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Sustainable Infrastructure Programme in Asia

OVERVIEW OF EMERGING TECHNOLOGIES & INNOVATION FOR FREIGHT TRANSPORT

Stakeholder Consultation Workshop

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On behalf of:

Federal Ministry for the Environment, Nature Conservation and Nuclear Safety

of the Federal Republic of Germany

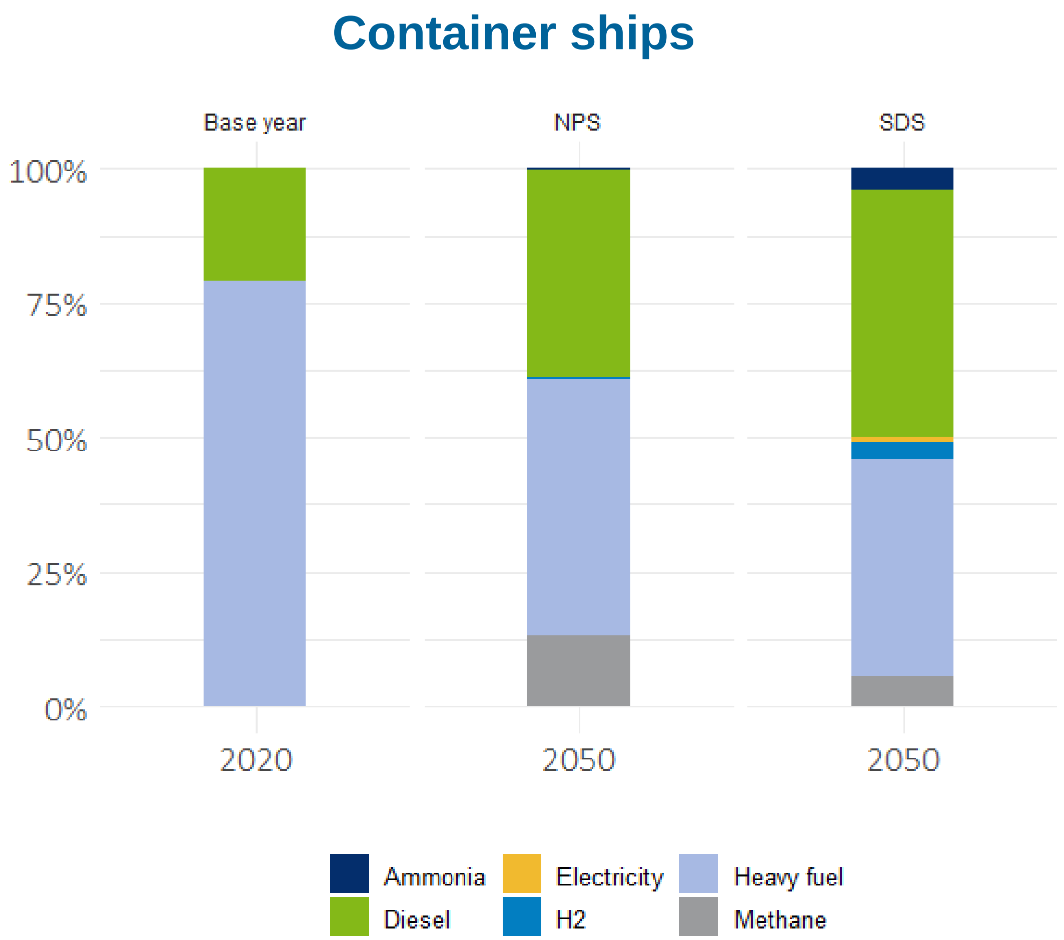
IKI INTERNATIONAL CLIMATE INITIATIVE

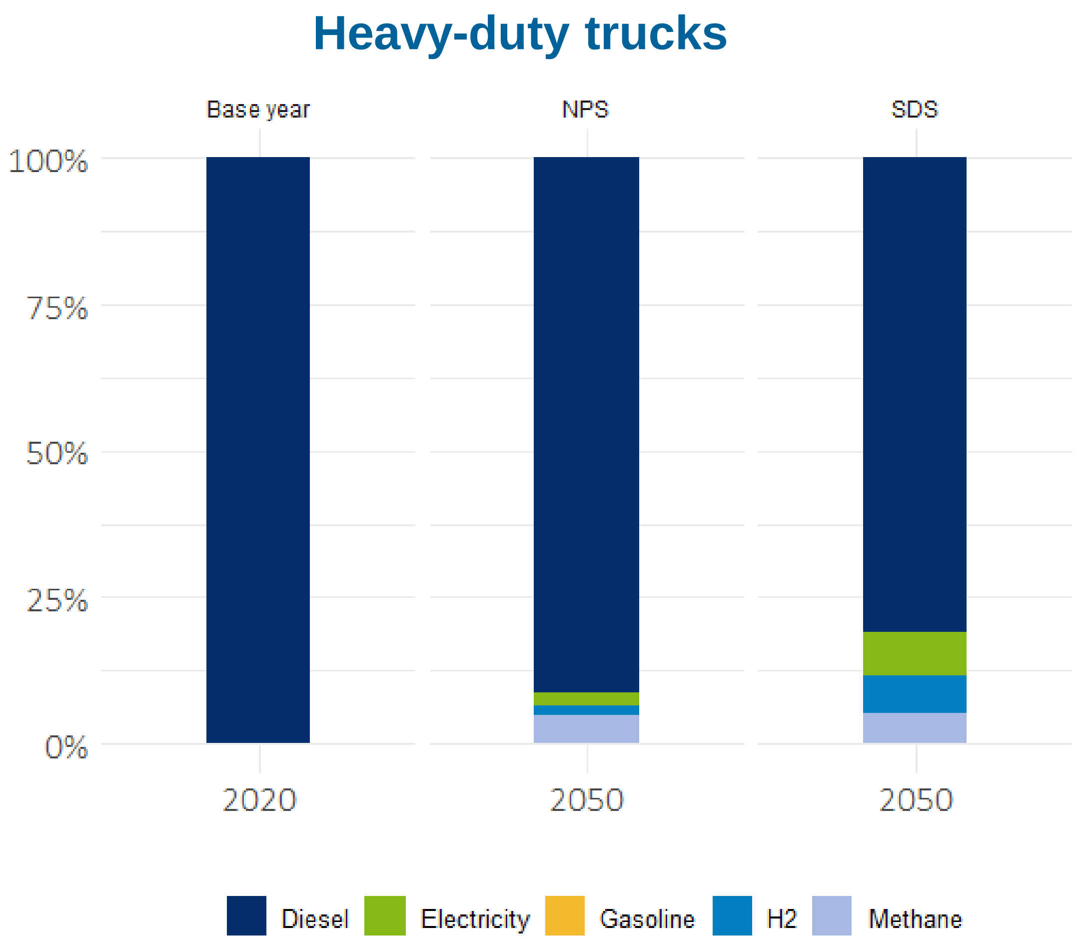
International Transport Forum

Introduction

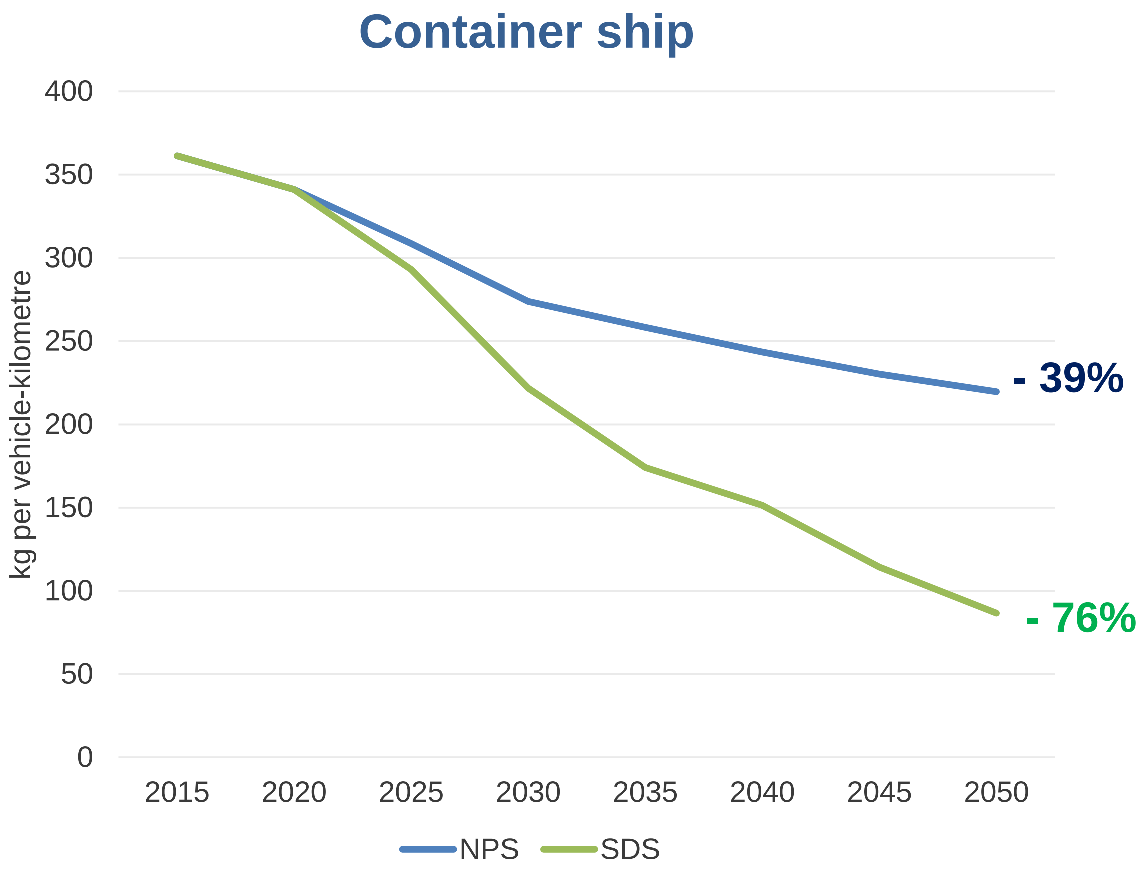
- An efficient freight transport system is essential to the economy and to ensure a high quality of life.
- In a world still heavily dominated by gas and diesel vehicles, low-emission and alternative fuel vehicles are emerging (e.g. hydrogen, biofuels, electric).
- During the last decade several innovative technologies and services concerning freight transportation have been developed.
  - Digital technology and intelligent systems increase the efficiency, capacity, safety and security, while at the same time decreasing the negative environmental impacts of freight transport

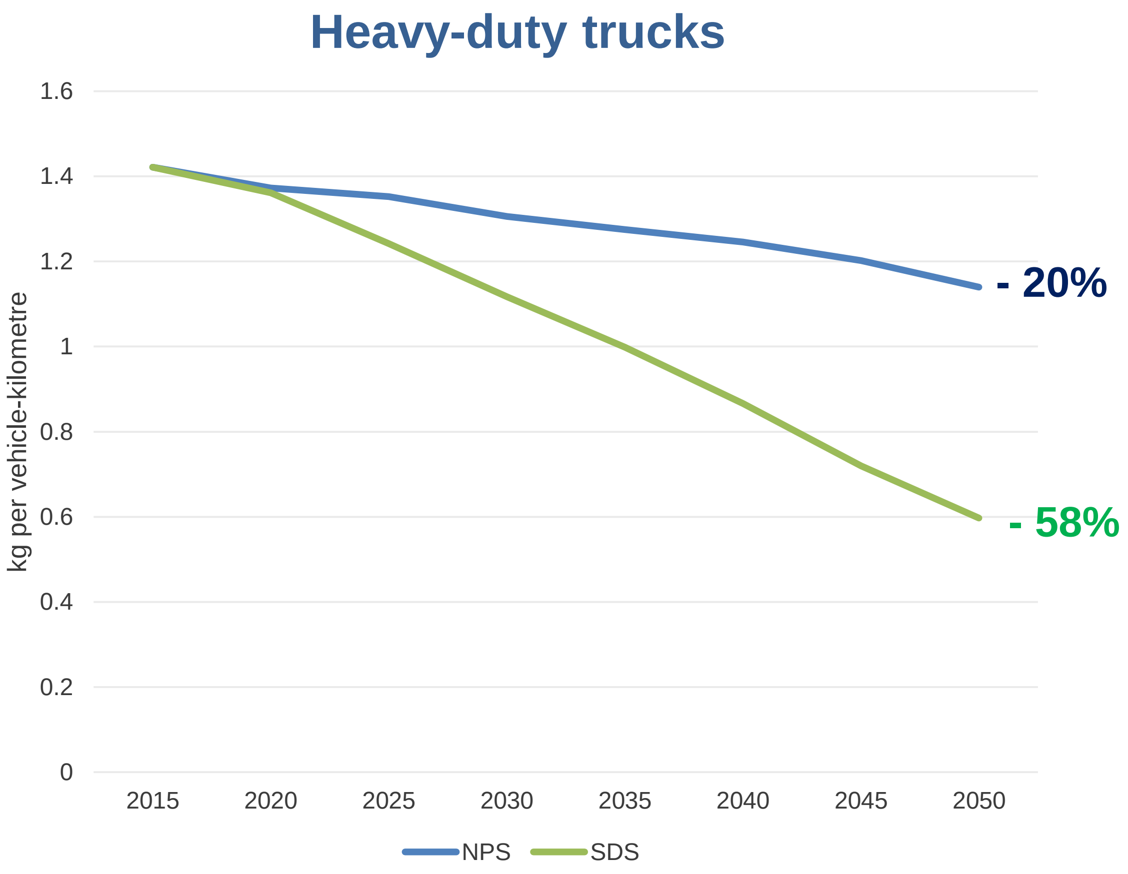
Fleet composition target in ASEAN (IEA)





Carbon intensity improvements in ASEAN (IEA)





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NEW VEHICLE TECHNOLOGY

Biofuels, gas and hydrogen alternatives for heavy-duty trucks

Deep decarbonisation of long-haul, heavy trucks will require the employment of alternative fuels.

- **Gas** powered vehicles - CNG is more effective for smaller sized vehicles. LNG is more suited to heavy-duty vehicles for long-haul operations.
  - Tailpipe emission reductions possible with LNG are limited when compared to the more efficient diesel engines
  - Current high cost of LNG vehicles is also a caveat.
  - The availability of renewable gas is limited
- **Biofuels** are considered more suited for long-haul trucks because their the ability to use the same existing oil fuels refuelling and distribution network.
  - Difficult to scale up production
  - High full life cycle well-to-wheel emissions
- **Hydrogen** has the advantage of zero tail pipe emissions.
  - Pollution-free sources of hydrogen are unlikely to be practical and affordable
  - Storing and transporting hydrogen poses important challenges
  - Infrastructure for distribution and re-fuelling is not yet in place.

Battery electric heavy-duty trucks

- Manufacturers and other companies have been investing in **electric battery** heavier vehicles (e.g. Tesla, BDY, Daimler).
- The feasibility of powering heavy freight trucks with electric batteries is still a topic open to contentious debate.
  - United States class 8 truck (36 tonnes gross vehicle weight) for long range operations would require a 12 tonne battery or more.
  - Tesla stated that with a battery of 4-6 tonnes is possible to achieve the same performance and a range above 450 km, something contested by others.
- Heavier trucks pilot projects are mostly directed at the delivery market, not the long-haul.
- In the short- to medium-term it is an option directed especially at light commercial vehicles for deliveries and urban or regional transport.

Low carbon road operation: Electric road systems

- **Electric roads** consist of the direct supply of electric energy to the vehicles while on motorways. This can be assured by overhead catenary, ground conductive or inductive solutions.

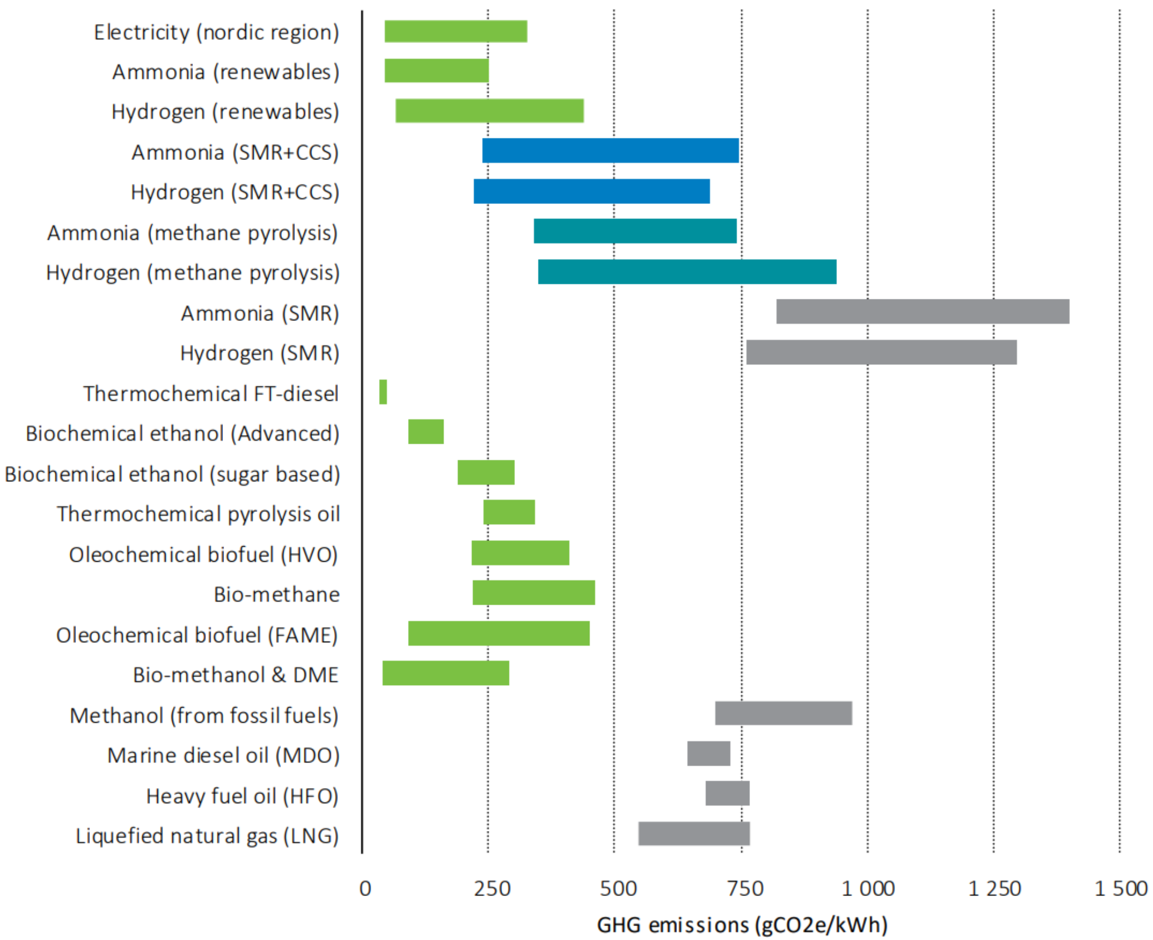
- Trucks can be equipped with batteries, hydrogen fuel cells or other options that power the engine when driving outside the direct supply system – although at least 20% and preferably 50% of the annual distance driven should be on an electric road.
  - eHighway: electrified heavy-duty road transport
  - A particular electric road system is the eHighway being developed by Siemens.

Alternatively-powered rolling stock for rail (hydrogen or battery)

- Electrification has been highlighted as a potential way forward, but electrification itself can carry high front-end infrastructure costs.
- Studies have suggested adopting rolling stock capable of using alternative energy sources as an alternative option.
- **Hydrogen fuel cells** can serve as a source of energy for train propulsion.
  - In the United Kingdom, simulations for a specific route showed that a hydrogen-powered train and hydrogen-hybrid train led to CO_2 decreases of 59% and 77%, respectively.
  - But, how clean this technology really is will depend on the initial way in which hydrogen is produced.
- **Rechargeable batteries** for powering rolling stock and hybrid vehicles can provide CO_2 mitigation gains.
  - Their main claimed advantage for decarbonisation purposes is linked to lower cost compared to the investment needed for electrifying infrastructure.
  - weight and capacity of batteries can raise operational difficulties

Low-carbon fuels for maritime transport

Well-to-wake greenhouse gas emissions of different fuel options per kWh of shaft work



- Due to methane emissions in natural gas production and methane slip, LNG or methanol (when produced using fossil fuels) do not deliver, in current conditions, lower GHG emissions than conventional marine fuels
- Biofuels, electricity, hydrogen and ammonia are promising options, if produced with low-carbon energy and (where relevant) renewable carbon, when comparing energy options based on well-to-wake and lifecycle assessments

Main barriers to adoption of renewable energy

- Price, costs of vehicle manufacturing and shipbuilding
- Maturity of technology and experience
- Availability/scalability of alternative fuels
- Lack of distribution, refueling/charging infrastructure
- Uncertain demand
- Lack of incentive/regulation

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INNOVATION AND DIGITALISATION

Asset sharing and digital platform

Sharing assets (information flows, vehicles or warehouses) can promote efficiency in resource management for logistics activities.

- Sharing assets can increase logistic efficiencies (e.g. increasing vehicles occupancy rate)
- Asset sharing can also reduce costs for enterprises by increasing efficiencies (e.g. less fuel consumption and less warehousing infrastructure).
- Governments may need to consider appropriate competition regulation to facilitate such asset sharing and may need to consider how such actions could be enabled (for example through third parties' digital platforms).

In one study in the UK, reductions of up to 40% CO2 emissions were observed thanks to the pooling of freight resources.

Intelligent systems and eco-driving

- **Advanced assisted driving systems** (e.g. adaptive cruise control, real-time fuel consumption monitors) suggest modifications to driving behaviour
- **Vehicle-to-vehicle communication** systems can be used to set up semi-automated vehicle columns (truck platooning)
- The contribution of **truck platooning and autonomous trucks** towards decarbonisation is less clear.
  - The benefits are more associated with the reduction of operational costs.
  - They can also increase driving efficiency, have more loading space and avoid congestion by using “off peak” periods.
- Driver training and assisted driving (**eco-driving**) is one of the most effective ways of reducing emissions.

Multimodal freight interfaces

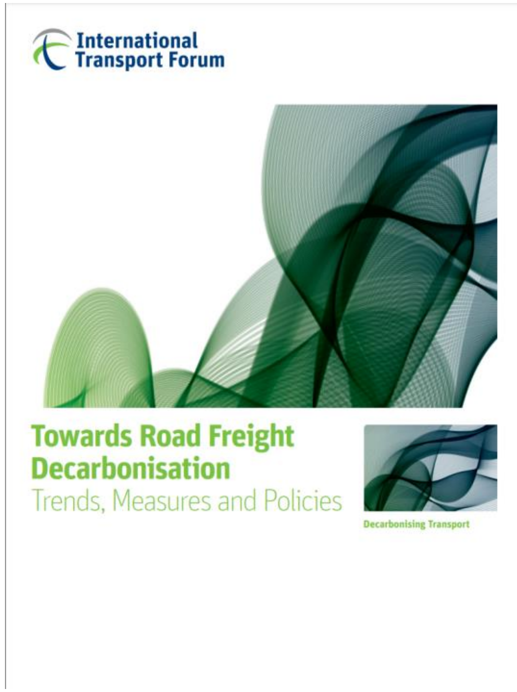
- Improving **multimodal freight interfaces** will enable maximising the efficiency of operations;
- Improving the interfaces can also help increase capacity, lower costs, increase reliability, employ the right mode for the right tasks and decrease the carbon footprint of freight transportation.
- Multimodal interfaces have three basic components: physical, information and institutional.
  - **Physical** facilities where cargo transfers take place are a critical element
  - Another critical interface involves the exchange of all the **information** – business, regulatory and operational – required to manage the flow of goods.
  - **Institutional** alignment is also required – between different agents and operators in the supply chain, but also at a higher inter-governmental level.
- After adopting a rail-oriented strategy to develop its hinterland, the Port of Barcelona increased, by a factor of six, the amount of twenty-foot equivalent units (TEUs) moved by rail from/to the port.

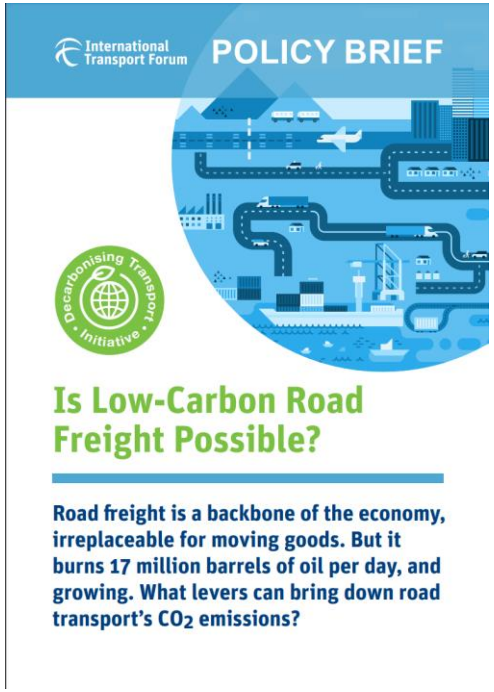
Capacity increases in rail by automatisation and digitalisation

- **Railway digitalisation** involves internet of things (IoT) and wireless communication, cloud computing and data centralisation, big data analytics, and automation.
  - Mobile phone applications providing real-time data to service providers and end users, e-ticketing, digital train control, signal and traffic management optimisation, and enhanced predictive maintenance strategies.
- They contribute towards generally improving the level of service by reducing the energy consumption, and by increasing safety, reliability, capacity and traffic flows.
- Improved competitiveness can generate a mode shift to rail freight, which generates less CO_2 emissions per tonne-kilometre.
- Other CO_2 emissions reductions come from the optimisation of the rail freight system management, increasing average load factors and decreasing empty trips, and from better traffic management and train control, which can result in reduced energy requirements.

ITF work on decarbonising freight transport

Transport
Climate Action
Directory





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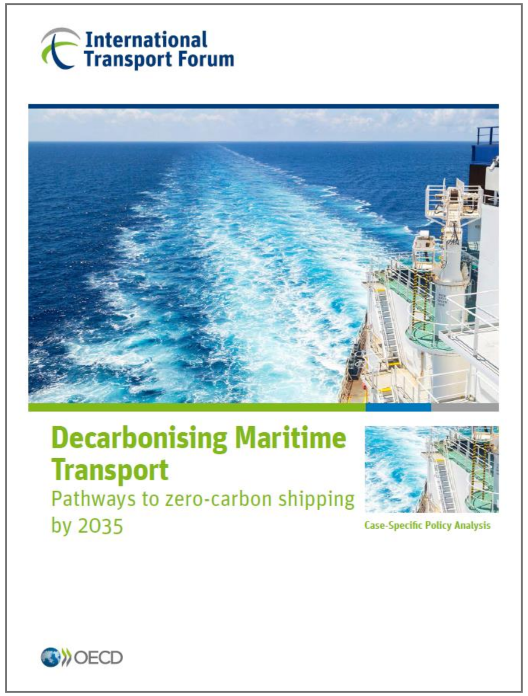
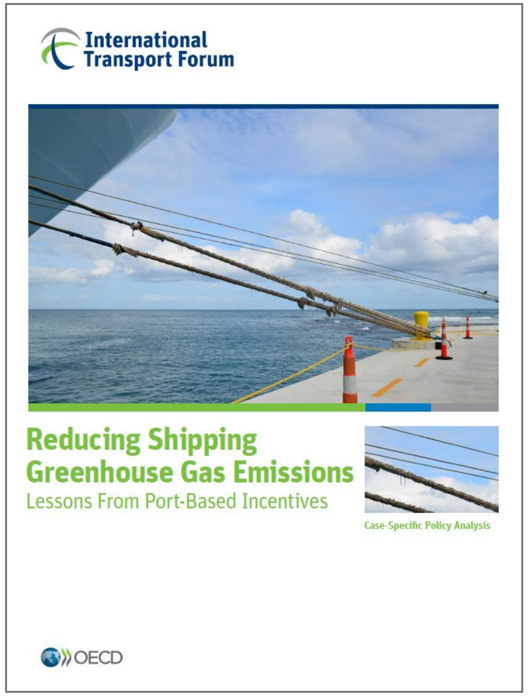
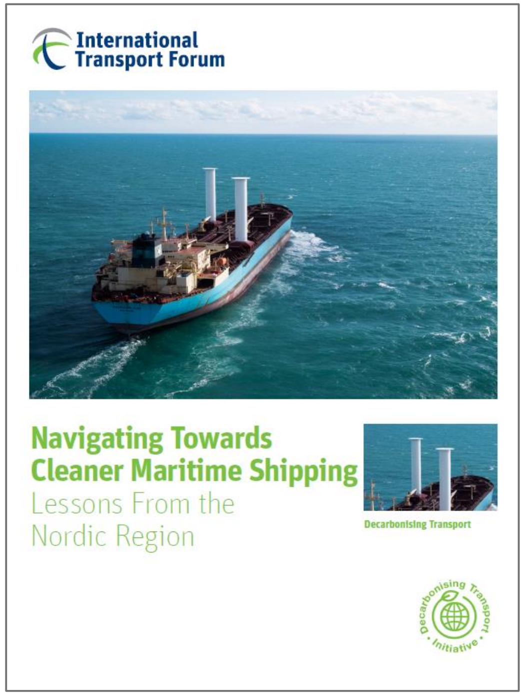
ITF work on decarbonising maritime transport







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THANK YOU FOR YOUR ATTENTION

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