Steering transport toward sustainability
Cross-modal analysis with a focus on trucks

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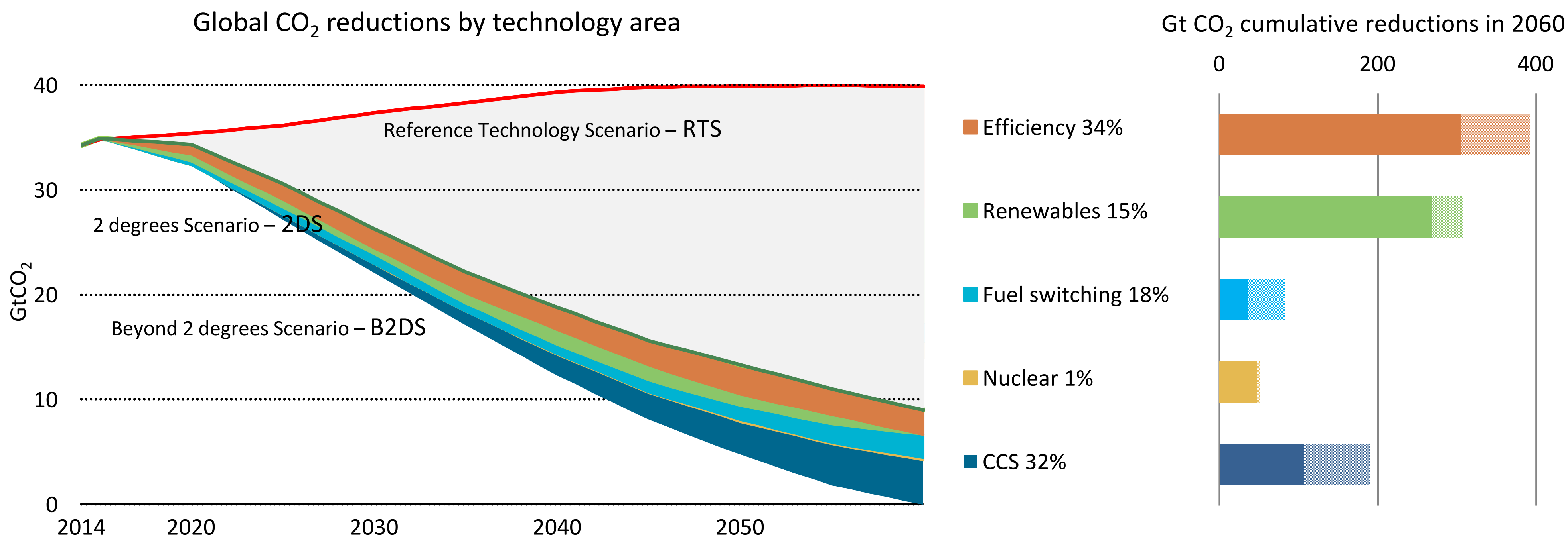
How far can technology take us?

Technology area contribution to global cumulative CO_2 reductions



Pushing energy technology to achieve carbon neutrality by 2060
could meet the mid-point of the range of ambitions expressed in Paris.

Decarbonizing Transport is a formidable challenge

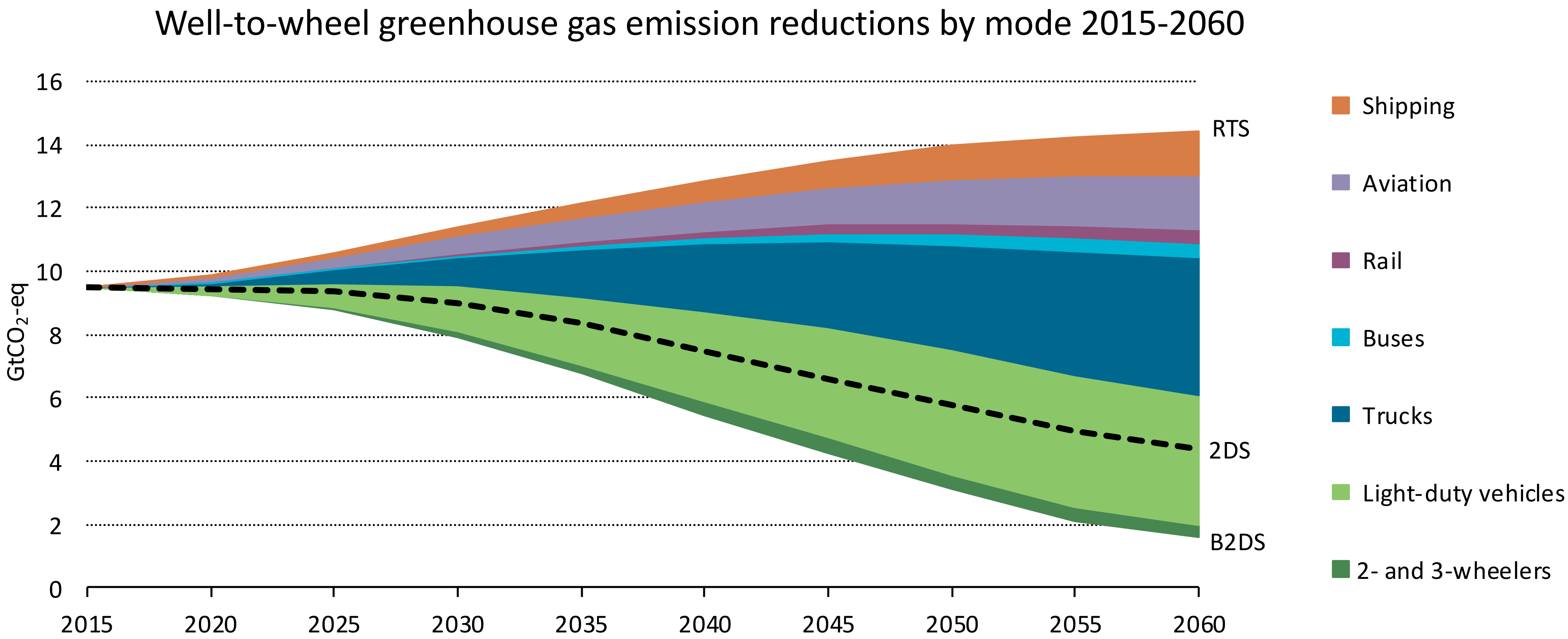
Transport accounts for 28% of global final energy demand and 23% of global carbon dioxide (CO_2) emissions from fuel combustion. In 2014, the transport sector consumed 65% of global oil final energy demand.

Decarbonising the sector requires:

- changing the nature and the structure of transport demand,
- major improvements in efficiency,
- and rapid transitions in the energy mix used to move people and goods.

Decarbonising long-distance transport modes – in particular aviation, heavy-duty road transport (i.e. trucking and buses) and shipping – is most challenging.

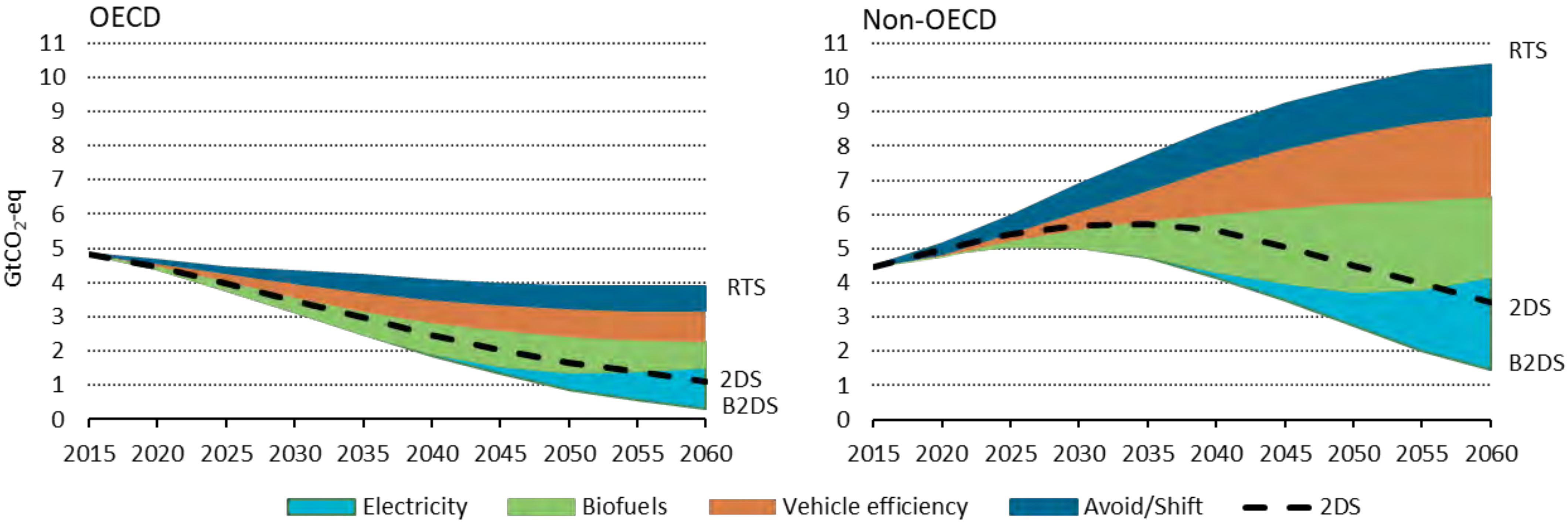
Ambitious policy action is needed across all transport modes



WTW GHG emissions from transport are 89% lower in 2060 than in 2015 in the B2DS, while in the 2DS they decline by 54% over the same period. All modes contribute to decarbonisation.

Measures are needed across the developed and developing world

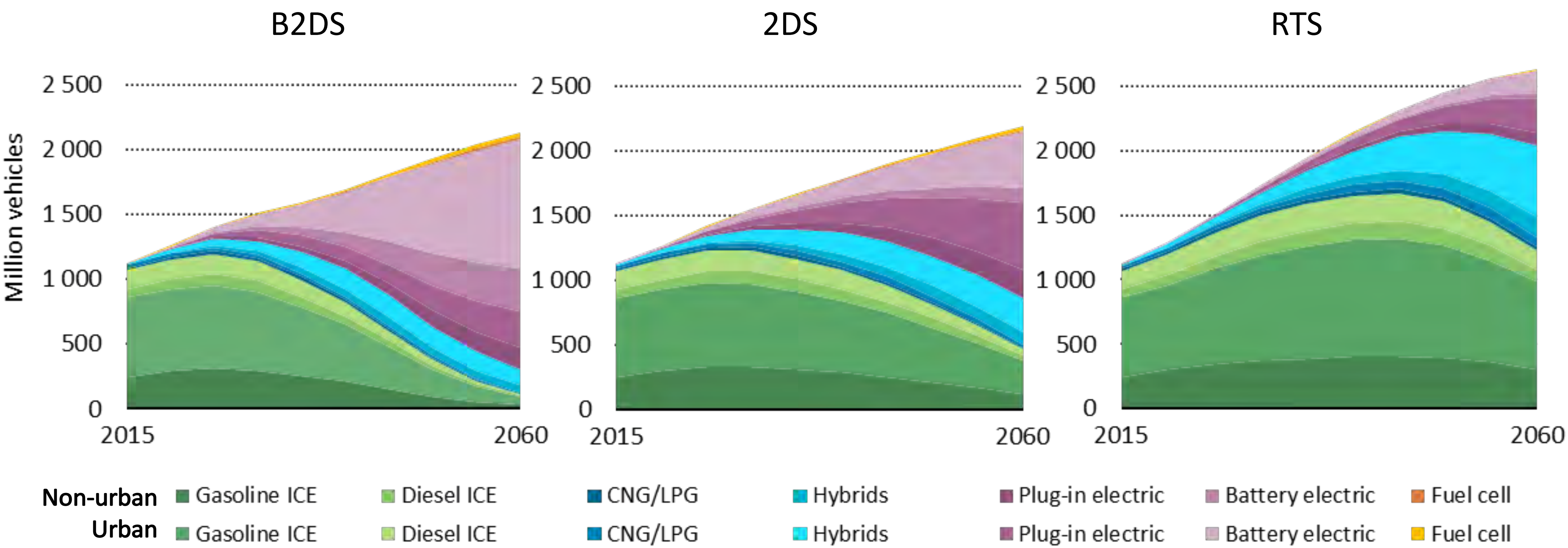
Well-to-wheel greenhouse gas emissions in OECD and non-OECD countries by scenario, 2015-2060



Achieving the B2DS target requires OECD countries to reduce WTW GHG emissions by 90% and non-OECD countries by 66% from 2015 levels by 2060.

Rapid electrification of light-duty fleet drives deep decarbonisation

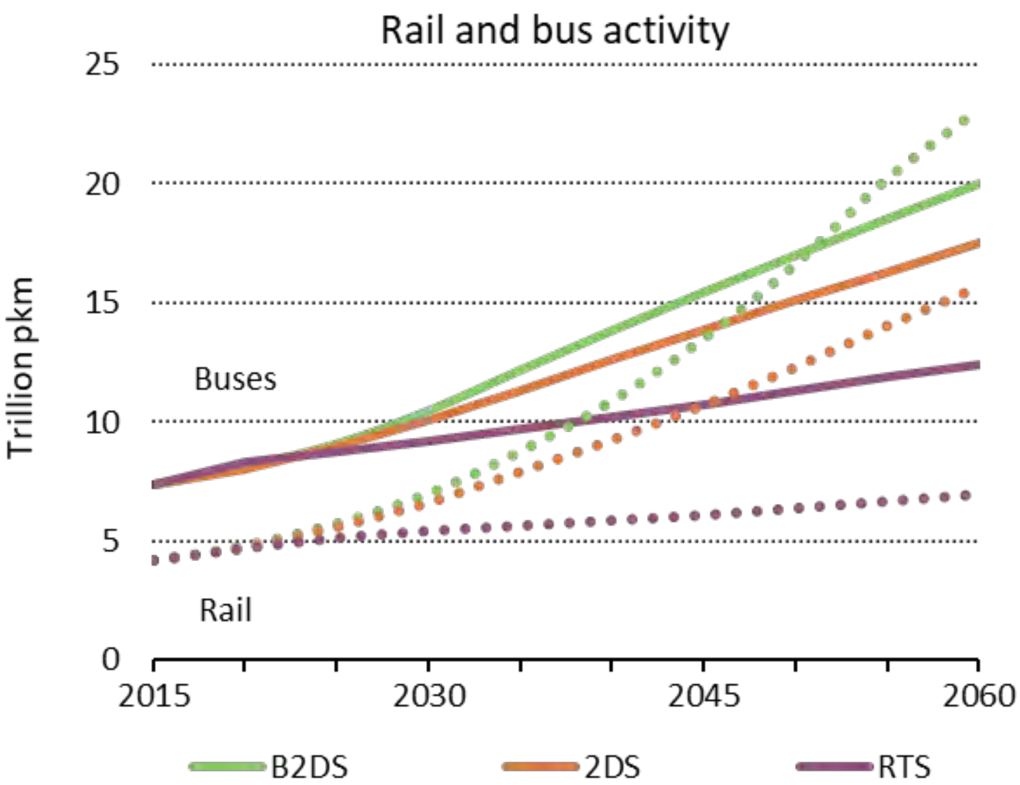
Global technology penetrations in the Light-Duty Vehicle (LDV) stock by scenario, 2015-2060

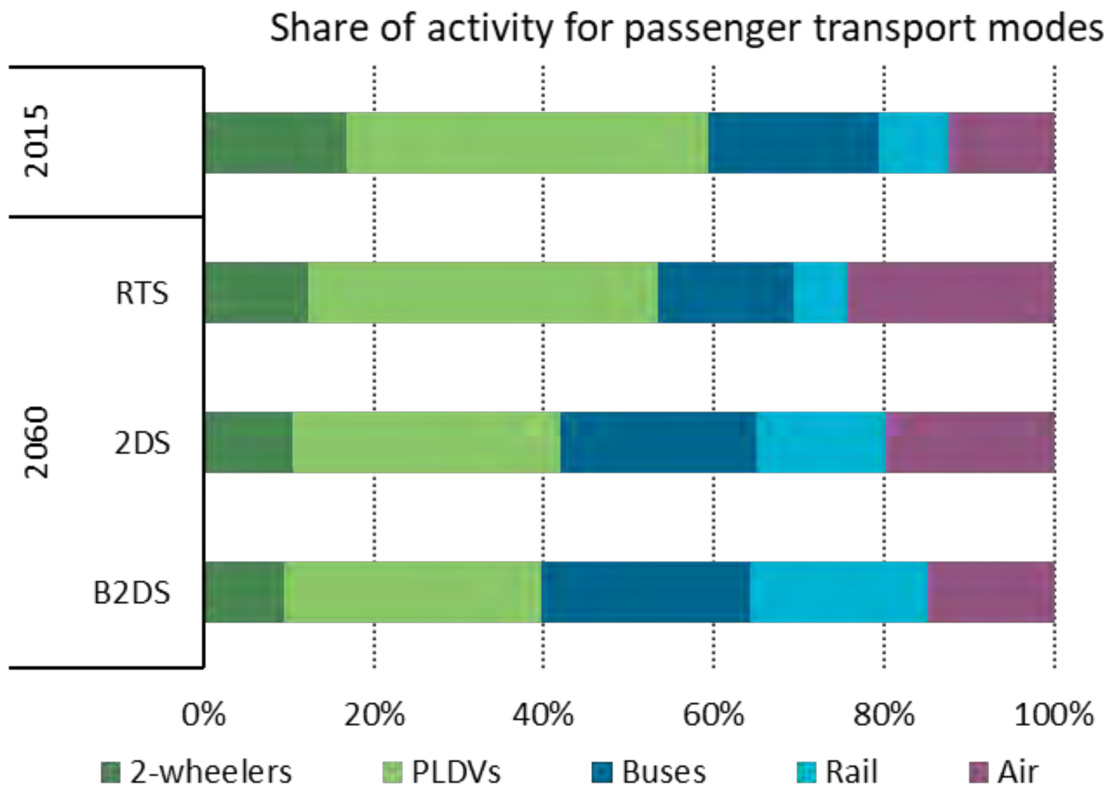


By 2060, the share of alternative powertrain vehicles in the global LDV stock will reach 94% in the B2DS and 77% in the 2DS.

Need to avoid pkm on cars and shift to public transport

Bus and rail activity by scenario and passenger transport activity by mode, 2015-2060





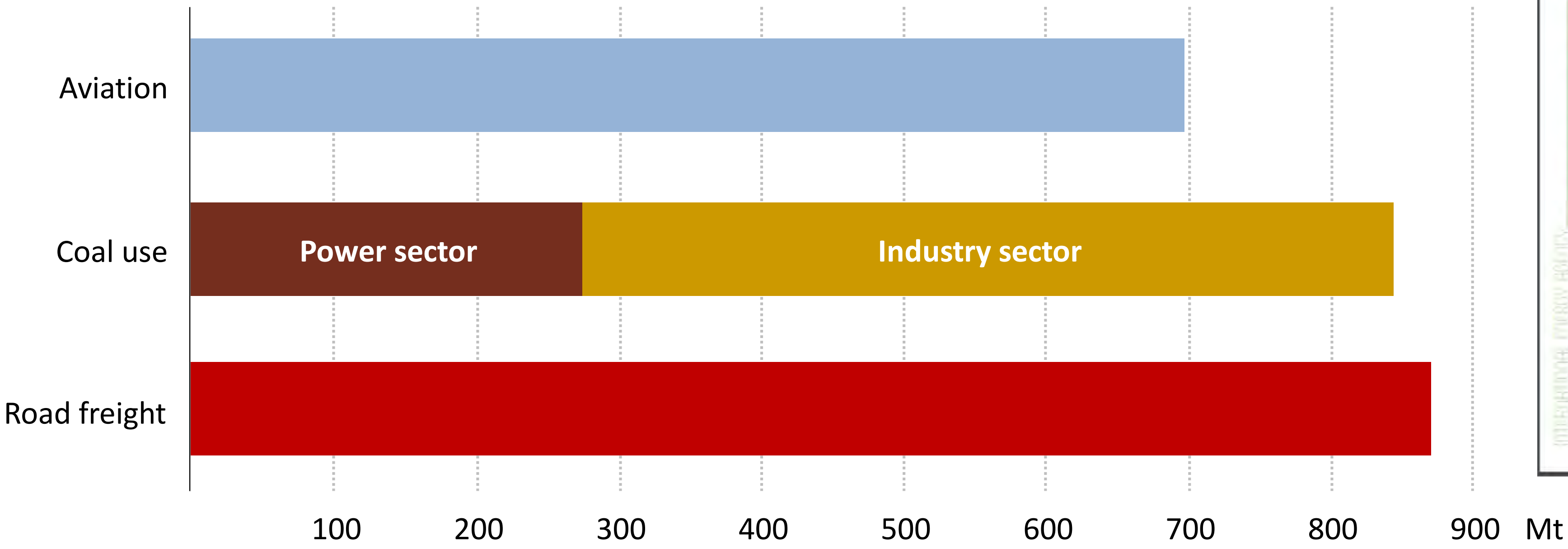
Policies are necessary to induce this change. This results in a 25% to 27% reduction in passenger activity (passenger kilometres [pkm]) on cars by 2060, relative to the RTS

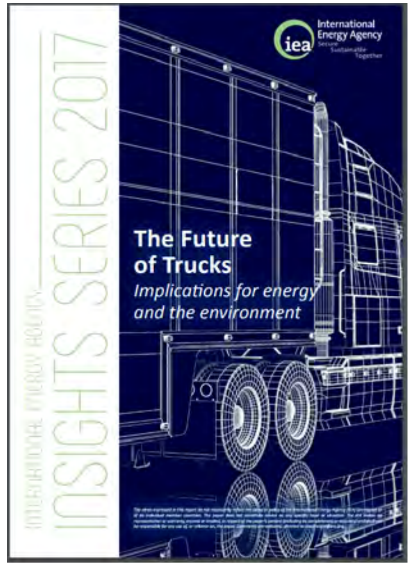
Road freight: current context

- At around 17 mb/d, trucks are the second largest users of oil (after passenger cars) today
  - Trucks account for around half of global diesel demand
- Trucks are an important source of emissions
  - Around 35% of transport-related CO_2 emissions, and 20% of energy-related NO_x emissions
- Trucks were also responsible for nearly 40% of the oil demand growth since 2000
  - This is similar to cars, and twice the increase due to demand for petrochemical products

Trucks will surpass passenger cars as the major oil consumer

CO_2 emissions growth in the Reference Scenario, 2015-2050





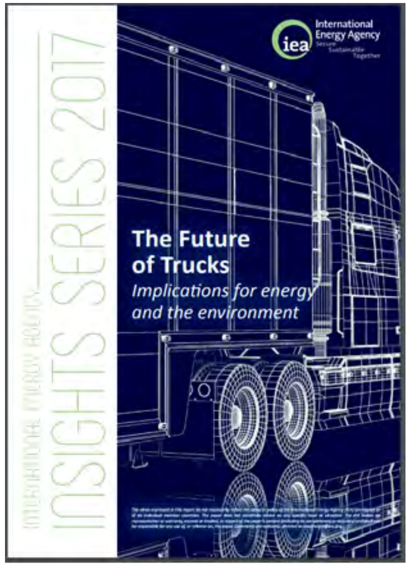
Trucks are the fastest growing source of global oil demand in RTS, where they account for 40% of the oil demand growth to 2050 and 15% of the increase in global CO_2 emissions

An IEA vision for a modern truck future

- Policy efforts to limit this growth are not widespread
  - Only four countries have truck fuel economy standards in place; international debate focuses largely on passenger cars

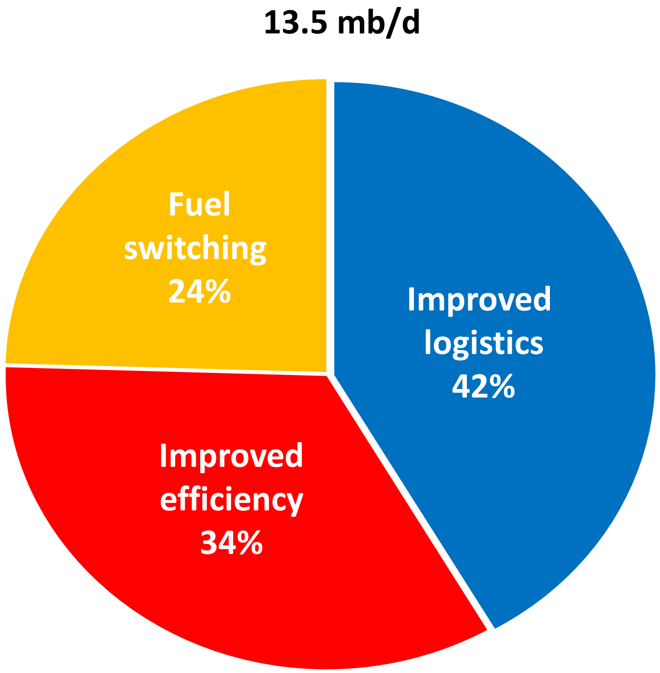
- The IEA proposes a vision for modernising truck transport, in light of the increasing relevance of the sector for future oil demand & emissions growth

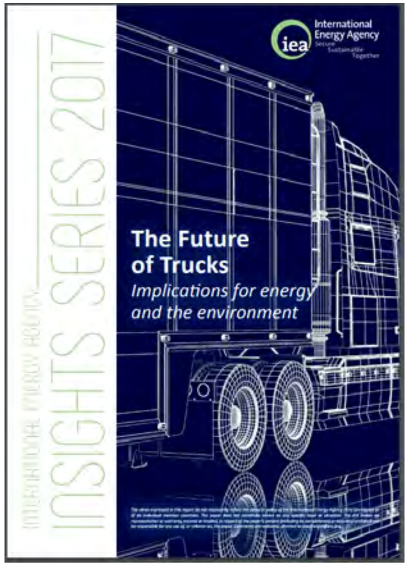
- The **IEA Modern Truck Scenario** requires near-term efforts across three central areas:
  - *Fuel economy policies* to increase the efficiency of trucks through standards and differentiated taxes
  - *Improvements of logistics*, enabled by data gathering and sharing, to realise some of the potential that underlies system-wide improvements
  - *Support to the use of alternative fuels*, such as through RD&D and support to the build-up of infrastructure



An achievable, yet ambitious, vision for the future of trucks

Fuel demand saving in the Modern Truck Scenario relative to the Reference Scenario, 2050

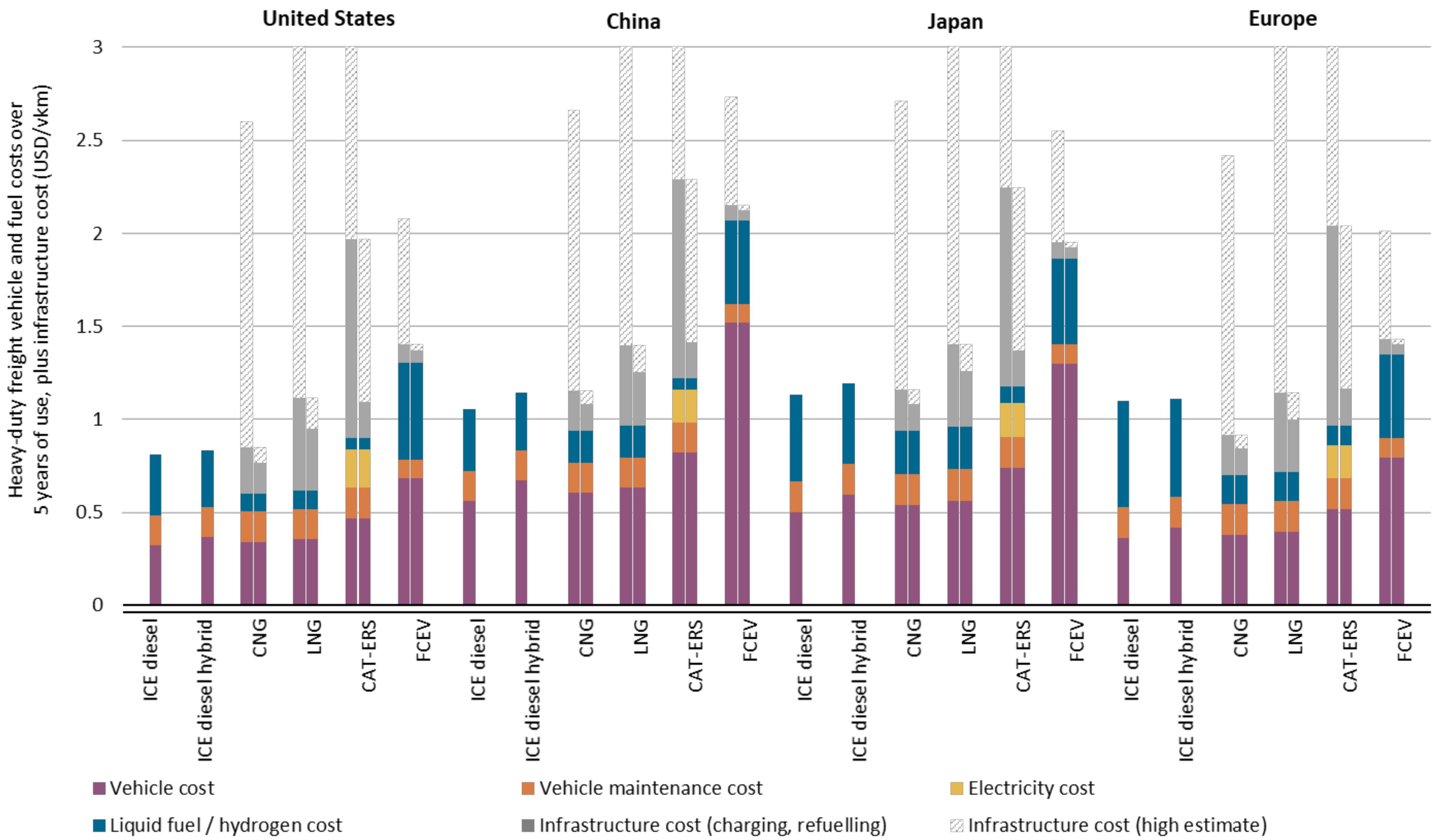




Modernising trucks and systems operations could reduce fuel demand from trucks by 50% in 2050 and emissions by up to 75%, with benefits for energy security and environmental goals

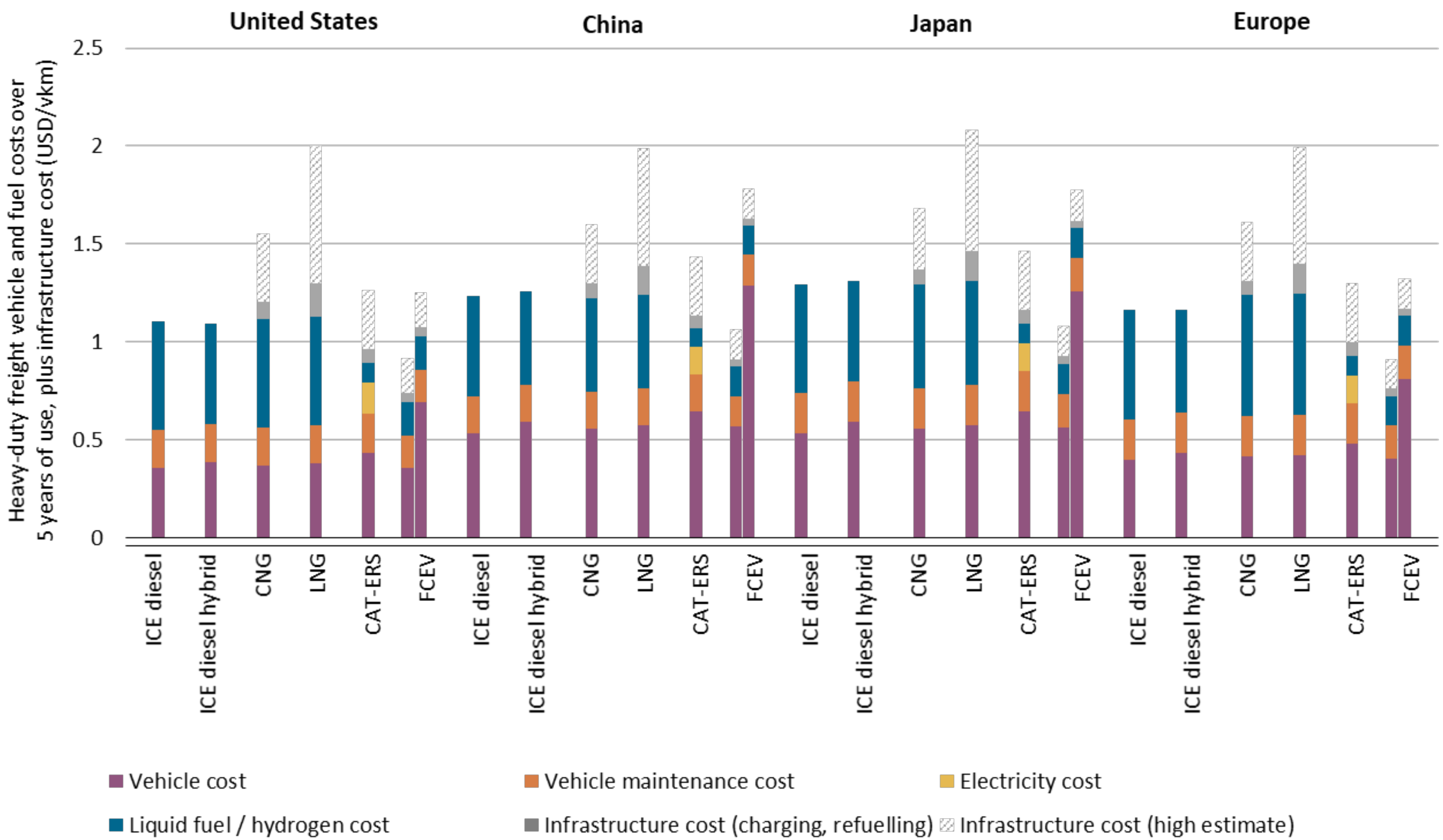
Alternative fuel truck technologies come at higher cost today

Heavy-duty freight vehicle & fuel costs over five years of use, including infrastructure cost, 2015



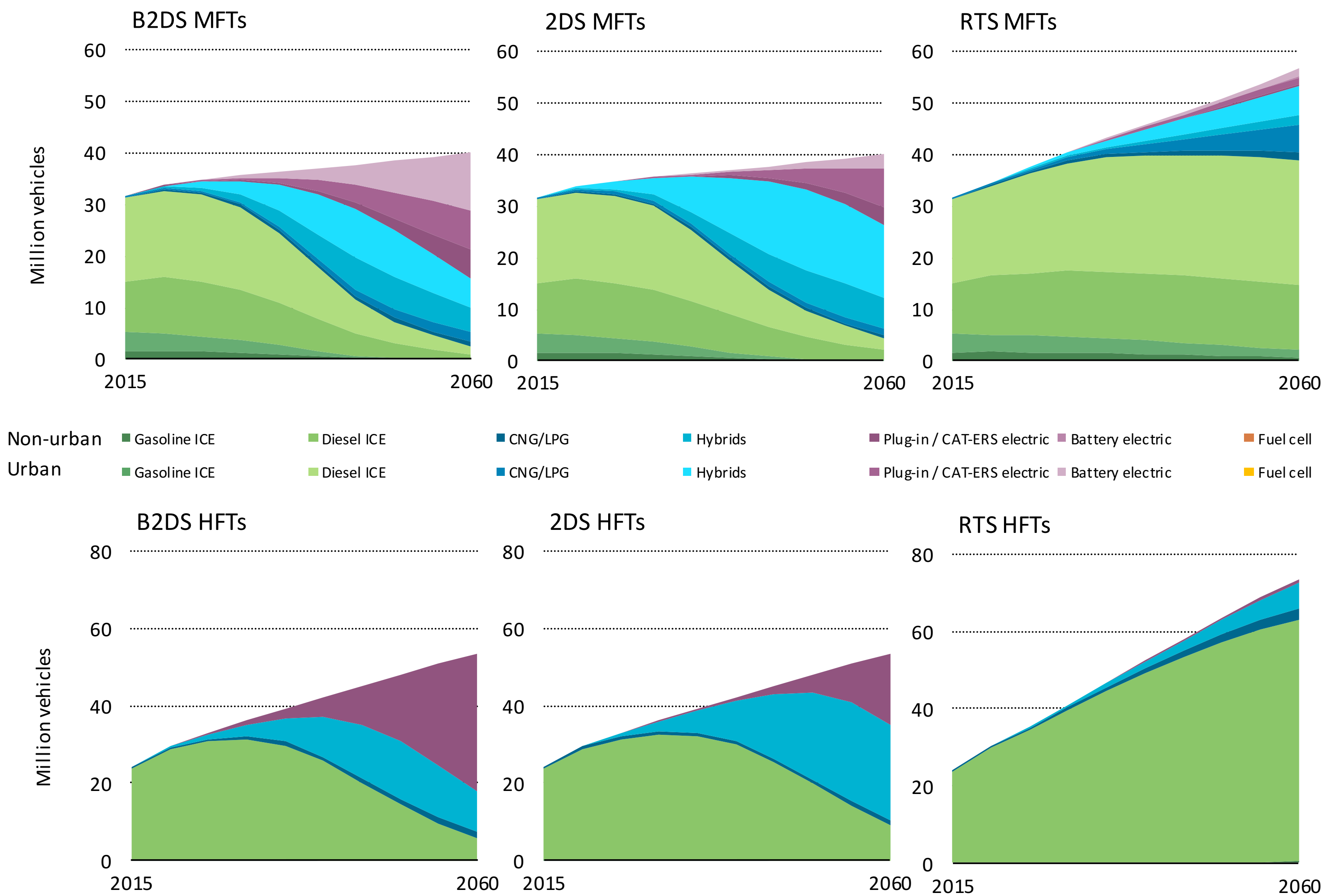
Sustained policy commitment can change the current context…

Heavy-duty freight vehicle & fuel costs over five years of use, including infrastructure cost, 2060



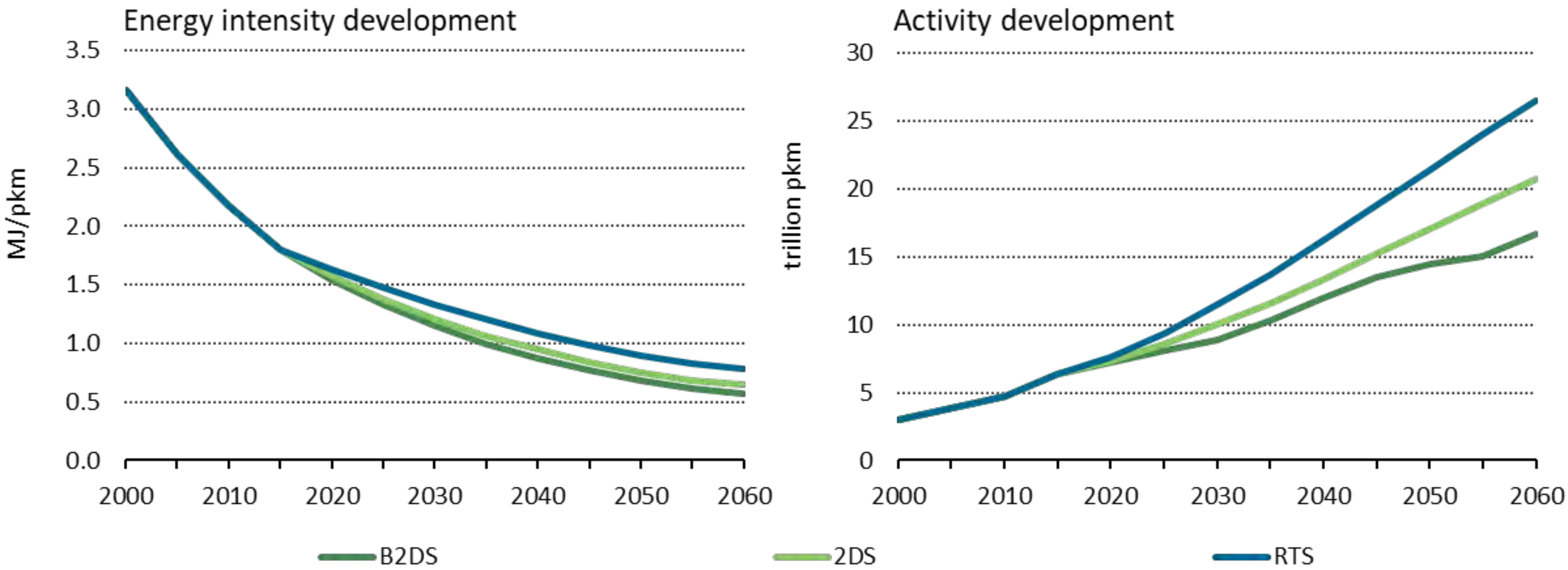
… and foster the uptake of zero emission trucks (electric and H_2)

Global technology penetrations in truck stock by scenario, 2015-60



Efficiency, mode shift and low carbon fuels in aviation

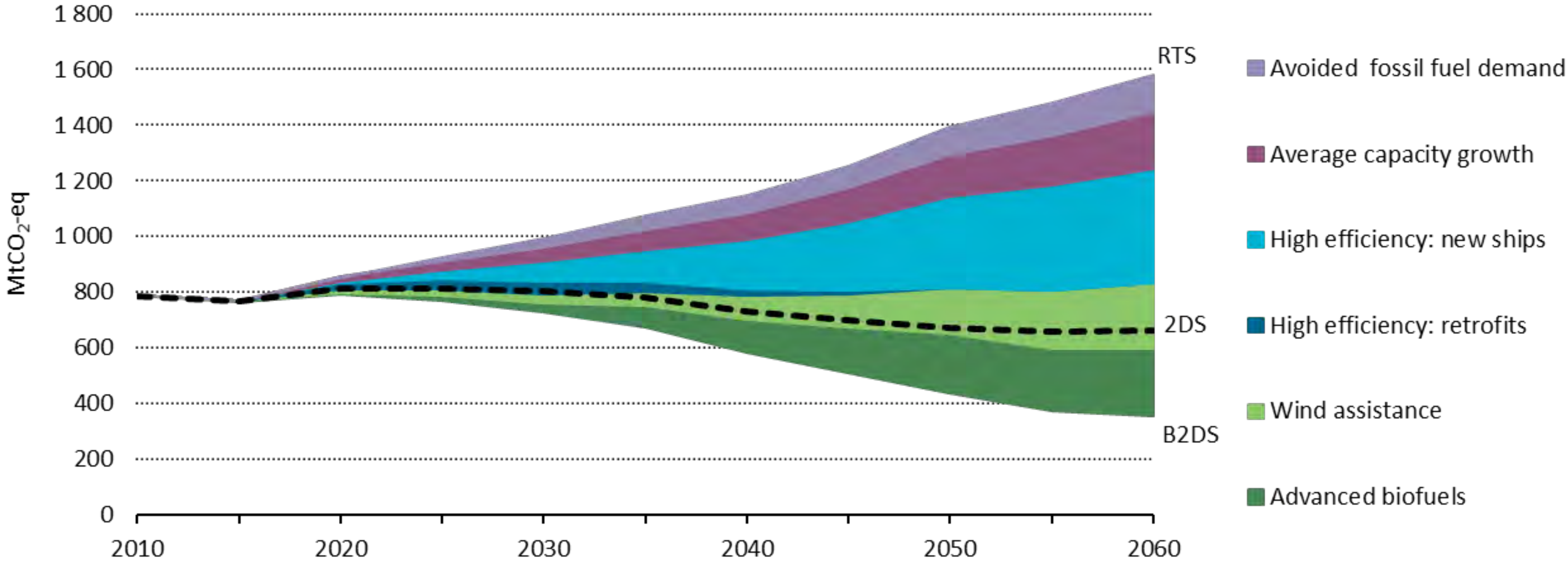
Energy intensity improvements in global aviation by scenario



Energy efficiency needs to reflect maximum available potential. High speed rail has to replace aircrafts for medium distance. Major shares of low carbon biofuels are also necessary to decarbonise aviation

In international shipping, a broad portfolio of measures is needed

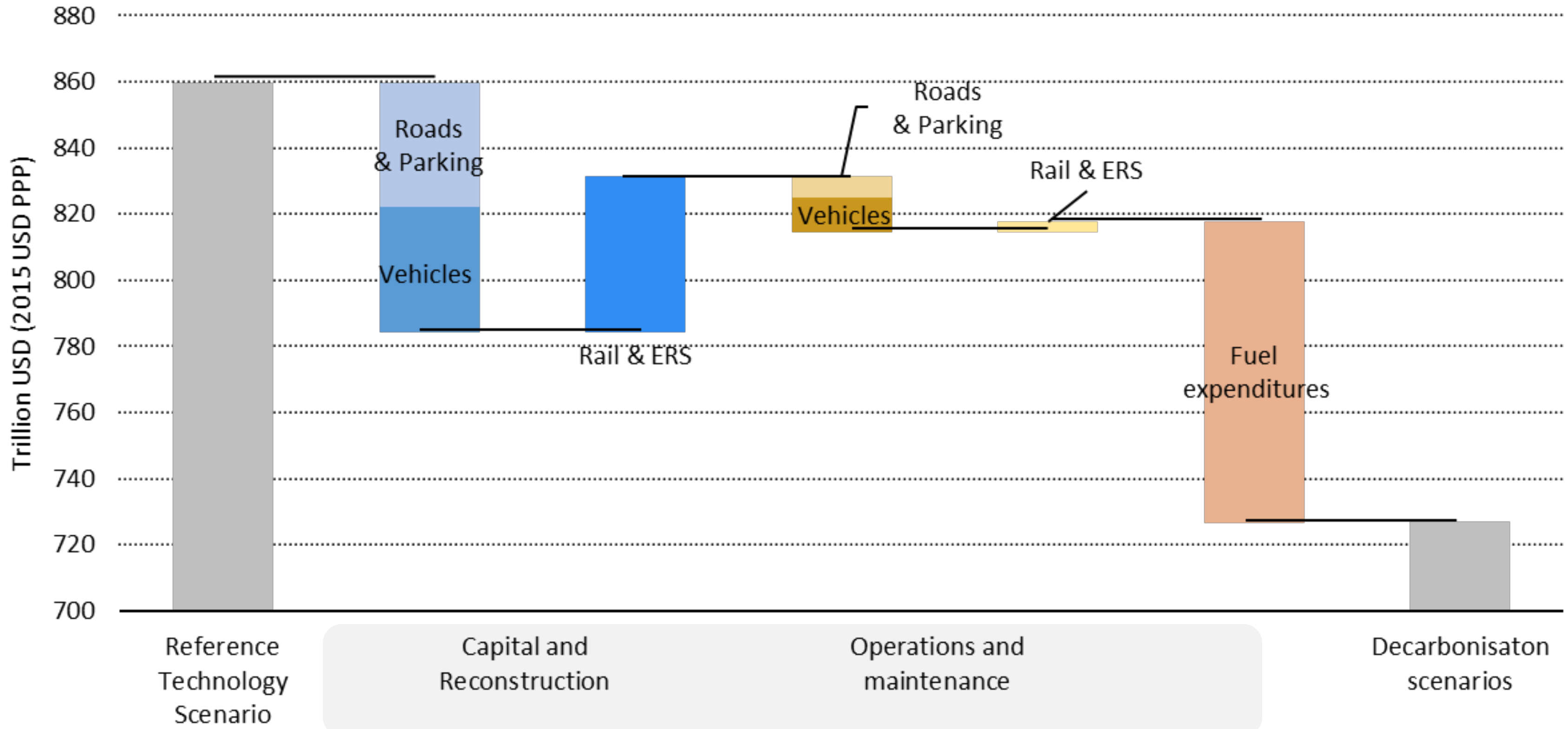
WTW GHG emissions in international shipping in the B2DS relative to RTS



The largest share of GHG abatement in shipping results from operational and technological efficiency improvement, combined with wind assistance in the B2DS. Low carbon fuels need to complement this

Expenditures on vehicles, infrastructure and fuels

Cumulative investment needs by scenario, 2017-2060



Decarbonising transport saves more than USD 100 trillion in the period to 2060, or about 1% of cumulative global GDP, mostly from reduced expenditures on road vehicles, roads and fuel.

Thank you for your attention

transportinfo@iea.org

Key policies to decarbonise the transport sector

- **Fuel taxes** that reflect life-cycle GHG emissions intensities
- **Regulatory measures**, including in particular fuel economy standards
- **Economic instruments**, such as differentiated taxes on vehicle purchase
- Policies to transition to **ultra-low and zero-emission technologies**
- **Local policies**
- Public funding to support **research, development, demonstration** and deployment of crucial decarbonisation technologies and infrastructure.
- As low carbon energy carriers take hold, the taxation of transport needs to shift towards **road pricing**

Certain modes could decarbonize completely

Total well-to-wheel greenhouse gas emission reductions by mode relative to the RTS, 2060

Transport mode	2DS	B2DS
2- and 3-wheelers	99%	>100%
LDVs	73%	92%
Trucks	70%	91%
Bus	65%	93%
Rail	87%	>100%
Aviation	69%	85%
Shipping	54%	71%

Note: in the B2DS, WTW emissions of some modes are reduced by more than 100% in 2060, relative to the RTS. This happens in modes relying largely on energy carriers with negative WTW emissions (primarily electricity from bioenergy with carbon capture and storage [CCS]).

In road freight, multiple measures are needed

- ***Systemic improvements***, i.e. improvements to the way the larger road freight system operates with a focus on reducing the road activity (in tonne-kilometres [t-km]) required to deliver the same amount of goods;

- ***Vehicle technologies*** that increase the energy efficiency of trucks, i.e. improvements to the amount of fuel used by individual road freight vehicles; and

- ***The use of alternative fuels and alternative truck powertrains***, i.e. switch away the use of oil-based transport fuels to other fuels, such as natural gas, biofuels, electricity or hydrogen.

Systemic measures can improve the efficiency of trucking

Measures requiring little or no co-operation across stakeholders

	Range of energy savings
Route optimization	5-10% intra-city, 1% long haul
High Capacity Vehicles (HCVs)	Up to 20%, primarily in long haul, risk of rebound
Driver training and feedback	3 to 10%
Platooning	5 to 15%
Last mile delivery optimization	5 to 10%, depends on degree of implementation

Examples
- Delivery booking and re-timing to optimize use of available facilities
- Changing delivery frequency
- Consolidating orders and suppliers
- Manage waste, reduce volumes and collection frequencies
- Promote the use of efficient and zero emission vehicles

Systemic measures can improve the efficiency of trucking

Measures requiring closer collaboration, including sharing of assets and services between and among companies and more radical re-envisioning of how logistics systems operate

	Range of energy savings
Supply chain collaboration/co-loading	Up to 15%
Matching cargo and vehicles via IT • Includes freight exchanges, digital freight matching • Links with crowdshipping and co-modality	5 to 10% in urban areas
Urban consolidation centres	20-50% in urban centres (all measures combined, including vehicle techs)
Physical internet	Up to 20%

Efficiency and collaboration can drive major changes leading to reduced GHG emissions – this conflicts with “just-in-time” and same- or next-day deliveries

Vehicle efficiency

Vehicle and powertrain technologies allowing to reduce consumption

	Range of energy savings
Improved aerodynamics	Up to 3-5% of energy use*, retrofit possible
Lower rolling resistance tyres	10% to 30% reduction of rolling resistance and about 3-5% of total energy use*, retrofit possible
Light weighting/material substitution	1-3% in near term, up to 7% in the long term
Transmission and drivetrain improvements	1 to 5% from automatic transmission (mission profile matters)
Engine efficiency	4 to 18% (long haul)
Reducing idling	Up to 2.5%
Hybridization	6% to 35%, range depends on mission profile

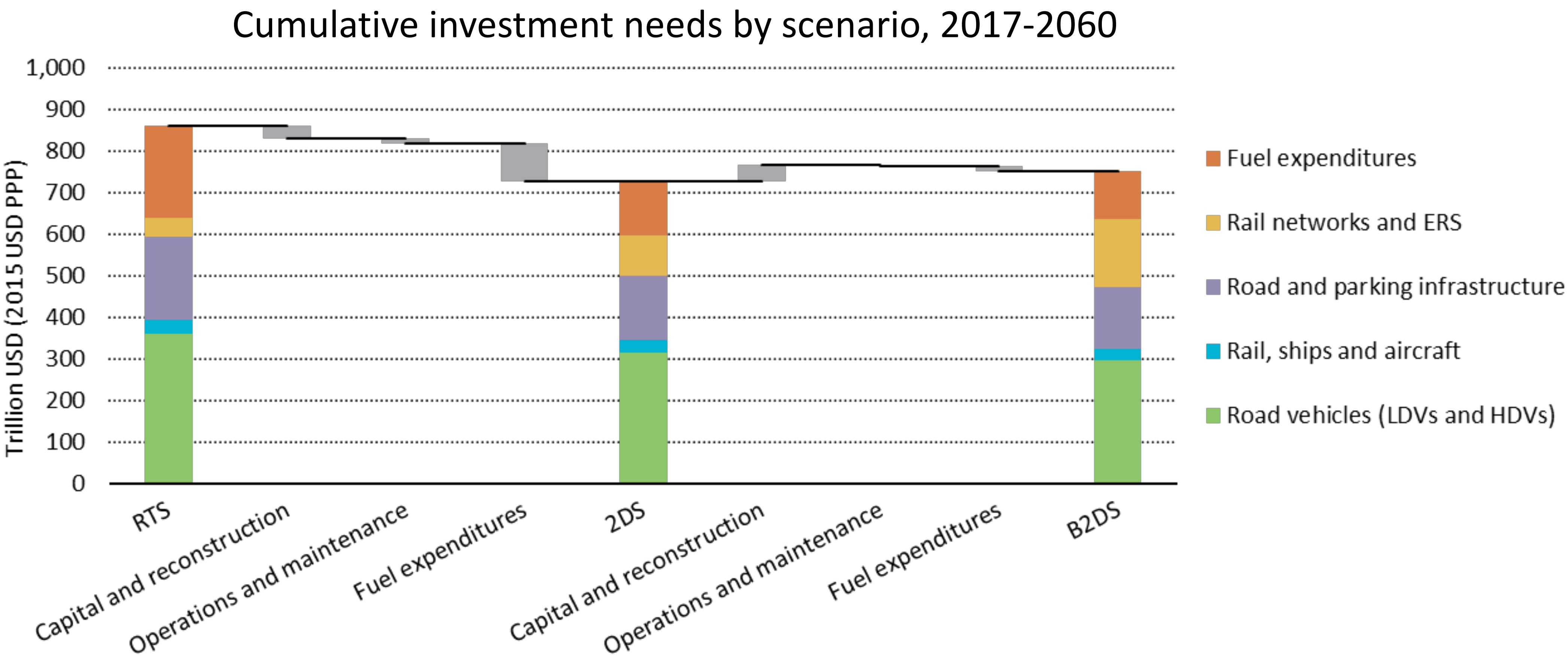
* excluding engine power adjustments

Other changes facing high barriers

Solutions that still face technological barriers and are at the centre of major research activities

- Autonomous trucks
- Zero emission trucks
  - Electric Road Systems (catenary, induction)
  - Hydrogen

Expenditures on vehicles, infrastructure and fuels



Decarbonising transport saves more than USD 100 trillion in the period to 2060, or about 1% of cumulative global GDP, mostly from reduced expenditures on cars and fuel.