Data for 2019 were estimated for the following countries: Canada, Denmark, Iceland, South Korea, Switzerland, the United Kingdom, and the United States for road, Denmark, Spain and the United Kingdom for rail, and the United Kingdom and the United States for inland waterways. Data for 2018 were estimated for the United States inland waterways.

StatLink https://doi.org/10.1787/888934239040

**Fast-growing and emerging economies have the highest share of surface transport activity.** In 2015 Asia accounted for 39% of the world's surface freight transport tonne-kilometres. By 2050 nearly half will be concentrated there. Sub Saharan Africa (SSA), Asia and the Middle East and North Africa (MENA) are the regions with the highest growth rates of surface activity. On the other hand, the European Economic Area (EEA) and Turkey region, the United States and Canada, and the OECD Pacific region have the lowest growth.

**Asia's share of import-related transport movements will grow significantly,** from 28% in 2015 to more than 40% by 2050. Import transport activity to Latin America and the Caribbean (LAC) and MENA will also grow faster than in other world regions. In the developed world, import driven transport will still increase, but at annual rates below 1% for the *Reshape* and *Reshape+* scenarios. In the EEA and Turkey, in particular, this is associated with the decrease in fossil-fuel trade. Export activity in regions like MENA and Transition countries (includes part of the Former Soviet Union and non-EU south-eastern European countries). In the more ambitious scenarios, exports from these regions will be a quarter to one-third lower in 2050 than in 2015. Regions that rely on fossil-fuel exports today will face a challenging transition to a decarbonised world. Those dependent on fossil-fuel imports have a greater incentive to decarbonise.

**Regions with more ambitious decarbonising policies will increase their competitiveness in the world market**. Europe adopts bolder measures in the scenarios and sees its export-related transport costs drop the most compared to 2015 in a *Reshape* scenario. On the other hand, regions that are distant from the main consumption centres (such as OECD Pacific) or that slower to decarbonise, such as MENA and SSA, see average transport costs for their exports rise. The latter will bear the greatest increases in transport cost due to a combination of factors that include rising GDP per capita but also some of the decarbonising measures, such as carbon taxes. Efforts for global transport decarbonisation risk being perceived as unfair if the deployment of measures in these regions is not accelerated or their negative cost impacts mitigated.

We need to pay as much attention to the carbon footprint from the movement of goods as the carbon footprint from the movement of people

### *Freight's main challenges*

**The slow pace of technological progress is a major challenge for freight transport.** Technological advances allowing carbon-neutral transport for long-haul heavy-duty trucks remain mostly confined to experimental trials. Road freight will remain the dominant mode of surface transport and is responsible for the largest share of freight transport emissions. The development of batteries, other alternative fuels, supply and distribution infrastructure and vehicles have not matured yet to the point of having readily available commercial solutions for widespread adoption.

**The shortcomings of global rules for international freight modes also poses a challenge.** International maritime and aviation emissions are not included in the National Determined Contributions (NDCs) of the Paris Agreement. Efforts and regulations aimed at decarbonising these sectors are not bound to a specific country or regional body; they fall under the purview of international organisations; the International Maritime Organization (IMO) and the International Civil Aviation Organization (ICAO). Enacting bold measures is particularly difficult and time-consuming in such a context.

**A lack of policy action is holding back freight decarbonisation.** Traditionally, more attention has been paid to the movement of people than the movement of goods in the fight against climate change. Freight is mainly a private business, less subjected to public service obligations and has not been as central in

policy making as passenger transport. This has implications that include a lack of monitoring, data, and even mature methodological tools to evaluate policies.

**The lack of commercially viable carbon-neutral technologies for long-haul freight transport must be overcome**. It needs to be attractive for carriers to invest in zero-carbon fleets and zero-carbon fuels. Few carriers will invest in low-carbon fleets or low-carbon fuels if they have to pay more than conventional vehicles or fuels. This price difference arises partly because negative externalities such as greenhouse gas emissions and climate change are not reflected in the price of conventional vehicles or fuels. In fact, some parts of freight transport, such as maritime transport, receive generous fuel tax exemptions. These are an obstacle to any attempt to move to low-carbon transport.

**Tax exemptions for fossil fuels must be phased out to decarbonise freight transport successfully**. Freight transport emissions inclusion in carbon-pricing schemes at regional, national, supra-national or global levels can help pave the way to a low-carbon transition. Although global industries, like international shipping, should ideally be subject to global rules, supra-national initiatives could serve as the second-best options when there is no international agreement on carbon pricing.

**Carbon-pricing schemes present significant equity challenges**. The added costs of this type of measures can fall unequally on different population groups, economic sectors, and regions of the world. Taxation designed to eliminate pollution and inefficiency must take a fair distribution of its costs and benefits into account. Perceptions of injustice risk creating a backlash.

### *Three steps towards decarbonising freight*

**There are many low-hanging fruits to pick in freight decarbonisation.** Available solutions ready to implement for road freight include aerodynamic retrofits, reduced-rolling resistance of tyres, vehicle weight reduction, increased engine efficiency and hybridisation. Ambitious fuel economy and $CO_2$ emission standards will help the widespread deployment of these measures. For urban freight operations, alternative fuels already provide a viable commercial solution, or shortly will. Policy must foster measures such as the adoption of alternative fuels for urban logistics operations through pricing mechanisms and other incentives, stricter emission standards, zero-emissions zones, recharging infrastructure and policies geared towards the adoption of alternative fuels by large fleets. Other prime examples include eco-driving training and fewer restrictions on truck length and weight to maximise efficiencies from the introduction of high-capacity vehicles (HCVs) on certain corridors. Further measures include the adoption of common standards for new equipment and processes, promoting off-peak deliveries, creation of collection points, route optimisation or voluntary emissions reduction programmes with set targets. These and other measures are outlined in various ITF reports and resources such as the *Transport Climate Action Directory* (ITF, 2020[6]), *Towards Road Freight Decarbonisation Trends, Measures and Policies* (ITF, 2018[7]), *Decarbonising Maritime Transport Pathways to zero-carbon shipping by 2035* (ITF, 2018[8]), *How Urban Delivery Vehicles can Boost Electric Mobility* (ITF, 2020[9]).

**More collaboration between logistics companies can reduce emissions and save costs.** So far, inter-company collaboration in surface transport has only taken place to a limited extent. Scaling up collaboration will be critical to unlocking its significant decarbonisation potential. Yet antitrust legislation sometimes hinders horizontal collaboration, and legal risk has already prevented some trials (ITF, 2018[7]). Digital collaboration platforms, operated by neutral, trusted third parties, offer a promising pathway to overcome these barriers and offer the prospect of a pathway towards the Physical Internet. The shock induced by the pandemic provided a push to increase asset sharing between companies and fill otherwise empty return trips. The aftermath of the crisis can lead to market consolidation, which can in some fragmented freight transport sectors – such as trucking - lead to more opportunities to share assets and allow the scale economies that favour fleet renewals and more rapid deployment of clean technologies. A renewed emphasis on resilience with a relaxation of the just-in-time paradigm in favour of a just-in-case

approach provides more opportunities for consolidating loads and shipments. Consolidation favours the adoption of intermodal solutions that include lower carbon intensity modes such as rail or inland waterways.

**To reach climate targets, freight transport must achieve the transition to low- or zero-carbon energy sources**. Currently, only rail offers a mature and readily available solution for widespread use in zero-emissions transport. Even if some modal shift can be expected, the result is still far from what is necessary to achieve meaningful emission reductions. A significant share of road freight trips simply cannot shift to rail, not to mention intercontinental trade, which relies on sea transport and to a lesser degree on airfreight. For long-haul heavy freight trucks, shipping or aviation, the widespread use of zero-emissions technology remains some way off. For now, it remains unattractive for carriers to invest in low-carbon fleets and alternative fuels. To meet climate goals, zero-emissions technologies will need to be available and attractive to ensure adoption. Direct supply of electric energy to road vehicles ("electric roads"), hydrogen and electric batteries already hold the potential to transform heavy-duty long-distance haulage. This, however, does not include emissions from electric power generation and the availability of green hydrogen.

**It is unlikely that a single alternative will replace the internal combustion engine.** Even if electric roads can efficiently power long-haul road freight, they will not cover all trips. Hydrogen, electric batteries, or advanced biofuels could complement them where electric road infrastructure is not in place. Strategic policy choices are likely to be needed to decide which set of alternative fuels will be scaled up for general use. They will involve significant funding, especially for supply infrastructure. Scaling up solutions implies prioritising, yet some flexibility can be maintained in the short term. Trial and error are part of the prioritisation process, and further research and pilot projects must be highly encouraged. Breakthroughs in low-carbon liquid fuels, such as advanced biofuels or synthetic renewable fuels (e-fuels), or an acceleration in the deployment of carbon capture and sequestration (CCS) should not be ruled out even if not foreseeable at present. A useful resource to further explore the range of policy options and type of parameters influencing freight transport decarbonisation is the logistics decarbonisation framework proposed by Alan McKinnon is (McKinnon, 2018[10]). Recent ITF work on this topic is highlighted in Box 5.1.

### Box 5.1. Recent International Transport Forum work on freight transport

#### Electrifying Postal Delivery Vehicles in Korea

ITF (2020[11]) evaluated the costs and benefits of replacing postal delivery motorcycles with electric vehicles in eight Korean cities. It accounted for operating costs, safety performance and environmental impacts based on data from a field trial involving both vehicle types. The study recommended that the replacement scheme be continued as its combined benefits exceeded costs by 243%. Insights from focus groups of trial participants further demonstrated the importance of pilot studies and consultations with drivers to understand the local context. Driver education and adjustment of delivery routes to better suit the comparatively larger EVs were identified as key to gaining driver confidence in the programme.

#### Vietnam Logistics Statistical System

The ITF has been contributing to the establishment of a Logistics Statistical System for Vietnam (VLSS) since May 2018. The main motivation behind creating the VLSS was to house all relevant transport and logistics data within a single institute, which can then facilitate the management and dissemination of the data so that it can be used most effectively. To fill the most urgent data gap identified, the ITF created a survey to collect provincial level origin-destination data on movements of goods in tonnes and Vietnamese dong, by transport mode and commodity type for the year 2018. The study generated the first data for Vietnam on freight flows by province.

**Impact Analysis of Improving Transport Connectivity in the North East Asia Region**

The main goal of this study is to provide a methodology to assess freight cargo potential within North East Asia under particular infrastructure development scenarios. The existing ITF freight model (ITF, 2020[12]), was adjusted and applied to obtain quantitative indicators on the current connectivity levels as well as the connectivity and network performance under two different what-if scenarios for border crossings between the Republic of Korea (ROK), the Democratic People's Republic of Korea (DPRK), and China. The scenarios differ in terms of the intensity and efficiency of the border activity between ROK, DPRK, and China.

**Regulations and Standards for Clean Trucks and Buses**

This ITF (2020[13]) report reviews progress on technical standards for heavy vehicles that could enable trucks and buses with zero or near-zero emissions. It focuses on plug-in and fuel cell electric vehicles that use technologies at the forefront of green and inclusive economic development. It includes information on technical standards on charging and refuelling infrastructure and identifies remaining barriers and opportunities for their future development.

## Mastering the pandemic: Challenges and opportunities for freight after Covid-19

The downturn in freight activity caused by the pandemic has no precedent in recent decades. Freight volumes in the second quarter of 2020 were lower than during the peak of the 2008 financial crisis (ITF, 2020[14]). The ITF estimates that global freight transport dropped by 4% in 2020 on the previous year. Global GDP and trade, two critical underlying drivers of freight demand, have fallen drastically. For the first time since the Great Depression of the 1930s, world GDP will shrink year on year. The latest available projections are for a 4.2% drop according to the OECD, 4.9% for the IMF and 5.2% for the World Bank (The World Bank, 2020[15]; IMF, 2020[16]; OECD, 2020[17]). Global trade values will go down 20% according to the United Nations Conference on Trade and Development (UNCTAD, 2020[18]) and by 9.2% according to the World Trade Organisation (WTO, 2020[19]). These drops will be in line with, or surpass, the dramatic fall registered in 2008/9. The crisis affects all regions simultaneously, unlike the 2008 financial crisis when effects were concentrated in developed countries while having minor impacts on fast-growing and emerging economies. Even by the standards of systemic crises, this is a once in a century, global – truly global – crisis (Reinhart and Reinhart, 2020[20]).

### Crises of the magnitude of the Covid-19 pandemic always spark or accelerate changes in the production and movement of goods

**The pandemic will prompt long-term changes in freight transport and logistics**. Crises of this magnitude always spark or accelerate qualitative changes in the production and movement of goods. The 2008 financial crisis marked the decoupling of GDP and trade growth. It also ushered in the rise of the gig economy. From 2008 to 2018, trade grew only at half the rate of the preceding decade, and the elasticity of trade to GDP dropped (ITF, 2017[2]). Airbnb and Uber were created during the last crisis. Services based on digital platforms have expanded with new options for how people move and shop. The current shock to our economy and societies will likely be even greater, reinforcing current trends like e-commerce and trade regionalisation or leading to a new balance between supply chain resilience and efficiency.

**Freight activity decreased less than passenger transport.** The fall in consumption and disruptions to the transport network at border crossings, ports and airports affected freight transport. Nevertheless, the lockdowns and mobility restrictions introduced to contain the pandemic had a more direct impact on the

movement of people than goods. Home deliveries and e-commerce actually increased. In the United Kingdom, they increased by more than 50% compared to pre-pandemic levels (Office for National Statistics, 2020[21]). In August 2020, air passenger activity volumes (passenger-kilometres) were down 75% compared to the previous year, while freight activity (tonne-kilometres) was down 13% (IATA Economics, 2020[22]). In March and April 2020, passenger vehicle-kilometres in the United States decreased by 46% and 13% for trucks (Pishue, 2020[23]). While people had to stay put, goods had to keep moving (see Box 5.2).

### Box 5.2. Covid-19 response for road passenger and freight transport in Europe

In March 2020, the ITF launched a *Covid-19 Information* webpage collecting the road transport and border crossing measures introduced by each of the ITF/ European Conference of Ministers of Transport (ECMT) member countries (https://www.itf-oecd.org/road-transport-group/covid-19-road-group). It also contained relevant communications from the Observer organisations, European Commission (EC) and International Road Transport Union (IRU). At the time of publication, this information is still constantly updated and comes directly from the member country governments. At a time when each European country was adopting their own rules, this webpage consolidated information on what was happening across the continent. The initial motivation for the page was to provide support to drivers who had to navigate the myriad of rules. Resources for truck drivers included documents required to enter each country, quarantine rules and exceptions. Policy makers also found it extremely useful to monitor developments in other countries.

**The economic impact of the pandemic has been patchy**. Total trade values for 2020 fell significantly, but some sectors were harder hit than others. Energy trade decreased by 40% in April. Automotive products fell by a whopping 50%, according to UNCTAD. Car sales in 2020 will shrink 20% year-on-year, at least (IHS Markit, 2020[24]). Projections have oil consumption down 9% in 2020, with consumption in April falling to levels last seen in 1995, driven mainly by the sharp decrease in transport activity (IEA, 2020[25]). The 2020 decline for coal is 8% from 2019, driven by cuts to electricity generation and greater availability of renewables.

In contrast, trade in agriculture products and food grew by 2% in the first quarter of the year with cereal production expected to grow by 2.6% (FAO, 2020[26]). Not surprisingly, the goods and commodities most related to mobility suffered the most. Essential products like food and medical equipment did not fall or even grew. Telecommunications equipment saw increases in the second quarter, rising above 2019 levels. Other types of electronics also showed resilience. Digitalisation and virtualisation of processes are gathering pace.

**Public awareness of the vital role played by freight and logistics has increased**. The pandemic was a potent reminder of the essential functions required to keep societies running. Logistics and supply chains work in the background of our lives. Warehouses, delivery vans, trucks, cargo planes, freight trains, container ships, and ports are mostly either disregarded or considered a nuisance. But perceptions change. During the pandemic, societies discovered that these companies and workers were on the frontlines of the fight against the virus. They moved vaccines, critical medical equipment and supplied the essential goods people needed. This boost to the sector's public profile can help move it higher up the list of public policy priorities and towards an equitable, inclusive, and clean mobility transition.

**The freight sector suffered severe losses of revenues and jobs during the pandemic**. Global road freight annual losses for 2020 are expected to exceed EUR 550 billion, with revenues down 18% compared to 2019 (IRU, 2020[27]). The U.S. Bureau of Labor Statistics reported that 88 300 trucking jobs were lost in April 2020, more than the total job loss in the industry in 2008. These negative impacts extended to air and rail freight, although the container shipping sector made record profits in 2020. Trucking and the freight

transport sector more generally are major employers (Eurostat, 2020[28]) (RTS, 2017[29]). The decrease in transport capacity adds to the social and economic impacts of these losses and can jeopardise economic recovery. Job creation and economic revival will necessarily be a significant concern for policy makers moving forward. This will also offer a unique opportunity for public policy to shape the sector, accelerate a green transition and enhance the profile and competence levels of the sector workforce. For instance, wider training in eco-driving and fleet management skills for Small and Medium-Sized Enterprises (SMEs) would help reduce emissions among companies that make up the bulk of the road freight sector. These measures can help address the driver shortage afflicting the road freight industry (IRU, 2019[30]), also aided for instance by measures to increase safety and security for truck drivers,

**Policy decisions that will shape the future must be taken in a highly fractured and uncertain environment**. Short-term economic and transport developments depend on the evolution of the health crisis. It is not possible to overstate how uncertain this time is. Though all regions are affected, WTO data from the first semester of 2020 (WTO, 2020[31]) shows the impacts on Europe and North America are higher than in Asia. In the former regions, exports fell more than 20%, while in the latter they decreased 6.1%. Uncertainty can freeze new investments into construction or fleet renewals as well as consumer spending, leading to lower growth in the medium-term. But, companies are rapidly adapting, increasing the pace of digitalisation and automation, reallocating resources with even traditional sectors harnessing new technologies. In this time of global crisis, public policy will play a prominent role in shaping the future and the trends that will take hold (for a discussion focused on emerging economies see Box 5.3).

### Box 5.3. The ITF Decarbonising Transport in Emerging Economies project

One of the biggest challenges for climate change mitigation is to enable emerging economies to continue lifting people out of poverty while at the same time reducing greenhouse gas emissions. The ITF's *Decarbonising Transport in Emerging Economies* (DTEE) project helps governments of emerging nations to identify ways to reduce their transport $CO_2$ emissions and meet their climate goals, https://www.itf-oecd.org/dtee.

The DTEE project supports transport decarbonisation in Argentina, Azerbaijan, India, and Morocco. It is designing a common assessment framework for transport emissions that will cover several transport sub-sectors and transport modes. Country-specific modelling tools and policy scenarios will help the participating governments to implement ambitious CO2-reduction initiatives for their transport sectors. Stakeholder workshops, training sessions, briefings for policy makers and mitigation action plans will stimulate further research and the development of policies beyond the duration of the project.

The DTEE projects conference "Decarbonising transport in an unprecedented global crisis: A virtual conference" explored how transport decarbonisation policies can promote low-carbon economic growth and increased resilience of Argentina's and Latin America's transport systems following the Covid-19 crisis. Some of the questions addressed were: How can a transport decarbonisation agenda be adapted to this period of severe crisis? More specifically, how can transport decarbonisation, economic recovery and added resilience in transport systems be combined? In the short-medium term, what are the greatest challenges and opportunities to jointly address climate change mitigation and sustainable economic development?

Notes: Outputs of the virtual conference *Decarbonising Transport in an Unprecedented Global Crisis* are available at https://www.itf-oecd.org/dtee-output

**The pandemic is accelerating several trends that affect freight transport.** Digitalisation and e-commerce, trade regionalisation and decreased fossil-fuel consumption are the most noticeable trends to emerge from the pandemic. The crisis has hastened the faster adoption of technologies and business

models that were already emerging. This was led by trends where it was possible to scale up quickly, becoming a standard or even the only alternative to stay in business. On the other hand, the vulnerabilities of older systems were highlighted by the crisis and provoked dramatic downsizing.

## Digitalisation and e-commerce, trade regionalisation and decreased fossil-fuel consumption are the most noticeable trends to emerge from the pandemic

**Digitalisation, automation, virtualisation, e-commerce, and home deliveries are picking up steam**. To keep freight and essential supplies moving across borders safely and expediently, initiatives promoting paperless processes and documentation gained traction (UNCTAD, 2020[32]), (European Commission, 2020[33]). Companies, particularly large multinationals, are also making efforts to make supply chains more data-driven to manage their assets better. Accelerated automation is also likely, including for health and sanitary reasons, particularly at logistical terminals, ports, and other critical nodes of the supply chain (Rodrigue, 2020[34]). With much of bricks-and-mortar retail closed or facing restrictions, consumer goods companies were forced to step up their online presence to reach customers. Likewise, restaurants had to start or ramp up home deliveries to keep operating. The movement towards online retail and home delivery was widespread and included traditional mom-and-pop stores in small cities or the countryside as well as large franchises and shops in big cities.

**The focus has shifted to more resilient and diversified supply chains**. Supply chain vulnerabilities experienced during Covid-19 coupled with increased automation of production (e.g. through 3D-printing), trade tensions and rising wages in China are all pushing companies to build more resilience into their supply chains (Economist Intelligence Unit, 2020[35]) to gain an edge against any future shocks. This includes relocating parts of their activities, moving production closer to consumption centres and sourcing more of their products from suppliers in closer proximity. Such strategies will lead to less trans-continental transport with more regional or local supply chains that have shorter average transport distances (Friedel Sehlleier, 2020[36]), a phenomenon known as trade regionalisation (World Economic Forum, 2020[37]). Since supply chains are difficult to set up and move, as more industries take this decision, the shift in trade patterns will have long-lasting consequences. The transition to a more regionalised trade system was already underway before the crisis. In 2019 the Association of Southeast Asian Nations (ASEAN) overtook the United States as China's second-largest trading partner (Huang and Smith, 2020[38]) (Nikkei Asia, 2020[39]). Emerging and fast-growing economies have gained a larger share in global trade and increasingly trade with each other as trade tensions between the two largest economies remain.

## The transport of fossil fuels account for 30% of global international freight activity in tonne-kilometres

**The energy transition and the phasing-out of fossil fuels accelerate**. The current crisis severely affected fossil-fuel trade, with the largest drop in coal consumption since World War 2 (IEA, 2020[40]) and an unprecedented year-on-year fall in oil demand (IEA, 2020[41]). This shock will likely accelerate the phase-out of fossil fuels required to achieve the goals outlined in the Paris Agreement. Reaching the climate targets implies major shifts in energy demand. Projections by the ITF (ITF, 2018[42]) suggest that coal needs to be phased out by 2030 in OECD countries, by 2040 in China, and the rest of the world by 2050. Oil consumption would need to decline up to 22% by 2040. This would have a major impact on freight transport demand. According to ITF estimates, fossil fuels account for 30% of global international freight activity (in tonne-kilometres). In 2016, oil and gas represented 30% of the total international seaborne trade (in terms of millions of tonnes loaded), and coal represented 11% (ITF, 2018[42]). Ambitious

plans in major economies to confront climate change and diversify energy supply are already underway (European Commission, 2019[43]). These efforts will increase as the competitiveness of renewable energy increases and economic recovery programmes invest in the transition towards cleaner energy and mobility.

**Market concentration can open the door to increased asset sharing and faster adoption of cleaner technologies in surface transport**. Scale can improve the ability to cope with disruptions. Larger logistics firms are showing greater resilience in the current crisis. Small companies with low-profit margins dominate domestic freight markets and trucking in general. Many of these companies do not have the financial buffers required to overcome the current shock that can lead to a greater concentration of the sector in the future. This, in turn, can increase logistic efficiency and the industry's decarbonisation. Larger fleets tend to use more of their loading capacity, having more opportunities to consolidate loads and fill return trips. Larger companies also have more resources to invest in fleet renewals and uptake of cleaner technologies. Nonetheless, the shipping sector provides a cautionary tale. Consolidation has progressed over the last decades with no benefits to decarbonisation, particularly where large shipping companies are concerned.

**Greater emphasis on the resilience of transport systems offers opportunities for decarbonisation.** Relaxing the just-in-time paradigm allows for more widespread adoption of slow steaming in maritime shipping and lower speeds for trucks, including via stricter speed limits. Lower speeds require less energy and emit less $CO_2$. Additionally, reduced pressure to meet strict schedules will allow increased load consolidation, i.e. the fullest use of available vehicle capacity. This will also favour multimodal solutions that include less carbon-intensive modes especially suited to moving larger-scale shipments. Rail and inland waterways have much more capacity and run on dedicated, more controlled infrastructure. Hence they offered some advantages in the context of the pandemic, specifically at border crossings. The sharp growth for rail transport between Europe and China in 2020 is a sign of how greater modal and route diversity is a critical feature of more resilient transport systems (Knowler, 2020[44]; RailFreight.com, 2020[45]).

### Table 5.1. Potential challenges and opportunities for decarbonising transport post-Covid-19

| Impacts | Opportunities | Challenges |
|---|---|---|
| **Short-term impacts** | • An overall decrease in demand and transport activity<br>• Reduction in consumption and transport of fossil fuels<br>• Faster deployment of automation and digital solutions (e.g. at port terminals or border crossings)<br>• Greater resilience of less carbon-intensive modes (rail and inland waterways) | • Increase in e-commerce and home deliveries<br>• Companies delaying vehicle fleet renewals and other investments, including cleaner technologies |
| **Long-term or structural** | • Slower growth rate due to delay in economic recovery<br>• Faster decline of fossil fuels demand and need to move them<br>• Greater focus on resilience, not just efficiency, move from "just-in-time" to "just-in-case". Favours cargo consolidation, higher average loads and multimodal solutions<br>• Faster deployment of digital technology and automation that increase efficiency<br>• More suitable environment for logistical collaboration and share assets<br>• Greater market concentration can speed up the adoption of greener tech and operations<br>• Trade regionalisation can shorten supply chains and decrease transport activity (tkm) even if total volume (tonnes) remain the same<br>• Stimulus packages to aid green recovery with greater political will and opportunity to foster greener technologies and operations | • Financial constraints can delay the adoption of cleaner technologies, both private companies ability to renew fleets and equipment's and government´s ability to deploy new infrastructure<br>• Lower costs of fossil fuels reducing the commercial attractiveness of cleaner technologies. New technologies tend to have higher initial costs but can have lower total ownership costs (TOCs) mostly due to lower fuel costs and consumption. With lower fuel costs the commercial break-even for new greener technologies is longer<br>• Even faster growth in e-commerce and home deliveries, increasing congestion, emissions and decreasing consolidation and average loads<br>• Stimulus packages that support a return to the status quo |

**"Build back better" stimulus packages will accelerate transport decarbonisation**. Public policy has taken centre stage in the pandemic. Only governments have the means to bailout and restart the economy. The political opportunity and tools available to policy makers to make bold choices that reshape the economy and move it towards a clean and equitable transition is unprecedented. Long-term interest rates close to zero in many developed economies increase the likelihood of the social rate of return exceeding the financial costs of projects (OECD, 2020[46]). Historically low fuel prices provide an opportunity to phase out fossil-fuel subsidies (IEA, 2020[47]). Stimulus programmes can include investment in alternative fuel production, distribution and supply infrastructure while also improving the competitiveness and availability of multimodal solutions. Incentives can be offered to encourage ready-to-implement decarbonisation solutions and fleet renewals. Regulatory changes, which do not have direct costs for taxpayers in many instances, can be rolled out. These measures include the increased deployment of high-capacity vehicles, zoning restrictions in urban areas and stricter fuel economy standards.

**Lower fossil-fuel costs due to the pandemic undermine the competitiveness of cleaner technologies**. New cleaner technologies tend to have higher initial costs than legacy solutions. Even improvements and add-ons to increase the efficiency of existing internal combustion engine (ICE) vehicles imply some initial costs. However, these solutions decrease operational costs in the longer term and can lead to lower total ownership costs (TOCs). They are more efficient, lowering the consumption of fuel and respective costs, while in some cases they use cheaper energy sources and have lower maintenance requirements (e.g. electric engines). With lower fossil-fuel costs, the commercial break-even period for cleaner technologies increases, discouraging their adoption without changes to regulation and incentives.

**Many companies will cancel or postpone investments** in the face of uncertainty, slower demand growth and high debt (OECD, 2020[48]). This will slow down fleet renewal and the deployment of new infrastructure, including for the distribution of alternative energy. Thus decarbonisation will slow down unless public policy counteracts this trend, for instance by making bailouts conditional on decarbonisation commitments. Pressing short-term concerns about employment and the economy might move decarbonisation further down the policy agenda, with delays to implementation. A "build back better" policy that can jointly address employment, growth, equity, and decarbonisation concerns faces several challenges. These challenges include the need to stimulate the economy quickly, increasing the temptation to simply shore up incomes and prop up existing industries to the detriment of decarbonisation.

**The rise of e-commerce and online retailing could also increase freight emissions.** More e-commerce and home deliveries lead to increased congestion, more empty runs, less capacity use and higher emissions in urban areas. Short time windows for deliveries and free returns policies can exacerbate this. Also, 80% of cross border e-commerce is transported by air (IATA, 2020[49]), by far the most carbon-intensive mode. Air cargo capacity is severely constrained because much of the belly capacity is not available; cargo moved under the plane belly on passenger flights. Demand for passengers has contracted much more than freight, and many passenger flights that used to also carry cargo were cancelled or suspended. In fact, freight movements are increasingly important sources of income for the aviation industry. Several routes have reopened for cargo flights only, and passenger aircraft have been converted for freight purposes (FreightWaves, 2020[50]). Policy can steer these developments. In urban areas, the use of collection points, off-peak deliveries, zero-emissions zoning and incentives for low- to zero-emission vehicles will mitigate emissions (World Economic Forum, 2020[51]). Distance-based charges and carbon taxes could nudge operators to make better use of vehicle capacity and make multimodal solutions attractive. Table 5.1 lists further short and long-term impacts of the pandemic on freight transport decarbonisation.

## *Recover, Reshape, Reshape+*: Three possible futures for freight transport

This section explores potential development paths for freight transport to 2050. Its projections, presented in subsequent sections, are based on three different policy scenarios: *Recover*, *Reshape*, and *Reshape+*. These scenarios represent increasingly ambitious efforts by policy makers to reduce freight $CO_2$ emissions and decarbonise freight transport.

The definition of policies within these scenarios was based on inputs from experts in the form of a policy scenario survey disseminated to policy experts from all regions of the world in early 2020, ITF research – e.g. *Decarbonising Maritime Transport Pathways to zero-carbon shipping by 2035* (ITF, 2018[42]), *Towards Road Freight Decarbonisation Trends, Measures and Policies* (ITF, 2018[7]), *Enhancing Connectivity and Freight in Central Asia* (ITF, 2019[52]) – and from ITF workshops held for projects under the ITF Decarbonisation Initiative in 2020 – namely, *Modelling International Transport and Related $CO_2$ Mitigation Measures Expert Workshop* (ITF, 2019[53]) and *Setting Scenarios for Non-Urban Transport and Related $CO_2$ Measures Workshop* (ITF, 2020[54]). Table 5.3 details the assumed uptake of policy measures in the scenarios.

All three include the same baseline economic assumptions to reflect the impact of the Covid-19 pandemic: a five-year delay in GDP and trade projections compared to pre-Covid-19 levels.

The results are based on the ITF freight model, which simulates the development of goods transport activity, freight's mode shares and $CO_2$ emissions to 2050 from the base year 2015. The underlying average carbon intensities of each mode follow the IEA's Stated Policies Scenario (STEPS) in *Recover* and Sustainable Development Scenario (SDS) in *Reshape* and *Reshape+*. Box 5.4 offers a detailed description of the ITF freight transport model and changes to previous versions.

### Box 5.4. Improvements to the International Transport Forum freight transport model

The ITF freight model assesses all freight activity in all regions of the world. It estimates freight transport activity (urban, domestic non-urban activity and international) for 27 commodities for all major transport modes including sea, road, rail, air, and inland waterways. The underlying network contains 8 437 centroids, where consumption and production of goods take place. Of these, 1 134 represent the origins and destinations (ODs) for international trade flows, and 7 303 represent the ODs of domestic flows. Each of the 156 737 links of the network is described by several attributes. These include length, capacity, travel time (including border crossing times), and travel costs (per tonne-kilometre). The network also represents 102 404 nodes, encompassing 2 810 ports, 3 118 airports, 7 441 intermodal logistic platforms. It estimates tonne-kilometres, mode shares, vehicle-kilometres, energy consumption and $CO_2$ emissions from 2015 to 2050. The current version models the impact of 18 policy measures and technology developments, which are specified for each of the 19 regional markets included in the model. The key drivers of demand for freight transportation are GDP and trade, though, particularly for the domestic component, several other factors are accounted for. The methodological paper (ITF, 2020[12]) explains how these two critical elements and these other factors influence transport activity in the ITF freight model. The model was developed by ITF and first presented in 2015. It is constantly being updated and improved. New features are described in the table below.

The model was also adapted to address the drop in demand resulting from the Covid-19 pandemic in 2020 and subsequent recovery in the following years. Observed data from the freight sector and trade activity – e.g. (WTO, 2020[31]), (UNCTAD, 2020[18]) – are used as a benchmark to calibrate the estimated drops across commodities and regions. The demand follows the projected recovery of the trade activity and economic activity in a post-pandemic as projected by IMF (2020[16]). ITF approximates this

economic trajectory by introducing a 5-year delay in global trade activity compared to pre-2020 estimates. Several potential Covid-19 related aftereffects are also included as trends.

### Table 5.2. Summary of freight model updates

| | 2019 version | 2021 version |
|---|---|---|
| **Spatial resolution (centroids)** | International: 404 centroids<br>Domestic: 7 303 centroids | International:1 134 centroids<br>Domestic:7 303 centroids<br>Hierarchical structure with 493 regional hubs |
| **Domestic freight modes** | Road, rail and inland waterways | Road, rail, inland waterways, air and coastal shipping |
| **Intermodal network and infrastructure plans** | Links: 156 102<br>Nodes: 101 701<br>Port expansion plans by sea region<br>Alternative sea route (Arctic route)<br>Some Infrastructure development plans for Central Asia | Links: 156 737<br>Nodes: 102 404<br>Infrastructure is the same as previous, plus greater network detail and incorporation of infrastructure plans in some regions (e.g. Europe – TEN-T network, Central Asia and North-East Asia) |
| **Network attributes** | Travel time, border crossing time, cost and capacity | Greater resolution on pre-existing attributes, mainly on differentiating energy costs or additional charges (distance charges or carbon taxation) |
| **Network assignment** | Equilibrium assignment, with route choice model for maritime routes and shortest path for other modes in each iteration | Same assignment as before, incorporating a route choice model for airfreight as well |
| **Environmental performance** | Average tank-to-wheel vehicle $CO_2$ emissions based on the IEA mobility model (IEA, 2020[55]) | Includes both tank-to-wheel and well-to-tank $CO_2$ emissions based on the IEA mobility model (IEA, 2020[55]) |
| **Tracking of freight performance (exports/imports)** | Not included | Links freight activity and externalities and to generator (exporter/importer) |

### *Freight transport in the Recover scenario*

In the *Recover* scenario, pre-pandemic thinking in terms of policies, investment priorities and technologies shapes freight transport in the coming decade. Governments prioritise and reinforce primarily established economic activities to buttress the recovery. The main objective is the return to a pre-pandemic "normal". *Recover* is a more ambitious version of the *Current Ambition* scenario in the *ITF Transport Outlook 2019*.

**Distance-based charges and carbon taxes are introduced.** They increase transport costs, favour efficiency, and encourage a shift towards cleaner technologies.

**Infrastructure improvements increase capacity and mode choice** while lowering costs and travel times. Among these investments is the full deployment of the European Union's planned TEN-T network.

**Infrastructure and incentives for low-carbon road freight are set up**, preparing the ground for the energy transition of carbon-intensive long-haul road freight. Enhancements of terminals and operations increase the attractiveness of intermodal solutions that include rail and inland waterways. Operational changes raise average loads, for instance, asset sharing.

**Regulatory policies are pursued to lower the carbon intensity of freight transport**, such as fuel economy standards, incentives to low energy fuels, heavy capacity vehicles and lower speed limits. Innovations in Intelligent Transport Systems (ITS) and eco-driving, particularly for road freight, are deployed leading to lower costs and higher efficiency.

### *Paradigm change: Freight transport in the Reshape scenario*

In the *Reshape* scenario, the impacts of Covid-19 on freight transport also gradually disappear by 2030, as under *Recover*. *Reshape* differs in that policy makers set ambitious climate goals and implement stringent policies in their pursuit. Also, these more ambitious policies are put in place worldwide, not only regionally. *Reshape* is a more ambitious version of the *High Ambition* scenario in the *ITF Transport Outlook 2019*.

**The transition towards low-carbon energy sources for long-haul road freight vehicles accelerates** under the *Reshape* scenario, as charging and refuelling infrastructure is made available more widely.

**Autonomous road freight transport comes into play** and enables efficiency and cost gains in the freight sector. In general, technology and fuel efficiency standards advance in much bolder steps. While in *Recover*, they follow the IEA´s Stated Policies Scenario assumptions (IEA, 2020[56]); *Reshape* bases them on the IEA's more activist Sustainable Development Scenario.

The transport network improvement plans (e.g. TEN-T and developments in Central Asia) are applied equally in all scenarios.

**Important factors outside the transport sector such as fossil-fuel consumption shape freight decarbonisation.** Whereas consumption of oil and coal remains roughly constant under *Recover*, it declines under *Reshape*. Falling demand for fossil energy will change overall transport volumes and patterns since fossil fuels account for almost one-third of all international tonne-kilometres. New manufacturing techniques such as 3D printing will, to a degree, affect the trade of some manufactured commodities and therefore demand for freight transport.

### *Reshape+*: *Reinforcing Reshape*

In the *Reshape+* scenario, positive decarbonisation trends from the pandemic are locked in through policies that lead to permanent change. As in the other two scenarios, the negative impacts of Covid-19 on freight transport are overcome by 2030. For instance, although e-commerce is very likely to expand, it is assumed policies are put in place to mitigate negative impacts. As in the *Reshape* scenario, governments set ambitious decarbonisation targets and implement policies that can deliver them. However, governments seize opportunities for decarbonisation that emerged during the pandemic. By aligning economic stimuli with climate and equity objectives, they leverage economic recovery for environmental and social sustainability.

**Trade becomes less global and more regional.** An increased focus on resilience sparks more near-shoring. Shorter supply chains mean shorter distance, intra-regional goods movements rather than longer-distance inter-continental movements leading to a decrease in activity measured in tonne-kilometres

**Other policies and measures are deployed more aggressively** under *Reshape+* than under *Reshape*. They have an array of effects from changing demand volumes, costs, travel times, average loads, carbon intensities, perceptions of the attractiveness of specific modes and the transport network itself. The latter influences mode availability, capacity, travel times and costs too. These dynamics combine to determine transport activity, routing, mode choice and, ultimately, freight emissions.

## Table 5.3. Scenario specifications for freight transport

Shading denotes policies with stronger implementation in *Reshape+*

| Measure/ Exogenous factor | Description | *Recover* | *Reshape* | *Reshape+* |
|---|---|---|---|---|
| **Economic Instruments** | | | | |
| Distance charges | Distance based charges for road freight. | Charges introduced in 2030 growing to 1 cent per tonne-kilometre by 2050. | Charges introduced in 2030 growing to 2.5 cents per tonne-kilometre by 2050. | Charges introduced in 2025 growing to 6 cents per tonne-kilometre by 2050. |
| Port fees | Differentiated port fees depending on environmental performance of vessels, i.e. ships with no clean technologies have higher port fees. | Port fees grow an additional 1% by 2050 decreasing the carbon intensity of shipping by 0.5%. | Port fees grow an additional 20% by 2050 decreasing the carbon intensity of shipping by 10%. | Port fees grow an additional 30% by 2050 decreasing the carbon intensity of shipping by 15%. |
| Carbon pricing | Pricing of carbon-based fuels based on the emissions they produce. | Carbon pricing varies across regions: USD 150- 250 per tonne of $CO_2$ in 2050. | Carbon pricing varies across regions: USD 300-500 per tonne of $CO_2$ in 2050. | |
| **Enhancement of infrastructure** | | | | |
| Rail and inland waterways improvements | Increase in attractiveness of intermodal solutions, namely trips with a rail or inland waterway component. | The penalty for mode transfers at intermodal terminals is decreased and alternative specific constant of rail and inland waterways increases. The rate of change varies by world region, e.g. in Western Europe it grows from 2% in 2020 to 20% in 2050. | The penalty for mode transfers at intermodal terminals is decreased and alternative specific constant of rail and inland waterways increases. The rate of change varies by world region, e.g. in Western Europe it grows from 4% in 2020 to 40% in 2050. | The penalty for mode transfers at intermodal terminals is decreased and alternative specific constant of rail and inland waterways increases. The rate of change varies by world region, e.g. in Western Europe it grows from 10% in 2020 to 80% in 2050. |
| Transport network improvement plans | Construction and upgrade of new infrastructure, e.g. new roads, railways or port expansion. | The transport network is updated with planned new infrastructure and upgrades (e.g. increases in port capacity, developments in Central Asia, TEN-T European projects) expected to become operational between 2020 and 2050. | | |
| Energy transition for long-haul heavy-duty road freight vehicles | Includes a range of solutions to achieve zero emissions for long haul heavy duty road vehicles, including: Electric Roads (ERS), hydrogen fuel cells, advanced batteries, or low carbon fuels (for more check (ITF, 2019[1])) | Very low, marginal implementation | 14% of heavy trucks tkm are on these systems by 2050. Costs begin higher than conventional fuels but by 2050 become lower. Differences in uptakes and costs by regions. | 37% of heavy trucks tkm are on these systems by 2050. Costs begin higher than conventional fuels but by 2050 become lower. Differences in uptakes and costs by regions. |
| **Operations management** | | | | |
| Asset sharing and the Physical Internet | Sharing assets (e.g. vehicles or warehouses) to make resource management for logistics activities more efficient. | Less than 1% Increase in average loads of road freight by 2020 growing to 2% in 2050. | 4% Increase in average loads of road freight by 2020 growing to 10% in 2050. | Less than 4% Increase in average loads of road freight in 2020 growing to 20% in 2050. Accelerated increase between 2020 and 2030. |

| Measure/ Exogenous factor | Description | *Recover* | *Reshape* | *Reshape+* |
|---|---|---|---|---|
| **Regulatory instruments** | | | | |
| Slow steaming and speed reduction for maritime and trucks | Reduction of the average speed of ships or trucks to reduce emissions. | Decrease in the speed of road and maritime transport is less than 1% in 2020, growing to a 10% decrease by 2050. | Decrease in the speed of road and maritime transport is 1% in 2020, growing to a 20% decrease by 2050. | Decrease in the speed of Road and Maritime modes by more than 1% in 2020, growing to a 33% decrease by 2050. |
| Fuel economy standards for internal combustion engine (ICE) vehicles and fuel | Increase in fuel efficiency of ICE road freight vehicles. | Carbon intensity per tkm of ICE trucks reduces by less than 1% in 2020 up to 10% by 2020. | | Carbon intensity per tkm of ICE trucks reduces by 2% in 2020 up to 15% by 2020. |
| Low emission fuel incentives (including electric vehicles) and investment in distribution/supply infrastructure | Increases the share of low emission vehicles km (e.g. electric, hydrogen, clean biofuels, biogas) in commercial vehicle fleets, lowering the average carbon intensity of road freight. | Increases in low emission fuels vehicle shares vary by world-region, in faster adoption regions (e.g. Western Europe) there is an increase of 1% by 2025, growing to 10% by 2050. | Increases in low emission fuels vehicle shares vary by world-region, in faster adoption regions (e.g. Western Europe) there is an increase of 2.6% by 2025, growing to 20% by 2050. | Increases in low emission fuels vehicle shares vary by world-region, in faster adoption regions (e.g. Western Europe) there is an increase of 4% by 2025, growing to 30% by 2050. |
| Heavy Capacity Vehicles (HCV) | Road vehicles that exceed the general weight and dimension limitations set by national regulations. Truck loads increase 50% and costs fall 20% per tonne-kilometre where HCVs are adopted. | By 2050 2% of non-urban road freight transport activity (tkm) is done with high capacity vehicles. | By 2050 5% of non-urban road freight transport activity (tkm) is done with high capacity vehicles. | By 2050 10% of non-urban road freight transport activity (tkm) is done with high capacity vehicles. |
| **Stimulation of innovation and development** | | | | |
| Autonomous Vehicles and Platooning | Simulates the adoption of autonomous trucks (platooning and full autonomy) in road freight. The adoption of this technology reduces costs for road freight, but also its $CO_2$ intensity, on the other hand it can induce demand and reverse modal shift. | Adoption varies by sector (urban and non-Urban) and world-region. Very low to marginal adoption in this scenario. | Up to 45% uptake on non-urban in some regions by 2050 (Europe, North America, China, Japan and South Korea). Uptake on urban freight is lower. Decrease of 14% on carbon intensity and 45% on costs. | Up to 90% uptake on non-urban in some regions by 2050 (Europe, North America, China, Japan and South Korea). Uptake on urban freight is lower. Decrease of 14% on carbon intensity and 45% on costs. |
| Electric/alternative fuel vehicle penetration and increases in efficiency for all transport modes | Electric/alternative fuel vehicle penetration and increases in efficiency for all transport modes (including average loads and vehicle capacity). | Follows the IEA STEPS Scenario. | Follows the IEA SDS Scenario. | |
| Intelligent Transport Systems (ITS) and eco-driving | Development of ITS to provide better quality, real-time, automatic data collection and processing to improve fleet management, routing and assist driving. | Implemented with regional variations, in regions with faster deployment (e.g. Western Europe) reductions of 4% in carbon intensity in 2020 and close to zero in 2050. | Implemented with regional variations, in regions with faster deployment (e.g. Western Europe) reductions of 10% in carbon intensity in 2020 and 1% in 2050. | Implemented with regional variations, in regions with faster deployment (e.g. Western Europe) reductions of 15% in carbon intensity in 2020 and close to 2% in 2050. |

| Measure/ Exogenous factor | Description | *Recover* | *Reshape* | *Reshape+* |
|---|---|---|---|---|
| **Exogenous factors** | | | | |
| 3D Printing | Enables manufacturing closer to the point of consumption, leading to drop in long distance trade for several commodities compared to estimated values, namely manufactured goods. | Negligible impact on trade. | International trade shrinks 10% by 2050. Values differ by commodities, electronic and manufactured goods have higher falls. | |
| Decarbonisation of energy | Decreases in trade and consumption of oil and coal as societies decarbonise, directly impacting freight transport demand for fossil fuels. | Oil and Coal grow less than other commodities (following ENV-Linkages model (ENV-OECD), (Chateau et al., 2014) | Yearly decrease of 3.35% for coal and 2.1% for oil. By 2050 coal trade has reduced 65% and oil close to 50%, compared to 2020 estimates. | Yearly decrease of 10% for coal and 2.1% for oil. By 2050 coal trade has reduced by 96% being almost phased-out globally and there is close to a 50% decrease in oil consumption compared to 2020 estimates. |
| Trade regionalisation | Simulates increased trade exchanges within regions or trade blocks, while decreasing longer distance trade between regions. | No additional fees compared to baseline. | | 5% increase in penalty fees for inter-regional trade. |
| E-commerce | Simulates the impact of growth in e-commerce and home deliveries. Increases the estimated demand of goods over time in addition to the projected values. | Urban freight with an additional 5% demand increase by 2050, smaller impacts on non-urban freight. | | |

Note: There is an overlap between the "Energy transition for long-haul heavy-duty road freight vehicles", "Low emission fuel incentives (including electric vehicles) and investment in distribution/supply infrastructure" and "Electric/alternative fuel vehicle penetration" measures. But they apply differently to different regions of the world and vehicle types, the adoption rate implemented in the scenario matches the highest value between this three measures for each world region and vehicle type/operation.

## Demand for freight: Substantial growth at a slower pace

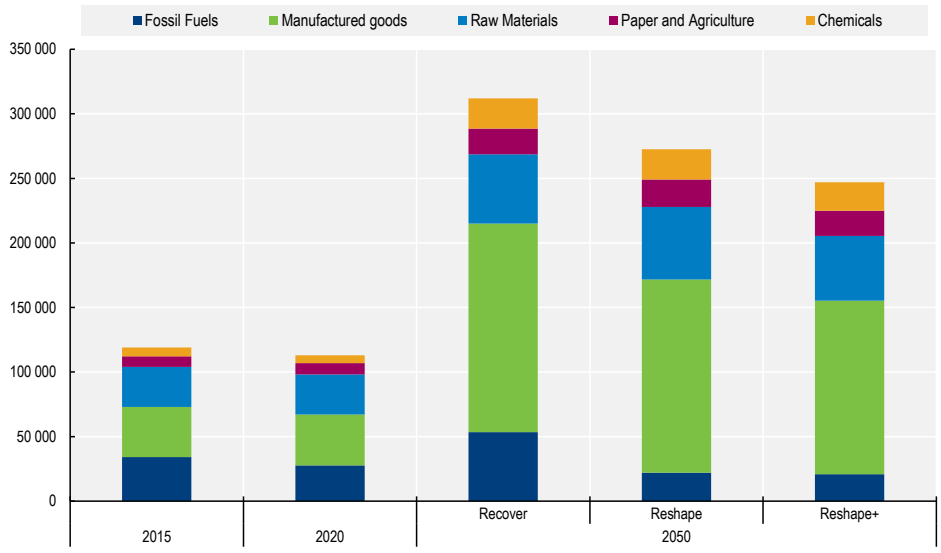
Demand for freight transport will grow more slowly than previously estimated. Its compound annual growth rate between 2015 and 2050 is adjusted down to 2.7% in the *Recover* scenario, from 3.4% in the ITF's previous baseline estimate (ITF, 2019[1]). Freight activity in 2020 decreased by 4% compared to 2019 in the ITF simulation. Meanwhile, moderate adoption of 3D printing and an accelerated shift away from fossil fuels in the *Reshape* scenario bring the growth rate of freight movement down further to 2.4% annually. In *Reshape+*, an even quicker substitution of fossil fuels, more prevalent trade regionalisation and, to a lesser extent, 3D printing combine to further reduce the annual growth rate to 2.1%.

**A drop in consumption of fossil fuels will significantly affect trade flows**. In 2015, the shipment of fossil fuels accounted for 29% of all international freight activity. By 2050, that share drops to 17% in *Recover* and 8% in *Reshape* and *Reshape+* (see Figure 5.5). However, absolute movements of fossil fuels increase in *Recover*, decline in *Reshape*, and fall further in *Reshape+*. Europe depends heavily on fossil fuels from other regions and will see related import activity decline below 2015 levels by 51% in *Reshape* and 53% in *Reshape+* by 2050. Meanwhile, regions that rely heavily on fossil-fuel exports see related freight activity decline. In Transition countries, fossil fuel export activity falls by 21% in *Reshape* and 26% in *Reshape+* between 2015 and 2050. MENA exhibits a similar pattern, with drops of 27% in *Reshape* and

32% in *Reshape+* over the same period. On the other hand, the EEA and Turkey region, as well as the United States and Canada region, are poised for growing export activity across all scenarios. *Reshape+* generally tempers export activity, although Europe sees its export activity grow faster in this scenario.

## Figure 5.5. Import-related freight transport by type of goods to 2050

Under three scenarios, billion tonne-kilometres




Note: Figure depicts ITF modelled estimates. *Recover*, *Reshape* and *Reshape+* refer to the three scenarios modelled, which represent increasingly ambitious post-pandemic policies to decarbonise transport.

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**Trade movements are shaped by a set of often opposing forces.** Macroeconomic forces beyond the purview of transport policy makers strongly determine trade volumes but are moderately elastic for shipping costs. Carbon taxes and wage increases drive these up, but improved fuel efficiency, better infrastructure and adoption of cleaner technology may cause them to fall. Trade activity in 2050 is generally lower in *Reshape* than *Recover* in 2050. The exception is European exports, which benefit from the region's early adoption of low-carbon technologies. More trade regionalisation and, to a lesser extent, 3D printing further temper growth in trade movements in the *Reshape+* scenario.

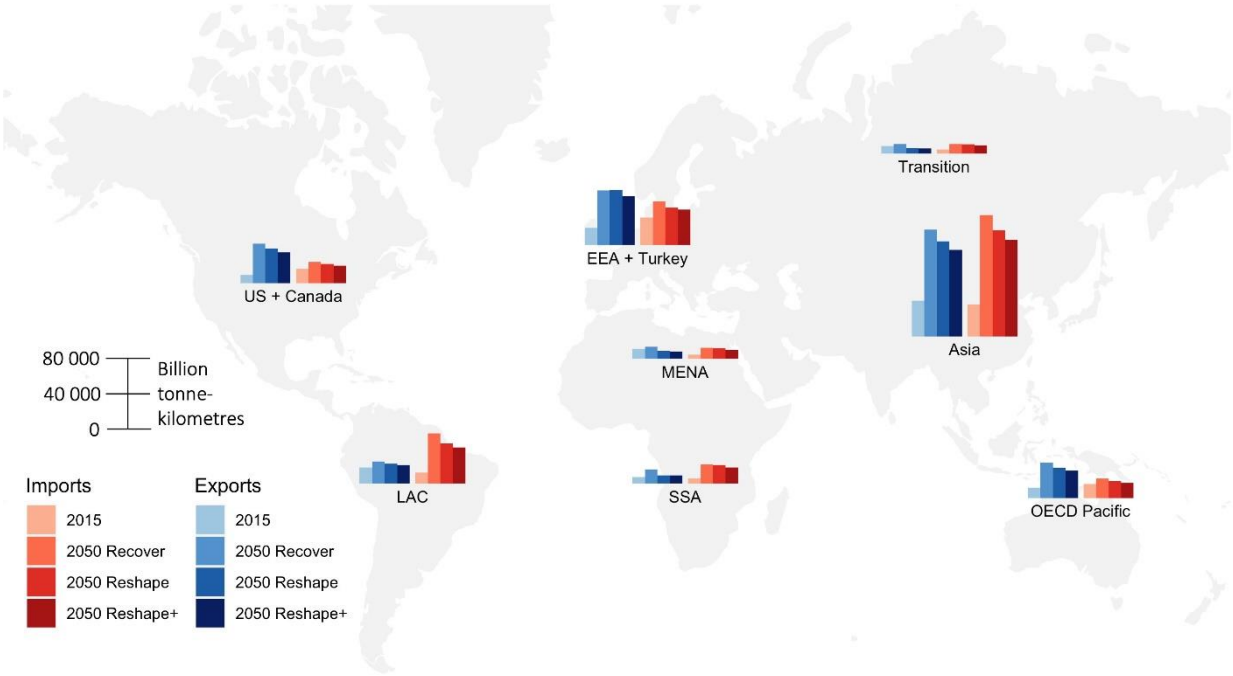
**Export-related transport will grow in OECD countries, but different policies affect regions differently.** The United States and Canada will see the most significant increase in export-related transport across all scenarios. Exports from the OECD Pacific region will also grow, but at a lower rate in *Reshape* and *Reshape+* than in *Recover*. EEA and Turkey, benefitting from a central location and faster deployment of cleaner technologies, sees higher growth in the *Reshape+* scenario. Transition countries and MENA see exports grow moderately in *Recover* and decline below 2015 levels in the other scenarios (see Figure 5.6).

**Import-related transport will grow at the highest rates in fast-growing countries in Latin America, Asia and Sub-Saharan Africa** in all three scenarios. However, more ambitious decarbonisation will temper growth, leading to 20% less import activity in *Reshape* and 28% less in *Reshape+* by 2050 compared to *Recover* levels in LAC. With less dependence on fossil fuels and slower economic growth, the OECD Pacific, the United States and Canada, and the EEA and Turkey will see the lowest growth rates

for import activity. For example, import activity to OECD Pacific will only rise 7% above 2015 levels in 2050 under *Reshape+*.

## Figure 5.6. Import- and export-related freight transport by world region in 2050

Under three scenarios, billion tonne-kilometres




Note: Figure depicts ITF modelled estimates. *Recover*, *Reshape* and *Reshape+* refer to the three scenarios modelled, which represent increasingly ambitious post-pandemic policies to decarbonise transport. EEA: European Economic Area. LAC: Latin America and the Caribbean. MENA: Middle East and North Africa. OECD Pacific: Australia, Japan, New Zealand, South Korea. SSA: Sub-Saharan Africa. Transition economies: Former Soviet Union and non-EU South-Eastern Europe.

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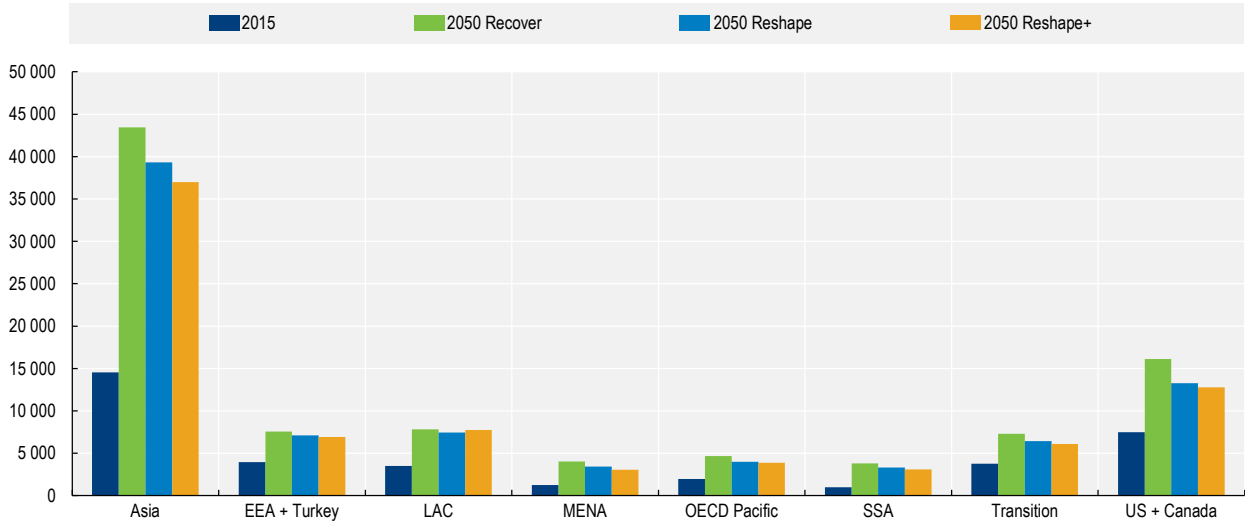
**The non-OECD share of freight transport activity will grow**, with 63% of surface and domestic air and shipping in non-OECD economies in 2015 increasing to 69% by 2050. Surface freight transport grows fastest in SSA, the region with low volumes to start with. Asia will see its share of activity increase, while that of the Transition countries will fall.

**Asia has the highest level of freight activity by far**, considering surface and domestic shipping and air transport. Thus, Asia could provide support for realising economies of scale for emerging low-carbon freight technologies and systems. On a per-capita basis, however, activity levels are roughly twice as high in Transition and three times as high in the United States and Canada. Surface transport and domestic sea and air will increase in all regions by 2050, although to a lesser extent in *Reshape* and *Reshape+* scenarios. *Reshape+* generally lightens activity further than *Reshape,* although there is a slight increase in LAC due to a shift to greater regional trade activity (see Figure 5.7).

## Figure 5.7. Freight activity by world region to 2050

Under three scenarios, surface and domestic air and sea movements in billion tonne-kilometres




Note: Figure depicts ITF modelled estimates. *Recover*, *Reshape* and *Reshape+* refer to the three scenarios modelled, which represent increasingly ambitious post-pandemic policies to decarbonise transport. EEA: European Economic Area. LAC: Latin America and the Caribbean. MENA: Middle East and North Africa. OECD Pacific: Australia, Japan, New Zealand, South Korea. SSA: Sub-Saharan Africa. Transition economies: Former Soviet Union and non-EU South-Eastern Europe.

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## Road freight will continue to dominate future surface transport in all three scenarios

**Maritime transport will continue to be the dominant freight mode.** Sea transport offers high capacity, access to global markets at low cost and relatively low carbon-intensity, and more than 70% of total tonne-kilometres will take place by sea in all three scenarios (see Figure 5.8). Sea movements are even more dominant in longer distance import-export related transport where their share of the mode split is above 90%. Maritime's mode share is slightly lower in *Reshape+* as trade regionalisation, and climate measures discourage long-distance trade flows. While total freight activity is 18% lower in *Reshape+* than *Recover* in 2050, the difference for maritime is 20%.

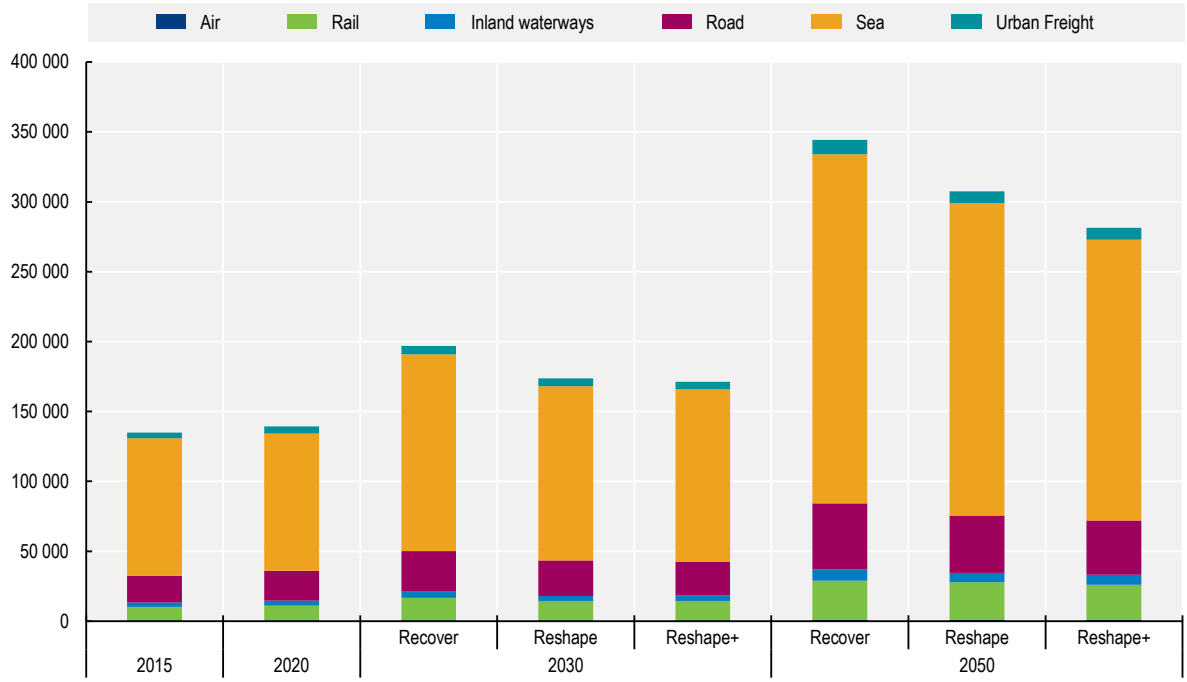
**Among surface modes, rail is forecast to account for an increasing share of non-urban freight activity**. Since rail is less carbon-intensive than road freight, its share of activity grows even faster with more ambitious decarbonisation policies, despite the declining share of fossil-fuel transport, the main commodity moved by rail today. With 30% of non-urban freight activity in 2015, rail will capture 34% in *Recover* and 36% in *Reshape* and *Reshape+* by 2050. Even with this growth, road freight will continue to dominate future surface transport in all three scenarios. Airfreight's share of activity, measured in tonne-kilometres, also increases but does not surpass 1%.

**E-commerce sparks growth in urban freight that has accelerated during the pandemic.** Although this growth may appear moderate in terms of tonne-kilometres, e-commerce tends to incur higher levels of vehicle activity, which is more directly associated with carbon emissions, congestion, and other externalities. Because these side-effects are so significant and apparent, all policy scenarios assume that governments will implement a range of policies (e.g. carbon taxes, distance charges, zoning restrictions,

dedicated pick-up locations) to manage parcel movements better. Urban freight activity is estimated to grow faster than non-urban trucking but can be addressed with more ambitious policies.

## Figure 5.8. Freight activity by transport mode to 2050

Under three scenarios, billion tonne-kilometres




Note: Figure depicts ITF modelled estimates. *Recover*, *Reshape* and *Reshape+* refer to the three scenarios modelled, which represent increasingly ambitious post-pandemic policies to decarbonise transport. Air transport accounts for less than 1% of total demand. Urban freight specifies road freight in urban areas.

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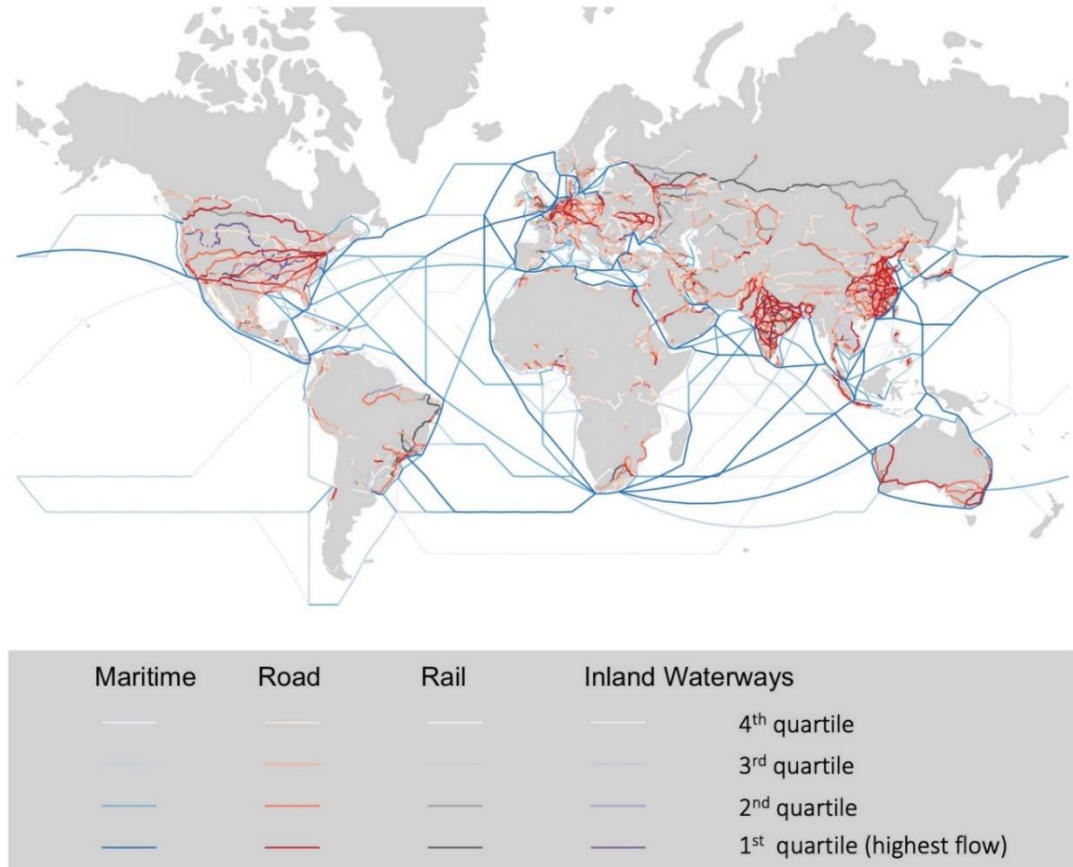
**Some rail corridors stand out for their potential to increase traffic.** Freight flow maps reveal patterns and opportunities that are less apparent in aggregate graphics. In alignment with the mode shares illustrated in Figure 5.8, the road and maritime freight networks are especially developed. A handful of rail corridors stand out for their potential to increase traffic, particularly freight lines connecting Asia to Europe through Transition countries and the coast-to-coast routes of North America. Dense and busy road networks in the United States and Canada, central Europe, China, and India could be fertile ground for collaborative decarbonisation measures, such as the transition to clean energies of heavy-duty long-haul trucks or shared logistics assets. A few inland waterways also carry considerable freight volumes, for instance, the Missouri and Mississippi rivers in the United States and the Amazon River in Brazil (see Figure 5.9 and Figure 5.10).

**Today's policies will determine the distribution, routing, and mode shares of freight flow in 2050.** In all scenarios, fast-growing countries will further develop their road freight networks, and global warming will open new maritime routes through the Arctic Ocean. However, more ambitious decarbonisation measures in *Reshape* favour flows between Europe and East Asian countries, which can take advantage of existing and developing rail corridors. Similarly, increased trade regionalisation in *Reshape+* encourages greater flows between the United States and Canada region and the nearby LAC region.

## Figure 5.9. Global freight flows in the network by mode, 2015

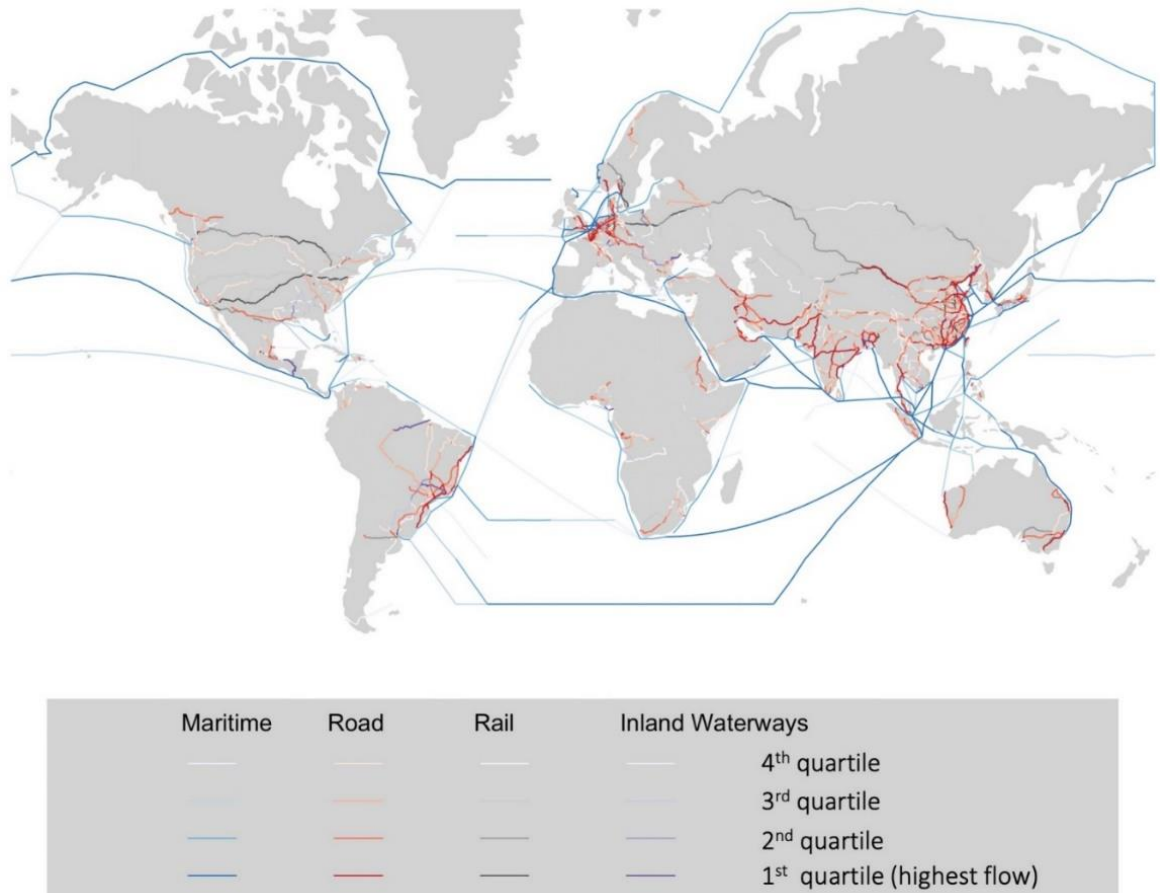
Quartiles based on weight of goods. Excludes airfreight.




Notes: Figure depicts ITF modelled estimates. Only the top 20% most active links in terms of weight of goods transported are depicted.

## Figure 5.10. Variation in freight flows between 2015 and 2050

Quartiles indicate percentage change in weight of goods transported between 2015 and 2050 under the *Reshape* scenario. Excludes air freight.




Notes: Figure depicts ITF modelled estimates. Only the top 10% most active links in terms of weight of goods transported are depicted. 1st quartile includes routes with the highest increase in freight flows.

### Box 5.5. Future maritime trade flows

Economic development and population growth will continue to drive future demand for maritime trade. However, the transition to non-fossil fuels and the regionalisation of trade patterns will likely have a substantial impact, according to the ITF (2020[57]) report *Future Maritime Trade Flows.*

The cost of maritime transport will increase as a result of expected regulations to decarbonise shipping. However, these cost increases will be small in relation to the total value of traded goods and the impact on global trade may be marginal. Trade routes to and from less-developed countries at the end of poorly serviced transport chains may feel significant repercussions but affected countries could be compensated for some of the adverse impacts on trade.

Increased ship size and industry consolidation, as well as other developments in liner shipping, have changed maritime trade patterns by reducing the number of calls to secondary ports. However, the trend towards marginalisation of secondary ports may have come to an end, as the movement of ever-larger ships seems to have run its course.

China's Belt and Road Initiative (BRI) will likely have a significant impact on maritime trade flows if fully implemented. The maritime part of the initiative has a stronger potential to impact overall trade than the terrestrial investments, focused on railway links and pipelines. Investment in the ports connecting China with other parts of the world could cut maritime trade costs, thereby reducing trade costs, and increasing imports and exports.

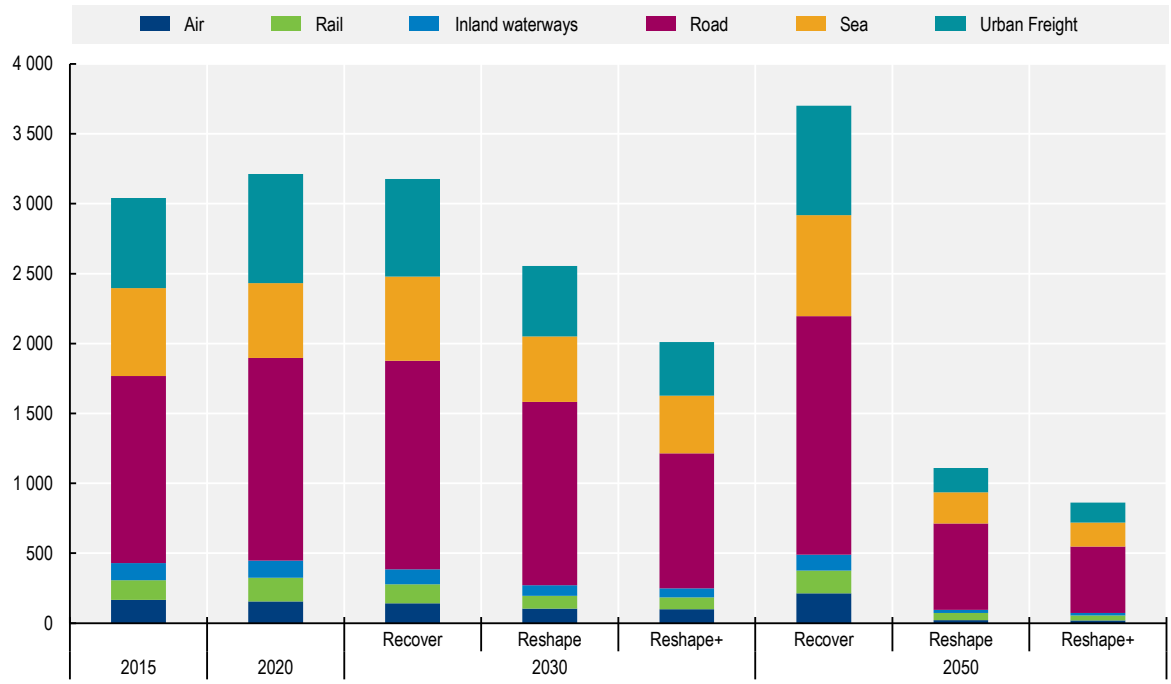
Modelling projections show that the share of global trade using the Northern Sea Route by the next century will be fairly small, at less than 5%, even in extreme climate change scenarios. Interest in developing relevant infrastructure in the Arctic Seas continues despite uncertainties, however. If a Central Arctic passage became feasible, it could trigger a considerable change in the configuration of maritime trade flows.

## $CO_2$ emissions from freight transport: Reversing emission growth

Sharply falling freight emissions in the *Reshape* and *Reshape+* scenarios offer pathways to achieving the transport sector's climate targets. Freight emissions are poised to increase by 2050 under *Recover* assumptions but decline from 2015 levels by 64% in *Reshape* and 72% in *Reshape+*. A moderate shift to rail, which is less carbon-intensive, accounts for only a small share of the reductions. Most of the decarbonisation is due to the broad adoption of low-carbon technologies across all modes. By 2050, more ambitious measures in *Reshape* and *Reshape+* could reduce the overall carbon intensity of freight transport by 84% and 86% below *Recover* levels, respectively. There is also a 10% drop in activity in *Reshape* and 18% in *Reshape+* compared to *Recover*. Although the measures in the former two scenarios reduce emissions from trucking considerably, this transport mode proves particularly difficult to decarbonise.

## Figure 5.11. $CO_2$ emissions from freight activity by transport mode in 2030 and 2050

Under three scenarios, million tonnes of $CO_2$ direct emissions (tank to wheel/wake)




Note: Figure depicts ITF modelled estimates. *Recover*, *Reshape* and *Reshape+* refer to the three scenarios modelled, which represent increasingly ambitious post-pandemic policies to decarbonise transport. Tank-to-wheel/wake emissions are produced by using a vehicle (i.e. from vehicles' fuel consumption). Tank to wake is specifically used to refer to ships and aircraft. Urban freight specifies road freight in urban areas.

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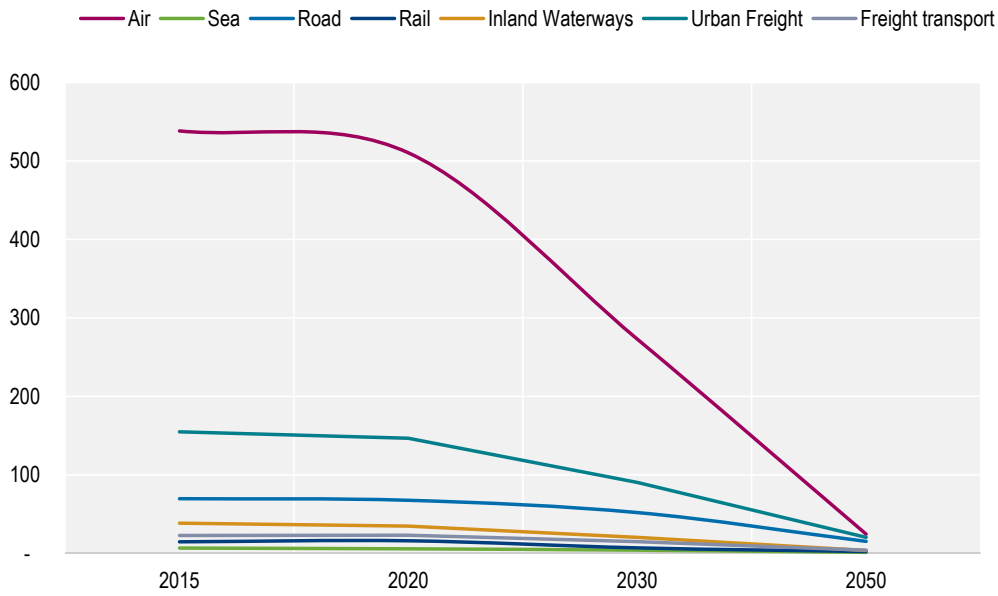
Global freight activity fell by 4% in 2020 due to the Covid-19 pandemic. Freight emissions only dropped by 1% because of the increase in high-emitting urban deliveries.

**Freight emissions fell less than freight activity in 2020 due to the spike in urban delivery.** Global activity volumes fell by 4% due to the pandemic in 2020 compared to 2019; emissions only dropped by 1% (see Figure 5.8 and Figure 5.11). The main reason is the growth in urban freight activity that increased by 7% from 2019 to 2020, driven by increased e-commerce and home deliveries. Urban freight has the highest carbon intensity of all modes except aviation (see Figure 5.12).

## Figure 5.12. Carbon intensity of freight by transport mode to 2050

Under *Reshape* scenario, grammes of $CO_2$ per tonne-kilometre




Note: Figure depicts modelled estimates based on ITF and IEA Mobility Model (IEA, 2020[55]). Reshape is one of the three scenarios modelled. It assumes ambitious post-pandemic policies to decarbonise transport are put in place. Urban freight specifies road freight in urban areas. Freight transport specifies the sector average.

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**Sharply falling freight emissions are driven by a steep decrease in carbon intensity across modes and by slower demand growth for freight** in the *Reshape* and *Reshape+* scenarios (see Figure 5.12). A combination of measures acting on different levers of decarbonisation can significantly drive down the carbon intensity of road freight. The deployment of infrastructure to support an energy transition for long-haul transport and incentives for low emission fuels pushes the road sector to cleaner energy sources. Fuel economy standards, ITS solutions, autonomous vehicles and lower speed limits all push for greater energy efficiency. Asset sharing and heavy capacity vehicles drive up average loads, hence also energy efficiency. Carbon taxes are an incentive to pursue both greater efficiency and move to cleaner technologies. Nonetheless, despite a substantial fall in carbon intensity of 78% between 2015 and 2050, road transport will be responsible for more than half of all freight transport emissions in 2050 in the *Reshape* scenario (56%; 72% if urban freight is included, see Figure 5.11).

Rail transport can become even closer to being carbon neutral with zero tank-to-wheel emissions, assuming a significant push towards the electrification of networks and the deployment of other clean tail-pipe energy sources such as hydrogen, batteries or clean biofuels. Improved operations and enhanced commercial attractiveness coupled with new infrastructure also allows rail to increase its mode share. This contributes to the overall fall in freight transport emissions given rail´s relatively lower average carbon intensity – unlike other non-urban modes, rail can avail itself of readily available and mature low-carbon solutions.

In aviation, fuel efficiency gathers pace with the faster introduction of advanced aircraft designs. Alternative fuel solutions are adopted by the industry, with synthetic aviation fuels available in quantities and in a price range that allows their commercial adoption. Government support for research, innovation and supply infrastructure will be necessary to make this a reality.

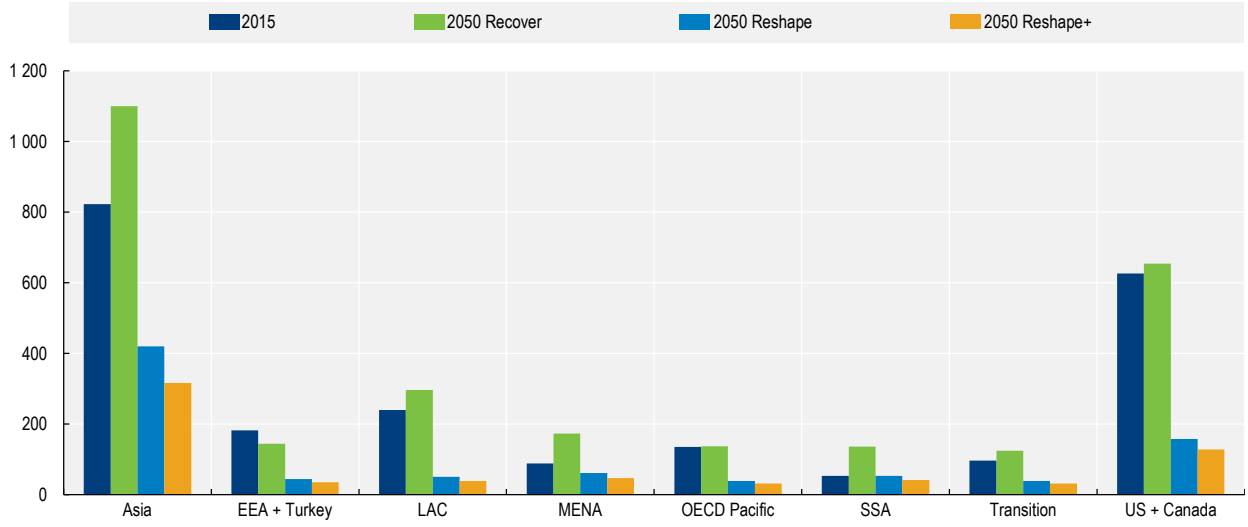
The emission factors in shipping also fall drastically in *Reshape*, a more aggressive deployment of slow steaming, port fees that favour clean ships and a wide array of technologies and operational changes contribute to this. A more in-depth exploration of the several technological options available to decarbonise this sector, along with the policy implication associated with their fast and mass adoption, are available in (ITF, 2018[8]) and (ITF, 2020[58]).

## Freight emissions per capita in 2050 will still be around three times higher in the OECD than non-OECD countries

**Surface freight emissions decrease more in OECD than non-OECD countries, but the per capita levels remain much higher.** The share of emissions from non-OECD economies will grow from around 55% to 69%, but when looking at numbers per inhabitant, the values in 2015 for OECD economies are four times higher when compared to non-OECD economies. Even decreasing at a faster pace due to the deployment of more ambitious policies, the emissions per capita in 2050 will still be around three times more in OECD than non-OECD countries. This highlights the significantly higher carbon footprint of developed economies which largely persists in the three scenarios tested.

### Figure 5.13. $CO_2$ emissions from surface freight transport by world region in 2050

Under three scenarios, million tonnes $CO_2$ direct emissions (tank-to-wheel)




Note: Figure depicts ITF modelled estimates. *Recover, Reshape* and *Reshape+* refer to the three scenarios modelled, which represent increasingly ambitious post-pandemic policies to decarbonise transport. EEA: European Economic Area. LAC: Latin America and the Caribbean. MENA: Middle East and North Africa. OECD Pacific: Australia, Japan, New Zealand, South Korea. SSA: Sub-Saharan Africa. Transition economies: Former Soviet Union and non-EU South-Eastern Europe.

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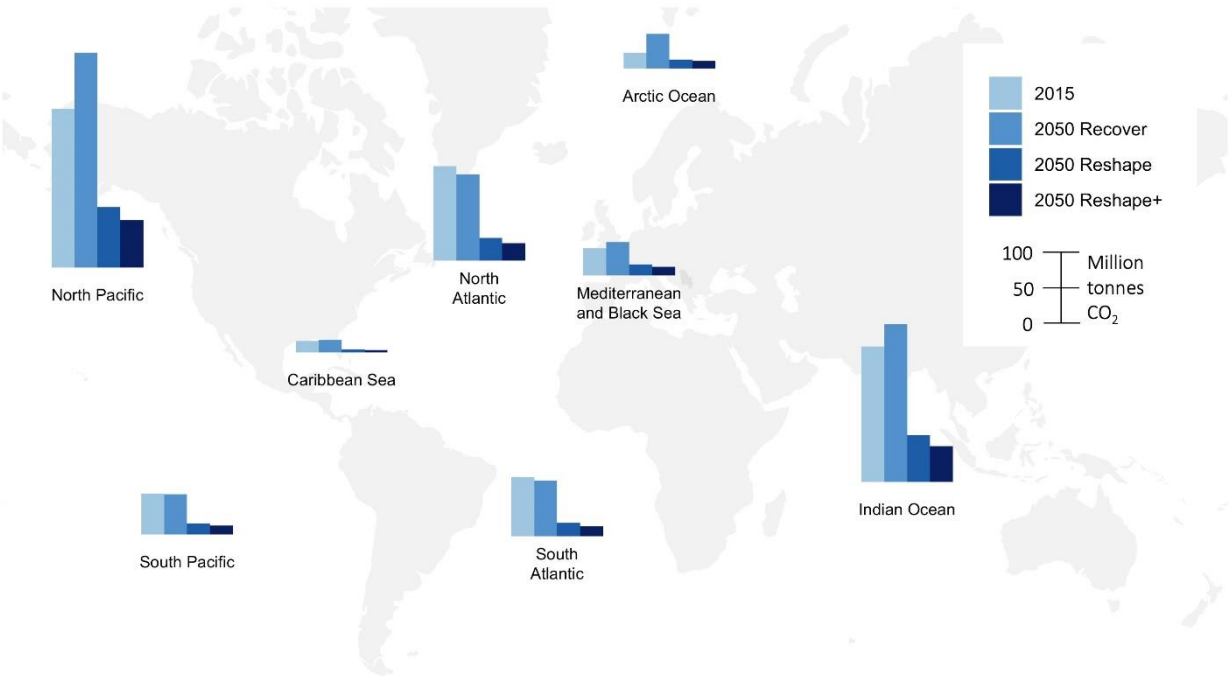
**Europe is the only region where emissions from surface freight transport decrease from 2015 to 2050 under current policies** (the *Recover* scenario)**.** In *Reshape* and *Reshape+*, several regions achieve sizeable reductions in surface transport emissions (see Figure 5.13). In the latter scenarios, the greatest reductions occur in LAC, followed by EEA and Turkey and the United States and Canada, which have similar decreases. The decarbonising measures tested have their highest impact on surface emissions in LAC, the region that presents a sharp contrast between the *Recover* and *Reshape* scenarios. The lowest

impact and difference between scenarios are in SSA and MENA, where there is a greater delay in the adoption of measures and activity grows at a faster rate. A similar dynamic takes place in Asia. Here, too, activity will grow at a faster pace than the global average and the deployment of decarbonisation measures will vary widely between nations of this vast region.

### Figure 5.14. $CO_2$ emissions from maritime freight transport in 2050

Under three scenarios, million tonnes $CO_2$ direct emissions (tank-to-wheel/wake)




Note: Figure depicts ITF modelled estimates. *Recover*, *Reshape* and *Reshape+* refer to the three scenarios modelled, which represent increasingly ambitious post-pandemic policies to decarbonise transport. Tank-to-wheel/wake emissions are produced by using a vehicle (i.e. from vehicles' fuel consumption). Tank-to-wake is specifically used to refer to ships and aircraft.

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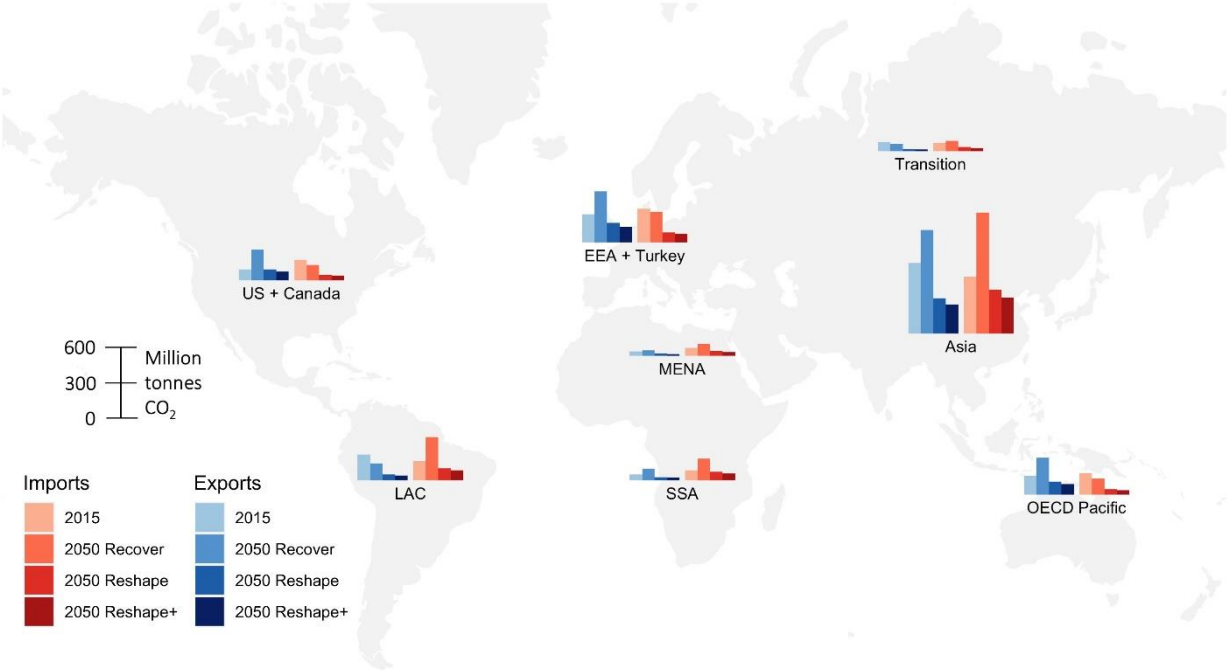
**Most freight transport activity in tonne-kilometres comes from imports and exports**. These often involve long-distance, inter-continental trips by sea. Nonetheless, most emissions are associated with surface transport, which tends to occur within the same country. The lower carbon intensity of maritime transport compared to road freight, which dominates surface transport, explains this result. Europe is an exception, mainly because import-export transport-related activity reaches much higher volumes than surface transport (see Figure 5.13, Figure 5.14, and Figure 5.15). Transport within the region covers relatively short distances, although there is considerable long-distance trade with other world regions. LAC and MENA are the only regions where export-related emissions decrease in the *Recover* scenario. They are also regions with some of the lowest growth in export-related transport activity.

## Figure 5.15. $CO_2$ emissions from import- and export-related freight transport by world region to 2050

Under three scenarios, million tonnes $CO_2$ direct emissions (tank-to-wheel/wake)




Note: Figure depicts ITF modelled estimates. *Recover*, *Reshape* and *Reshape+* refer to the three scenarios modelled, which represent increasingly ambitious post-pandemic policies to decarbonise transport. Tank-to-wheel/wake emissions are produced by using a vehicle (i.e. from vehicles' fuel consumption). Tank-to-wake is specifically used to refer to ships and aircraft. EEA: European Economic Area. LAC: Latin America and the Caribbean. MENA: Middle East and North Africa. OECD Pacific: Australia, Japan, New Zealand, South Korea. SSA: Sub-Saharan Africa. Transition economies: Former Soviet Union and non-EU South-Eastern Europe.

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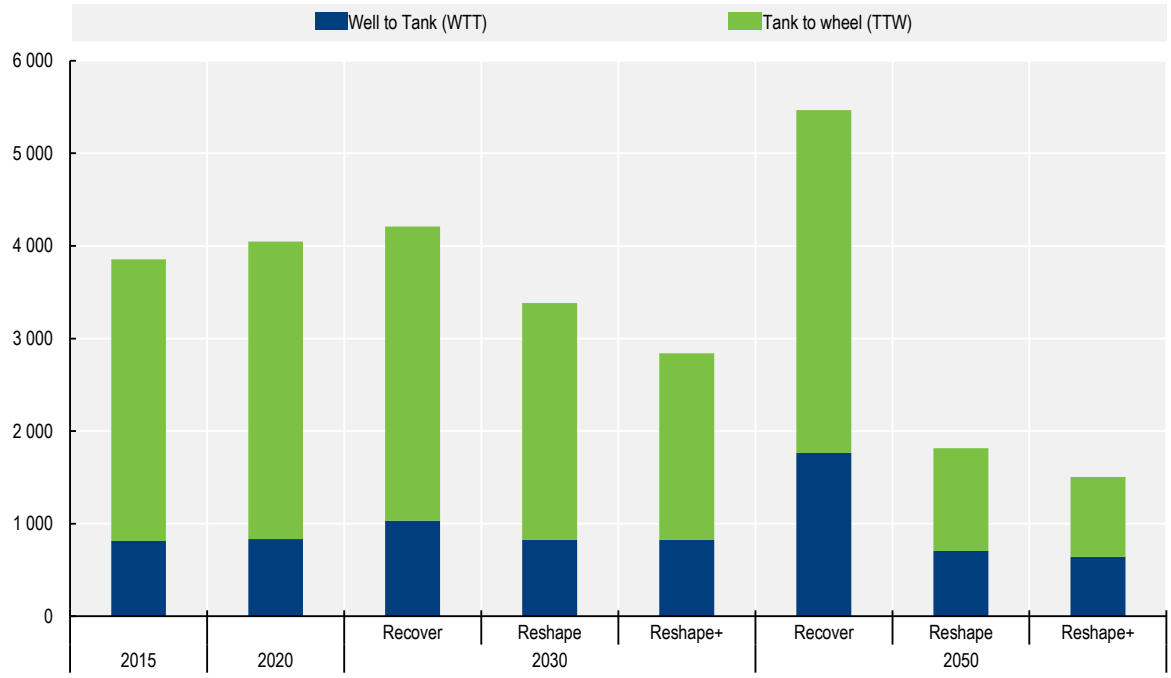
**Well-to-tank emissions will decline but account for a larger share of all freight emissions.** As the transport system shifts from fossil fuels to alternative energy, a part of tailpipe emissions will be simply displaced to other sectors (see Figure 5.16). Total well-to-wheel emissions decrease 53% to 2050 in *Reshape* and 61% in *Reshape+*, which is less than the reductions in tailpipe emissions. As a result, the share of well-to-tank to total well-to-wheel emissions grows from 21% in 2015 to 43% by 2050 in *Reshape+*.

### Figure 5.16. Evolution of tank-to-wheel/wake vs. well-to-tank $CO_2$ emissions from freight transport to 2050

Under three scenarios, Million tonnes $CO_2$ emissions




Note: Figure depicts ITF modelled estimates. *Recover*, *Reshape* and *Reshape+* refer to the three scenarios modelled, which represent increasingly ambitious post-pandemic policies to decarbonise transport. Tank-to-wheel emissions are produced by using a vehicle (i.e. from vehicles' fuel consumption). Well-to-tank emissions occur during energy production. Thus, well-to-tank emissions for electric vehicles (EVs) include emissions from electricity generation, while EVs tank-to-wheel emissions are zero. Tank to wake is specifically used to refer to ships and aircraft.

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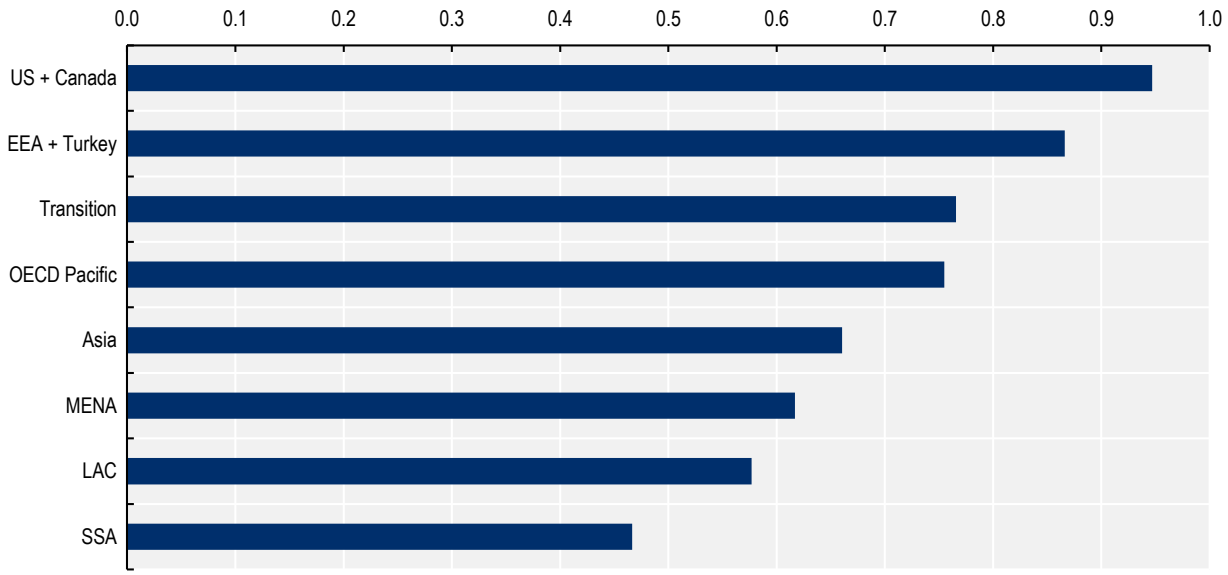
## Equitable freight decarbonisation: Avoiding regional imbalances

The question of equity in the context of freight decarbonisation has two main dimensions. First, the unequal impacts that decarbonisation measures can have in different world regions. Second, decarbonisation could lead to market concentration in freight transport, as small companies that cannot afford to implement expensive technologies, for example, are replaced by fewer larger firms. Currently, domestic freight markets are dominated by small, often family-owned businesses. Maritime shipping, on the other hand, has been moving towards greater concentration over the last decades. The pandemic crisis is likely to accentuate this trend, extending it to the domestic market and other modes besides sea transport.

Measuring the connectivity of different world regions to global markets provides a preliminary insight into the current imbalances in freight transport and logistic infrastructure and networks. The freight connectivity indicator developed by the ITF primarily reflects the quality and density of the transport networks, the ease of border crossings, and the proximity to major consumption centres (i.e. areas with high GDP). The indicator ranges between 0 (lowest connectivity) and 1 (highest connectivity). The world regions with the highest freight connectivity are the United States and Canada region and the EEA and Turkey region (see Figure 5.17). Sub Saharan Africa (SSA) has the lowest connectivity. Thus, most developed economies,

unsurprisingly, also are the best connected while developing nations lag behind. That said, the fact that the OECD Pacific region scores much higher on the index than Sub-Saharan Africa underscores that infrastructure development and administrative proficiency are relevant, even if the distance to global markets of course play a role.

## Figure 5.17. Freight connectivity by world region, 2015




Note: Figure depicts ITF modelled estimates. 0 = lowest connectivity, 1 = highest connectivity

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**The average transport cost of exports increases more in the *Recover* scenario than in *Reshape* and *Reshape+*** (see Figure 5.18). By 2050, they will be 9% higher for *Recover*, remain at 2015 cost levels under *Reshape* and increase by 7% in *Reshape+*.

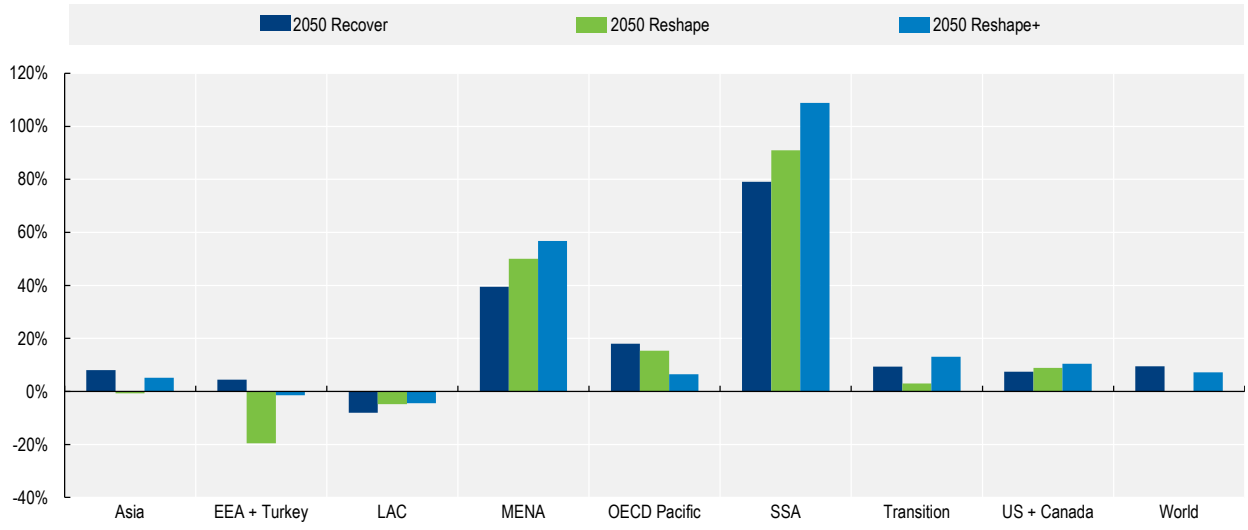
**Carbon taxes or distance charges push freight costs up but other decarbonising measures drive them down.** Asset-sharing, better intermodal solutions, heavy-capacity vehicles and autonomous trucks all help freight companies to cut costs. The extensive deployment of carbon-neutral fuels in *Reshape* decreases the costs due to carbon taxes. The initial costs of moving towards cleaner technologies are high. Still, in the long run, these solutions tend to be much more efficient and have lower operational costs than current technologies and operational practices. In *Reshape+*, the average cost per tonne-kilometre is higher than *Reshape* because there is relatively less long-distance maritime activity, the cheapest of all modes.

**Exports become more costly for remote countries.** Average transport cost of exports increases for countries situated far from the main consumption centres. The same is the case for countries lagging behind in terms of ambitious decarbonisation policies, such as MENA and Sub-Saharan Africa (SSA). The latter see costs progressively increase as their per-capita GDP grows and more ambitious decarbonisation policies are implemented globally. The implementation of some measures requires great attention to and equitable distribution of the costs and benefits of decarbonisation policies, such as carbon taxes that drive costs up and slow-steaming that increases travel times.

**The costs of bolder transport decarbonisation must not fall disproportionally on less-developed regions of the world.** There is a strong equity argument that developed economies need to pursue more ambitious transport decarbonisation targets, since their per-capita transport carbon far surpasses that in developing countries. Technology transfers and investments from developed countries in developing economies should be prioritised so that the latter are not left behind, shouldering prohibitive initial costs.

## Figure 5.18. Changes in freight costs for exports by world region

Percentage change in operational and time costs for each scenario in 2050, compared to 2015




Note: Figure depicts ITF modelled estimates. *Recover*, *Reshape* and *Reshape+* refer to the three scenarios modelled, which represent increasingly ambitious post-pandemic policies to decarbonise transport. These results represent the user or operator perspective, as they are derived from the mode-choice function of the freight model. Thus, they mostly reflect operational costs. They do not include all of the costs associated with new infrastructure implemented as part of ambitious decarbonisation policies, whether for new transport solutions or alternative fuels.

StatLink https://doi.org/10.1787/888934239268

### *More resilience, less carbon and lower costs with the right policy mix*

**Average transport costs tend to increase with trade regionalisation**. In logistics, the diversification or regionalisation of supply chains and the resulting growth in inventories will tend to push up the cost of goods. More resilience implies a greater diversity of suppliers, modes, and route choices. But relaxing the just-in-time paradigm also means keeping larger stocks and buffers for production. Hence, more warehousing and storage space is needed. This increased focus on resilience will imply adaptations and costs, some already underway.

**Greater resilience can reduce transport costs by relaxing just-in-time requirements and more load consolidation**, which reduces empty runs, increases capacity use, and facilitates multimodal solutions with lower unit costs. When coupled with digitalisation, automation and streamlined processes (e.g. single logistic windows type systems (UN, 2020[59])) any cost or time losses from resilience and decarbonisation inducing policies can be further offset (Sarkis et al., 2020[60]). Greater transparency and responsible business conduct can increase resilience and hedge risks (see Box 5.6). Nonetheless, some trade-offs are unavoidable between decarbonisation and resilience. More efficient fleet management and capacity use favours decarbonisation but can hinder system resilience and flexibility, e.g. by reducing the truck fleet size leading to less additional capacity available for transport.

**Disruption resulting from climate change can be very costly for the economy**. Natural disasters linked to climate change disrupt transport, and by extension the economy, with increasing frequency and severity. In future, infrastructure and operations could be disrupted even more, for even longer periods, and with even graver economic impacts. To manage such risks, companies would need to maintain larger stocks that tie capital. Protecting supply chains and transport infrastructure from extreme conditions would add further costs and make navigation in certain parts of the world increasingly challenging. According to some forecasts, global GDP would be 3% smaller in 2050 in a world where climate change has taken hold, compared to a scenario where global warming has been contained (Economist Intelligence Unit, 2020[35]).

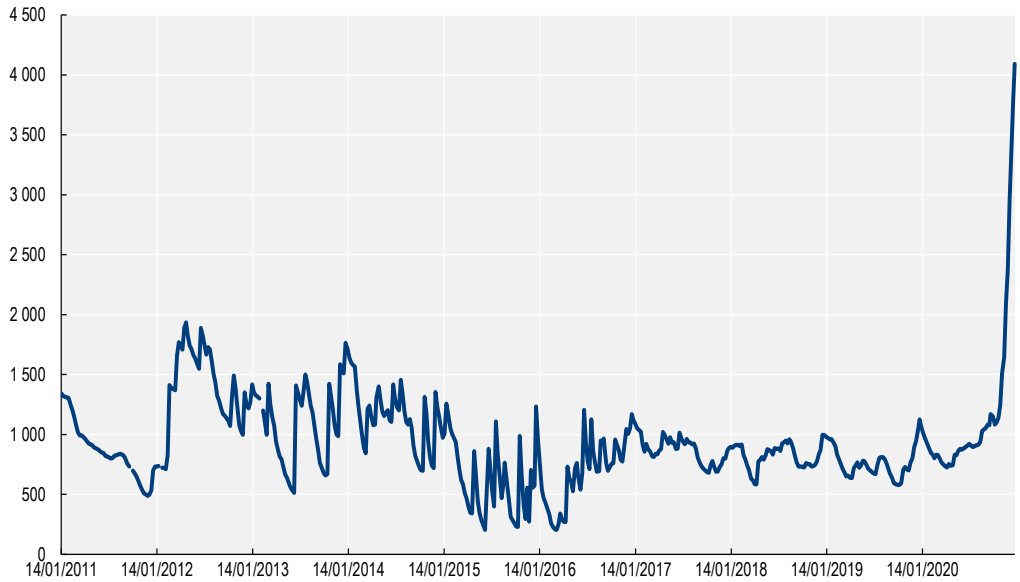
**The role of smaller players in the freight transport market may decrease.** The economic crisis, increased automation, expansion of online retail and investment in DT could lead to market consolidation giving less space to smaller players. The transition of the road freight industry from one where small family owned businesses play a prominent role to one where a few companies dominate the sector would have serious consequences. The sector employs a significant number of people, and many run their own businesses. However, consolidation could increase the pace of adopting cleaner technologies and operational solutions (e.g. alternative fuels and asset sharing). Another downside of consolidation could be decreased competition and increased monopoly power. This would be detrimental to consumers. Such trends have already taken hold in maritime shipping.

**Maritime shipping has become highly concentrated over the last decades.** This is the case for cruise shipping, car carriers and container shipping in particular. In addition, container carriers benefit from intensive co-operation via alliances and vessel-sharing agreements. This co-operation has made it possible to manage container ship capacity jointly (ITF, 2018[61]). During the Covid-19 pandemic, carriers collectively withdrew around one-third of their capacity. As a result, container freight rates went up despite a drop in demand (Figure 5.19). This has sparked action from regulators in China and the United States (Waters, 2020[62]) (Shen, 2020[63]), while the European Commission has not taken any action. Under EU regulations, liner shipping is granted exemption from competition rules applied to other sectors, on the premise that the exemption benefits the liners' clients (ITF, 2019[64]).

**The shipping industry suffers from a moral hazard problem.** The assurance that operators will be bailed out in combination with tax exemptions enables shipping firms to offload their risks to the public sector (ITF, 2020[65]). The Covid-19 pandemic has demonstrated the imbalance with regards to public and private risks of shipping companies. The shipping industry has a notoriously low effective corporate income tax rate of approximately 7% in comparison to the worldwide statutory tax rate of 24% (Merk, 2020[66]). This low rate is the result of tax avoidance by incorporating firms in tax havens and operating ships under flags of convenience. It is also the result of special, generous tax regimes for the shipping sector, such as the tonnage tax. The tonnage tax, based on a ship's internal volume, replaces the corporate income tax (ITF, 2019[67]). During the Covid-19 crisis, several shipping companies incorporated in tax havens received liquidity support from other states than those where they are incorporated (ITF, 2020[68]).

### Figure 5.19. Container freight rates 2011-20

Shanghai Containerised Freight Index Asia-Europe (USD/TEU)




Note: The Shanghai Containerized Freight Index reflects the weekly spot rates of container transport exports from Shanghai to 13 world regions. This figure reflects the weekly spot rates of container transport exports from Shanghai to Europe.
Source: Shanghai Shipping Exchange (2021).

### Box 5.6. Building resilience in the supply chain through responsible business conduct

The Covid-19 crisis has exposed significant vulnerabilities in company operations when it comes to disaster preparedness and supply chain continuity and resilience. Entire supply chains have come to a halt and placed millions of companies and workers at economic risk (OECD, 2020[69]), including already vulnerable populations, such as migrant workers (IOM, 2020[70]). Responsible business conduct (RBC) principles and standards, which are widely accepted in the global markets, can help build resilience in the supply chain without further destabilising them down the line (e.g. resurgence of forced or child labour in strategic sectors). Evidence is already showing that more resilient production networks can be achieved through better risk management strategies at the firm level, with the emphasis on risk awareness, greater transparency, and agility (OECD, 2020[71]).

The transport sector plays a critical role in this regard. As the underlying fabric for all global supply chains, the sector connects people to jobs, gets products to global markets, and is also a large employer itself. However, social, and environmental impacts across modes can vary. RBC instruments aim to unpack this complexity and look to a whole-of-supply chain perspective to address the responsibilities of different actors in the face of impacts that do not neatly fit within a specific country jurisdiction, sector, or even among business relationships. Consider, for example, that recent research has shown that just 100 companies have been the source of more than 70% of the world's greenhouse gas emissions since 1988 (CPD, 2017[72]).

The *OECD Guidelines for Multinational Enterprises* (https://mneguidelines.oecd.org/mneguidelines/) set out that all companies – regardless of their legal status, size, ownership, or sector – should 1) make

a positive contribution to the economic, environmental, and social progress of the countries in which they operate and 2) avoid and address negative impacts of their activities. This includes their core business activities as well as the supply chain and business relationships. The Guidelines provide recommendations on information disclosure, human rights, environment, employment and industrial relations, bribery, consumer interests, competition, and taxation.

The OECD also recommends that businesses know and show they are addressing their most significant environmental and social impacts through risk-based due diligence - a process through which businesses identify, prevent, and mitigate their actual and potential negative impacts across all business operations and account for how those impacts are addressed over time. The *OECD Due Diligence Guidance for Responsible Business Conduct (*https://www.oecd.org/investment/due-diligence-guidance-for-responsible-business-conduct.htm), developed in close consultation with businesses, governments, civil society, and trade unions, explains how to do so in practice.

## Policy recommendations

The freight sector is hard to decarbonise, but it can be done. Without low-carbon goods transport, the international community will fail to reach its climate objectives. Bold policy action to reshape freight transport can bring its $CO_2$ emissions down up to 72% by 2050. With business-as-usual policies, freight emissions will rise by almost a quarter, by 22%.

Two things need to change:

First, decarbonising freight has to move higher up on policy agendas. It can no longer take a back seat to passenger transport, in which public authorities have historically been more involved and which has been the focus of their attention.

Second, governments must create business cases for freight decarbonisation. Freight transport is a profit-driven sector dominated by private companies. Their buy-in is critical, as they will quickly adopt new practices if and where they see benefits. Policy must set regulatory frameworks that favour best practices.

The Covid-19 pandemic can become a turning point to accelerate the green transition of goods transport. The following policy recommendations will move us towards that goal.

### *Design stimulus packages that align to support economic recovery, freight decarbonisation and supply chain resilience*

Public funding and financing of economic recovery programmes should prioritise green transport infrastructure. Targets for investment include the transport network itself, for instance, the electrification of rail lines, and the production, distribution and supply of alternative fuels. Digitalisation and automation of terminals and logistic hubs can bring efficiency gains. The same is true for the streamlining of processes at border crossings or for issuing permits. Such measures can increase efficiency, lowering freight emissions, and make supply chains more reliable and resilient. Governments need to create a coherent framework of economic and regulatory incentives and penalties to align economic objectives with sustainability goals. The toolbox could include carbon taxes, zoning restrictions, fuel mandates, and bailouts conditional on decarbonisation actions.

### *Align price incentives with freight decarbonisation ambitions for carrier buy-in*

Few carriers will invest in low-carbon vehicles if they have to pay more than for conventional vehicles or fuels. The price of conventional vehicles or fuels generally does not reflect negative externalities such as greenhouse gas emissions. On the contrary, various parts of the freight sector receive generous fuel tax

exemptions. These undermine the attractiveness of cleaner, more efficient alternatives. Phasing out tax exemptions for fossil fuels is a crucial step on the road to freight transport decarbonisation and the widespread adoption of cleaner technologies and systems.

Including freight transport emissions in carbon-pricing schemes is part of the toolbox policy makers have at their disposal to foster a green transition. Taxation reforms need to ensure a fair distribution of costs and benefits when they eliminate incentives that reward inefficiencies and pollution. The equitable distribution of impacts between different world regions also needs to be addressed. The costs of a bold transport decarbonisation agenda should not fall disproportionally on less-developed economies and regions further from the main production and consumption centres. Otherwise, perceptions of injustice risk generating a backlash against decarbonisation.

### *Scale-up ready-to-adopt freight decarbonisation measures quickly to cut costs and emissions*

Many low-tech solutions and mature decarbonisation technologies could be quickly deployed and scaled up. Aerodynamic retrofits, tyres with reduced rolling resistance, lighter materials for weight reductions, more fuel-efficient engine and hybrid propulsion are technologies that exist. Tough standards for fuel economy and $CO_2$ emissions can drive their wider deployment, for which heavy freight trucks must be a priority target.

In urban freight, alternative fuels are becoming a viable solution. Carbon pricing, stricter emission standards, zero-emissions zones, more recharging points and incentives for greening whole vehicle fleets will spur this trend. Other low-hanging fruits include training for drivers ("eco-driving") and fewer restrictions on high-capacity lorries on certain corridors. Promoting off-peak deliveries, creating collection points, optimising routes can limit emissions if widely adopted, as can voluntary emissions reduction programmes.

Collaboration between logistics companies, for instance sharing vehicles to reduce empty runs, can save costs and cut emissions. Legal, technical or other barriers must be addressed. Digital collaboration platforms run by trusted third parties offer a promising path.

### *Strengthen international co-operation to combat freight emissions*

Transport decarbonisation needs greater international co-ordination than in the past. International aviation and shipping are not included in the Paris Agreement and need different mechanisms. For both, standards and regulations are set by international bodies that operate on a consensus basis. Implementing fuel standards and other decarbonisation measures for aviation and shipping will require political will to act jointly.

### *Accelerate standardisation procedures to speed-up the adoption of new clean technologies*

Low- and zero-carbon solutions under development will require scale to make them economically viable. Setting international standards for new technologies, services, and practices will help mainstream them quickly by leveraging the global scale. Where global standards are hard to achieve, co-ordination at a regional level is the next-best solution.

### *Tailor decarbonisation pathways to regional realities to address gaps in standard solutions*

Different geographic, economic, regulatory and infrastructure conditions around the world require different priorities and pathways. Decarbonising ageing second-hand vehicle fleets in developing countries requires other solutions than for the modern fleets in highly industrialised nations, for instance. Electric roads may

become soon operational within a relatively short time in advanced economies. For many developing countries, improving the quality of diesel fuel and replacing old trucks are more immediate tasks. In some regions, biofuel production may be nearly carbon-neutral and cost-effective, in others, this is a vision for the far-off future. Technology transfers and cross-border investment may reduce such gaps and should be prioritised. International regulations and decarbonisation roadmaps must reflect that the per capita carbon footprint in developed countries far surpasses that of people in developing economies.

### *Broaden access to privately owned data to improve policy design*

The importance of data to support decarbonisation policies for freight transport cannot be overstated. Data is critical for emissions accounting. It is also vital for evaluating the impact of innovative business models and new vehicle technologies. Relevant data for such purposes exist, but they are usually company-owned. Ensuring public-interest access to private data is imperative. Addressing privacy concerns and safeguarding legitimate commercial interests is possible and a critical requirement to enable access to corporate data for research and policy evaluation purposes. New modelling tools and more disaggregated approaches can use currently inaccessible data to provide important insights for policy makers and the freight transport (Office for National Statistics, 2020[21]) industry.

## References


CPD (2017), *The Carbon Majors Database - CDP Carbon Majors Report 2017*, https://b8f65cb373b1b7b15feb-c70d8ead6ced550b4d987d7c03fcdd1d.ssl.cf3.rackcdn.com/cms/reports/documents/000/002/327/original/Carbon-Majors-Report-2017.pdf?1499431371 (accessed on 27 November 2020). [72]

Economist Intelligence Unit (2020), *The Great Unwinding: Covid-19 and the regionalisation of global supply chains*, The Economist, https://www.eiu.com/n/campaigns/the-great-unwinding-covid-19-supply-chains-and-regional-blocs/ (accessed on 28 December 2020). [35]

European Commission (2020), *COMMUNICATION FROM THE COMMISSION on the implementation of the Green Lanes under the Guidelines for border management measures to protect health and ensure the availability of goods and essential services*, European Commission, https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:C:2020:096I:FULL&from=EN (accessed on 28 December 2020). [33]

European Commission (2019), *The European Green Deal COM(2019) 640 final*, European Commission, https://ec.europa.eu/info/sites/info/files/european-green-deal-communication_en.pdf. [43]

Eurostat (2020), *Majority of transport jobs held by men - Products Eurostat News - Eurostat*, Eurostat News, https://ec.europa.eu/eurostat/web/products-eurostat-news/-/DDN-20200421-1 (accessed on 23 December 2020). [28]

FAO (2020), *Global food markets still brace for uncertainty in 2020/21 because of COVID-19 says FAO*, http://www.fao.org/news/story/en/item/1287515/icode/ (accessed on 23 December 2020). [26]

FreightWaves (2020), *Substituting cargo for passengers becomes mainstream business for airlines*, https://www.freightwaves.com/news/substituting-cargo-for-passengers-becomes-mainstream-business-for-airlines (accessed on 29 December 2020). [50]

Friedel Sehlleier (2020), *Will the Corona Crisis Help or Hurt the Freight Decarbonisation Agenda?*, Changing Transport, https://www.changing-transport.org/will-the-corona-crisis-help-or-hurt-the-freight-decarbonisation-agenda/ (accessed on 28 December 2020). [36]

Huang, Y. and J. Smith (2020), *In U.S.-China Trade War, New Supply Chains Rattle Markets*, Carnegie Endowment for International Peace, https://carnegieendowment.org/2020/06/24/in-u.s.-china-trade-war-new-supply-chains-rattle-markets-pub-82145 (accessed on 28 December 2020). [38]

IATA (2020), *Air Cargo Market Analysis October 2020*, IATA, https://www.iata.org/en/iata-repository/publications/economic-reports/air-freight-monthly-analysis---october-2020/ (accessed on 29 December 2020). [49]

IATA Economics (2020), *Air Cargo Market Analysis - August 2020*, IATA, https://www.iata.org/en/iata-repository/publications/economic-reports/air-freight-monthly-analysis---august-2020/. [22]

ICAO (2018), *ICAO Annual Report of the Council 2017*, https://www.icao.int/annual-report-2017/Pages/default.aspx. [5]

IEA (2020), *Coal – Global Energy Review 2020*, Global Energy Review, https://www.iea.org/reports/global-energy-review-2020/coal (accessed on 28 December 2020). [40]

IEA (2020), *IEA Mobility Model*, https://www.iea.org/areas-of-work/programmes-and-partnerships/the-iea-mobility-model. [55]

IEA (2020), *Low fuel prices provide a historic opportunity to phase out fossil fuel consumption subsidies*, https://www.iea.org/articles/low-fuel-prices-provide-a-historic-opportunity-to-phase-out-fossil-fuel-consumption-subsidies. [47]

IEA (2020), *Oil – Global Energy Review 2020*, Global Energy Review, https://www.iea.org/reports/global-energy-review-2020/oil (accessed on 28 December 2020). [41]

IEA (2020), *Oil – Global Energy Review 2020 – Analysis - IEA*, https://www.iea.org/reports/global-energy-review-2020 (accessed on 5 October 2020). [25]

IEA (2020), *World Energy Outlook 2020*, IEA, https://www.iea.org/reports/world-energy-outlook-2020. [56]

IHS Markit (2020), *IHS Markit trims 2020 global light vehicle sales and production forecasts*, https://ihsmarkit.com/research-analysis/ihs-markit-trims-2020-global-light-vehicle-forecasts.html (accessed on 23 December 2020). [24]

IMF (2020), *World Economic Outlook Update, June 2020: A Crisis Like No Other, An Uncertain Recovery*, IMF, https://www.imf.org/en/Publications/WEO/Issues/2020/06/24/WEOUpdateJune2020 (accessed on 22 October 2020). [16]

IOM (2020), *Covid-19 places migrant workers in highly vulnerable situations*, https://crest.iom.int/news/covid-19-places-migrant-workers-highly-vulnerable-situations (accessed on 26 March 2020). [70]

IRU (2020), *COVID-19 Impacts on the Road Transport Industry*, IRU, Geneva, https://www.iru.org/resources/iru-library/covid-19-impacts-road-transport-industry-executive-summary?FormCompleted=1. [27]

IRU (2019), *Tackling Driver Shortage in Europe*, IRU, https://www.iru.org/resources/iru-library/tackling-driver-shortage-europe (accessed on 1 February 2021). [30]

ITF (2020), *Covid-19 Shipping bailouts: Overview and Considerations - Covid-19 Transport Brief*, ITF, Paris. [68]

ITF (2020), *Electrifying Postal Delivery Vehicles in Korea*, OECD Publishing, Paris, https://doi.org/10.1787/fb9f5812-en. [11]

ITF (2020), *Future Maritime Trade Flows*, ITF, Paris, https://doi.org/10.1787/e51b5ecc-en (accessed on 27 November 2020). [57]

ITF (2020), *Global Container Shipping and the Coronavirus Crisis - Covid-19 Transport Brief*, ITF. [65]

ITF (2020), *How Urban Delivery Vehicles can Boost Electric Mobility*, ITF, https://www.itf-oecd.org/how-urban-delivery-vehicles-can-boost-electric-mobility (accessed on 22 December 2020). [9]

ITF (2020), *Navigating Towards Cleaner Maritime Shipping*, ITF, https://www.itf-oecd.org/navigating-towards-cleaner-maritime-shipping%20 (accessed on 14 April 2021). [58]

ITF (2020), *Regulations and Standards for Clean Trucks and Buses: On the Right Track?*, OECD Publishing, Paris, https://doi.org/10.1787/ed7ef18b-en. [13]

ITF (2020), *Setting Scenarios for Non-Urban Transport and Related CO2 Measures - Workshop Summary*, ITF. [54]

ITF (2020), *The ITF non-urban freight transport model - Insights and example outputs*, International Transport Forum. [12]

ITF (2020), *Transport Climate Action Directory*, ITF, https://www.itf-oecd.org/transport-climate-action-directory-measures. [6]

ITF (2020), *Unprecedented Impact of Covid-19 on Freight Volumes in Second Quarter*, https://www.itf-oecd.org/unprecedented-impact-covid-19-freight-volumes-second-quarter (accessed on 23 December 2020). [14]

ITF (2019), *Container Shipping in Europe: Data contribution for the evaluation of EU's Consortia Block Exemption Regulation*, ITF. [64]

ITF (2019), *Enhancing Connectivity and Freight in Central Asia*, ITF. [52]

ITF (2019), *ITF Transport Outlook 2019*, OECD Publishing, Paris, https://dx.doi.org/10.1787/transp_outlook-en-2019-en. [1]

ITF (2019), *Maritime Subsidies, Do They Provide Value for Money?*, ITF. [67]

ITF (2019), *Modelling International Transport and Related CO2 - Expert Workshops*, ITF. [53]

ITF (2018), *Decarbonising Maritime Transport Pathways to zero-carbon shipping by 2035*, ITF, http://www.itf-oecd.org (accessed on 24 August 2018). [8]

ITF (2018), *Decarbonising Maritime Transport Pathways to zero-carbon shipping by 2035*, ITF. [42]

ITF (2018), *The Impact of Alliances in Container Shipping*, ITF. [61]

ITF (2018), *Towards Road Freight Decarbonisation Trends, Measures and Policies*, ITF. [7]

ITF (2017), *ITF Transport Outlook 2017*, OECD Publishing, Paris, https://dx.doi.org/10.1787/9789282108000-en. [2]

Knowler, G. (2020), *Box shortages challenge fast-growing China-Europe rail*, JOC.com, https://www.joc.com/rail-intermodal/box-shortages-challenge-fast-growing-china%E2%80%93europe-rail_20201118.html (accessed on 29 December 2020). [44]

McKinnon, A. (2018), *Decarbonizing Logistics: Distributing Goods in a Low Carbon World*, Kogan Page, London, https://www.the-klu.org/publications/decarbonizing-logistics-distributing-goods-in-a-lowcarbon-world-f543d/ (accessed on 3 February 2021). [10]

Merk, O. (2020), "Quantifying Tax Subsidies for Shipping", *Maritime Economics & Logistics*, Vol. 22/4. [66]

Nikkei Asia (2020), *China turned to ASEAN to cover US trade dip*, Nikkei Asia, https://asia.nikkei.com/Economy/China-turned-to-ASEAN-to-cover-US-trade-dip (accessed on 28 December 2020). [39]

OECD (2020), *COVID-19 and Global Value Chains: Chains Policy Options to Build More Resilient Production Networks*, https://read.oecd-ilibrary.org/view/?ref=134_134302-ocsbti4mh1&title=COVID-19-and-Global-Value-Chains-Chains-Policy-Options-to-Build-More-Resilient-Production-Networks (accessed on 3 June 2020). [71]

OECD (2020), *COVID-19 and Responsible Business Conduct*, OECD, Paris, https://read.oecd-ilibrary.org/view/?ref=129_129619-6upr496iui&title=COVID-19-and-Responsible-Business-Conduct (accessed on 27 November 2020). [69]

OECD (2020), *OECD Economic Outlook, December 2020 | Turning hope into reality*, https://www.oecd.org/economic-outlook/december-2020?utm_source=linkedin&utm_medium=social&utm_campaign=ecooutlookdec2020&utm_content=en&utm_term=pac (accessed on 23 December 2020). [17]

OECD (2020), *OECD Economic Outlook, Interim Report September 2020*, OECD Publishing, Paris, https://dx.doi.org/10.1787/34ffc900-en. [46]

OECD (2020), *OECD Economic Outlook, Volume 2020 Issue 2*, OECD Publishing, Paris, https://dx.doi.org/10.1787/39a88ab1-en. [48]

Office for National Statistics (2020), *Retail sales Great Britain*, https://www.ons.gov.uk/businessindustryandtrade/retailindustry/bulletins/retailsales/august2020. [21]

Pishue, B. (2020), *COVID-19's Impact on Freight: An Analysis of Long-Haul Freight Movement During a Pandemic*, INRIX. [23]

RailFreight.com (2020), *Significant increase in transit container shipping between China and Europe*, RailFreight.com, https://www.railfreight.com/uncategorized/2020/10/21/significant-increase-in-transit-container-shipping-between-china-and-europe/?utm_source=newsletter&utm_medium=email&utm_campaign=Newsletter%20week%202020-43 (accessed on 29 December 2020). [45]

Reinhart, C. and V. Reinhart (2020), *The Pandemic Depression*, Foreign Affairs, https://www.foreignaffairs.com/articles/united-states/2020-08-06/coronavirus-depression-global-economy (accessed on 20 January 2021). [20]

Rodrigue, J. (2020), *Challenges Facing Trade and Supply Chains: A Maritime Transport Perspective*, International Transport Forum, https://www.itf-oecd.org/sites/default/files/docs/challenges-facing-trade-supply-chains-maritime-transport-perspective.pdf (accessed on 3 February 2021). [34]

RTS (2017), *Why Trucking is Still America's Number One Job*, https://www.rtsinc.com/articles/why-trucking-still-america-s-number-one-job (accessed on 23 December 2020). [29]

Sarkis, J. et al. (2020), *A brave new world: Lessons from the COVID-19 pandemic for transitioning to sustainable supply and production*, Elsevier B.V., http://dx.doi.org/10.1016/j.resconrec.2020.104894. [60]

Shen, C. (2020), *Carriers summoned by China to curb transpacific mark-ups*, Lloyds List. [63]

The World Bank (2020), *COVID-19 to Plunge Global Economy into Worst Recession since World War II*, https://www.worldbank.org/en/news/press-release/2020/06/08/covid-19-to-plunge-global-economy-into-worst-recession-since-world-war-ii (accessed on 23 December 2020). [15]

UN (2020), *Single window concept*, Trade Facilitation Implementation Guide, http://tfig.unece.org/contents/single-window-concept.htm (accessed on 29 December 2020). [59]

UNCTAD (2020), *Global trade continues nosedive, UNCTAD forecasts 20% drop in 2020*, https://unctad.org/news/global-trade-continues-nosedive-unctad-forecasts-20-drop-2020 (accessed on 23 December 2020). [18]

UNCTAD (2020), *International transport and supply chains key to COVID-19 recovery: UN agencies*, https://unctad.org/news/international-transport-and-supply-chains-key-to-covid-19-recovery-un-agencies (accessed on 28 December 2020). [32]

UNCTAD (2020), *Review of Maritime Transport 2019*, https://unctad.org/system/files/official-document/rmt2019_en.pdf. [4]

UNCTAD (2020), *World seaborne trade database*, http://stats.unctad.org/seabornetrade. [3]

Waters, W. (2020), *US warns box lines against transpacific collusion*, Lloyds List. [62]

World Economic Forum (2020), *How to rebound stronger from COVID-19 Resilience in manufacturing and supply systems*, World Economic Forum, Geneva, http://www3.weforum.org/docs/WEF_GVC_the_impact_of_COVID_19_Report.pdf (accessed on 21 January 2021). [37]

World Economic Forum (2020), *The Future of the Last-Mile Ecosystem*, World Economic Forum, http://www3.weforum.org/docs/WEF_Future_of_the_last_mile_ecosystem.pdf. [51]

WTO (2020), *Trade falls steeply in first half of 2020*, https://www.wto.org/english/news_e/pres20_e/pr858_e.htm (accessed on 23 December 2020). [31]

WTO (2020), *Trade shows signs of rebound from COVID-19, recovery still uncertain*, https://www.wto.org/english/news_e/pres20_e/pr862_e.htm (accessed on 23 December 2020). [19]

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