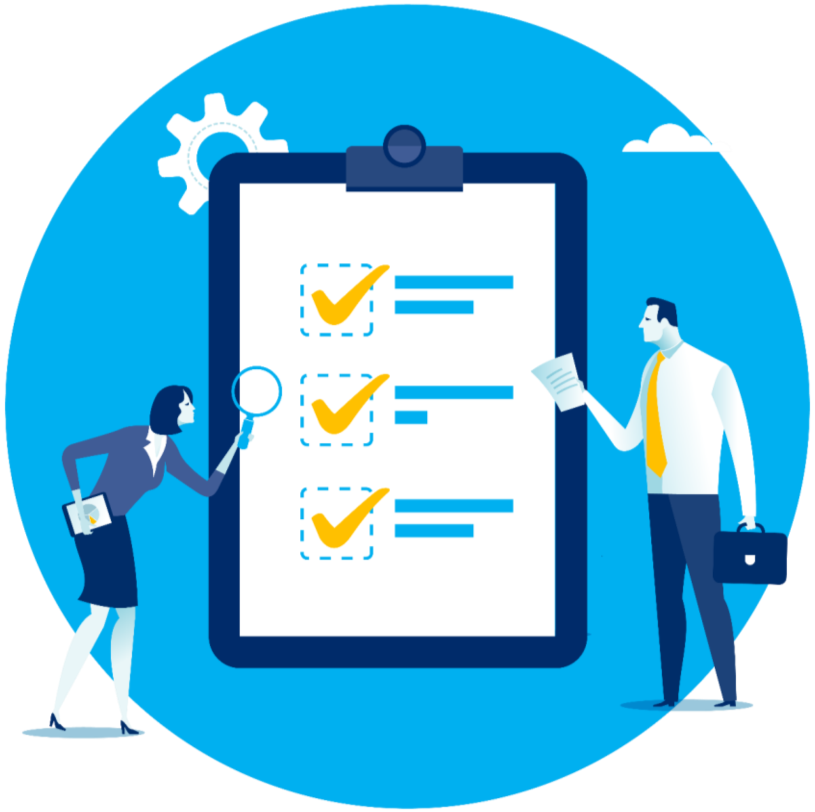
International Transport Forum

COALITION FOR Reimagined Mobility
Transportation Policy that Puts People First

How Digitally-driven Operational Improvements Can Reduce Global Freight Emissions

Scenario Results and Policy Findings

Outline



1. Modelling freight digitalisation
2. Impact of individual measures
3. Impact of Digital Transformation scenario

Modelling freight digitalisation

Digitalisation is vital to ensuring the freight transport sector's sustainable recovery after the Covid-19 pandemic. Digitalisation is a driving force for efficiency improvement in the freight sector, maximising profit and providing higher flexibility for shippers and carriers while improving sustainability. Moreover, digital technology is readily available for many operational improvements from the first to the last mile of freight transport.

Improving operational efficiency contributes to addressing the role of freight transport in climate change. But to what extent can digitalisation help reduce CO_2 emissions in the freight sector and contribute to the Paris Agreement goals?

This study aims to quantify how digitalisation of the freight sector can translate into operational efficiencies that reduce CO_2 emissions from the global freight transport sector. It looks at the effect of individual measures but also presents a Digital Transformation scenario, wherein all measures are applied in parallel.

Key findings

- Digitally driven operational improvements can significantly contribute to reaching the Paris Agreement goals. They are "low hanging fruits" that companies and policy makers can quickly deploy.
- The two measures that have the most significant individual impact on CO_2 emissions are:
  1) implementing smart steaming by optimising port call operations in the maritime sector and
  2) using digital technology to improve truck utilisation in the road transport sector through higher asset sharing. Each has the capacity to limit CO_2 emission growth to 40% between 2019 and 2050.
- Optimising maritime utilisation through digitally driven approaches to improve operational efficiency has the potential to significantly reduce CO_2 emissions in the maritime sector.
- Strengthening port capacity does not noticeably reduce the CO_2 emissions in the maritime sector because it also stimulates trade growth and alters port choice (choosing more distant ports with higher operational capacities).

Key findings

- Enhancing rail utilisation alone is not effective enough to reduce rail freight costs and increase the attractiveness of freight transport by rail. As such, it has a marginal effect on total freight emissions. However, combining enhanced rail utilisation with a reduced intermodal dwell time through cross-sector asset-sharing may encourage significant shifts from other modes of transport to rail, thus creating opportunities to lower CO_2 emissions.
- Airfreight operations are more digitalised compared to other modes. Therefore, no short-term actionable measures have been assessed for the sector. However, medium- to long-term fuel and technological transformations are still needed to decarbonise the air freight sector.
- The private sector could play a crucial role in decarbonising freight transport by deploying digital improvements, particularly in the maritime sector. However, digital improvements will not be sufficient on their own, and additional policy actions are needed.

Our Approach

Literature review and stakeholder consultation

Literature review, stakeholder consultation, and expert judgements were used to identify a list of effective operational improvements and their potential impacts on CO_2 emissions. The same approach was applied to validate the scenario design and scenario outputs.

Scenario design

The scenario design process was an iterative process of the following steps: 1) determine the list of effective measures; 2) identify their expected impacts on the input variables of the ITF global non-urban freight model until 2050; 3) test the impacts of individual measures using the model; 4) modify the impact assumptions.

Quantitative assessment

Based on the assumptions determined in the previous two steps, the ITF global non-urban freight model was used to quantify operational improvement scenarios. The base year 2019 was compared to the individual and combined scenarios in 2025, 2030 and 2050.

Our Measures

Improving truck utilisation

Improving asset-sharing through digitalisation (decreasing information costs, providing real-time data and asset-sharing platforms) can result in more efficient use of vehicle capacity and reduce the number of miles truck operate empty.

Enhancing rail utilisation

Improving asset utilisation through digitalisation (e.g. real-time data sharing) can reduce trips and create a more efficient use of vehicle capacity. It can also increase the competitiveness of rail in comparison to other modes.

Optimising maritime utilisation

Digitalisation can increase the maritime load factor (ratio of the average load to total vehicle capacity), reducing the required number of trips and empty miles. Examples of maritime digitalisation include freight space booking platforms and platform models for container distribution on ships.

Strengthening port capacity

The digitalisation of port operations could increase port throughput capacity thresholds by, for example, increasing their speed and real-time data sharing between digital operating systems.

Implementing smart steaming

Smart steaming uses dynamic data that allows ships to maintain optimal operating speed until arrival at the port at the time of availability. This “just-in-time” arrival optimises port call operations. It is different from slow steaming – wherein ship speeds are minimised to economise fuel use – as smart steaming does not necessarily mean that ships navigate at a slower speed; they operate more optimally.

Adopting intelligent transport systems

Improve transport system management and performance through further adoption of Intelligent Transport Systems (ITS). These systems provide better quality, relevant, dynamic and real-time, and automatically-collected data on the performance of transport systems.

Reducing intermodal dwell time

Improve connections between different freight modes by using digital transformation strategies that share and use near-real-time data. This could make operations more efficient and reduce transit time penalties.

Our Assumptions

Improving truck utilisation

10% increase in average load utilisation (load factor) of road freight by 2025, growing to 25% in 2050.

Enhancing rail utilisation

Rail load factors increase by 5% by 2025, growing to a 50% increase by 2050 (not exceeding a rail length of 7 500 feet or 286 000 pounds gross vehicle weight).

Optimising maritime utilisation

The maritime load factor increases by 5% by 2025, growing to a 25% increase by 2050. The load factors for liquid and dry bulk will grow at a rate of 25% of that expected for other types of cargo.

Strengthening port capacity

Maritime port throughput capacity will increase by 10% every five years as of 2020.

Implementing smart steaming

Optimised speeds for just-in-time arrival will increase maritime transport fuel efficiency by 10% by 2025 (4% for trips lasting less than two days), growing to a 25% increase by 2050 (10% for trips lasting less than two days).

Adopting intelligent transport systems

ITS adoption among truck fleets increases by five percentage points (in regions with below-median ITS penetration) or 15 percentage points (in regions with above-median ITS penetration) in 2025, growing to a 50 percentage point increase in 2050.

Reducing intermodal dwell time

Truck-to-port and truck-to-rail dwell times decrease by 20% by 2025 and by 45% by 2050. Rail-to-port dwell time decreases by 15% by 2025 and by 45% by 2050. Inland waterways dwell time decreases by 5% by 2025 and by 25% by 2050.

Note: the percentage increase or decrease in the assumptions are compared with the base year 2019.

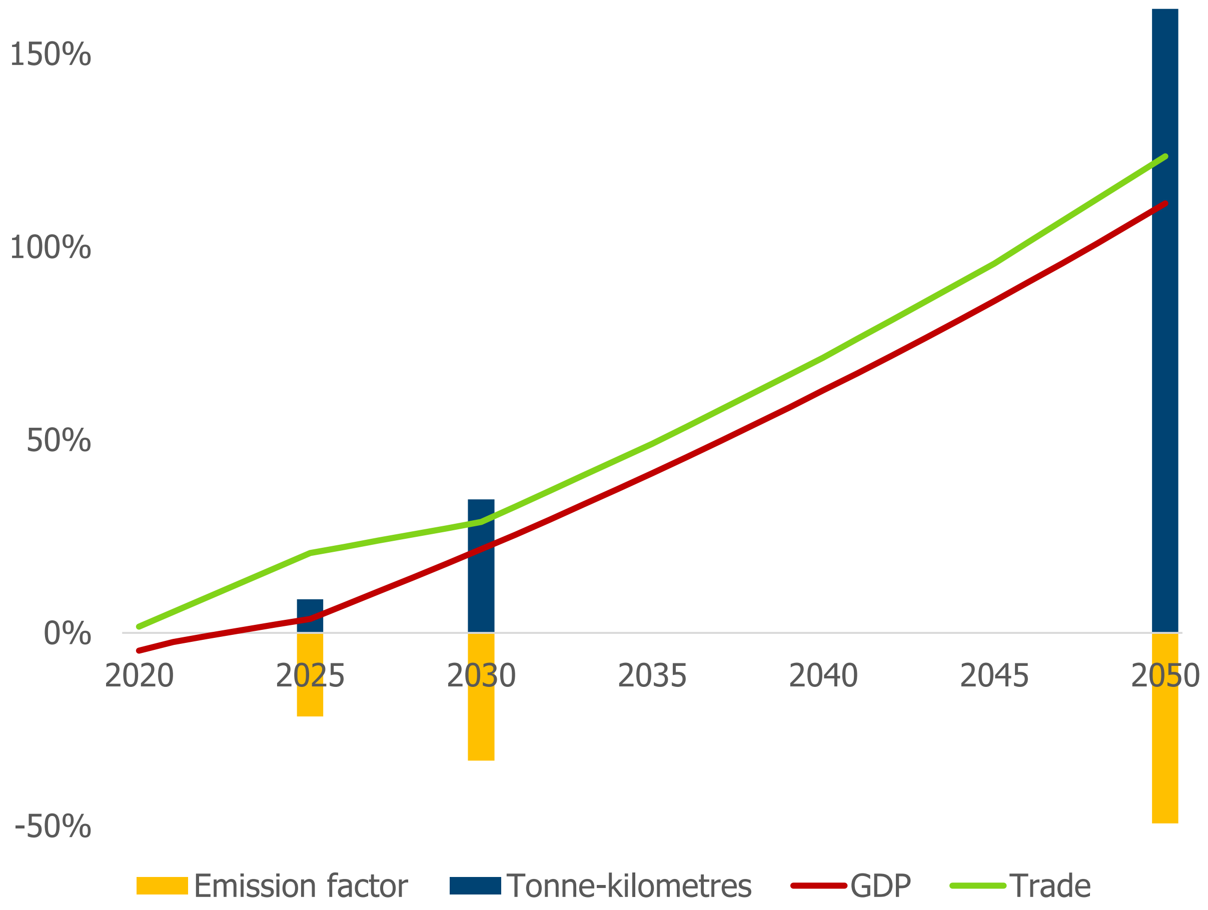
Underlying drivers

The Covid pandemic-induced fall in GDP and trade slows freight demand growth until 2025

Global GDP and trade growth are two critical underlying drivers of freight demand. Their development is expected to remain weak in the post-pandemic recovery phase until 2030, according to projections by OECD's Environment Directorate. As a result, freight movement volume will grow at a slower pace than before 2019.

Fuel efficiency gains and vehicle technology improvements reduce the carbon intensity of the freight transport sector. This outweighs demand growth until 2030, temporarily driving down the sector's CO_2 emissions during the post-pandemic recovery phase.

These developments in the global freight sector serve as the backdrop for the Digital Transformation scenarios.



Note: the growth trends are with respect to 2019.

Static baseline scenario

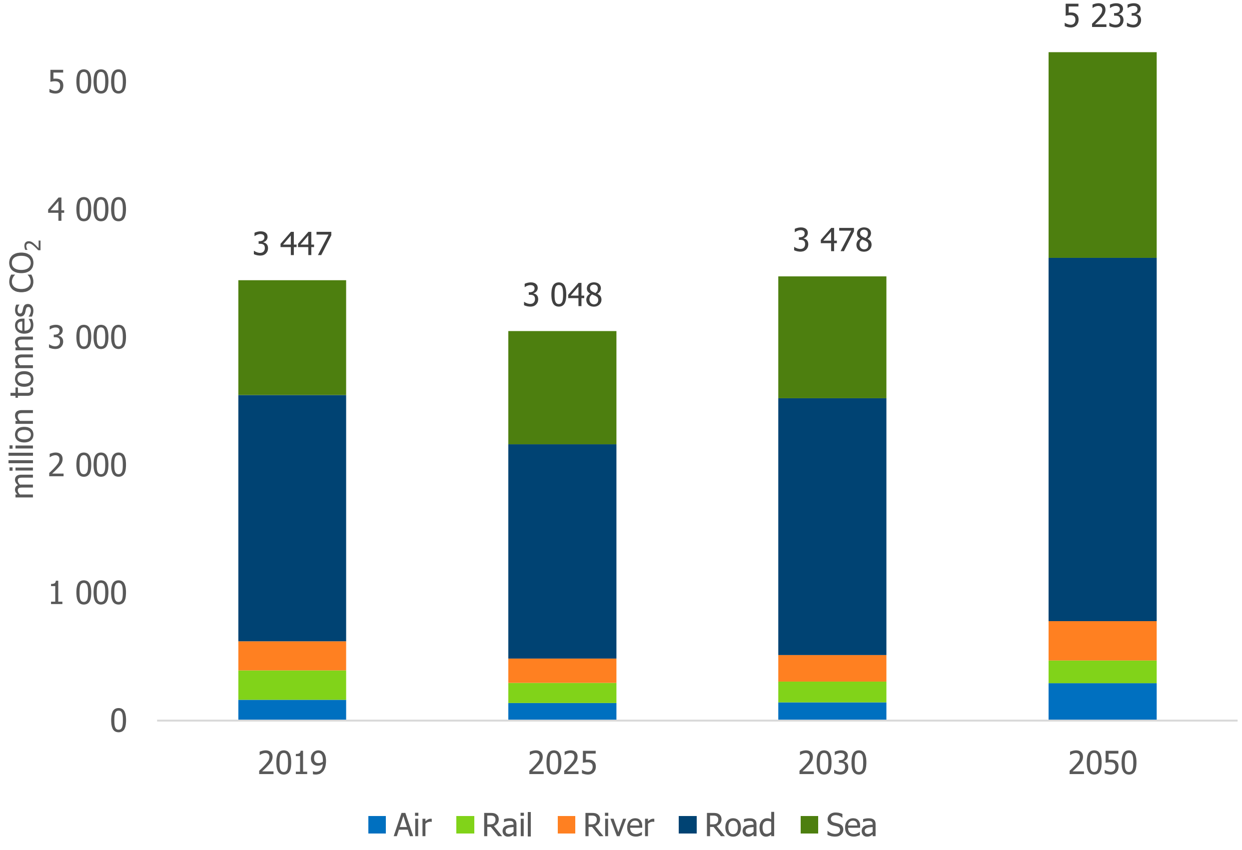
Freight emissions will rise by more than 50% if no additional policy interventions are enacted

In the static baseline scenario, where no additional policy actions are introduced after 2019, total freight CO_2 emissions are set to rise by 52% over the next three decades.

The static baseline scenario accounts for infrastructure developments (the construction of new infrastructure and improvement of current infrastructure), vehicle technology improvement (greater fuel efficiency), and growth in trade, GDP and population. All other contributing factors remain unchanged after 2019.

The static baseline scenario is a benchmarking point for identifying the impact of the individual measures and the combined Digital Transformation scenario.

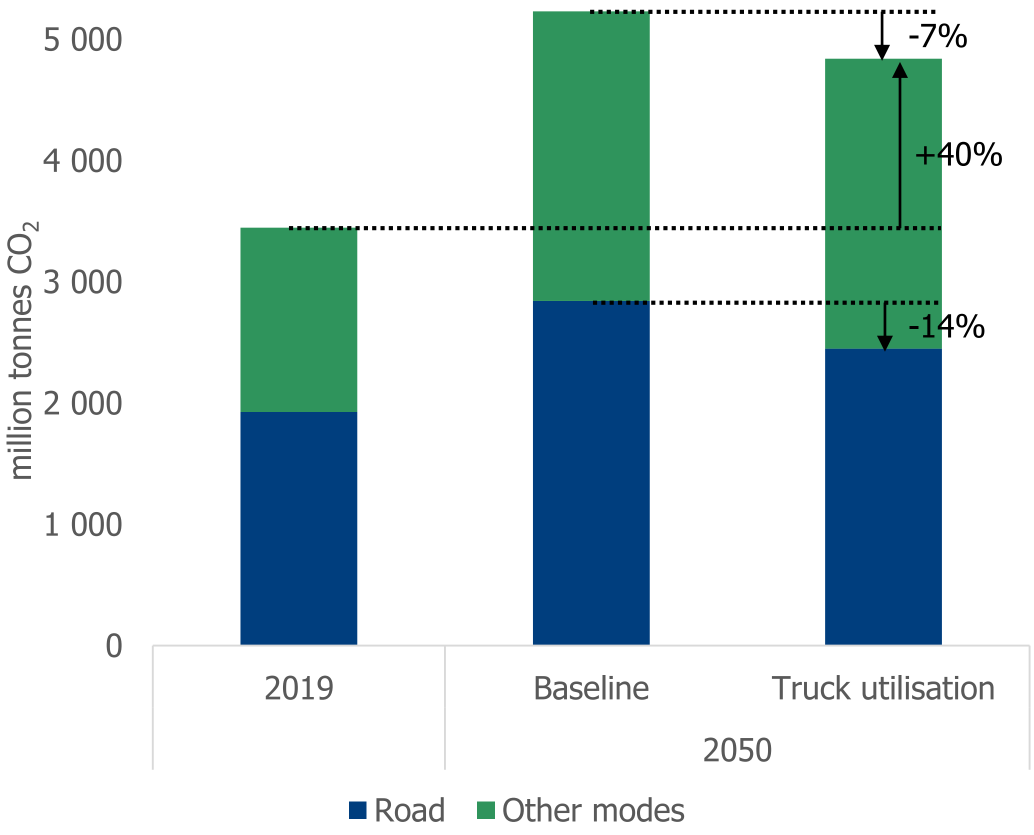
Static baseline scenario:
Evolution of freight CO_2 emissions by mode



Impact of individual digital improvement measures

The following section presents the impact of individual digital improvement measures on the freight transport demand and related CO_2 emissions up to 2050, evaluated using the ITF Global Non-urban Freight Model.

Improving truck utilisation

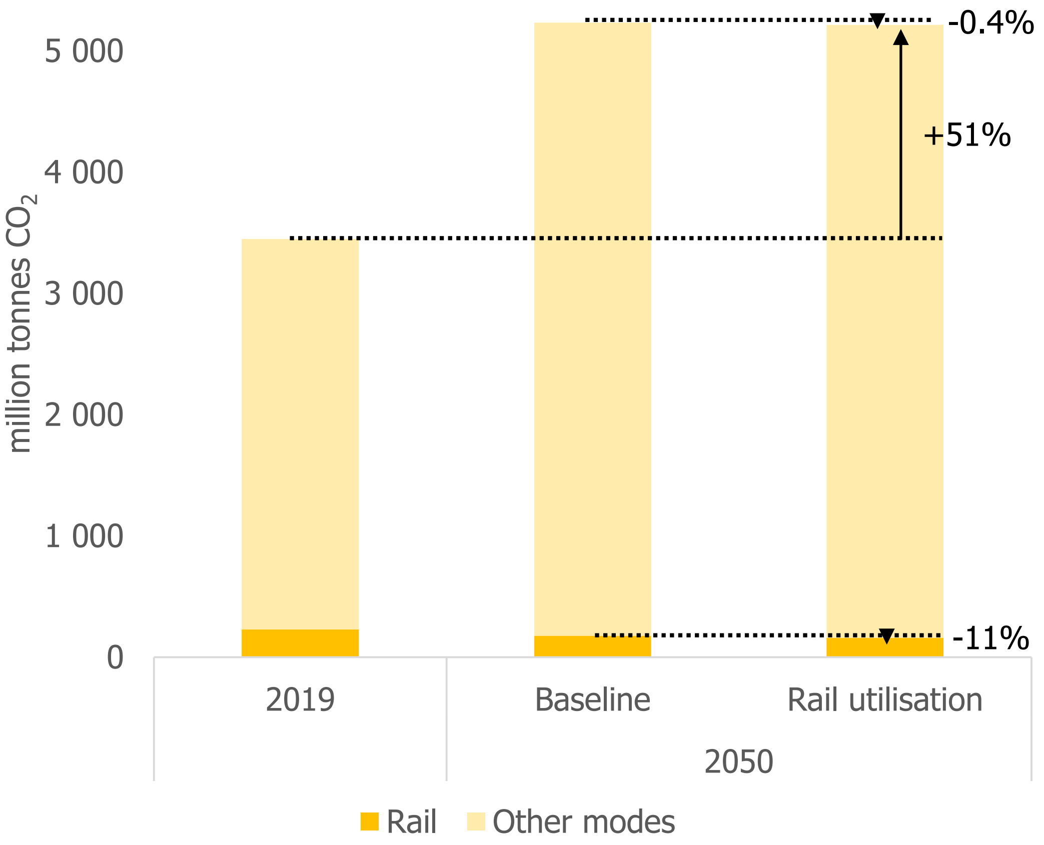


Efficient use of truck capacity can reduce the CO_2 emissions of road freight by 14% and the whole freight sector by 7% by 2050, compared to the baseline scenario.

The share of road transport in total freight emissions will drop by four percentage points, reducing to 50% in 2050 instead of 54% in the baseline scenario.

Implementing this measure alone does not reverse the CO_2 emissions growth curve. Total freight CO_2 emissions will rise by 40% in 2050 compared to 2019.

Enhancing rail utilisation

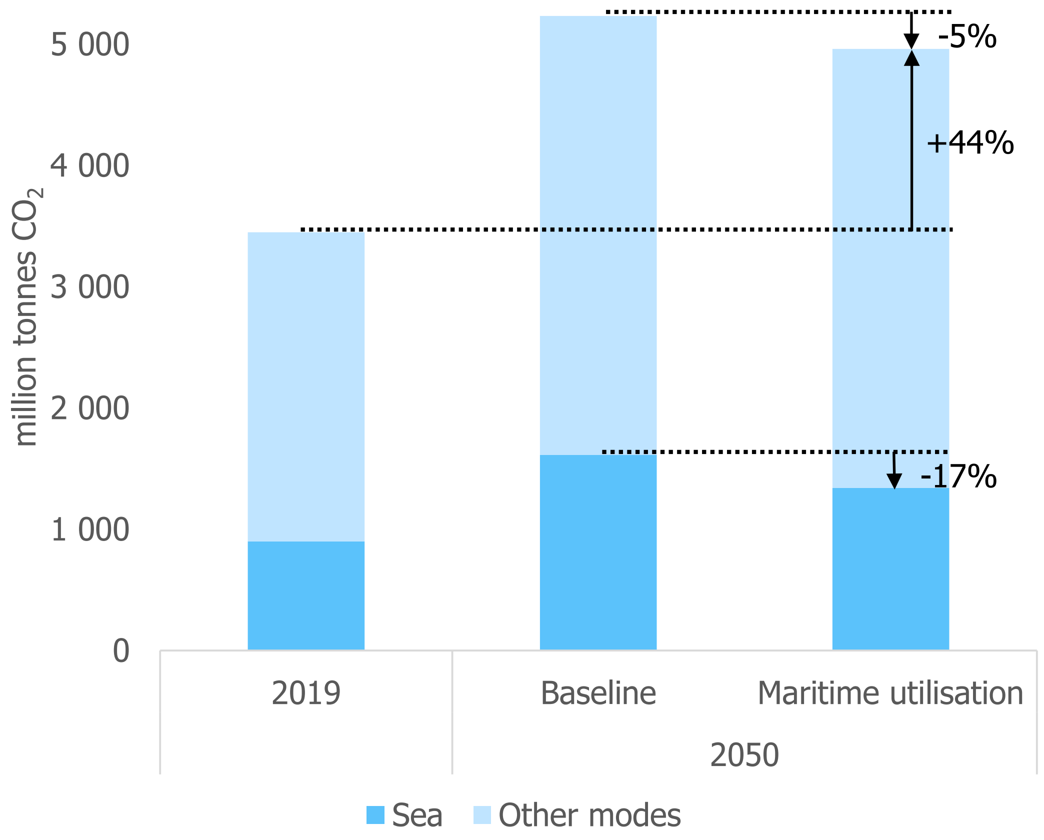


Enhancing rail utilisation has an insignificant impact on CO_2 emissions.

While an increase in rail utilisation does lead to slightly lower (-11%) CO_2 emissions by rail in 2050 compared to the baseline level, the effect on total freight emission is marginal (-0.4%). Compared to the base year 2019 level, this scenario sees a 51% increase in total CO_2 emissions by 2050.

Rail is already a very cost-effective mode. Utilisation improvement is not effective enough to further reduce rail freight costs and increase attractiveness. The focus needs to go beyond cost reduction to increase rail's attractiveness, such as improving its integration with other transport modes.

Optimising maritime utilisation

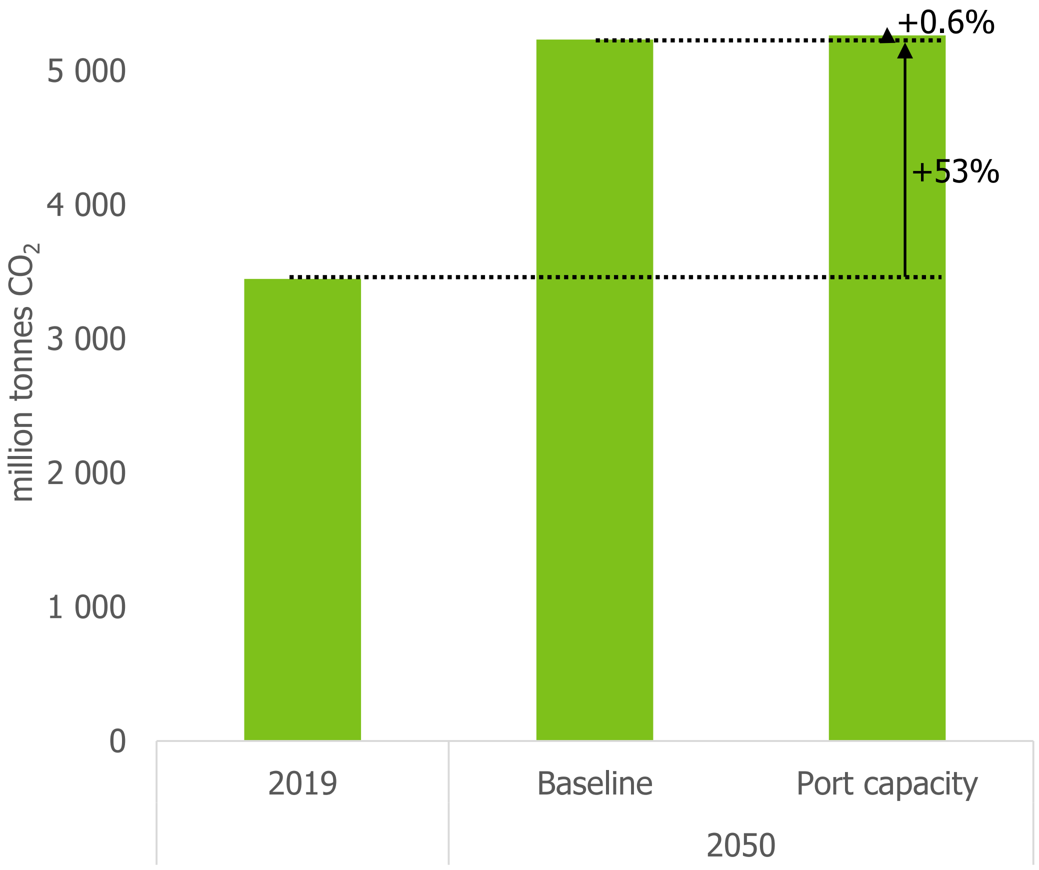


Increased maritime utilisation directly reduces maritime emissions compared to the baseline level. They are 17% lower in 2050 than the baseline scenario.

The implementation of the maritime utilisation improvement measure can reduce the share of maritime emissions in the freight sector. Instead of 31% in the 2050 baseline scenario, maritime freight transport would account for 27% of CO_2 emissions.

By applying this measure alone, total freight CO_2 emissions will rise by 44% in 2050 compared to 2019. This is just eight percentage points lower than the baseline scenario.

Strengthening port capacity



Improving the port handling capacity is the only measure with higher total freight CO_2 emissions in 2050 than the baseline scenario, albeit by only 0.6%.

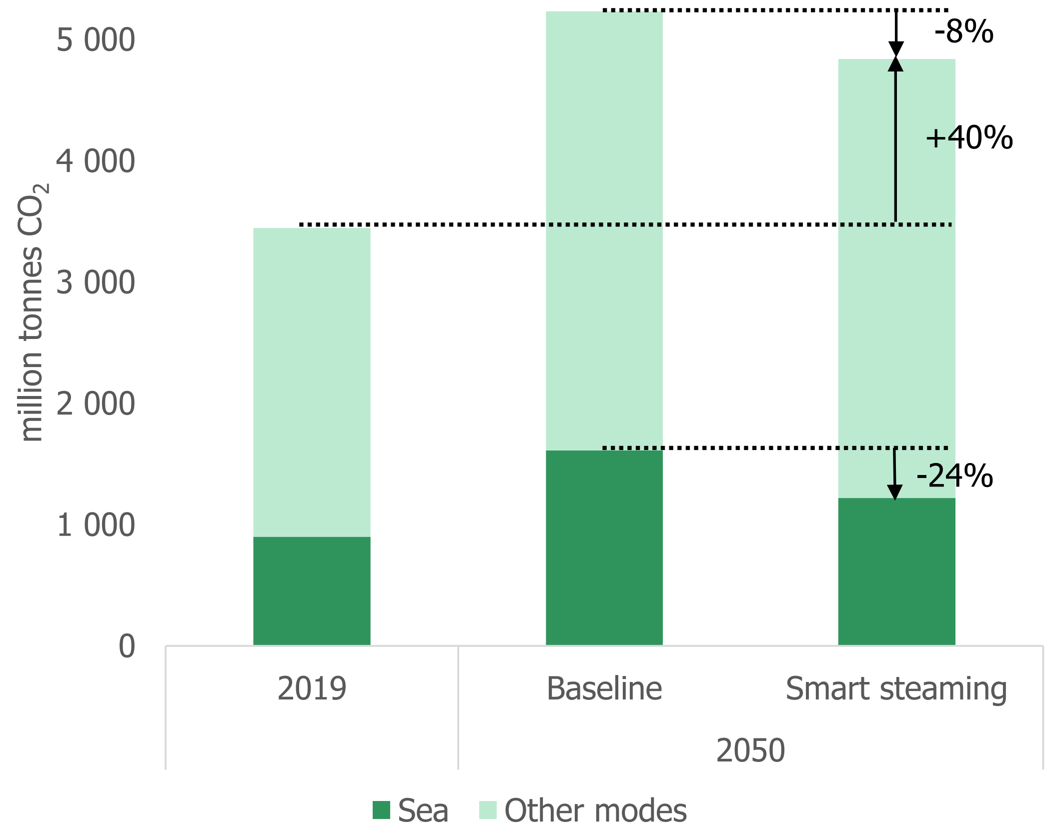
It is expected that higher port capacity due to increased operational efficiency can potentially:

- have a positive impact on stimulating trade growth
- alter port choice, leading to shippers selecting more distant ports with higher operational capacities.

However, the results show that tonne-kilometres in 2050 are not noticeably higher (+0.5%) compared to the baseline scenario. Mode shares remain the same as in the baseline scenario.

The emission growth is also lower than expected. Nonetheless, this development must be counteracted by measures that stimulate decarbonisation.

Implementing smart steaming



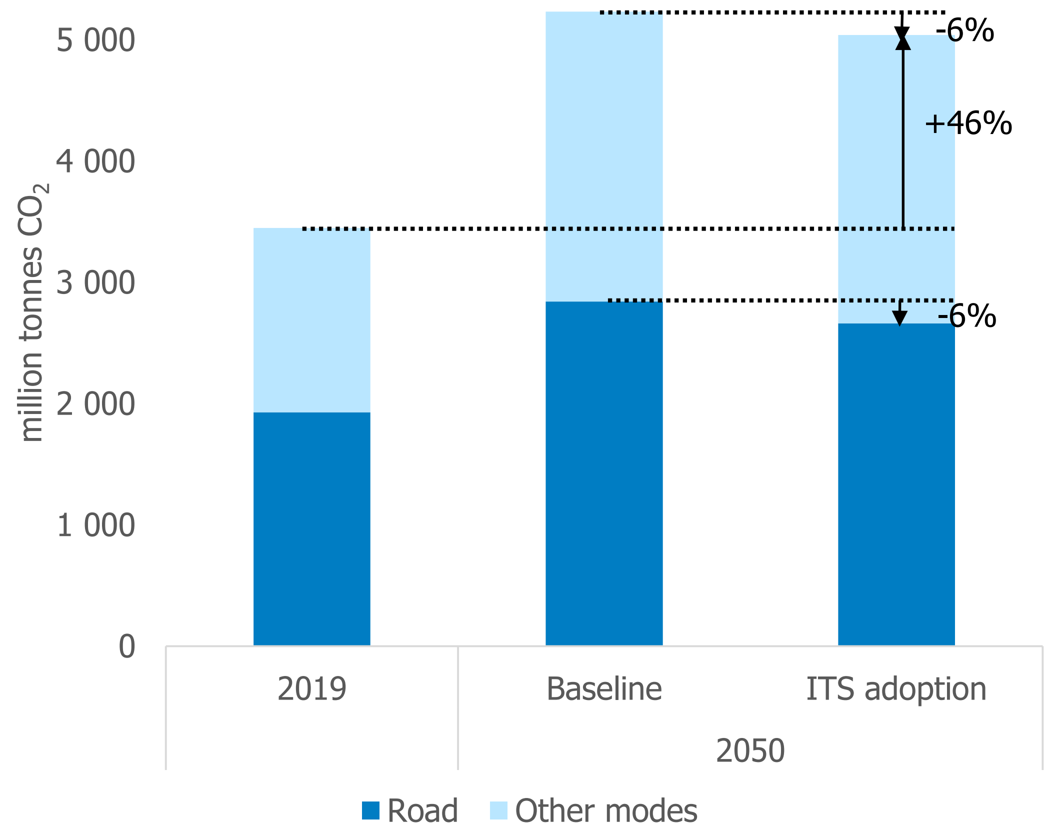
Smart steaming has the highest individual impact on decarbonisation.

Increased fuel efficiency induced by smart steaming leads to a direct reduction in CO_2 emissions compared to a scenario in which no policy actions are taken. As a result, emissions for maritime freight transport in 2050 are 24% lower than in the baseline scenario.

This shows that smart steaming can be highly effective in reducing CO_2 emissions in the maritime transport sector, especially when the total transport demand by sea remains unchanged.

While the mode share of sea transport measured in tonne-kilometres increases from 73% to 76% between 2019 and 2050, its contribution to freight CO_2 emissions drops from 27% to 25%.

Adopting intelligent transport systems

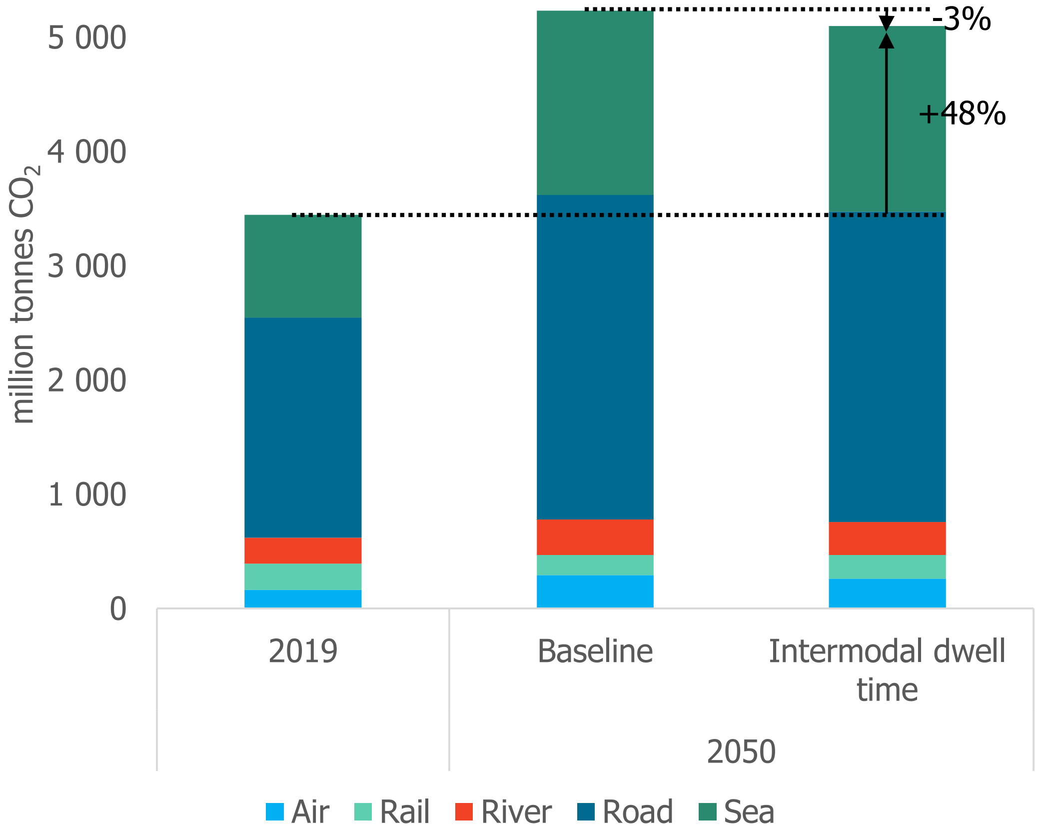


The wider adoption of intelligent transport systems (ITS) can help reduce the CO_2 emissions in the road transport sector. Emissions by road freight in 2050 are 6% lower compared to the baseline scenario.

The domestic freight sector benefits the most from ITS, with domestic freight CO_2 emissions in 2050 8.4% lower than in the baseline scenario.

Overall, total freight CO_2 emissions in 2050 will increase by 46% compared to 2019, which is six percentage points lower than the 2050 baseline scenario.

Reducing intermodal dwell time



Addressing inefficiencies in the intermodal network will enhance the overall supply chain and improve services for all modes. However, its impact on CO_2 emissions is somewhat limited, with only a 3% reduction in 2050 compared to the baseline scenario.

Increased intermodal connectivity positively impacts overall transport demand, with total tonne-kilometres being 0.5% higher in 2050 compared to the baseline scenario. This counteracts some of the CO_2 benefits of the measure.

This scenario shows a more significant modal shift to rail than the rail utilisation scenario: rail mode share is 7.8% in 2050, compared to 6.8% in the baseline and rail utilisation scenarios. A shift from inland waterways and road transport to rail transport is observed for international freight. This is also the case for domestic freight, albeit in smaller shares.

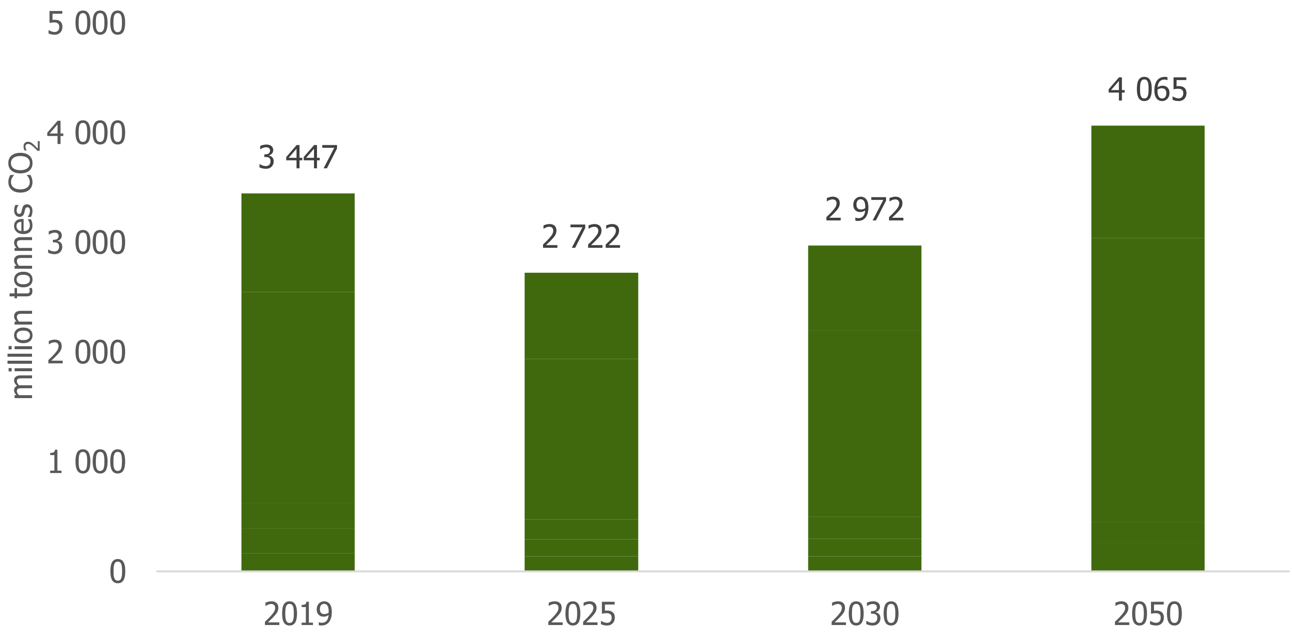
The Digital Transformation scenario and its impacts

The following section presents the overall impacts of the Digital Transformation scenario on CO_2 emissions, unit transport cost and overall transport cost savings. The Digital Transformation scenario assumes that all seven measures are fully implemented. The section also analyses the need for further policy interventions to reach the Paris Agreement goals.

The Digital Transformation scenario and total CO_2 emissions

The Digital Transformation scenario can effectively reduce CO_2 emissions by freight transport: the total rise in emissions between 2019 and 2050 is limited to only 18%, despite the expected 165% increase in freight transport demand.

Logically, the total CO_2 reduction compared to the baseline is smaller than the sum of CO_2 benefits obtained from individual measures. This is because the impacts of some measures overlap when combined in the same scenario.



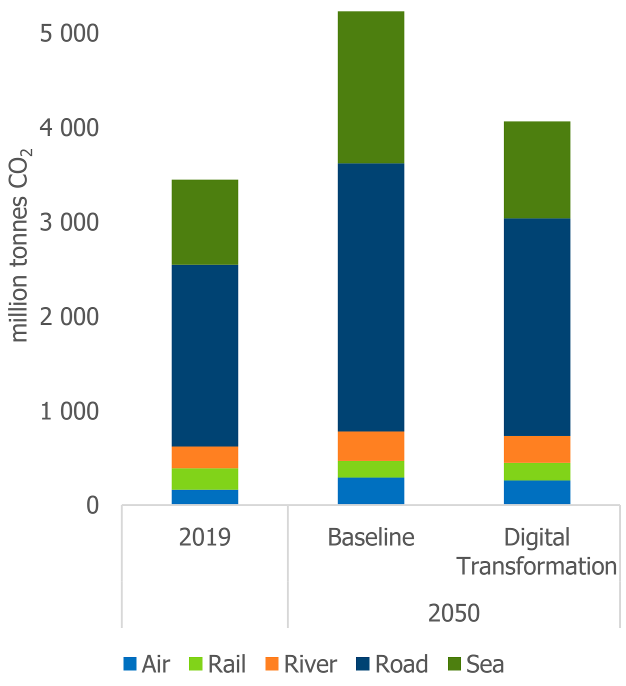
22%

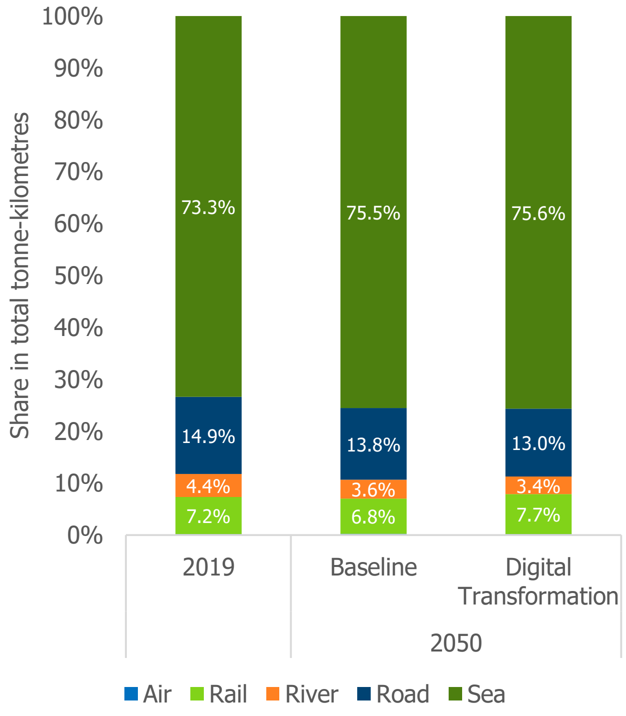
lower CO_2 emissions in 2050 compared to baseline

The Digital Transformation scenario and CO_2 emissions by mode

- **The maritime sector experiences the most significant emission reduction compared to other modes in the Digital Transformation scenario. Despite maritime emissions rising by 14% between 2019 and 2050, its emissions in 2050 are 36% lower than the baseline, proving the high potential for efficiency improvement in this sector.**

- **The road freight sector shows the second-largest emission reduction, with 19% lower emissions in 2050 than the baseline, limiting its emission growth to 20% between 2019 and 2050. The fall in emissions is attributed to truck utilisation improvement, ITS adoption and intermodal dwell time reduction.**





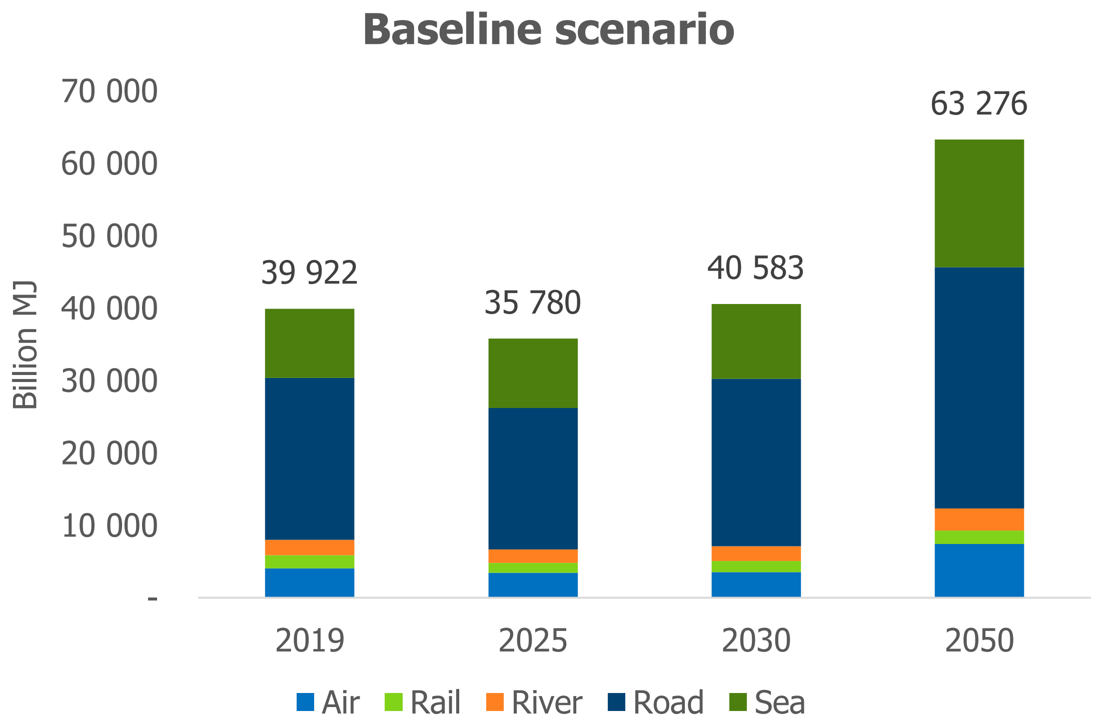
- **Rail freight emissions are 19% lower in 2050 compared to the 2019 level. However, emissions from the Digital Transformation scenario are 5% higher than the baseline in 2050 due to the modal shift towards the rail sector.**

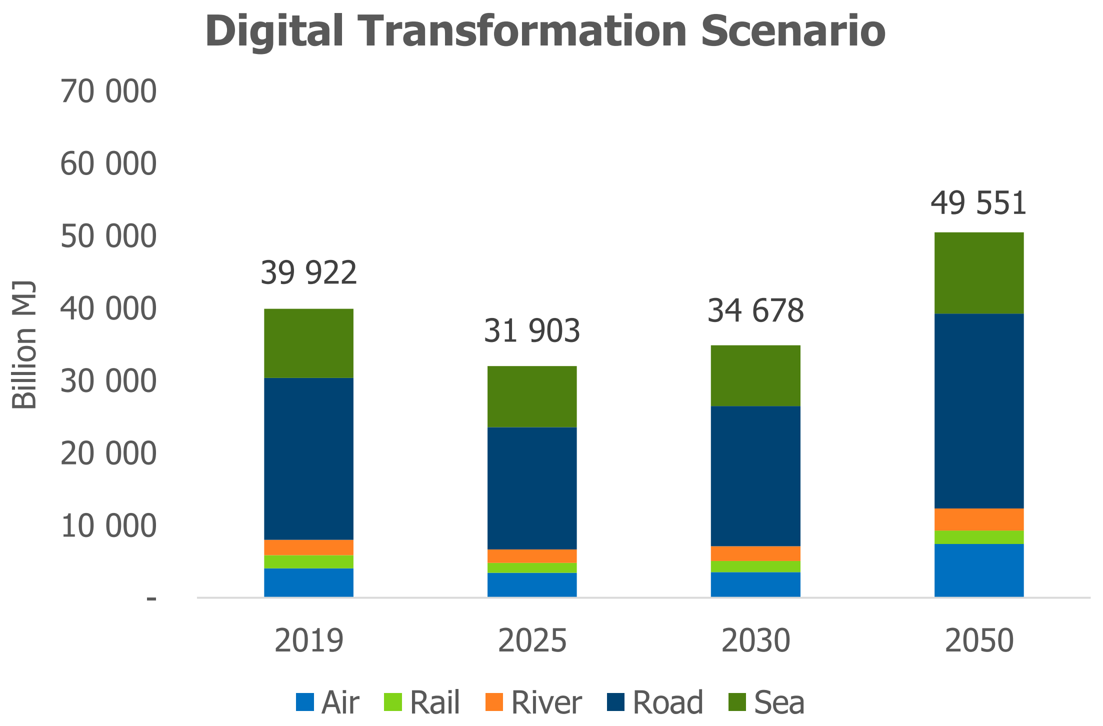
- **Inland waterway emissions are 8% lower in 2050 than the baseline. A modal shift from these waterways to rail reduces emission growth to 25% instead of 36% between 2019 and 2050.**

- **Given that no operational improvement measures are introduced for air freight, its emissions will increase by 62% between 2019 and 2050 in the Digital Transformation scenario, the highest growth of all modes. Nevertheless, air freight emissions in 2050 will still be 10% lower than the baseline value, thanks to the digital improvements that shift air freight to less carbon-intense modes.**

The Digital Transformation scenario and energy use

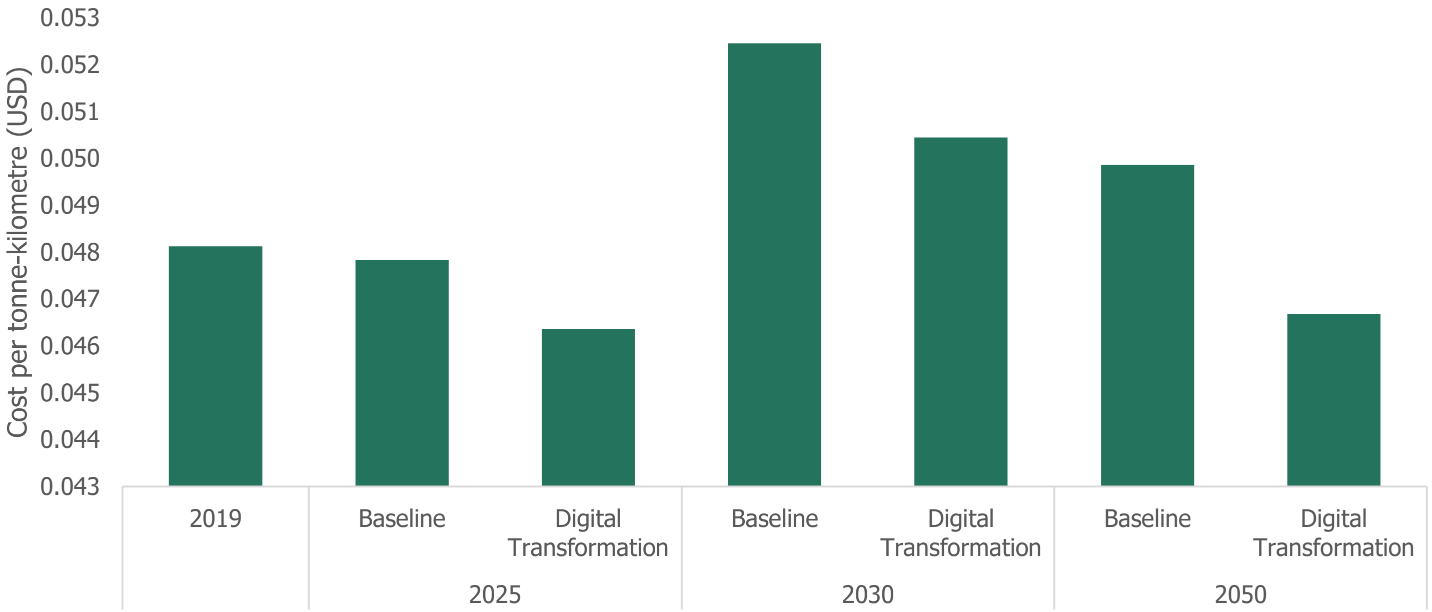
The Digital Transformation scenario shows a 24% increase in energy use between 2019 and 2050. This corresponds to the observations from the CO_2 emission trends. Energy use in 2050 is 22% less than the baseline scenario. Comparing the Digital Transformation scenario to the baseline scenario, energy use by sea transport is 36% lower in 2050, whereas rail energy use is 5% higher.





The Digital Transformation scenario and international trade transport costs

Digital transformation can bring cost savings of USD 1.5 trillion for international trade-related transport until 2030. Projections are even more optimistic in the longer term: an accumulated cost decrease of USD 13.3 trillion is foreseen until 2050. These savings are a result of significant reductions in transport unit costs, calculated in USD per tonne-kilometre, brought on by digitally driven operational improvements.

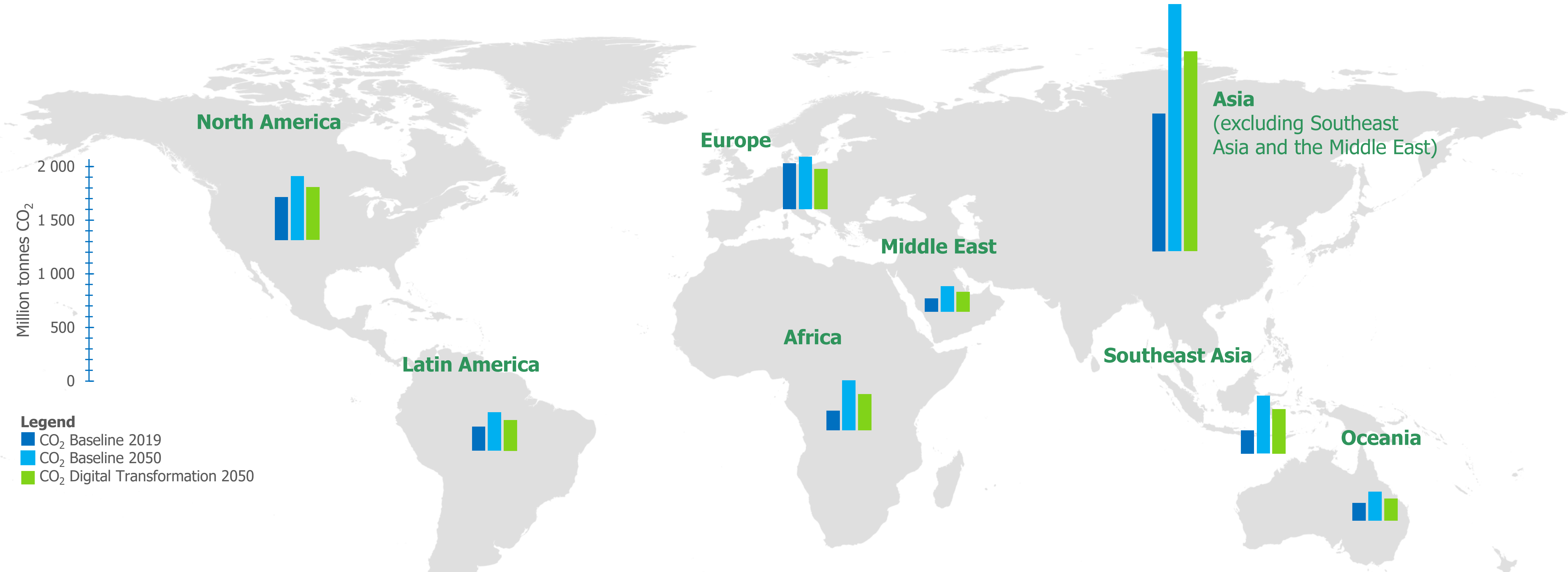


1.5

trillion USD saved on international freight transport until 2030, compared to baseline

The increase in accumulated savings of the Digital Transformation scenario versus the baseline is thanks to the declining transport unit costs (per tonne-kilometre) and comparable demand increase. The higher unit cost of 2030 is due to the International Energy Agency's projections of higher energy costs toward 2030 that later decline towards 2050.

Freight CO_2 emissions by region



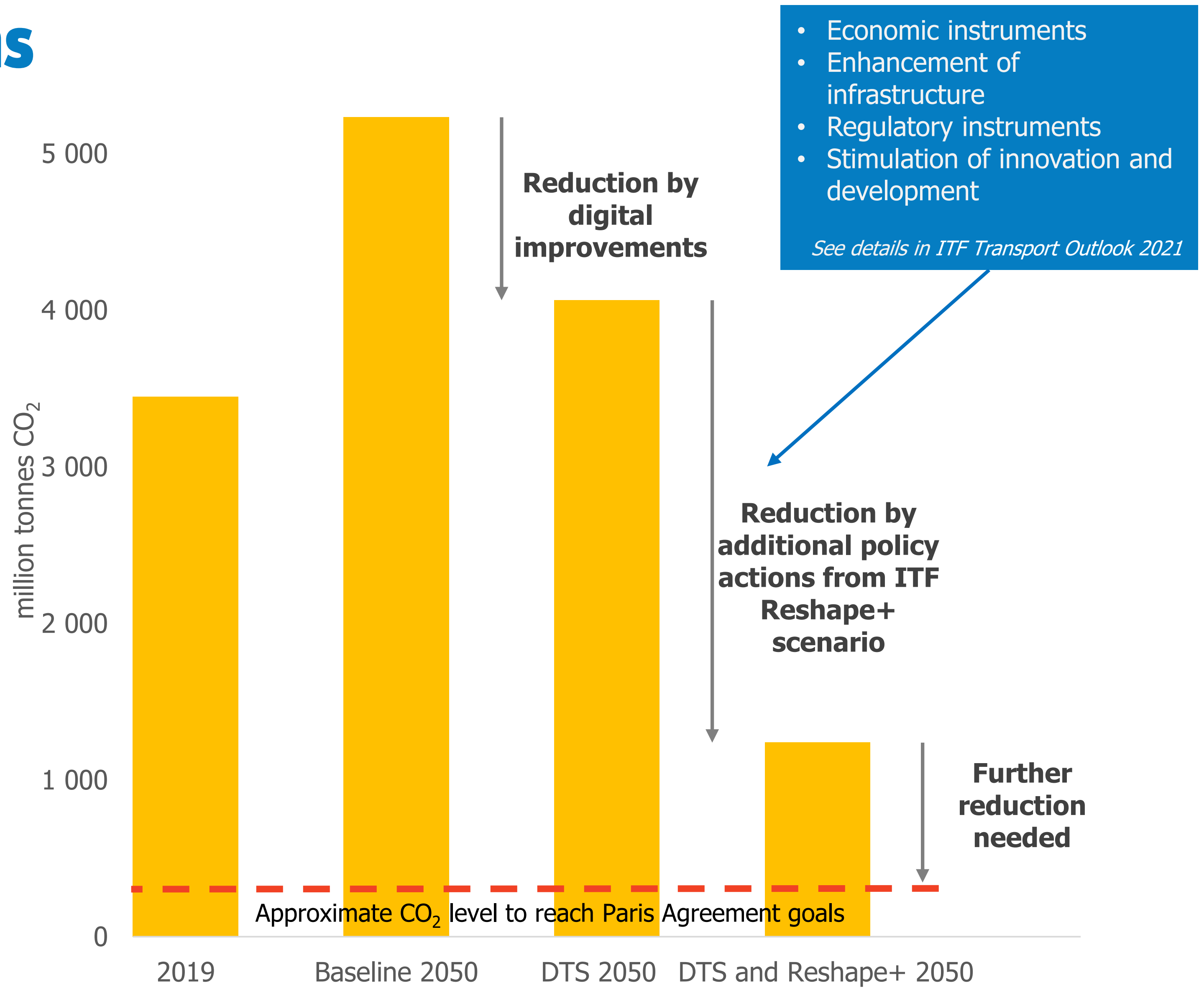
Digital improvements to freight transport operations in developed economies, such as North America, Europe and Oceania, can bring the 2050 CO_2 emission level close to or lower than the base year level in 2019.

Digital improvements to freight transport operations in developing economies such as Latin America, Asia and the Middle East can significantly reduce CO_2 emissions compared to the baseline scenario in 2050, dropping between 19% and 27%.

Further policy interventions are needed to reach Paris Agreement goals

Digital improvements to freight transport operations can help the transport sector reach the Paris Agreement goals. These improvement measures are readily available and easy to implement, with few implementation barriers or regulatory burdens.

However, digital improvements alone are not enough. Additional interventions are required to achieve further CO_2 reductions. They must lower transport demand, make more extensive use of clean fuels and vehicles, and shorten supply chains. Implementing such measures requires political will and concerted private and public collaboration. They entail higher investment costs and longer timelines than currently practiced, but are necessary to achieve the greater goal of decarbonisation.



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