



The future of trucks

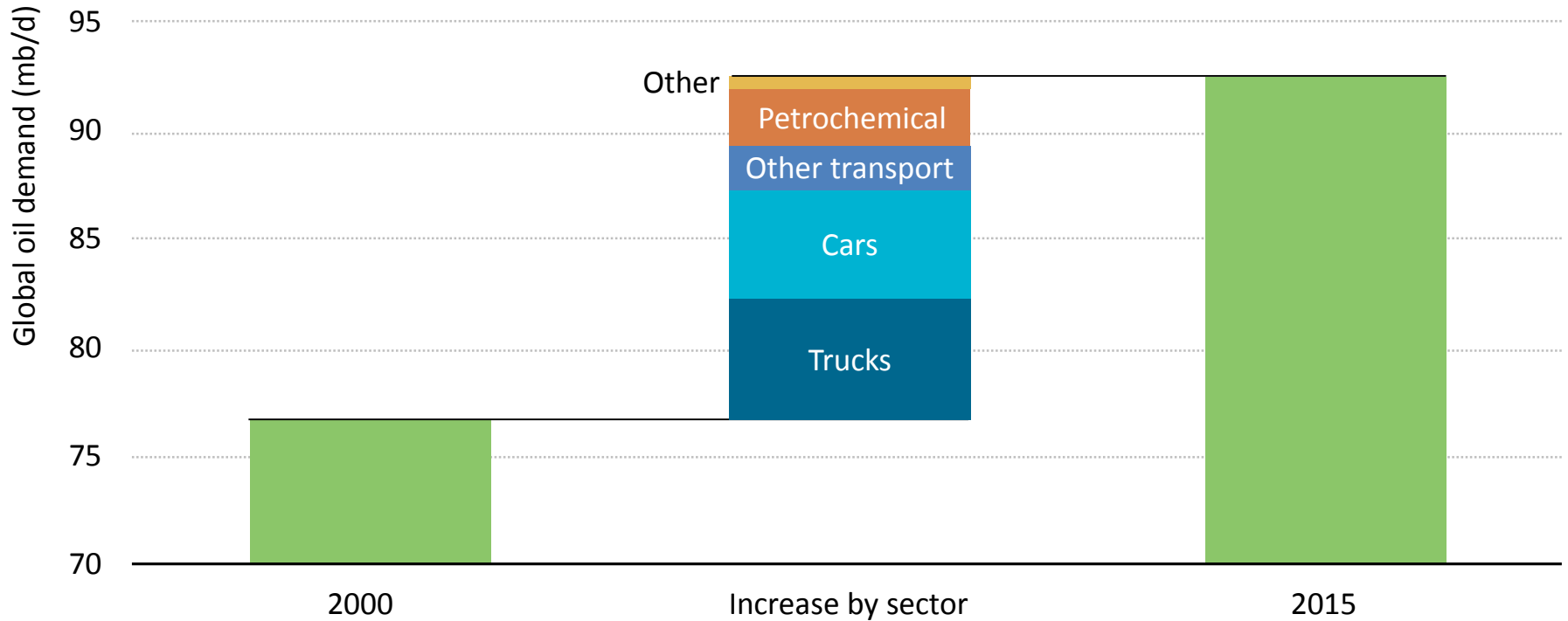
Implications for energy & the environment

Jacob Teter, Sustainable Technology Outlooks, International Energy Agency

Stakeholder meeting on the Impact Assessment on HDV CO₂ emission standards

16 January 2018

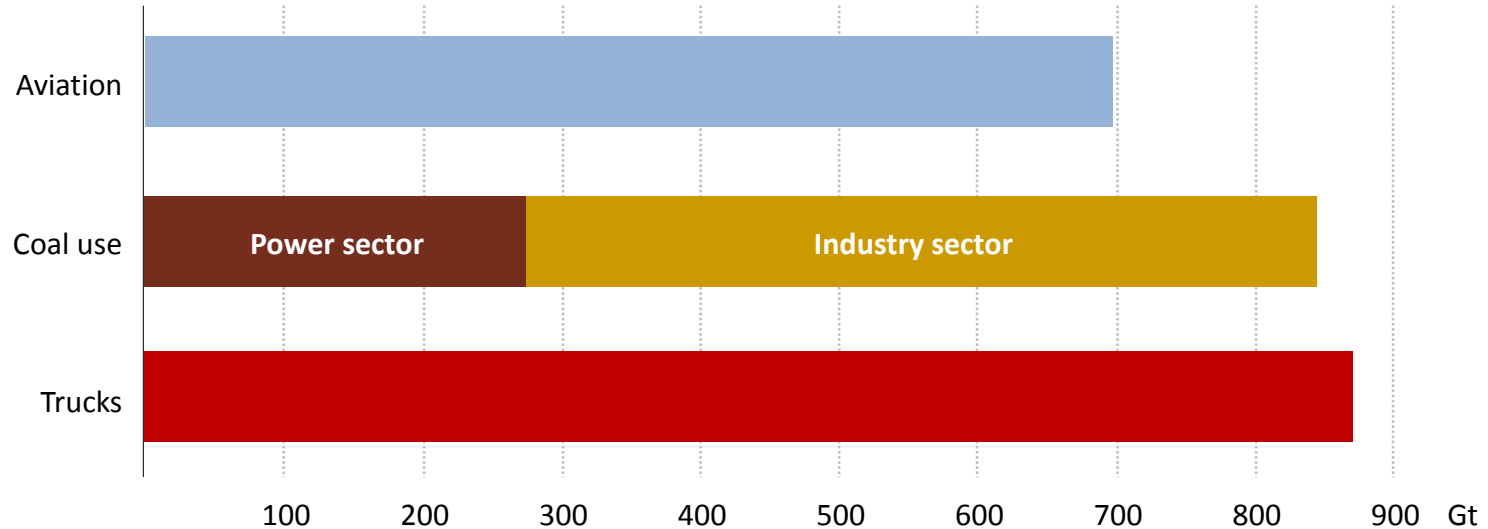
Trucks drive global oil demand



Trucks were responsible for nearly 40% of the growth in global oil demand since 2000; they are the fastest growing source of oil demand, in particular for diesel.

A modern truck sector is still a long haul away

CO₂ emissions growth in the Reference Scenario, 2015-2050



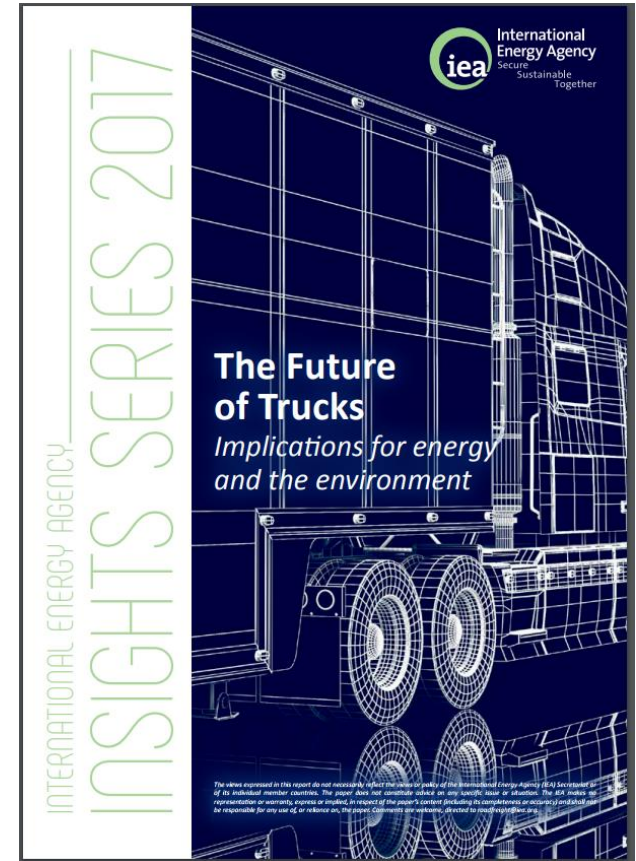
Without further policy efforts, trucks will account for 40% of the oil demand growth, and 15% of the increase in global energy-sector CO₂ emissions, to 2050

The Future of trucks

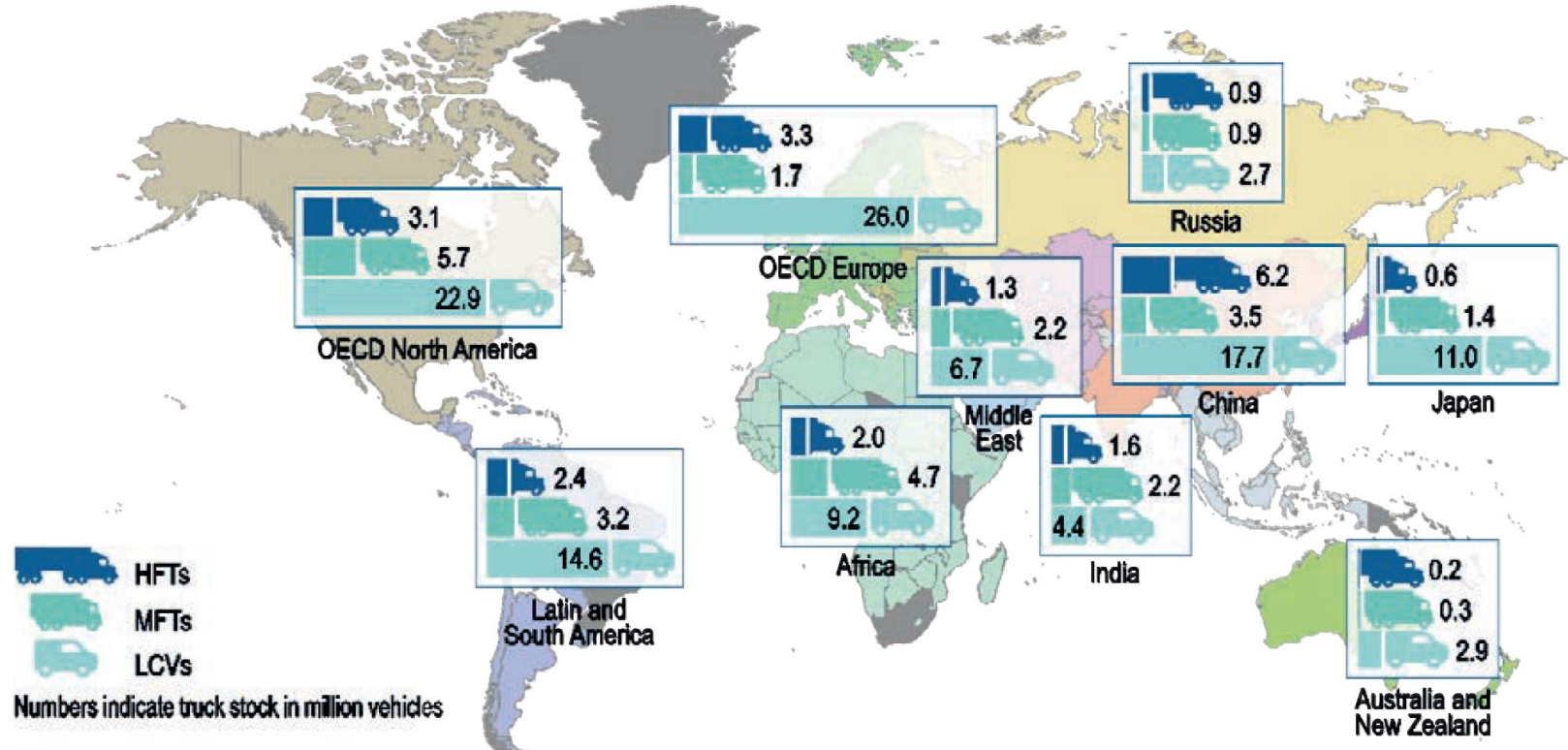
Implications for energy and the environment

Content

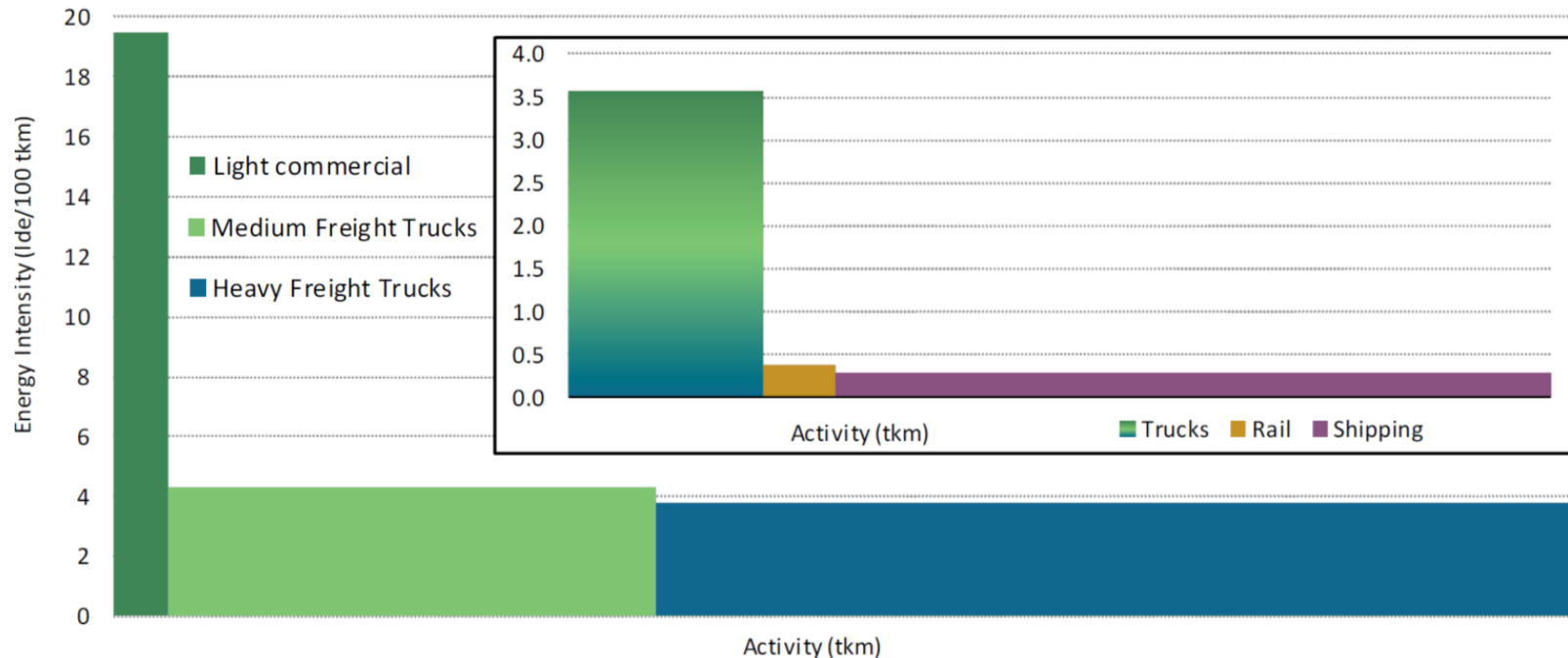
- Status of road freight transport
 - Activity, energy use, emissions
 - Rationale for assessment used in IEA report
 - Challenges in data collection
- Projections
 - Reference scenario results
 - IEA vision for a modern truck future
- Policy recommendations



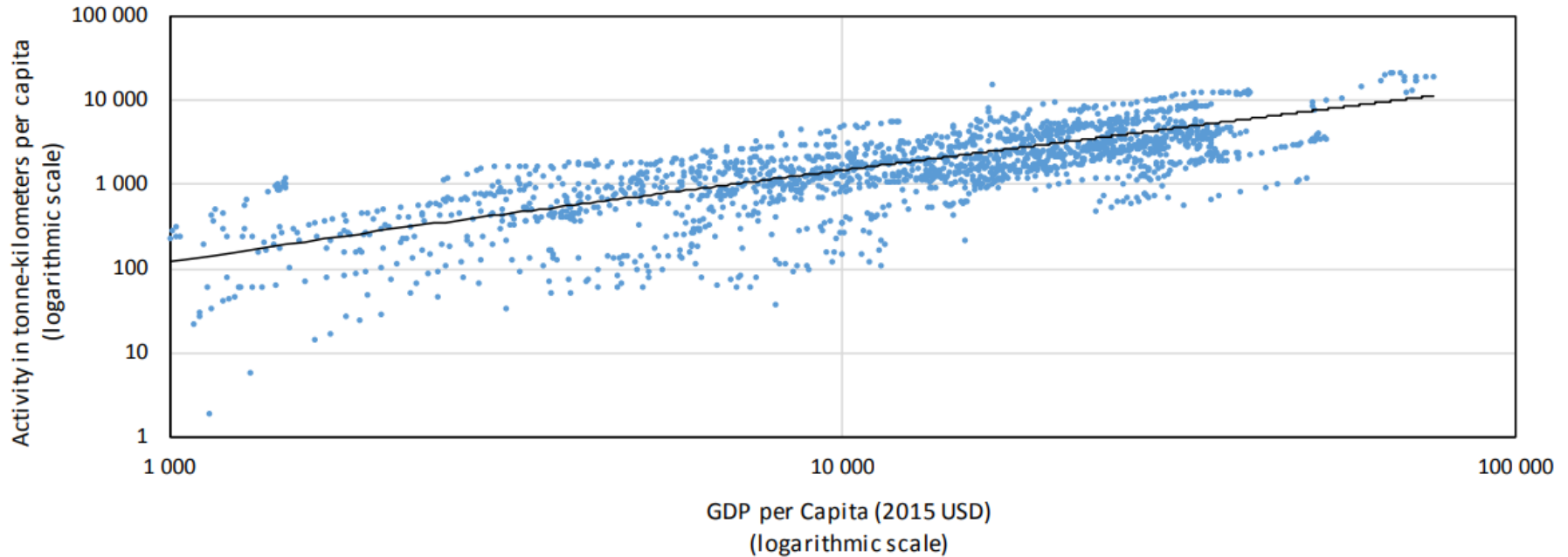
Vehicle stock



- Vehicle stock is one of the key determinants of road freight activity
- Relevance of different modes not uniform across global regions

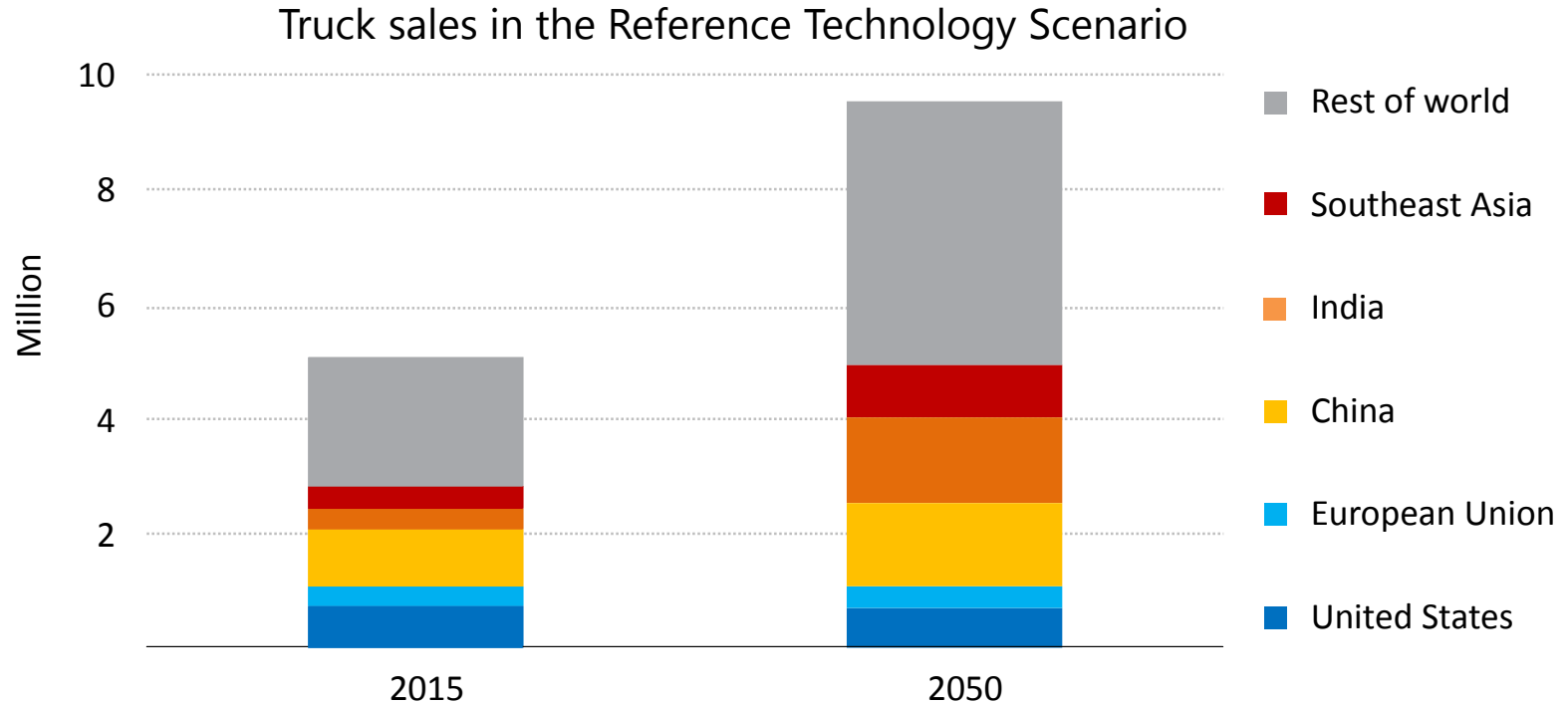


- Although it accounts for only 20% of global tkm, road freight consumes more than 70% of energy in freight modes
- At around 17 mb/d, road freight transport is the second largest consumer of oil products (after passenger cars)
- Most of this fuel goes to medium- and heavy-duty trucks
- LCVs are – by far – the least efficient road freight transport mode



- Freight activity is strongly correlated with income growth

Truck markets set to move to Asia

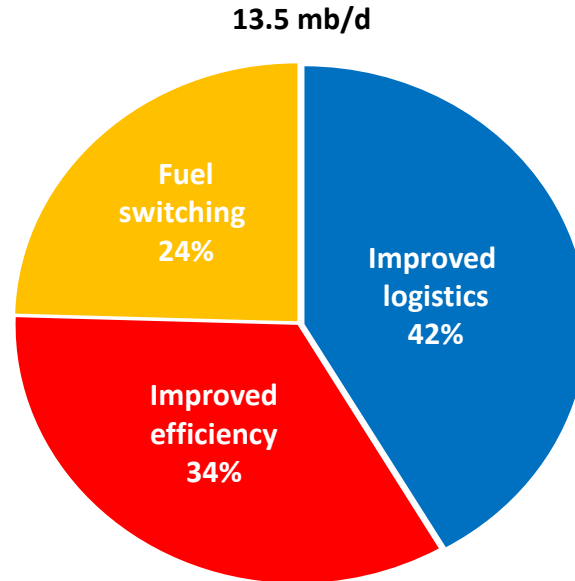


The truck market is shifting to emerging economies; by 2050, the United States and the European Union are expected to account for only 10% of the global truck sales, down from 20% today

- 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

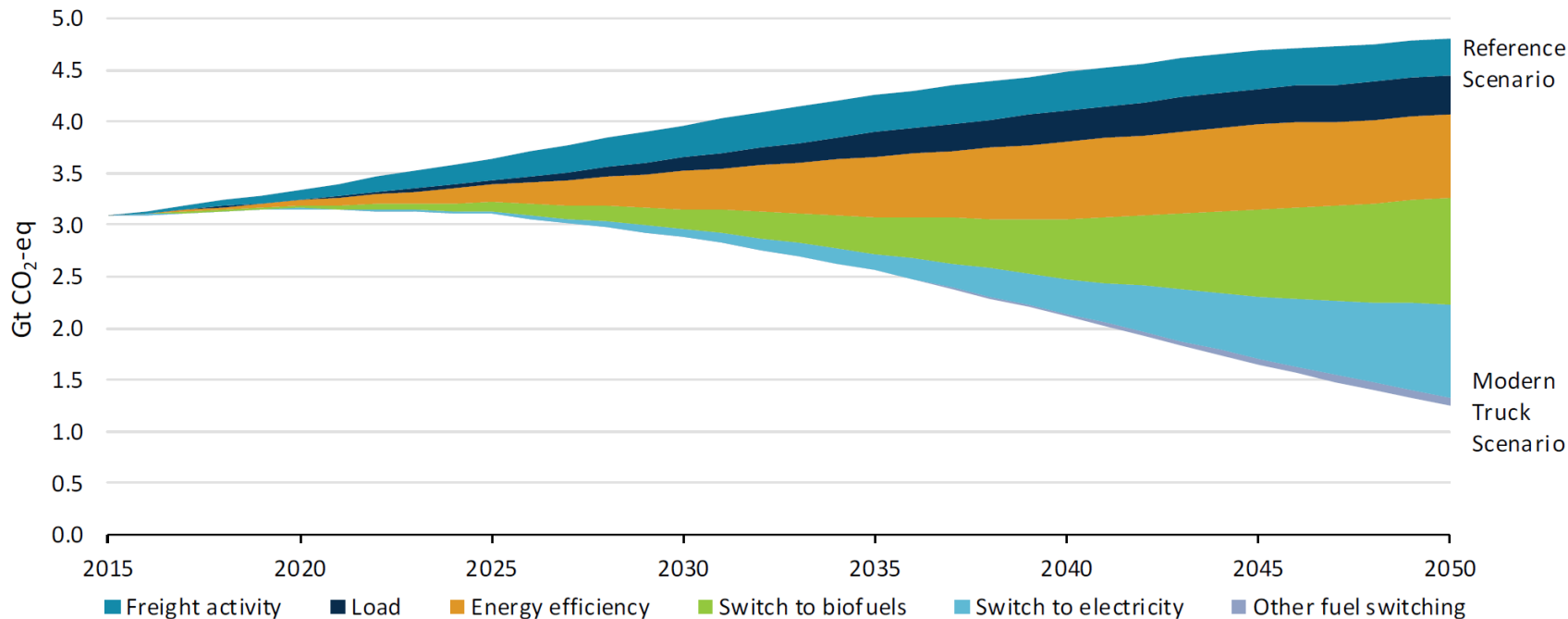
An achievable, yet ambitious, vision for the future of trucks

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

Emissions savings in Modern Truck Scenario vs. the RTS



- **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**
- **Policy action is key to enable the transition between MTS and RTS**

- **Adopting policies targeting vehicle efficiency, including fuel economy standards and differentiated taxes on vehicle purchase**

The two policies complement each other: the former regulatory policy ensures that all new truck sales achieve minimum efficiency performance, and the latter fiscal measure favours the best performing models, pushing further improvements.

For MFTs and HFTs taken together, the fuel use per kilometre of new vehicle registrations needs to be progressively reduced by 35%, relative to a 2015 baseline, by 2035.

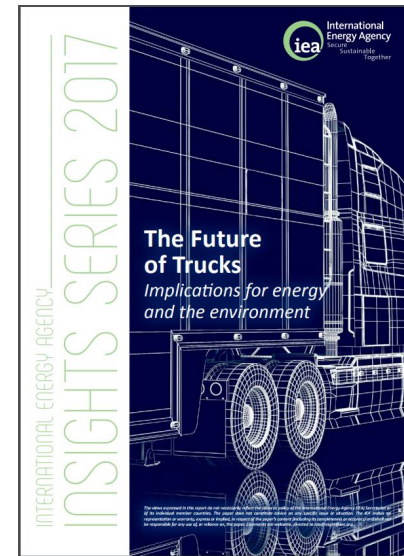
- **Supporting widespread data collection and information sharing in logistics**

Data gathering and information sharing are key prerequisites to realising some of the potential that underlies systemic improvements of freight logistics, including the sharing of assets and services.

Policy makers should take a proactive role in supporting data collection and sharing platforms by promoting closer collaboration among all stakeholders.

- **Promoting the deployment of alternative fuels and the vehicles that use them**

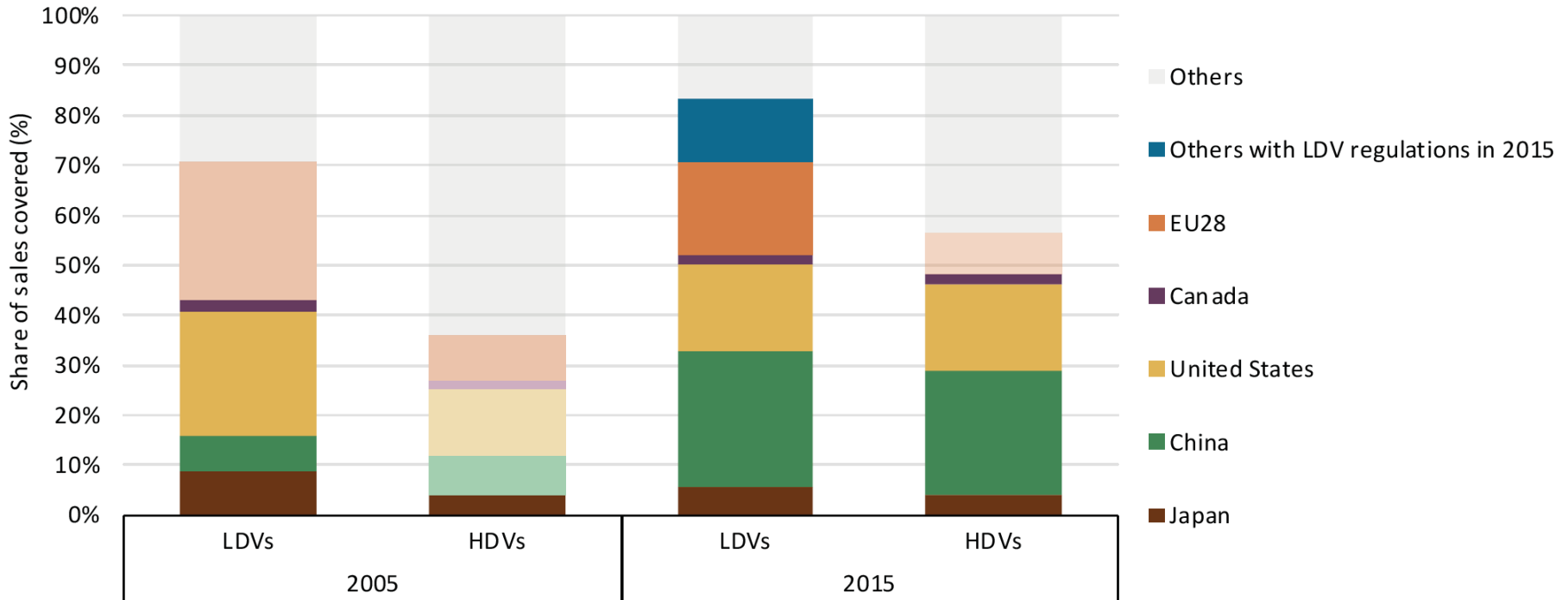
This typically requires support across four areas: RD&D, market uptake of alternative fuel vehicles, adequate access to charging or refuelling infrastructure and the availability of alternative fuels.





Only four countries have fuel economy standards in place on heavy-duty trucks

Vehicle efficiency standards for light-duty vehicles (LDVs) and heavy-duty vehicles (HDVs)



Such standards cover nearly 50% of new heavy-duty vehicle sales, as compared with light-duty fuel economy standards, which cover more than 80% of new LDV sales

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

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

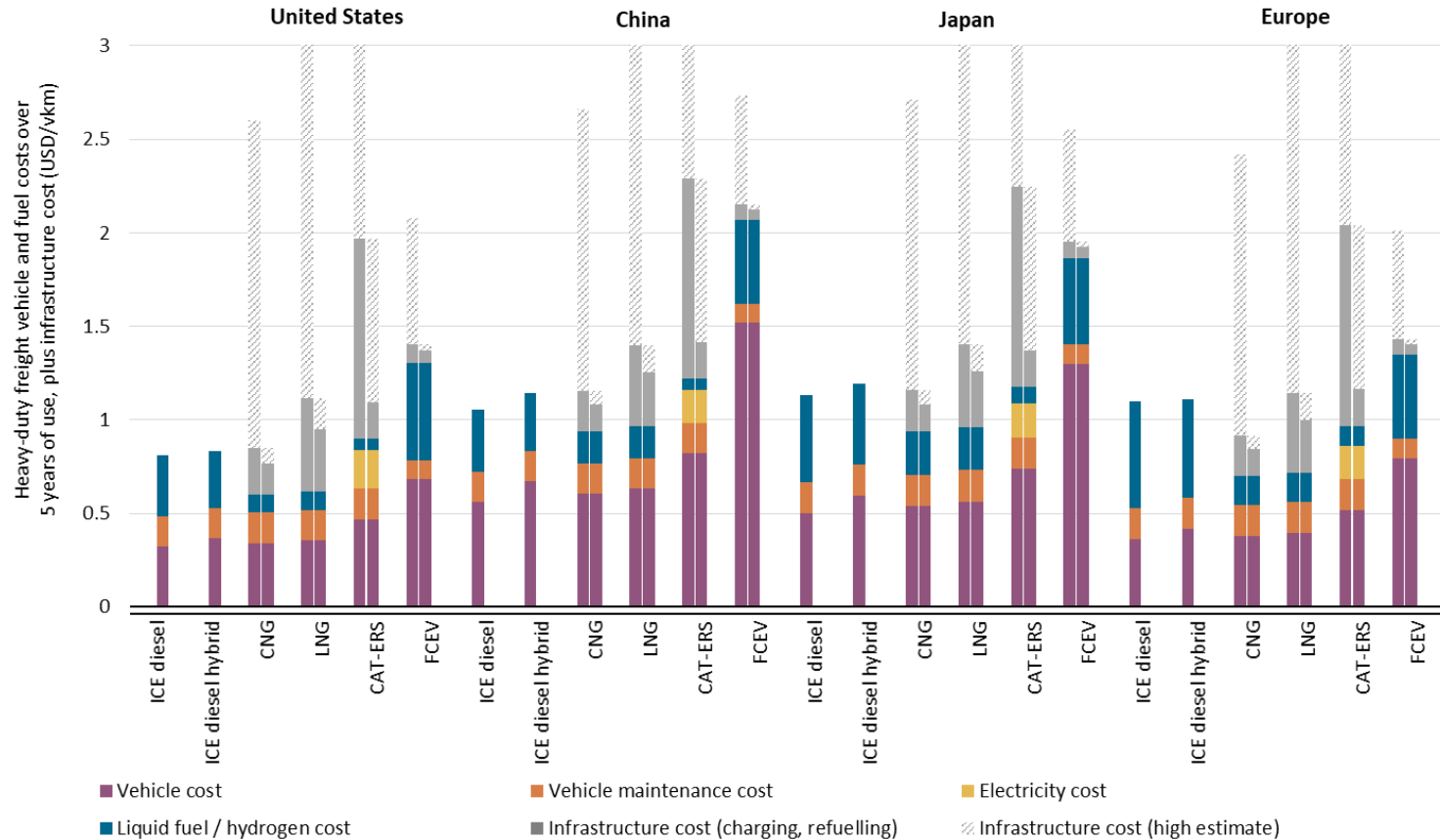
Measures requiring closer collaboration, including sharing of assets and services between and among companies and more radical re-envisioning of how logistics systems operate

	Range of energy savings
Supply chain collaboration/co-loading	Up to 15%
Matching cargo and vehicles via IT <ul style="list-style-type: none">• 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

Alternative fuel truck technologies come at higher cost today

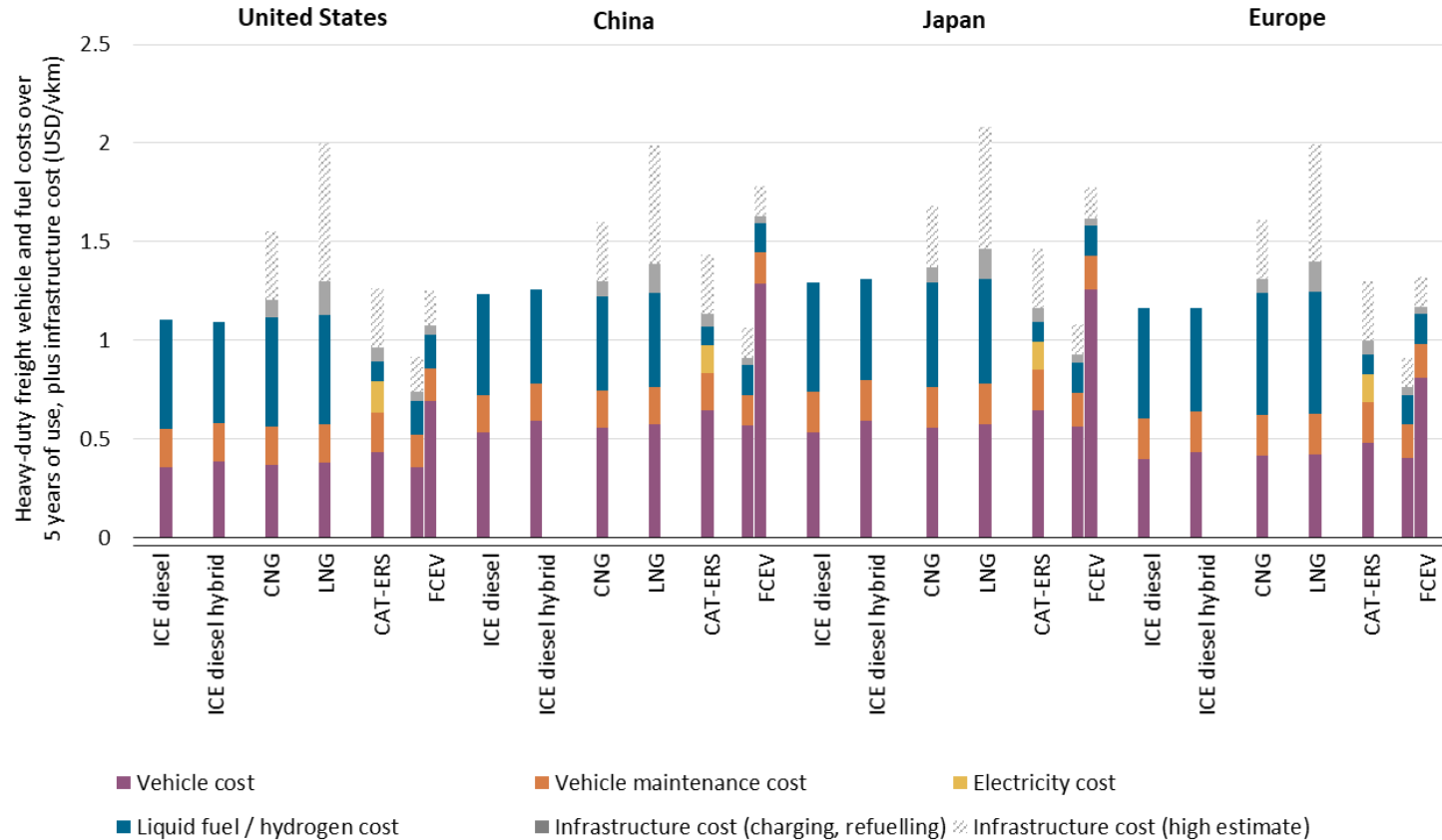
Heavy-duty freight vehicle & fuel costs over five years of use, including infrastructure cost, 2015



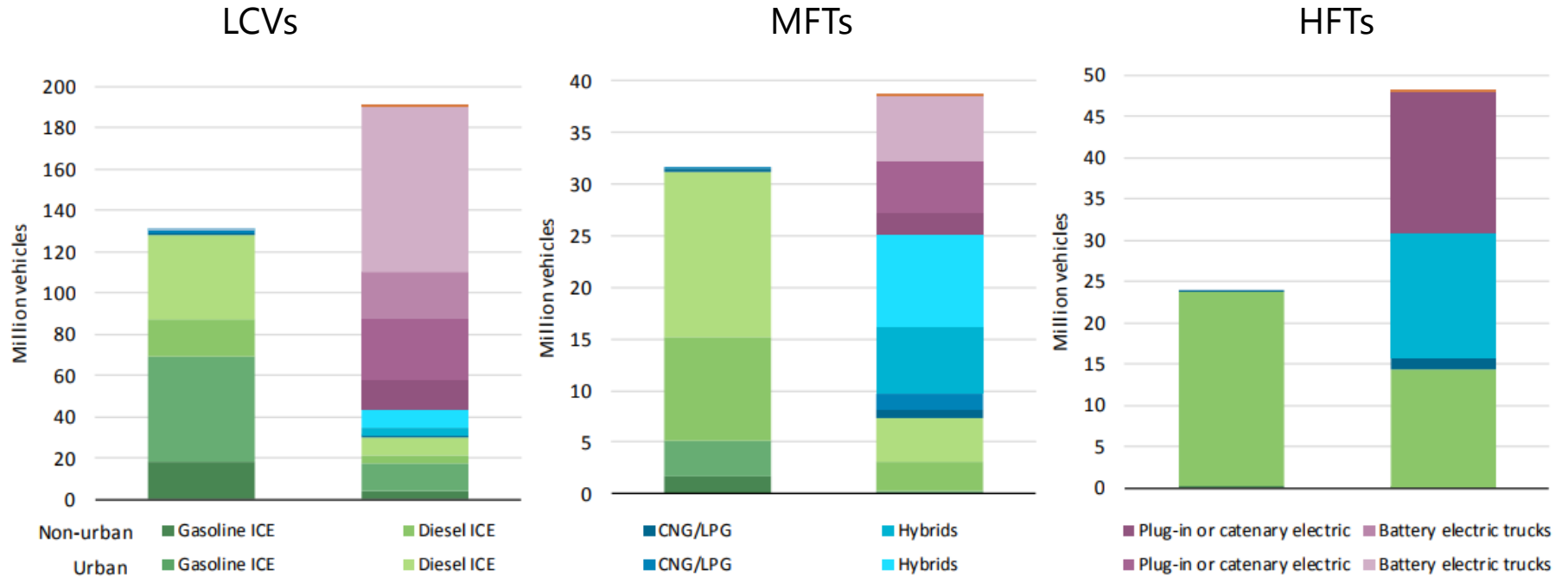
Sustained policy commitment can change the current context...



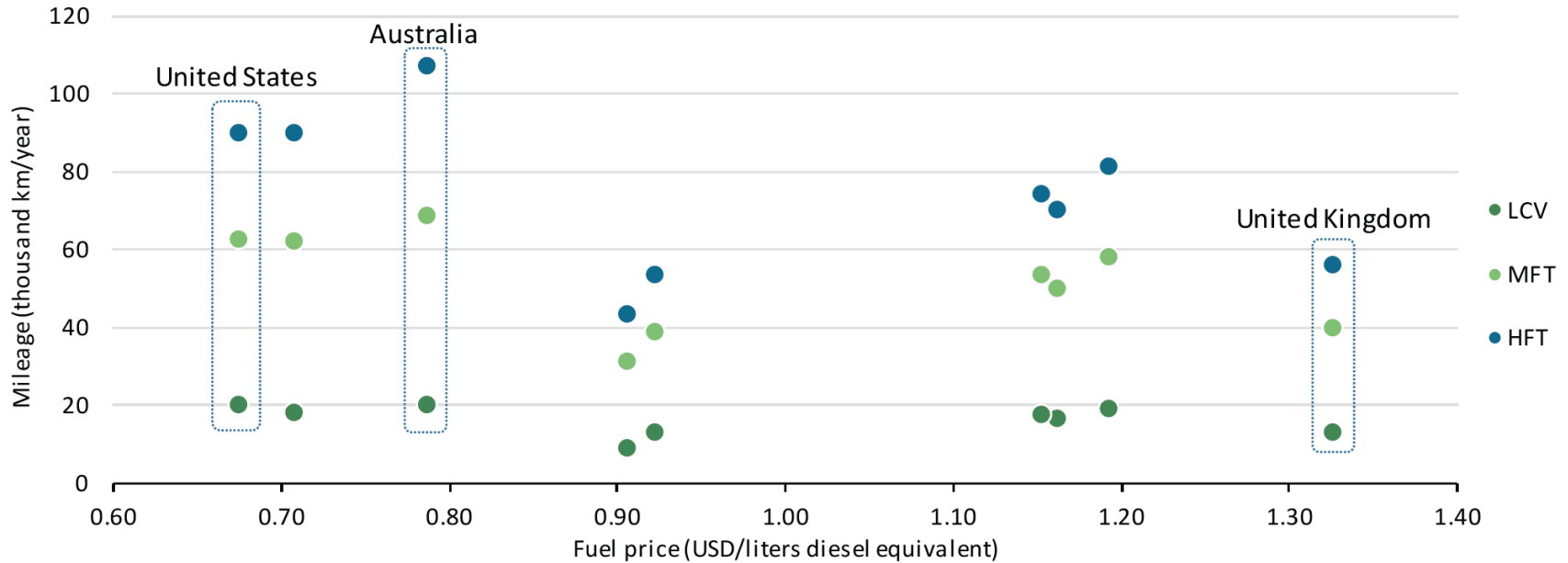
Heavy-duty freight vehicle & fuel costs over five years of use, including infrastructure cost, 2060



Projecting vehicle technology uptake (MTS)

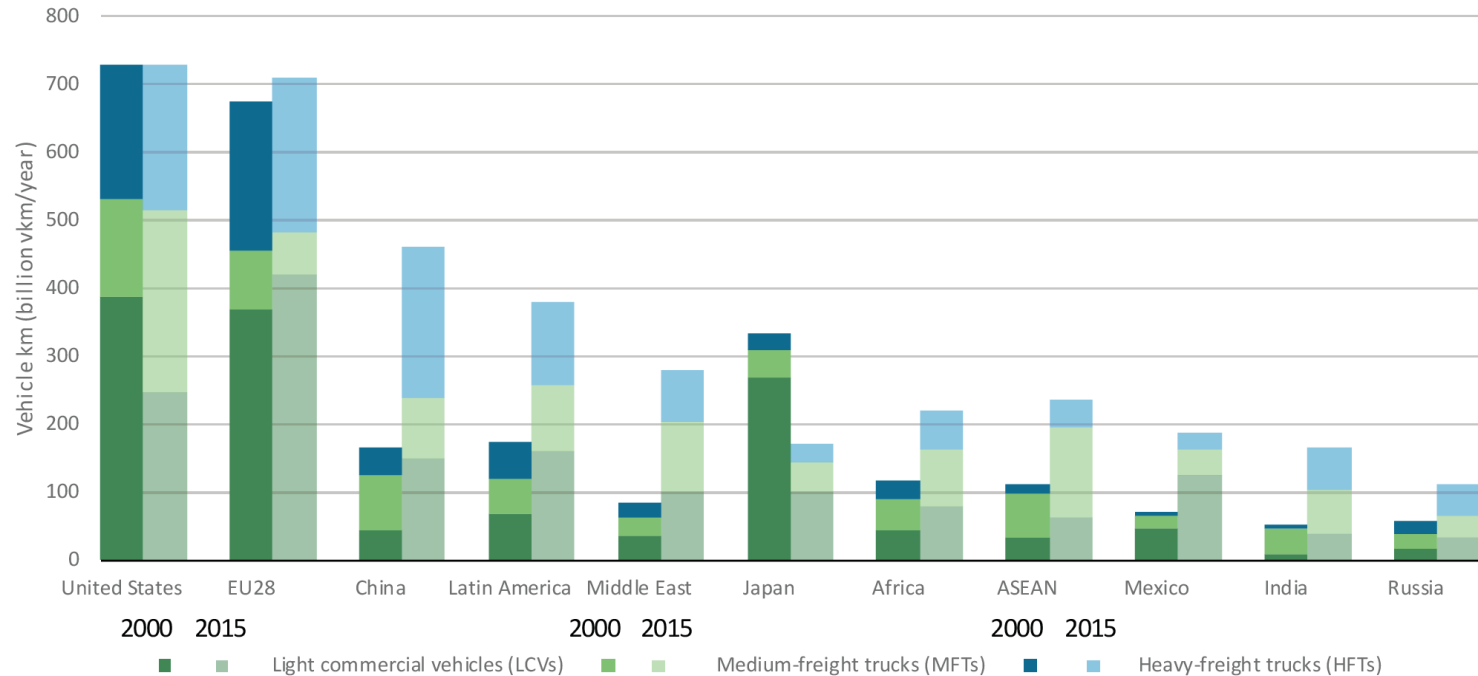


- MTS embeds major changes in the vehicle technology mix

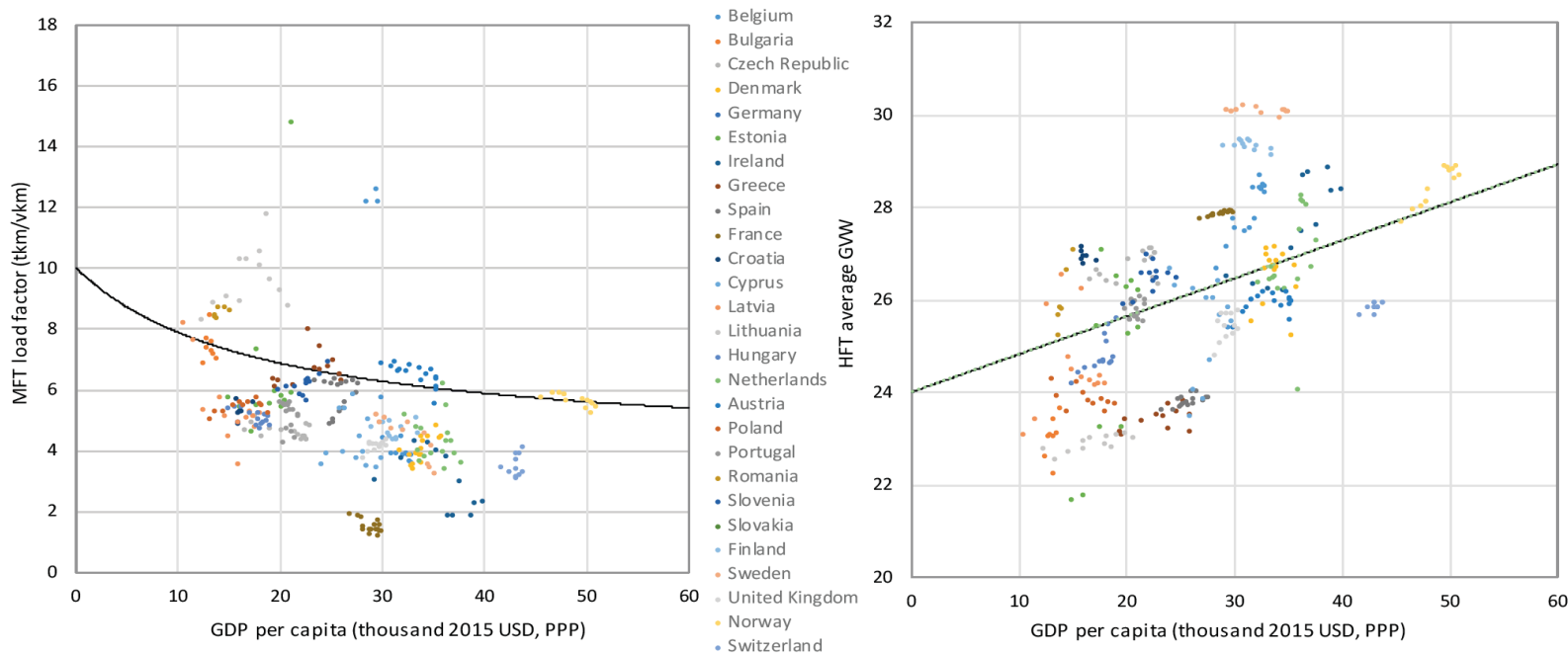


- Mileage tends to be larger in countries with lower fuel prices
- Fuel taxation tends to be lower in low-density countries (longer transport distances)
- Vehicle speed also matters: poorer conditions of the road network in developing regions lead to lower speeds, thereby limiting mileage

Vehicle activity



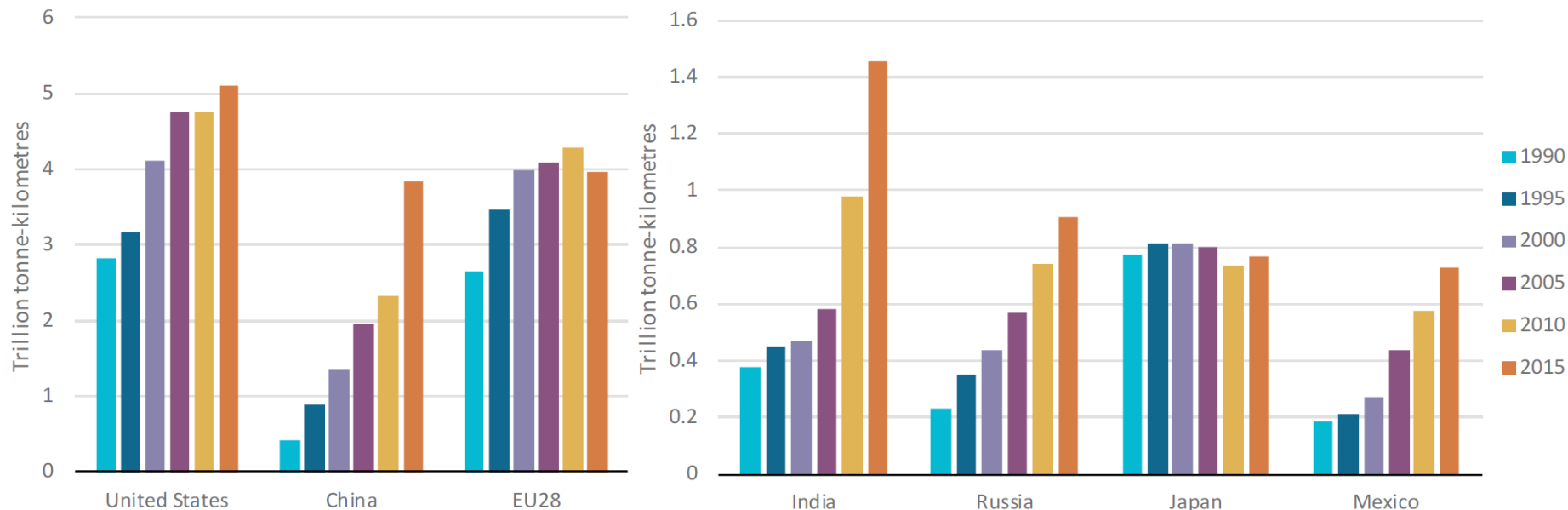
- China catching up fast against Europe and United States, primarily because of HFT and LCV vkm growth
- India still half of China, and with much greater relevance of MFTs



Sources: Grütter (2016); BTS (2016); Eurostat (2016).

- Loads decline with income growth for medium trucks
- Carrying capacities of heavy trucks increase with income growth

Road freight activity

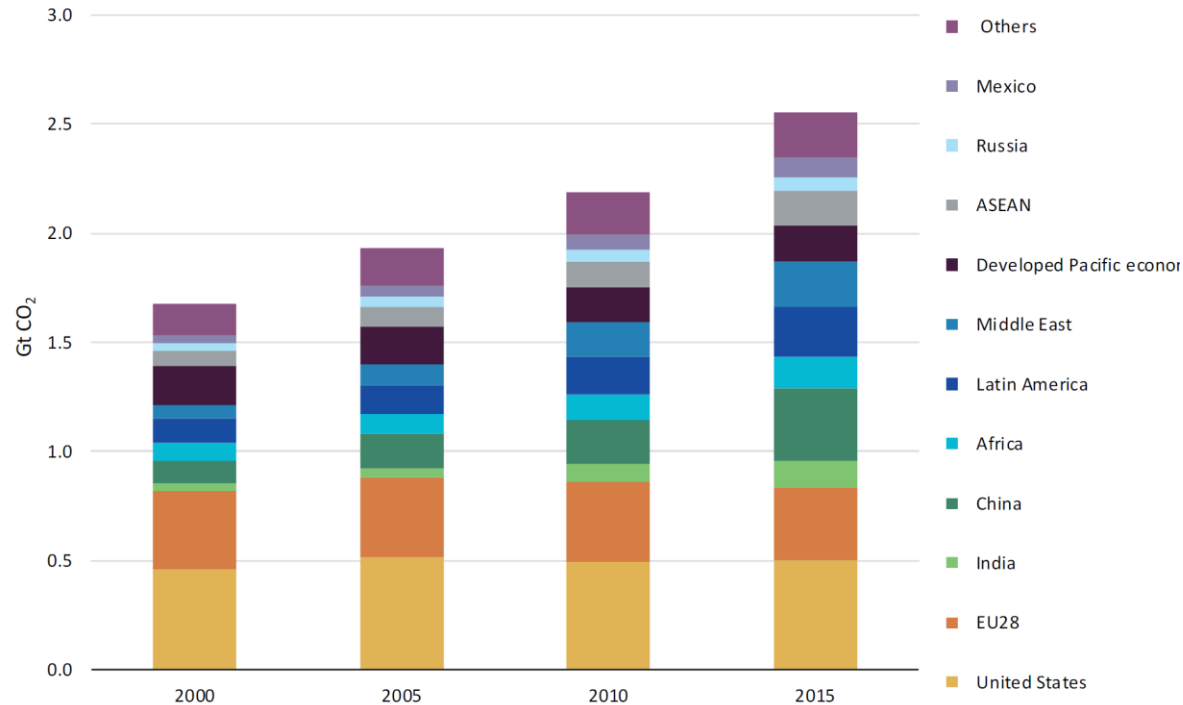


- **Combined effect of stock growth (and structural shifts), mileage and load dynamics**
- **Road freight activity is stagnating in developed countries, reflecting limited economic growth, while it is growing rapidly in developing economies**
- **In 2015, the volume of tkm in road freight in China was roughly similar to total activity in the United States and the European Union. Road freight activity in India was only about one-third these levels**

Country	LCVs			MFTs			HFTs		
	Ide/ 100 km	payload (tonnes)	Ide/ 100 tkm	Ide/ 100 km	payload (tonnes)	Ide/ 100 tkm	Ide/ 100 km	payload (tonnes) tkm	Ide/ 100
United States	7.9	0.55	14.4	28.2	6.4	4.4	41.2	15.4	2.7
European Union	6.8	0.62	11.0	23.3	7.0	3.3	34.6	14.5	2.4
China	9.9	0.82	12.1	23.3	8.7	2.7	39.1	13.3	2.9
India	6.4	0.96	6.7	25.0	9.7	2.6	44.9	12.9	3.5

- Differences in vehicle attributes, such as engine size and power, the availability of auxiliaries, and the mission profiles and vehicle size distributions in each category, complicate the comparison of average fuel economy and load across regions
- Trucks are most efficient in Europe
- Higher payloads on LCVs and MFTs lead to lower fuel use per tkm in China and India

CO₂ emissions



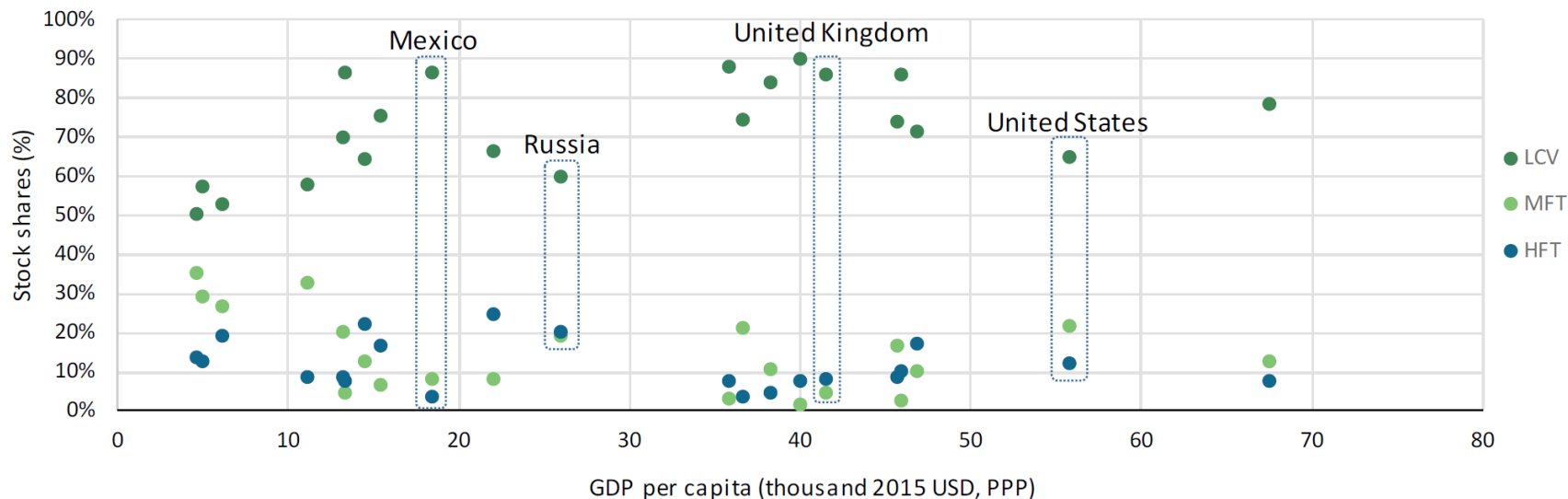
- Energy use and emissions were largely boosted in recent years by growth taking place in China, Latin America, India and other rapidly developing global economies
- By 2015, China's CO₂ emissions in road freight caught up with the EU
- India's road freight emissions were still only about one-third of China's

- Data availability limitations required the use of estimations
- The main rationale used in our assessment builds on the information flow that links vehicle sales with energy use (through survival rates, stocks, mileages, vkm and fuel economies)

$$A \sum_i S_i I_i = F$$

- Bottom up estimations of energy use require data on fuel economies
 - Our work relied primarily on research developed by the ICCT for the GFEI, complemented by information on the fuel consumption of vehicles reported by communities of vehicle users
- Tkm are linked to vkm by the share of empty running and average load on laden trips
 - Surveys focused on developing regions (Grütter, 2016) and available data points from the United States (BTS, 2016) and the European Union (Eurostat, 2016) were the main basis for this assessment
 - This information was then used as the basis for defining the average loads of medium- and heavy-freight trucks as functions of income and used to estimate the loads

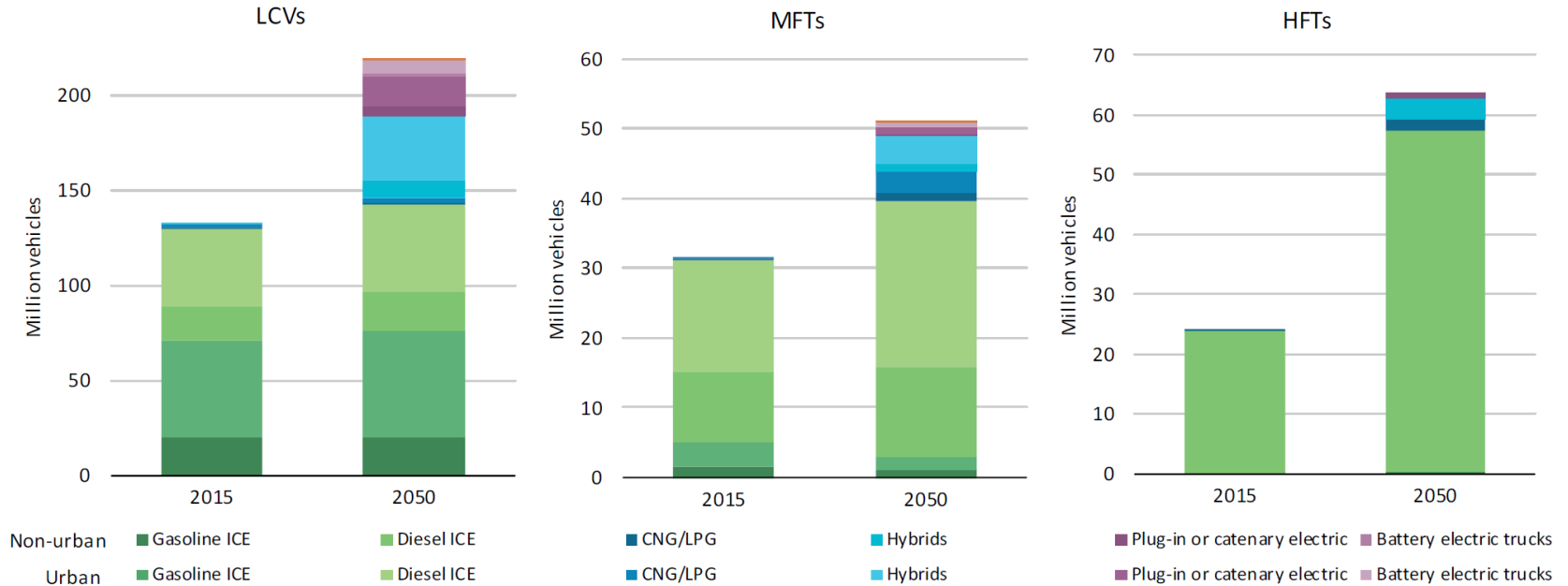
Projecting vehicle stock structure



Source: IEA (2017a), Mobility Model, June 2017 version, database and simulation model, www.iea.org/etp/etpmodel/transport.

- The share of LCVs and heavy trucks grows with increasing income levels due to an improving road network and increasing use of LCVs for services and urban deliveries.

Projecting vehicle technology uptake (RTS)

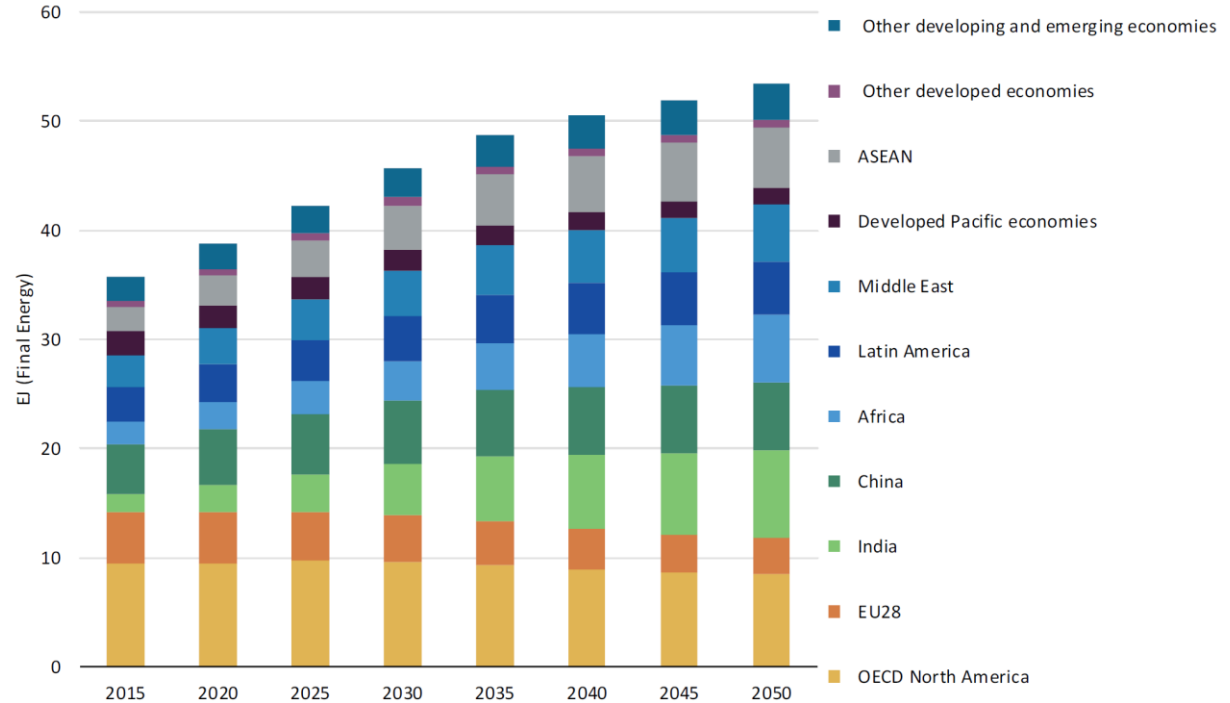


Note: CNG = compressed natural gas; ICE = internal combustion engine; LPG = liquefied petroleum gas.

- **The existing policy gap leads to limited uptake of fuel-saving technologies in the reference scenario**
- **Despite this, hybrids and EV stock shares grow in light commercial vehicles and in vehicles with mission profiles requiring frequent stops**

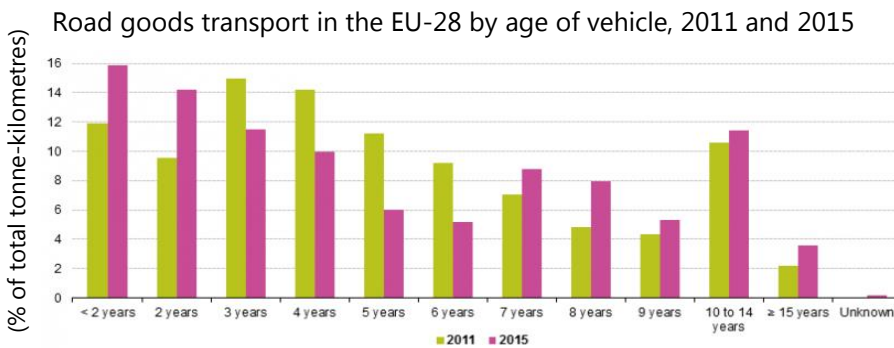
Energy use projections (RTS)

- **Combining freight activity growth with mileages and vehicle stock structures that broadly reflect historical development and vehicle technology development that does not factor in major changes leads to nearly 50% growth in energy use from road freight by 2060**
- **India catches up with China by 2035, and accounts as much as North America by 2060 in this scenario**



The Great European Data Dilemma

- Annual commercial vehicle registrations > 3.5 tonnes GVW ACEA
- Data gaps interpolated; vehicle stock estimated via aging function; calibration of road diesel consumption to national statistics (IEA energy balances)
- MoMo estimate of total heavy-duty truck stock in 2015: 4.0 million vehicles
 - Stock split: ~38% 3.5t – 16t / ~62% >16t
- This corresponds to the sum of all vehicle registrations over between 11-12 years



	Eurostat	MoMo	Units
stock	-	4.0	million vehicles
empty running	15%-30%	20%	share vkm
vkm	129	285	billion vkm
tkm	1768	3650	billion tkm
average load	13.7	12.8	tonnes (tkm/vkm)
average mileage	33,088	71,265	km/year