The Future of Rail

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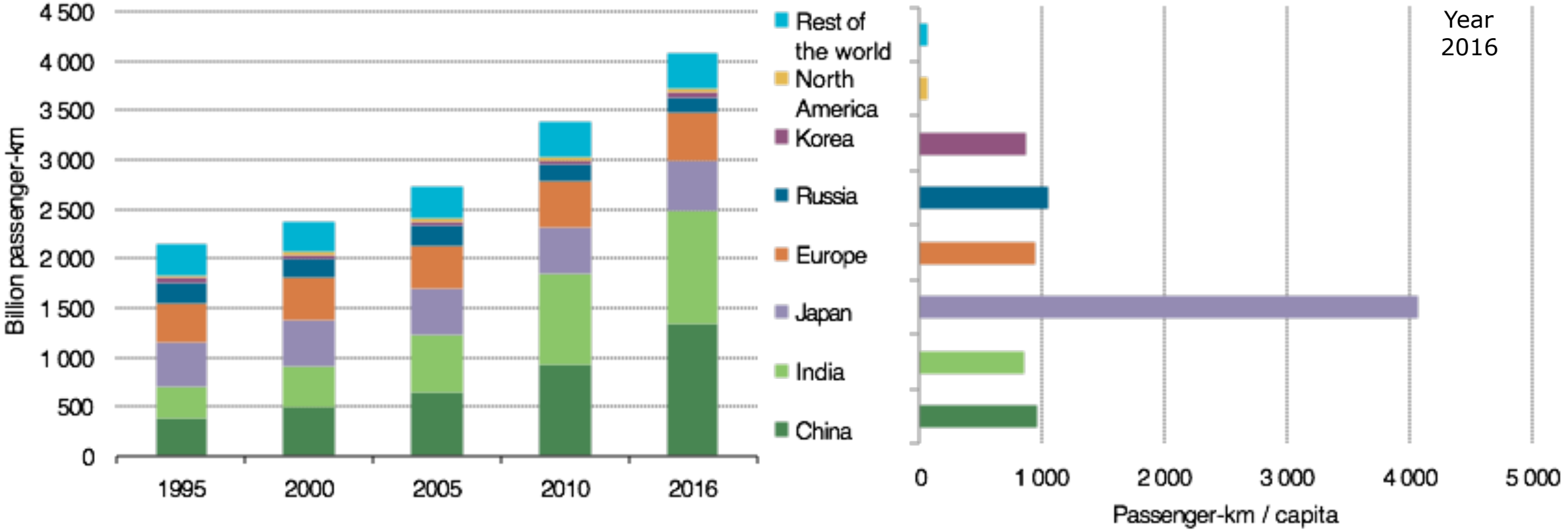
The Future of Rail examines how the role of rail in global transport might be elevated as a means to reduce the energy use and environmental impacts associated with transport

Rail is one of the pillars of passenger mobility

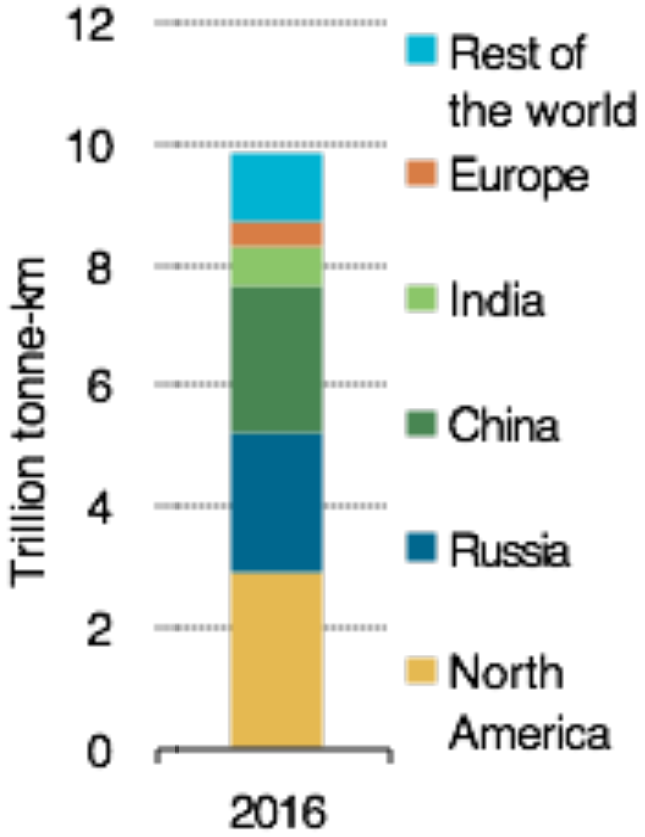


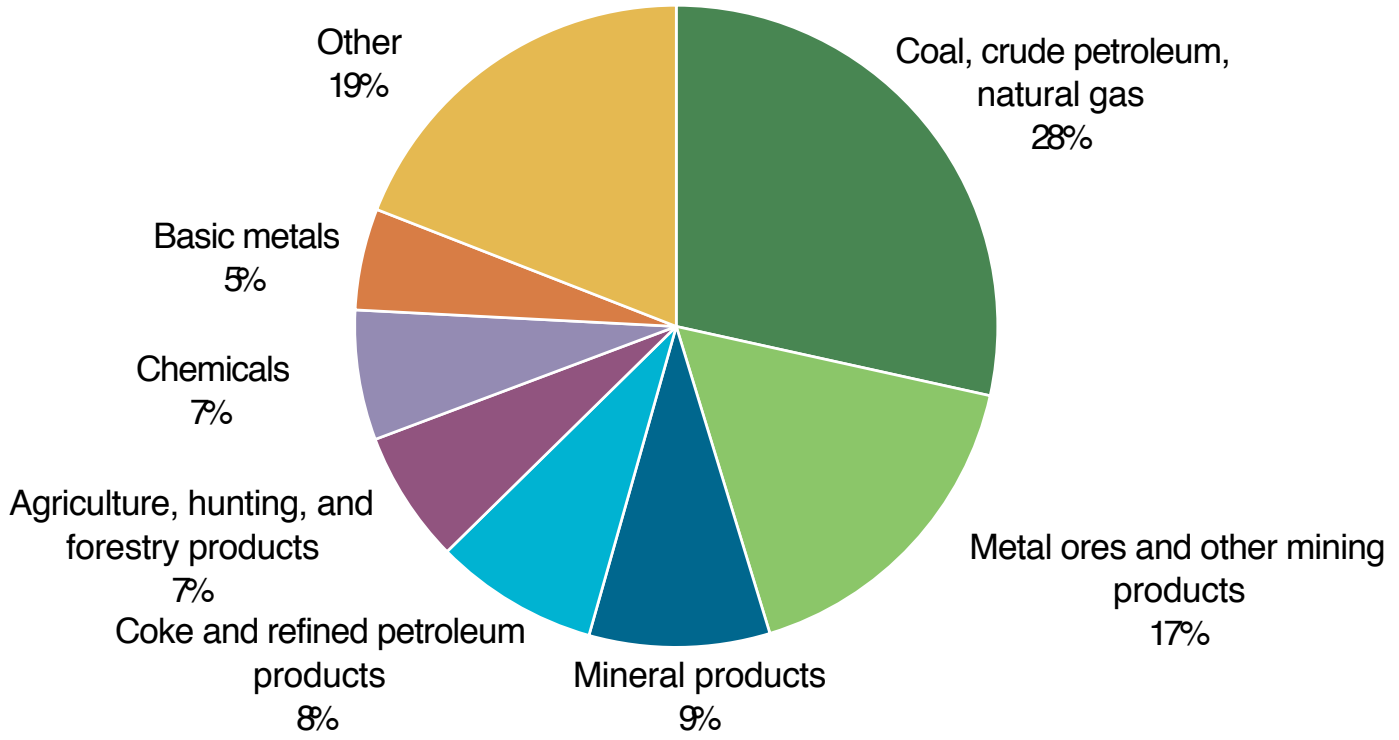
Globally, rail constituted 8% of passenger transport

Japan, by far, has the highest rail activity per capita

Other major rail regions globally include China, India, Europe, Russia and Korea

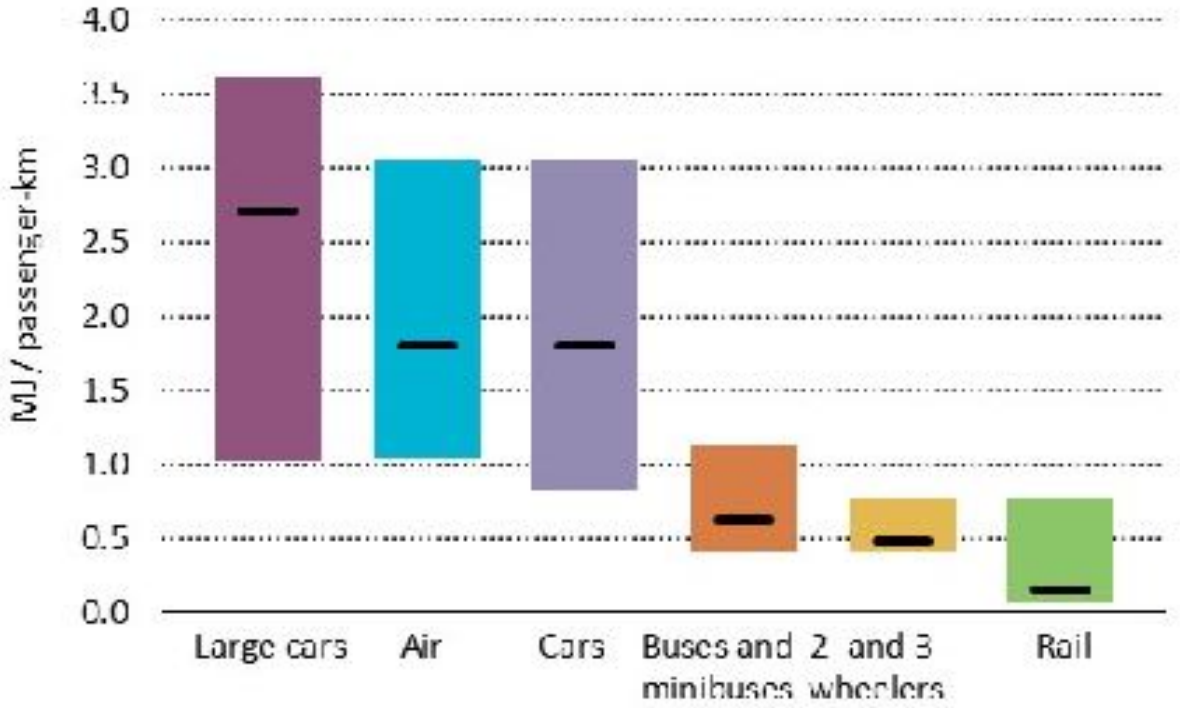
Rail is also a key pillar of freight transport

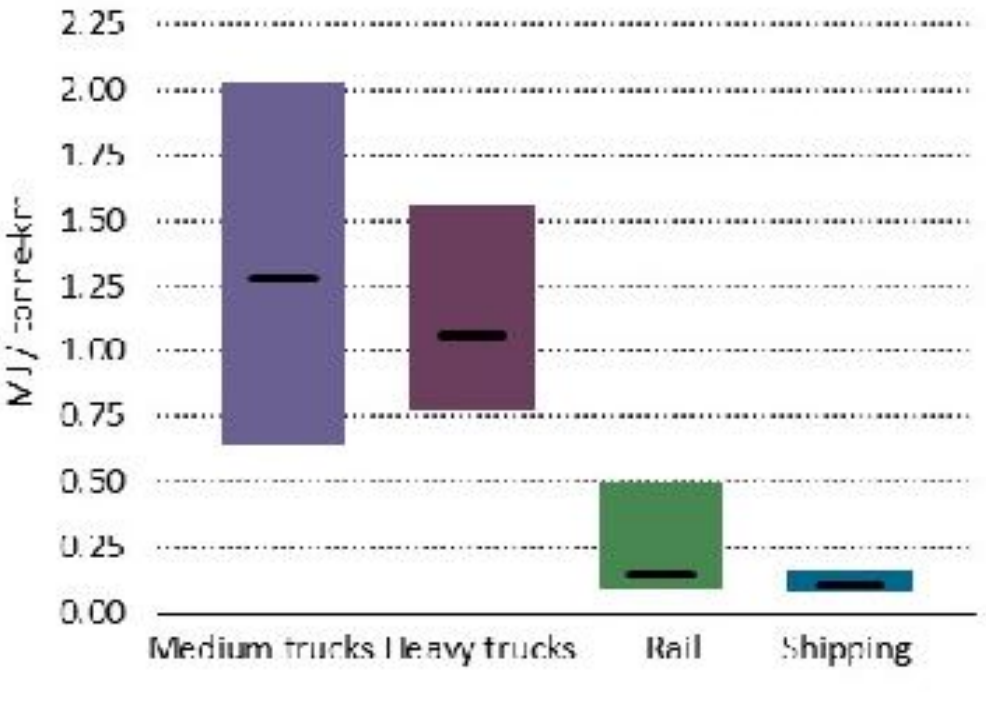




Globally, rail constitutes 7% of all freight transport
Freight rail enables high capacity goods movements over very long distances
It is especially relevant for large countries and currently mostly used to move bulk goods

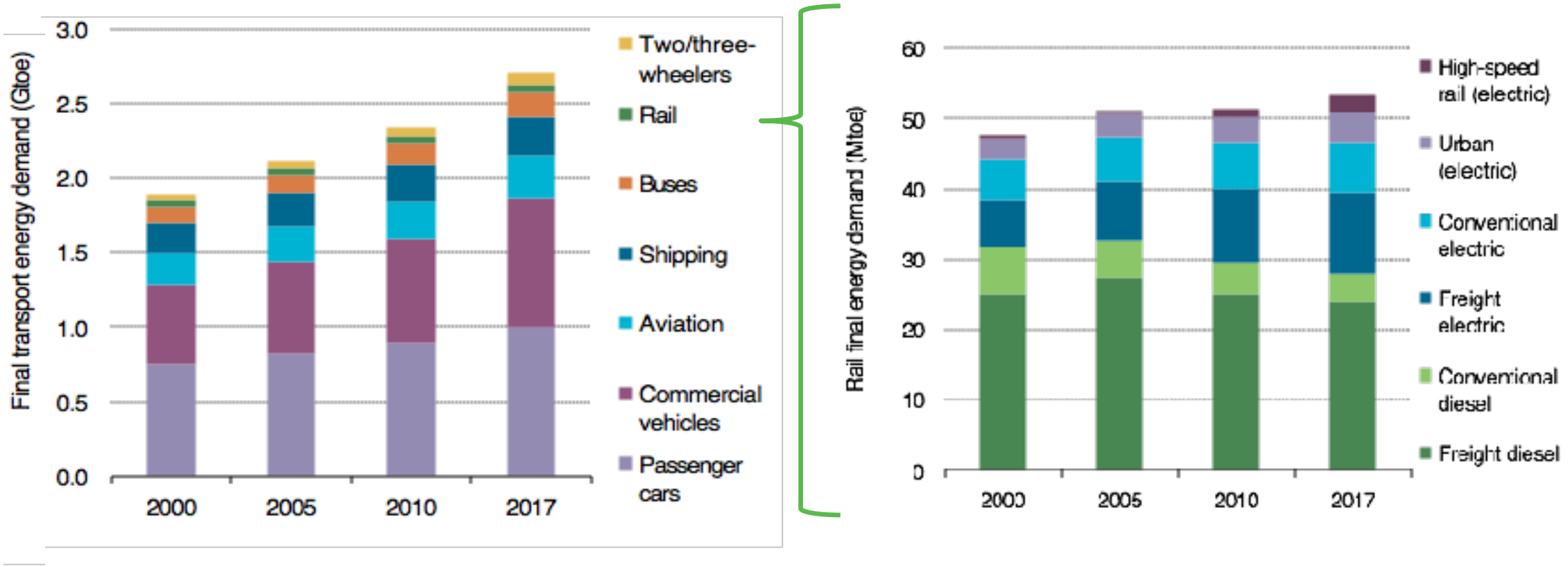
Rail is one of the most efficient and lowest emitting transport modes





Rail is the most energy-efficient means of motorised passenger transport
Rail is also much more energy efficient than road freight

Final energy use in transport by mode, 2000-2017

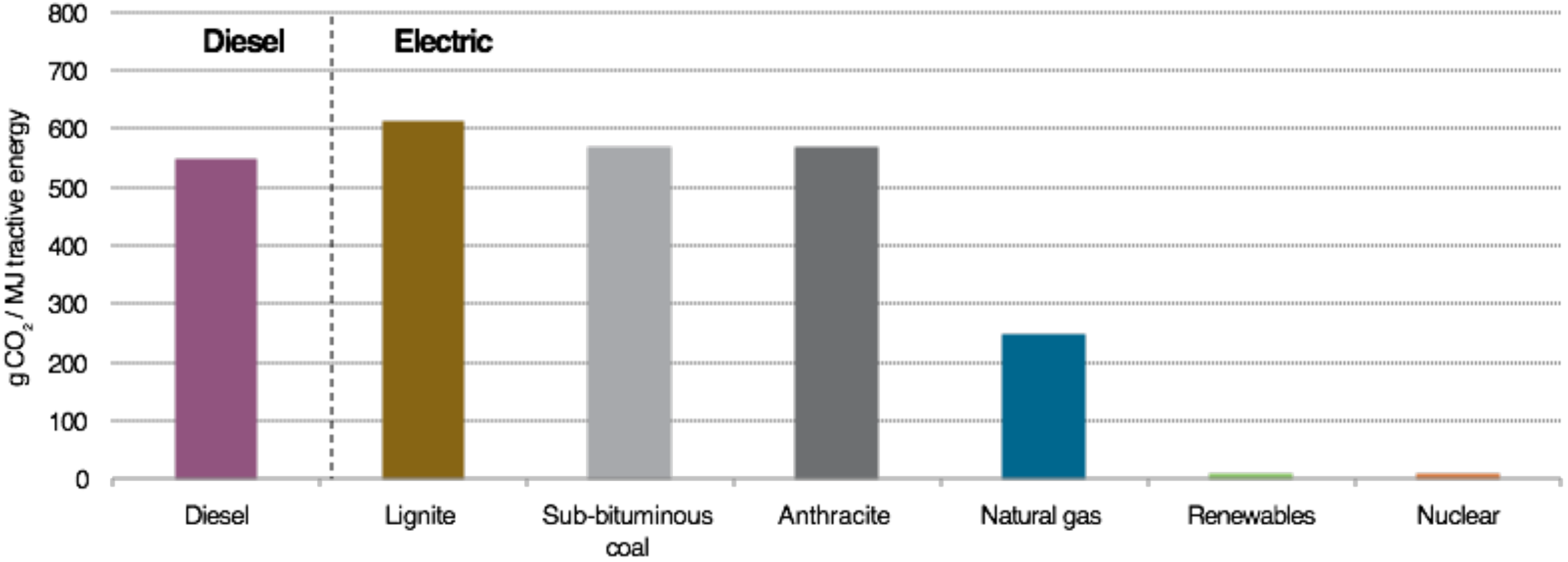


Energy demand from the transport sector has risen significantly in the past decade, driven mostly by growth in Asia and by demand in road transport

Thanks to its energy efficiency, rail accounts only for a minor fraction (2%) of transport energy use

Rail is the most diversified transport mode, with very significant reliance on electricity, especially in high-speed and urban rail services, which are almost entirely electrified

Well-to-wheel carbon intensities for trains



Electric trains are significantly less carbon intensive than diesel trains, provided that they draw power from primary energy sources with low-carbon content

Is rail capable to save GHG emissions?

Answering this question requires a life cycle assessment of the GHG emissions

Results depend on the characteristics of the infrastructure (lines with numerous tunnels, viaducts and bridges are emission-intensive), its passenger throughput and and its capacity to displace trips on other modes

- If optimal conditions are met (low infrastructure emissions, large displacement of car and air trips), a new high-speed rail line can produce almost immediate net CO_2 benefits by reducing air and car journeys
- In a pessimistic case (e.g. extensive shares of tunnels and bridges, low throughput), emissions due to the construction of rail infrastructure may be offset only after decades
- Metros achieve the most emissions savings if they can attract commuters who would otherwise use their car. The emissions intensity of the metro operation also plays a decisive role
- The energy efficiency of freight rail over transport by road leads to rapid net benefits

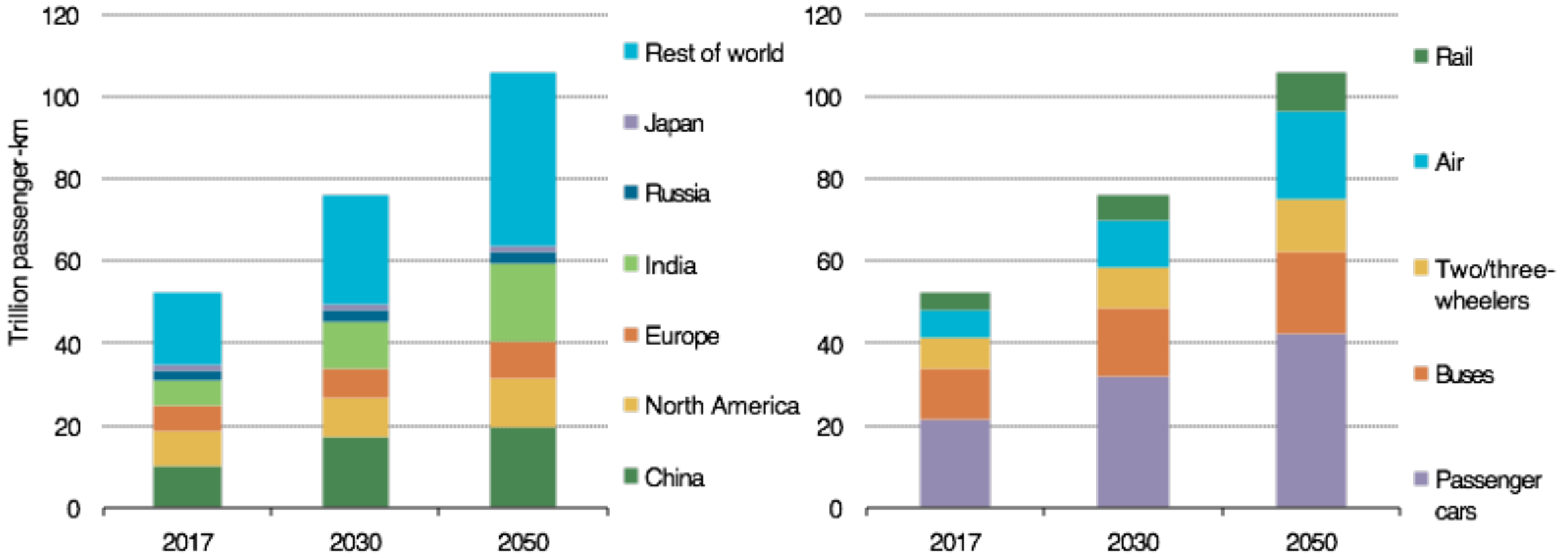
Projections

The future of rail will be determined by how it responds to both rising transport demand and rising pressure from competing transport modes

The report considers **two scenarios**

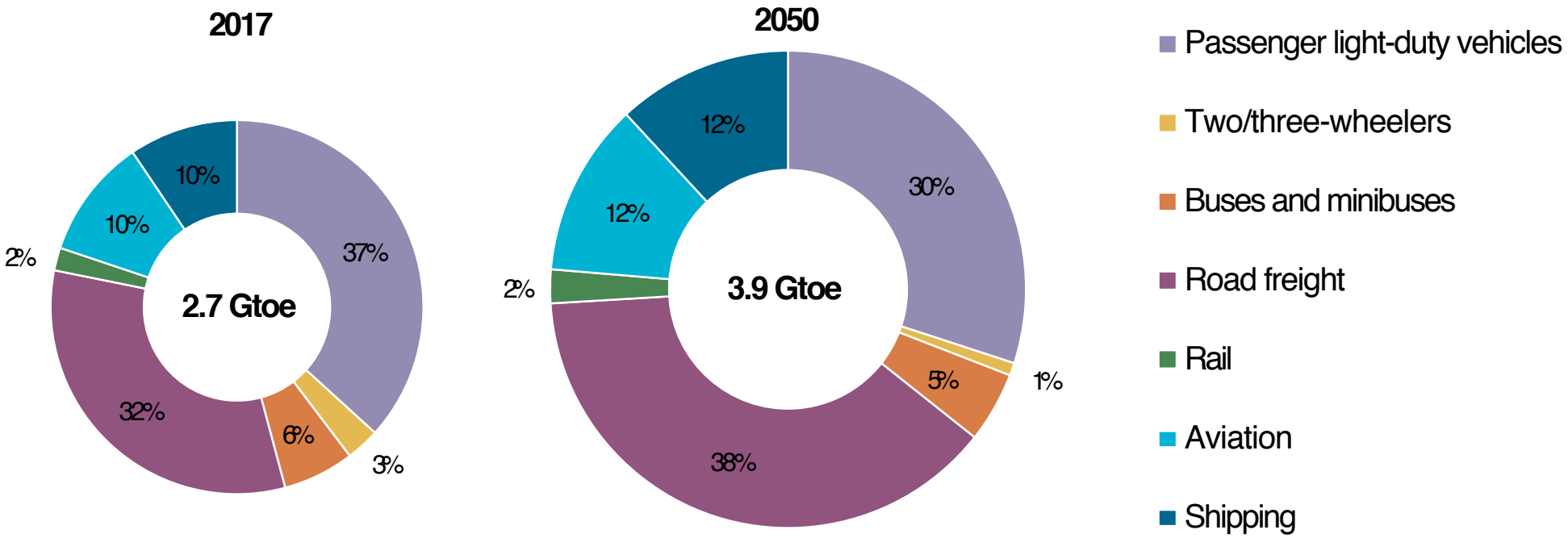
- The **Base Scenario** assumes no significant new emphasis on rail in policy making
  In this context:
  - Rail does no more than maintain its current share in global passenger activity relative to cars and air travel by 2050
  - The global freight activity share falls from 7% in 2017 to 5% in 2050, growing less than shipping and road freight transport
- The **High Rail Scenario** accounts for a greater reliance on rail for urban passenger movements and non-urban mobility, leading to CO_2 emissions in global transport to peak in the late 2030s and, by 2050, to an oil use that is more than 10 mb/d lower than in the Base Scenario

Passenger transport activity in the Base Scenario



Emerging economies significantly increase their share of total passenger travel in 2050
Rail accounts consistently for roughly one-tenth of all passenger activity through 2050

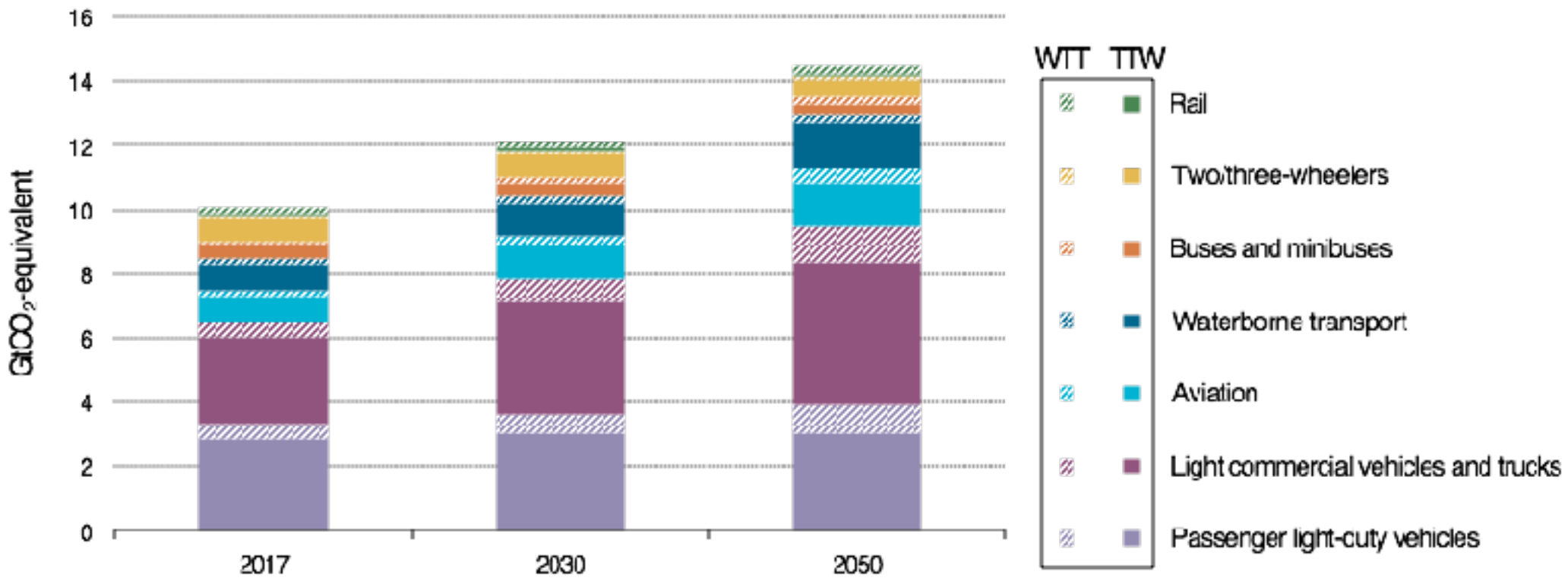
Energy demand from transport in the Base Scenario



Transport energy demand in the Base Scenario increases by 43% through 2050, driven, in particular, by road freight transport and aviation

Rail's energy use pales in comparison with the energy it saves by diverting traffic from other modes
If rail services were performed by cars and trucks in 2050, oil demand would be 9.5 mb/d (16%) higher

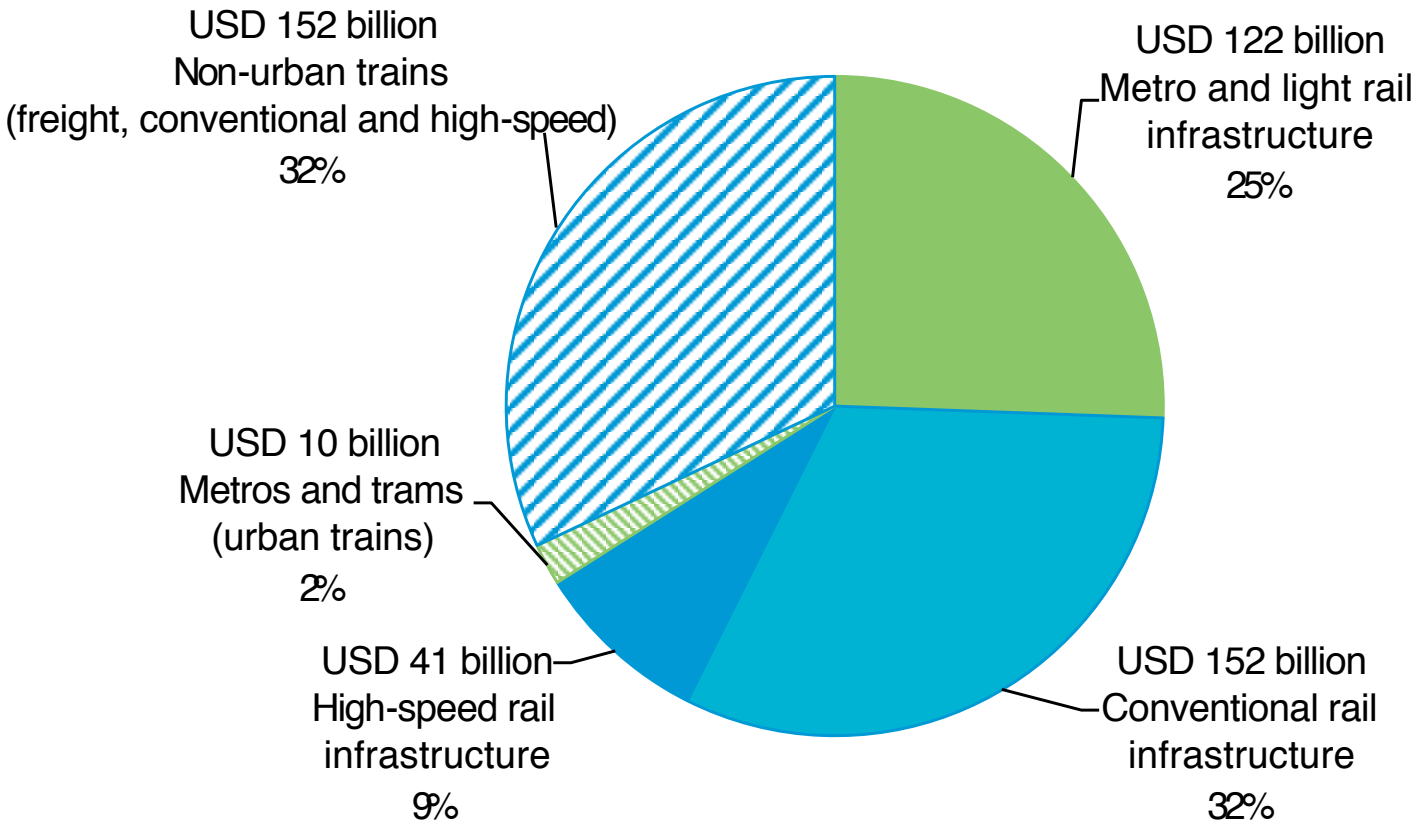
Well-to-wheel GHG emissions in the Base Scenario



Emissions growth closely tracks energy demand
Electrification, in both road and rail modes, leads to a reduction in well-to-wheel GHG emissions and to a growing share of tank-to-wheel emissions

Rail is clearly not a driver of large increases in WTW CO_2 emissions

Annual average investment in the Base Scenario, 2018 to 2050



Roughly USD 500 billion needs to be spent annually on building, operating and maintaining rail. Nearly two-thirds of this is required to build and maintain rail lines, and the remainder to renewing and expanding the rolling stock

The High Rail Scenario

The High Rail Scenario explores the extent to which rail can replace less efficient transport modes including cars, two/three-wheelers, aviation and trucks, and delivers significant benefits:

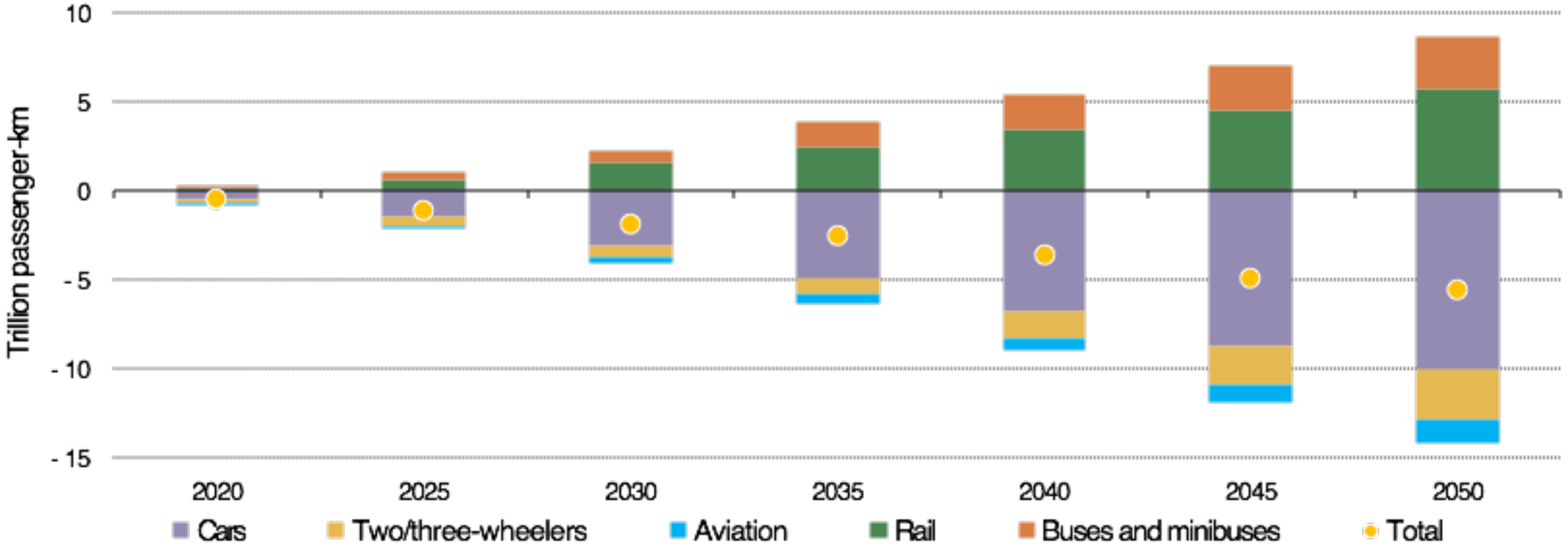
- By 2050, transport-related well-to-wheel GHG emissions are 2.1 Gt CO2-eq (or 16%) lower than in the Base Scenario, and rail makes it possible to avoid an additional 220 kt (35%) of PM2.5 emissions
- Direct energy-related CO_2 emissions from transport peak before 2040 in this outlook and then decline to 2015 levels by 2050

The High Rail Scenario alone does not achieve the targets of the Paris Agreement, but it shows that rail is an essential component of a more comprehensive energy and transport strategy.

The feasibility of this scenario rests on three pillars:

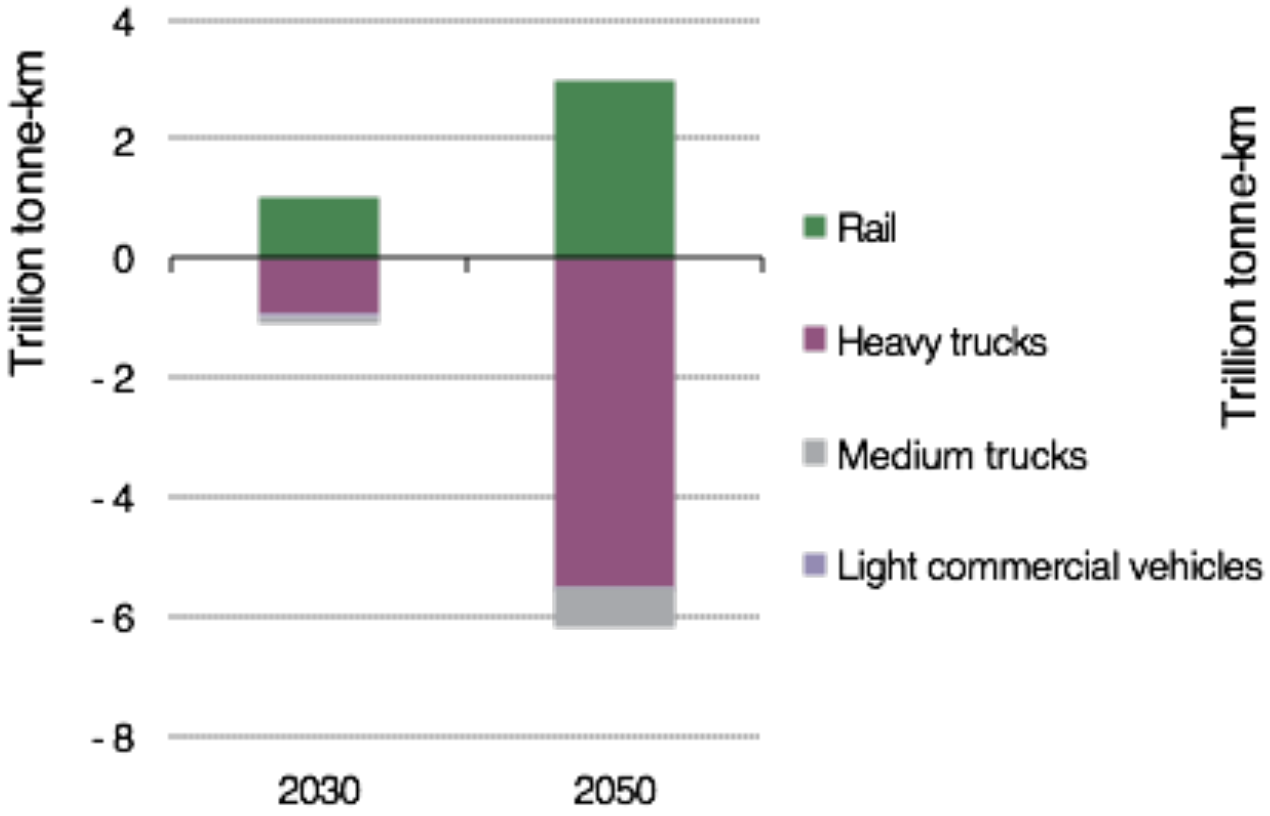
- Minimising costs per passenger-kilometre or tonne-kilometre moved by ensuring maximum rail network usage
- Maximising revenues from rail systems, such as through "land value capture", i.e. capitalising on the "aggregation" capacity of railway stations
- Implementing policies that ensure that all forms of transport pay adequately for the impacts they generate. Traditionally this has been accomplished through fuel taxes, but road pricing, and especially congestion charging, may be effective going forward

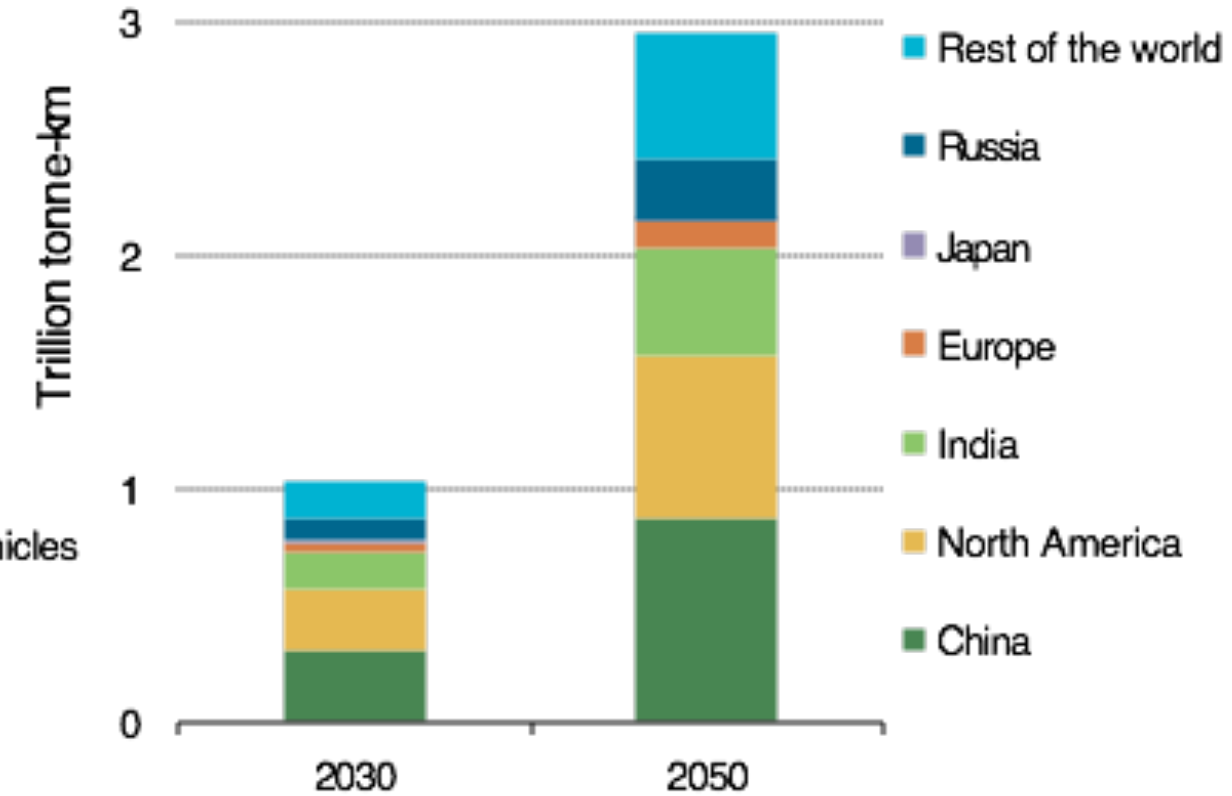
Change in passenger activity (High Rail vs. Base Scenario)



The High Rail Scenario results in a shift from transport in cars, two/three-wheelers and planes to public transport relative to the Base Scenario, combined with a reduction in total passenger activity

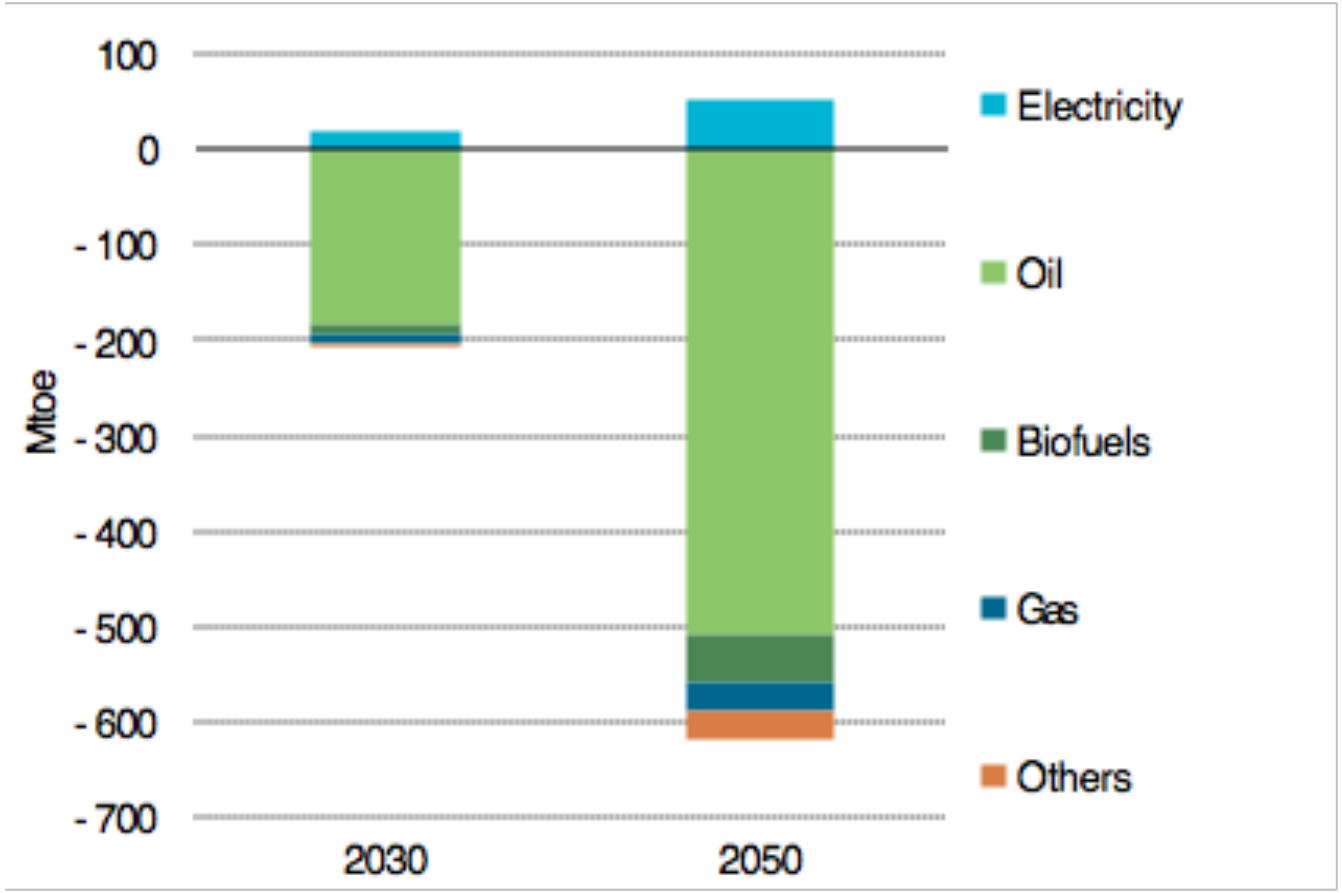
Changes in inland freight transport (High Rail vs. Base Scenario)





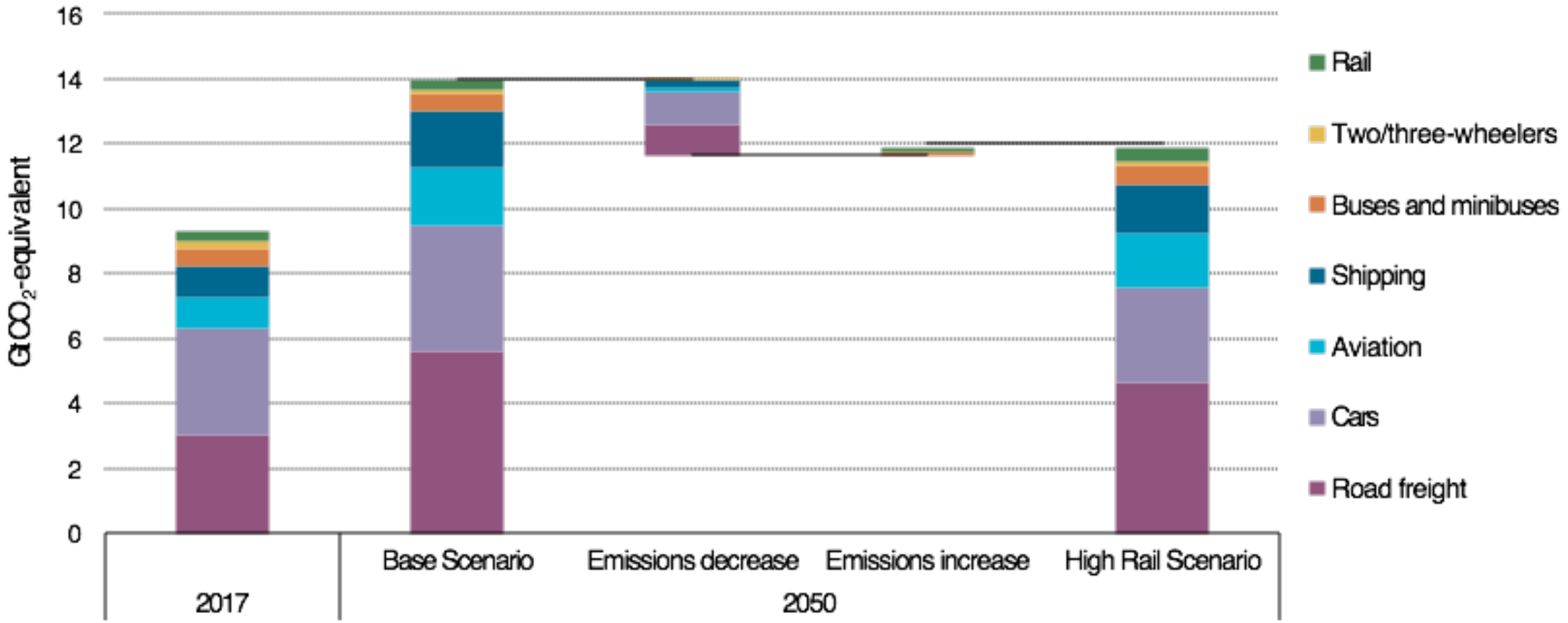
In the High Rail Scenario, increases in freight rail activity occur mainly at the expense of heavy trucks
The largest freight activity gains are in China, North America, Russia and India

Change in energy demand (High Rail vs. Base Scenario)



The High Rail Scenario sees a reduction in oil demand for transport of 10 mb/d in 2050, compared with the Base Scenario

Well-to-wheel GHG emissions (High Rail vs. Base Scenario)

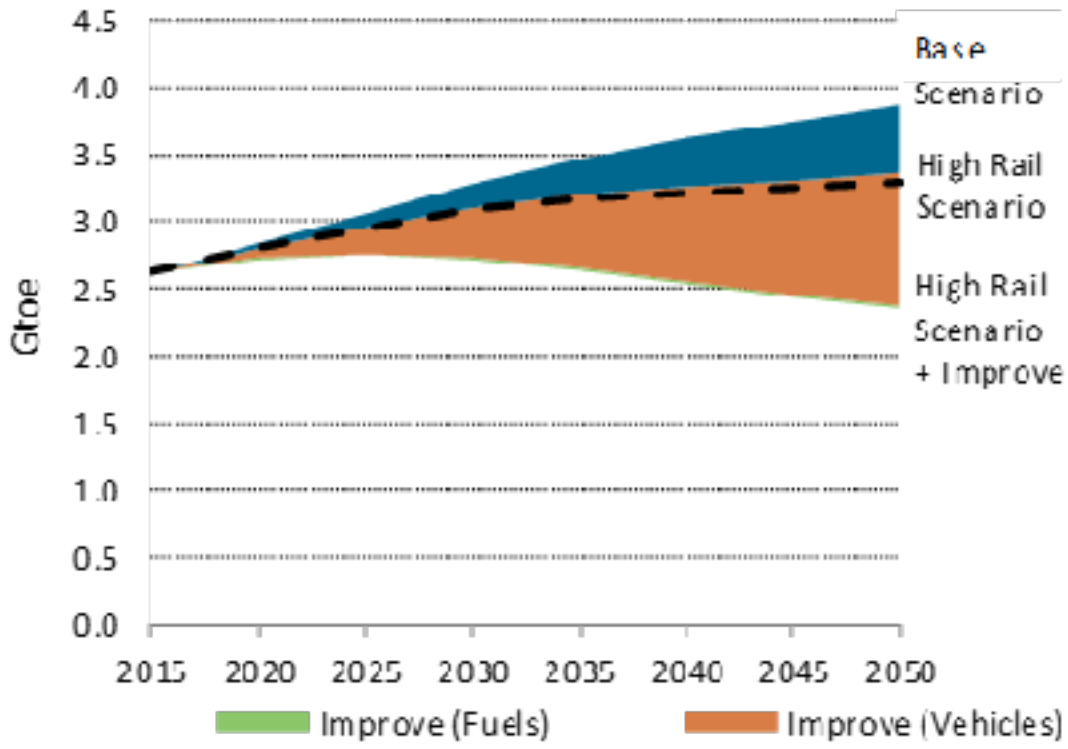


In the High Rail Scenario, modal shift cuts by half the emission increase (2015-50) of the Base Scenario

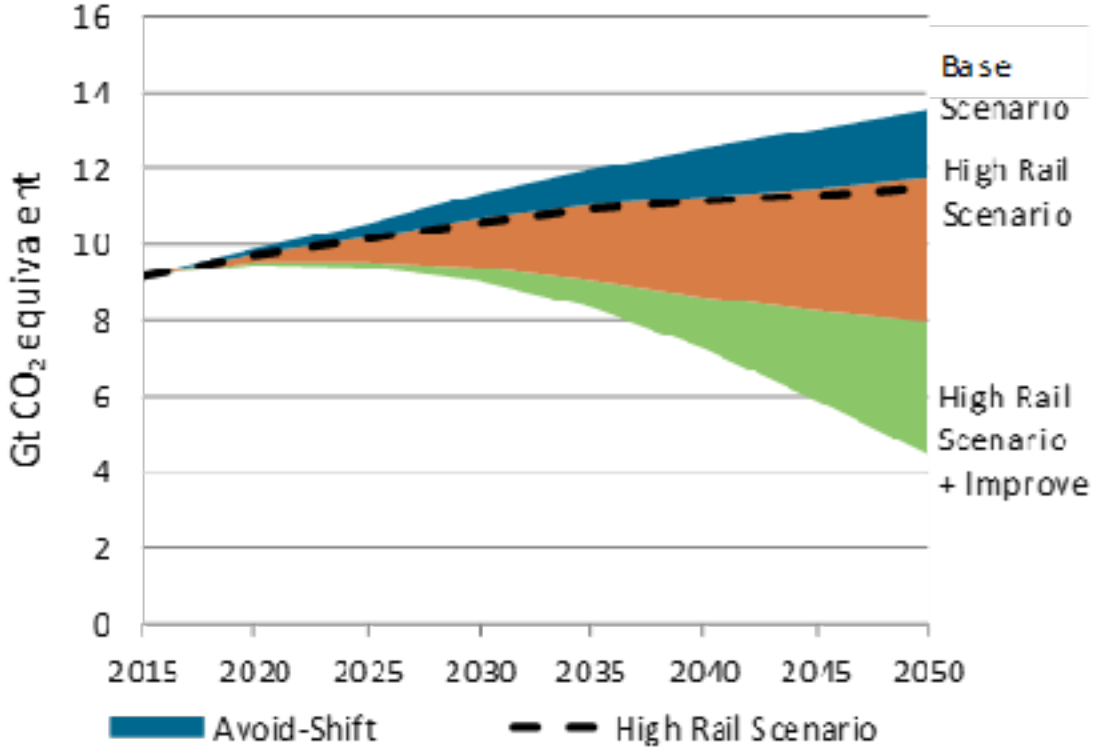
Emission increases due to shifting passenger and freight activity to rail are more than an order of magnitude lower than those displaced from other modes

Contribution of the High Rail Scenario to the Paris Agreement

Transport energy demand



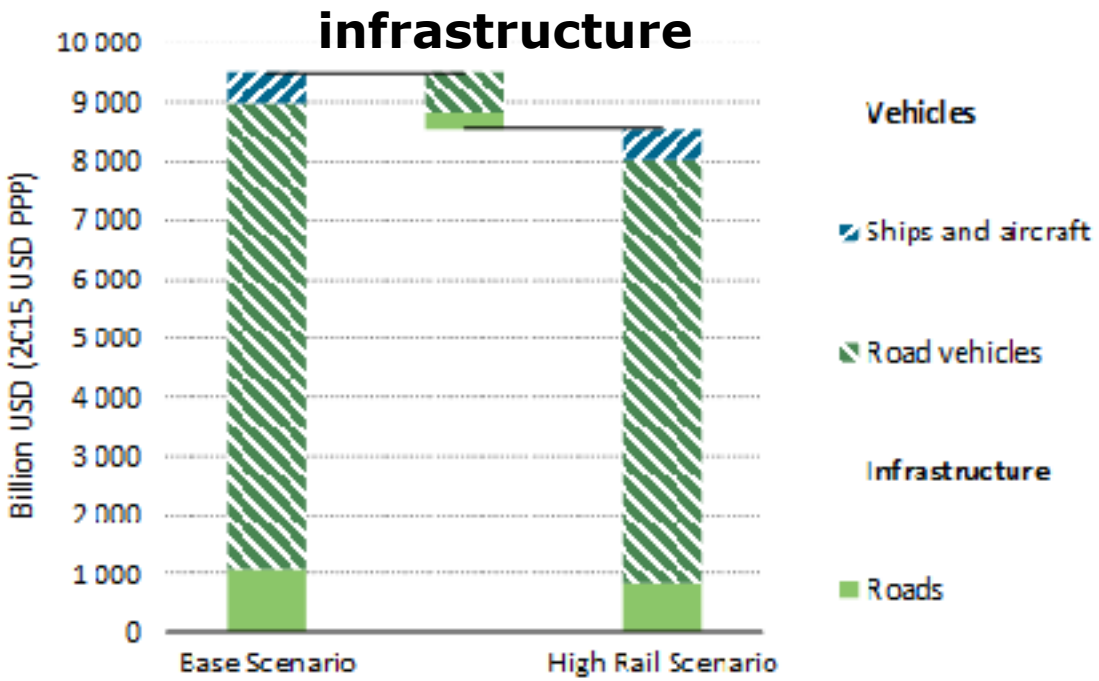
WTW GHG emissions



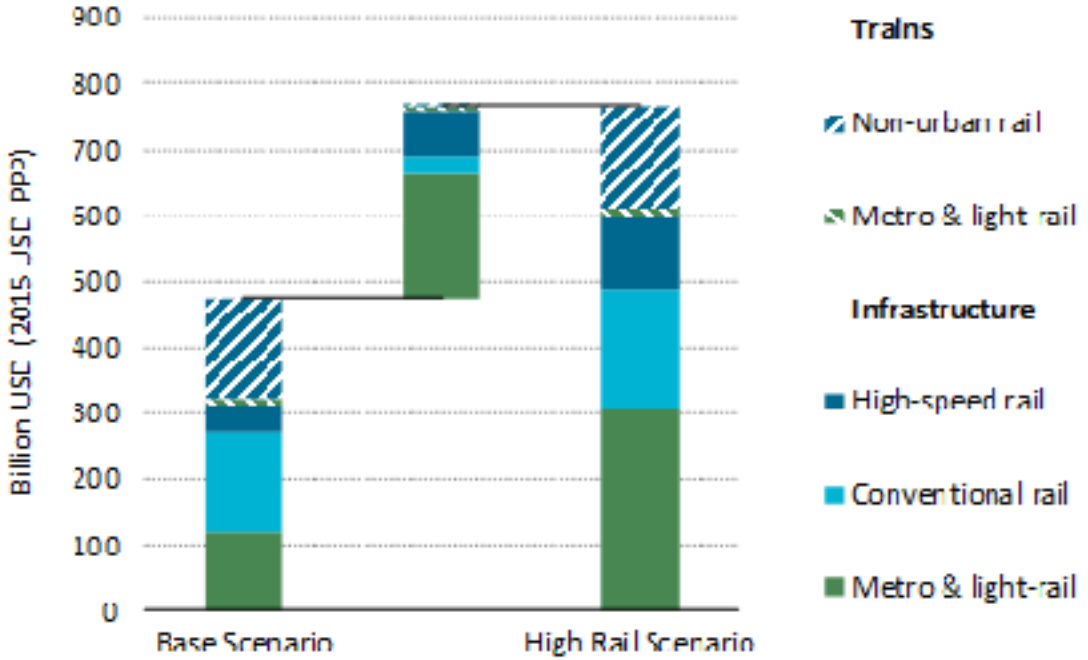
Reducing oil demand and GHG emissions from the transport sector in line with the Paris Agreement targets requires a combination of the modal shift of the High Rail Scenario with additional measures on vehicle efficiency/electrification, low-carbon fuels, and power sector decarbonisation

Investment requirements in the High Rail Scenario

Average annualised outlays on transport vehicles and infrastructure



Average annualised outlays on trains



Annual average savings on road infrastructure total USD 270 billion, and savings on vehicles (including cars, trucks, and aircraft) are around USD 670 billion

To achieve these savings, the High Rail Scenario requires additional annual average investments on the order of USD 290 billion, most of which are for urban and high-speed rail infrastructure

India's railway sector: status today and future plans

Conventional rail network

Metro systems: existing and under construction

High-speed rail corridors being built and under consideration

The railway network in India is widespread and connects the entire country; metro systems are expanding rapidly, and one high-speed rail corridor and two dedicated freight corridors are under construction.

India: key insights

- Rail has a long history in India and it is as important as ever as the lifeline of the nation
- Demand for mobility will boom in India, and satisfying it in an affordable, secure and environmentally sustainable manner is essential
- Rail has an important role to play in this effort, satisfying both transport and energy policy objectives
- There is no guarantee that rail will play the role in the long-run that our scenarios suggest
- The challenges that need to be overcome include:
  - Mobilising investment
  - Overcoming infrastructure bottlenecks
  - Maintaining the affordability of passenger rail while modernising and improving passenger rail services and safety
  - Enhancing the competitiveness of freight rail
  - Integrating rail into the overall transport strategy
- Generating revenues from sources beyond tariff-pricing, to improve rail services while boosting the competitiveness of freight rail and maintaining the affordability of passenger rail, is a critical element
- High-speed rail can play an important role in India