Estimating road and railway infrastructure capacity and costs

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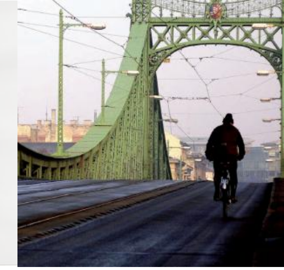
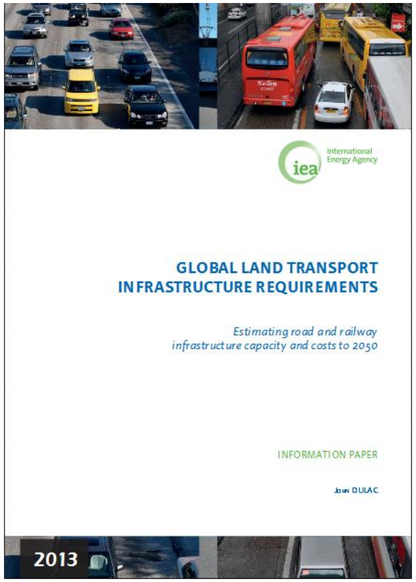
Focus on infrastructure



- IEA infrastructure partnerships:
  - UIC (rail)
  - IRF (roads)
  - UITP (public transport)
  - WRI EMBARQ (BRT)
- Structured analysis
  - Travel patterns and infrastructure demand
  - Transport fuel T&D/re-charging infrastructure
- Infrastructure insights (2013)
  www.iea.org/publications/freepublications/publication/name,34742,en.html
- ETP 2012 chapter on hydrogen
- Conference paper on EV recharging infrastructure



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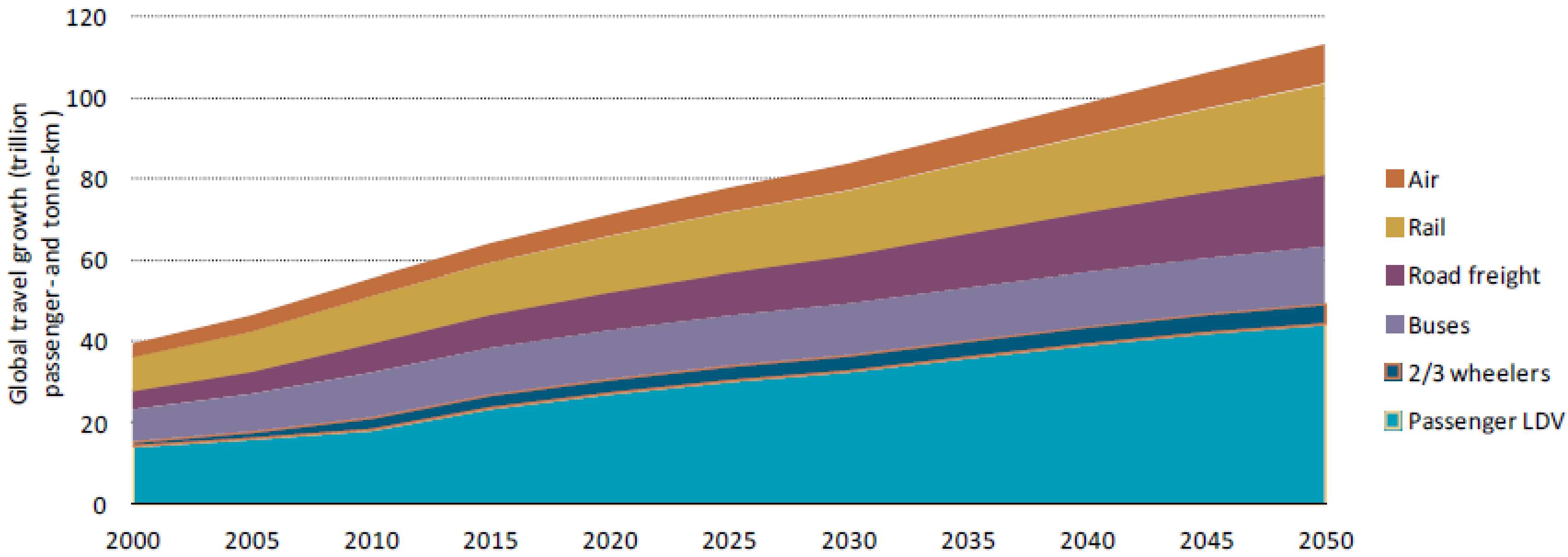
Travel demand to 2050

Passenger and freight travel by mode in the ETP 4DS



Total travel demand increased by almost 50% in the last decade and is likely to double until 2050 compared to 2010 levels.

With no dedicated policies, road travel might almost double as well.

Most of the demand growth is coming from non-OECD countries.

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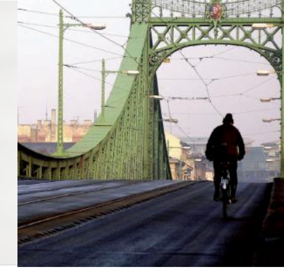
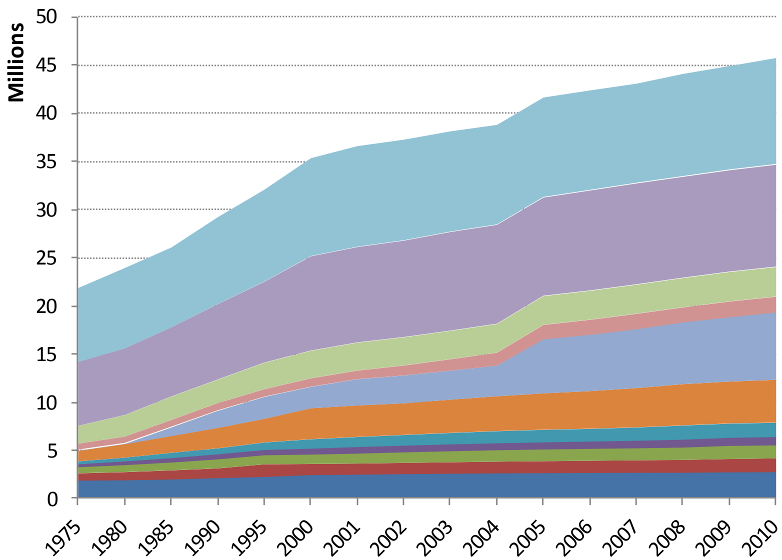
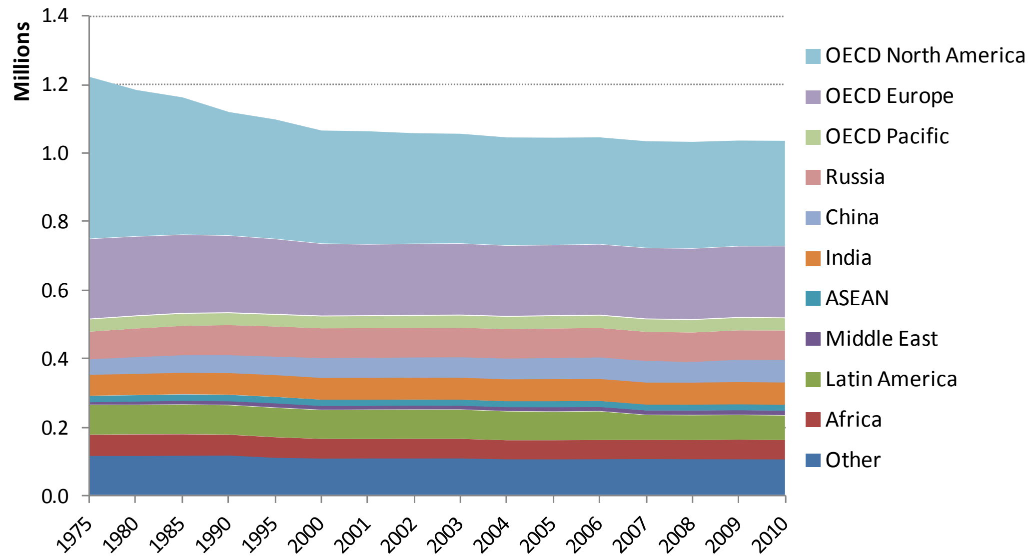
Historic infrastructure trends



Road (paved lane-km)



Rail (track-km)



Sources: IEA analysis based on IRF (2012) and UIC (2012)

Global road additions continue to grow at a rapid pace, while rail capacity has remained stagnant or even decreased.

Approx. 2% global GDP is spent on road and rail infrastructure!

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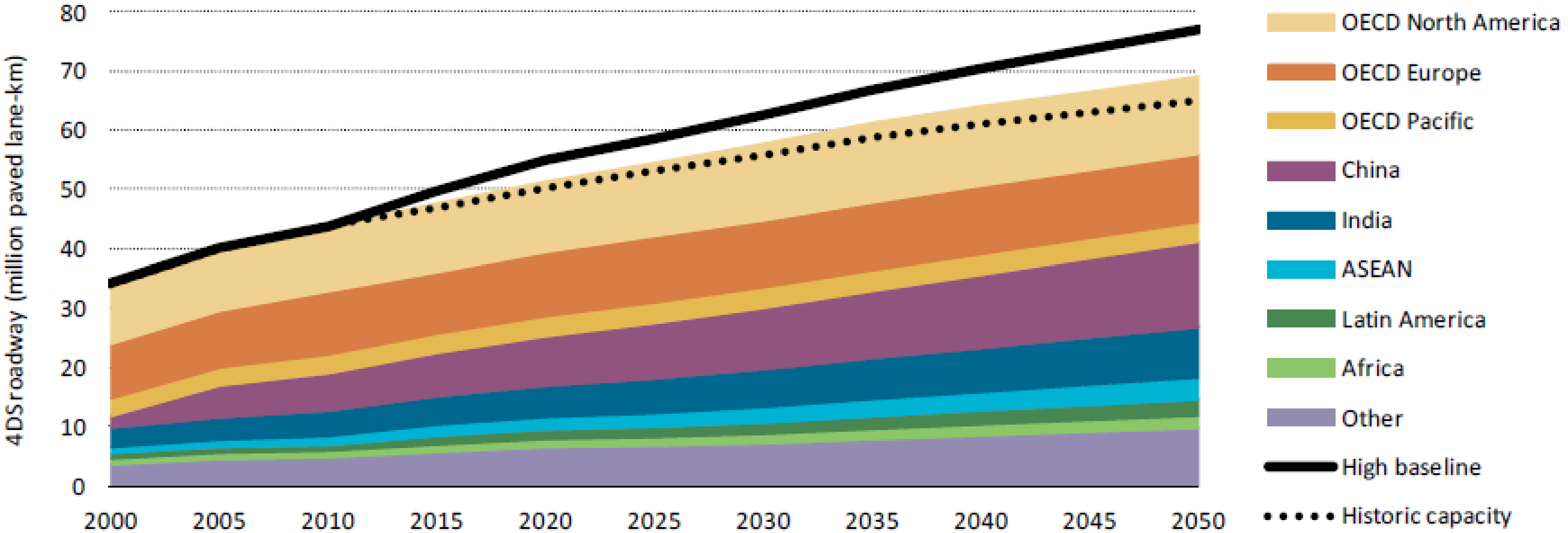
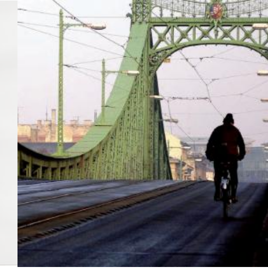
Required road capacity to 2050

Paved road lane-km in the ETP 4DS



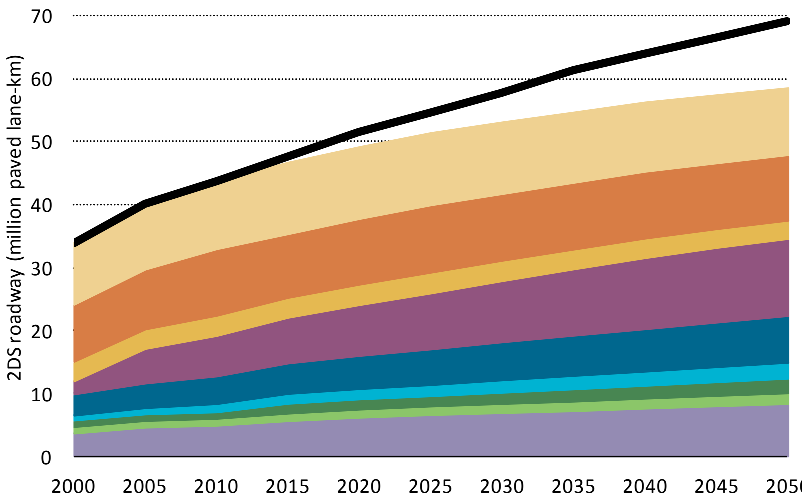
Global roads are likely to grow by nearly 25 million paved lane-km by 2050 in the 4DS, demanding for almost 80 trillion USD cumulative investment (110 trillion USD incl. parking space).

Benefits of avoided/shifted travel

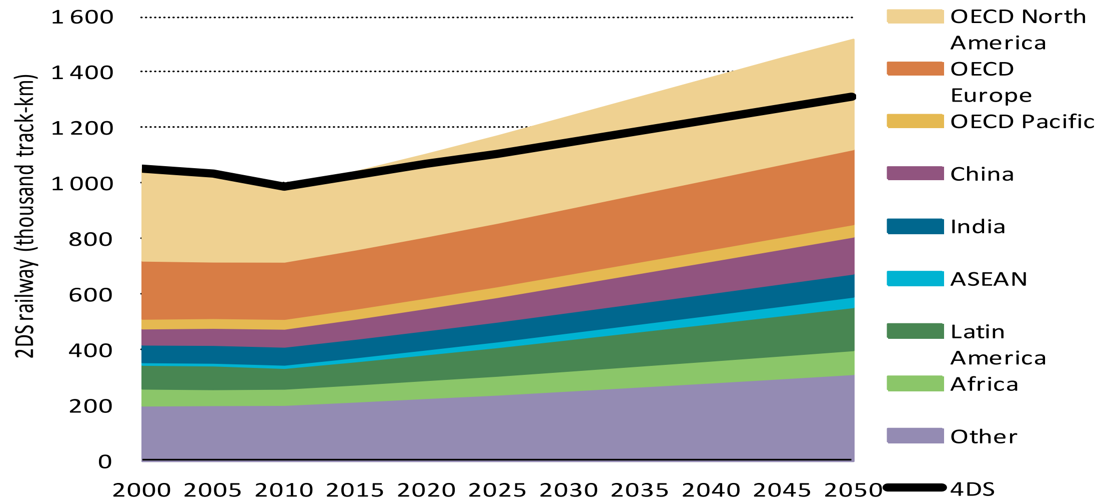


Avoid/shift approach (2DS) versus business as usual (4DS)

Road



Rail



An 'avoid/shift' approach could reduce road additions to 2050 by nearly 11 million paved lane-km. Rail would need to increase by 200 000 track-km

Potential cumulative savings due to less road infrastrucuture: USD 20 trillion

Additional 115 000 km new HSR ~ USD 4 trillion

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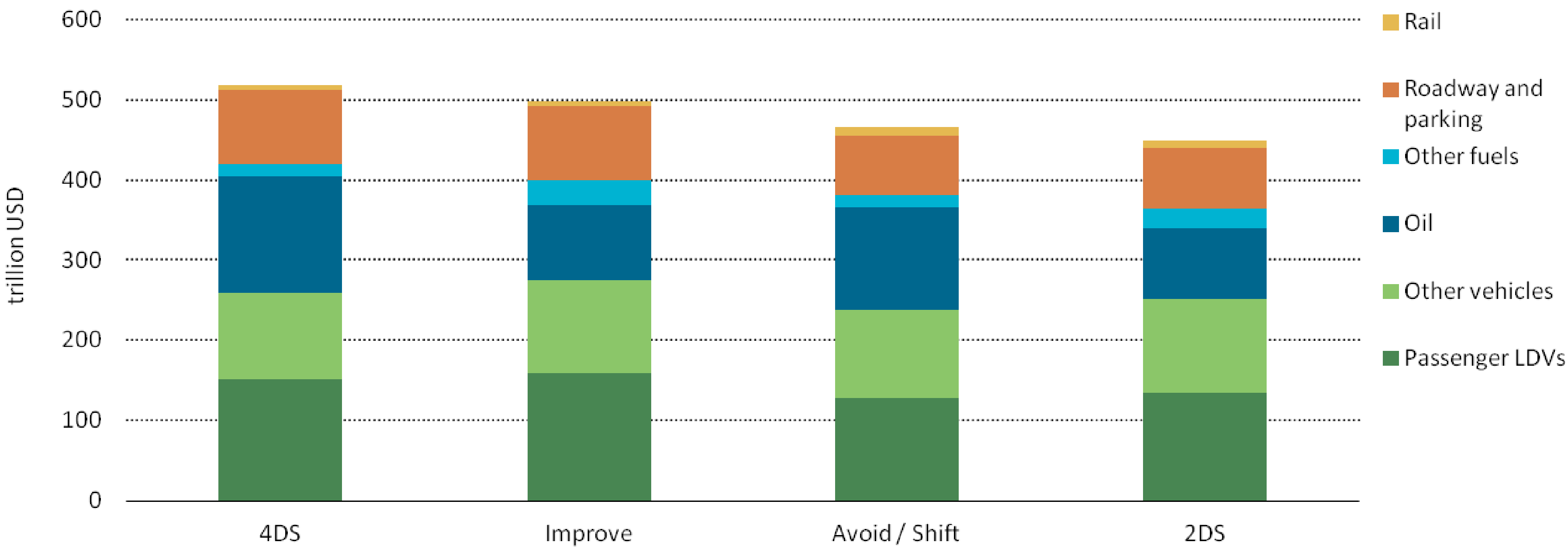
ETP 2012 scenarios: Cost comparison



The IEA *Improve* case (focus on technology) reduces expenditures on fuels, whereas the *Avoid/Shift* case (focus on behavioural change) cuts down infrastructure and vehicle costs.

An 'avoid, shift and improve' (2DS) approach could save as much as USD 90 trillion over 4DS spending. More than 20% of these cumulative savings can come from less infrastructure expenditures.

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Example: Road IS projection

- Based on historic road occupancy levels: Region specific ratio of vehicle-pkm per lane-km
- Future infrastructure expansion with respect to:
  - Construction capacity limit: How fast has road infrastructure been added in the past (e.g. China on average 350,000km per year)?
  - Density limits: Ratio of lane-km per land area; currently Japanese density is taken as constraint
  - Road occupancy limit: What is the acceptable road occupancy limit (currently: 1.8 mio vkm per lane km; for comparison: OECD average 0.5 mio vkm per lane km)

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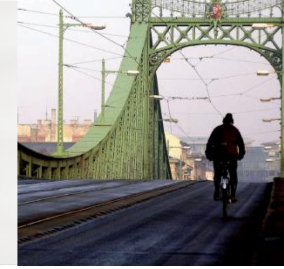
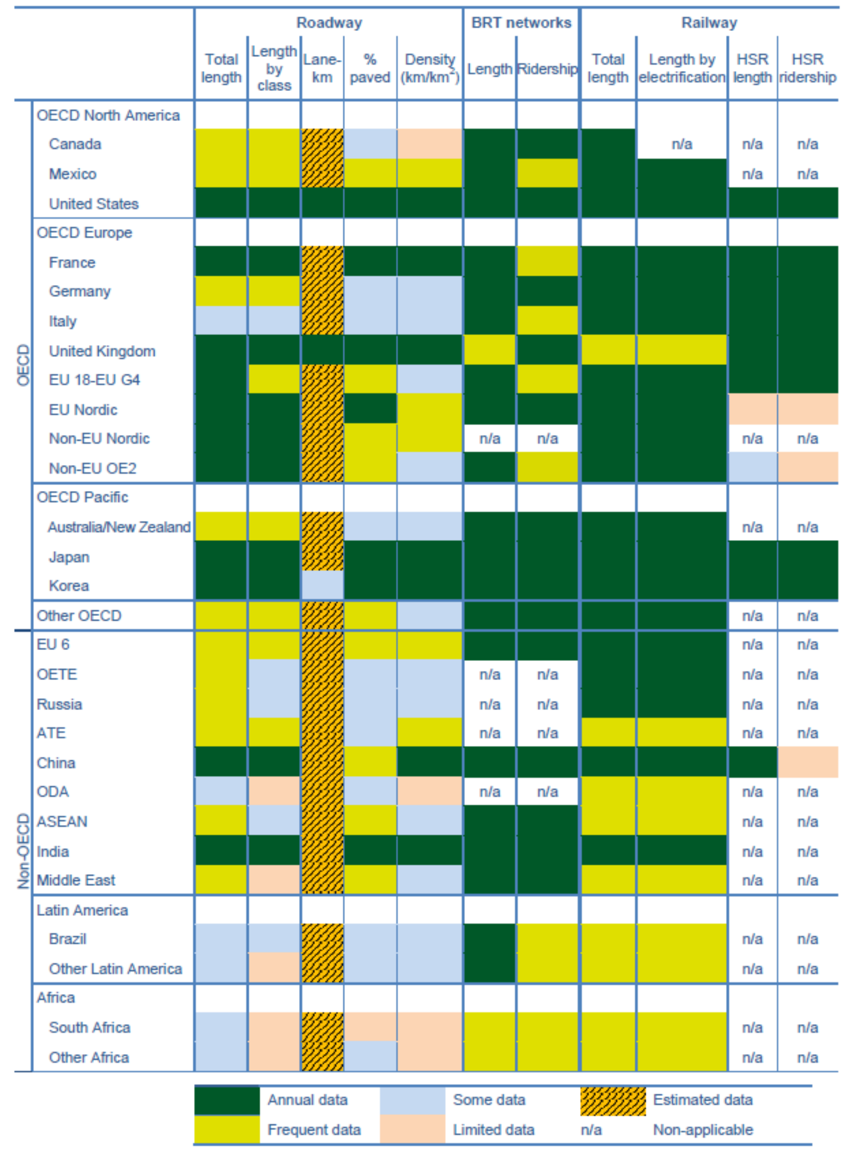
IEA road/rail infrastructure DB



- Infrastructure data from IRF, UIC, ITDP, EMBARQ
- Cost data: More than 1300 individual projects in 110 countries from ITF, IRF, UIC, ADB and regional initiatives
- Data issues:
  - Limited data on infrastructure on a detailed level (*e.g. number of lanes, % paved, annual updates)*
  - Even less data on infrastructure investments (*e.g. project costs, how money is spent, impact of investments)*

Data are key to understanding progress, future infrastructure needs and long-term impacts of investment decisions!

Table 3 • Data availability



Database - details

Table 3 • Data availability

		Roadway					BRT networks		Railway			
		Total length	Length by class	Lane-km	% paved	Density (km/km^2)	Length	Ridership	Total length	Length by electrification	HSR length	HSR ridership
OECD	OECD North America											
	Canada									n/a	n/a	n/a
	Mexico										n/a	n/a
	United States											
	OECD Europe											
	France											
	Germany											
	Italy											
	United Kingdom											
	EU 18-EU G4											
	EU Nordic											
	Non-EU Nordic						n/a	n/a			n/a	n/a
	Non-EU OE2											
	OECD Pacific											
	Australia/New Zealand										n/a	n/a
	Japan											

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Conclusions

- Road infrastructure accounts for almost 20% of all cumulative transport expenditures 2010 to 2050 – Need to re-think that!!!
- Infrastructure costs can be a key piece in climate change mitigation scenarios
- Avoid /Shift: Rail and public transit (bus, metro, light rail, BRT) offer big potential to accommodate travel growth at lower long-term costs while reducing GHG emissions at the same time
- Emerging/developing countries are primary targets, as the transport system is largely to be built
- Infrastructure data is imperative to understand how projected travel growth can be accommodated, and what are potential effects on congestion levels/utilization rates

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Thanks!

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Data needs

- Data requirements to provide better understanding:
  - Extent and class of infrastructure (length, capacity, paved vs. unpaved)
  - Age structure (e.g. state of repair)
  - Good estimates of specific cost of infrastructure (e.g. per km: capital, reconstruction, O&M)
  - Urbanization rates, density
  - Classification of land profile
  - Identification of main transport axis
  - Time series/detailed infrastructure investment data

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Data value

- Infrastructure data is imperative to understand how projected travel growth can be accommodated, and what are potential effects on congestion levels and utilization rates
- Financing infrastructure and macro-economic decision taking:
  - Road investments typically are less expensive (short term) but have higher long-term operational and maintenance costs
  - Rail and public transit (metro, light rail, BRT) offer significant potential to accommodate travel growth at lower long-term costs (while reducing energy consumption and emissions)
- Providing a complete picture on energy use, emissions and costs of the transport sector
  - Infrastrcuture costs can be a key piece in climate change mitigation scenarios

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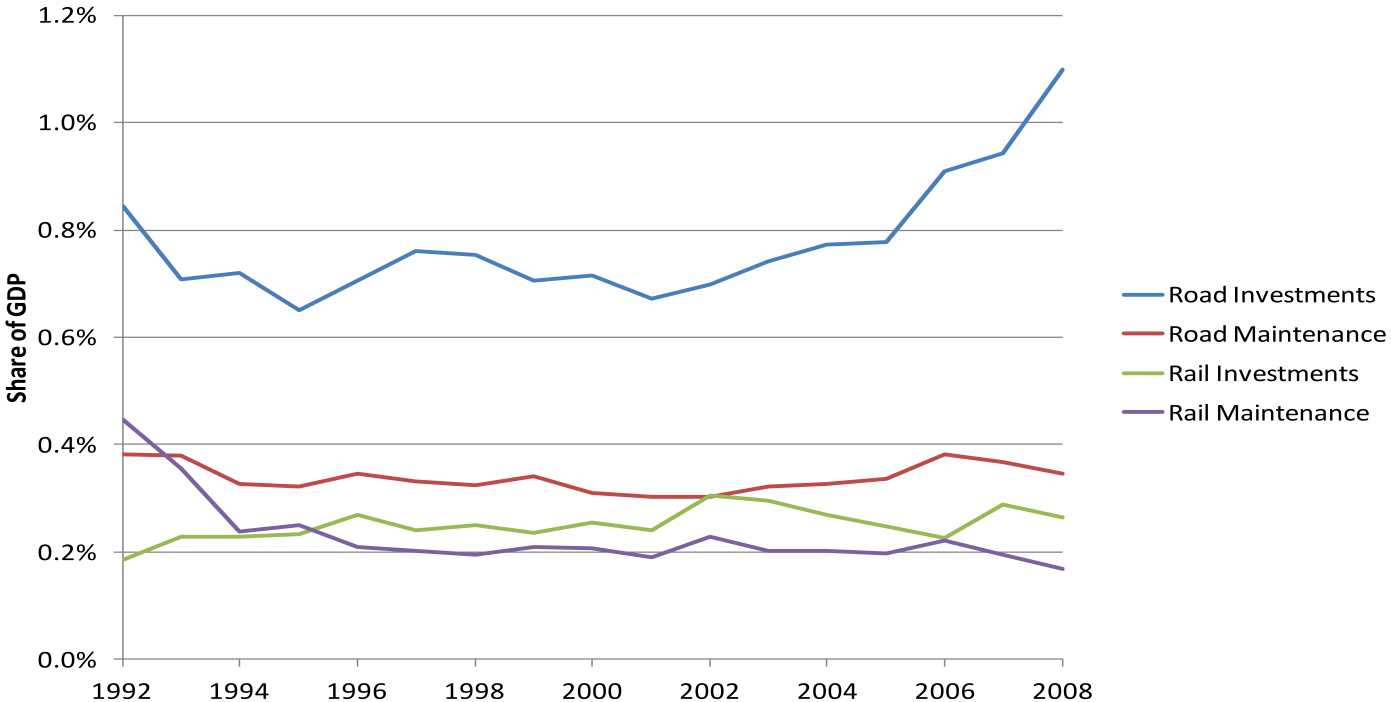
Global historic trends - investment

Average global spending on road and rail infrastructure



Sources: IEA analysis based on ITF and ADB member country data

Global road expenditures on capital construction have continued to increase in recent years, accounting for more than 50% of total spending.

Approx. 2% global GDP is spent on road and rail infrastructure!

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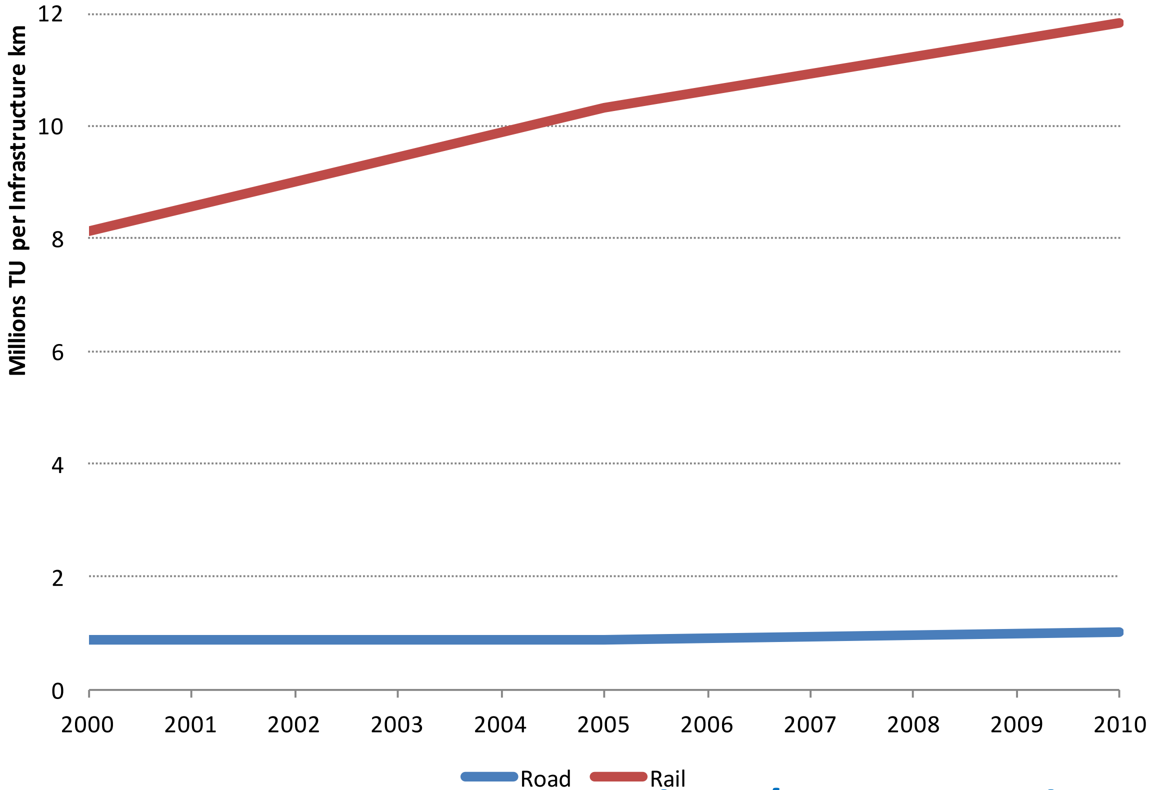
Capacity: Rail vs. road



Whilst road infrastructure carrying capacity (tkm/pkm per km) stayed almost constant, rail capacity increased by 50% over the last deacade.

In absolute terms rail capacity is about 12 times the capacity of road transport

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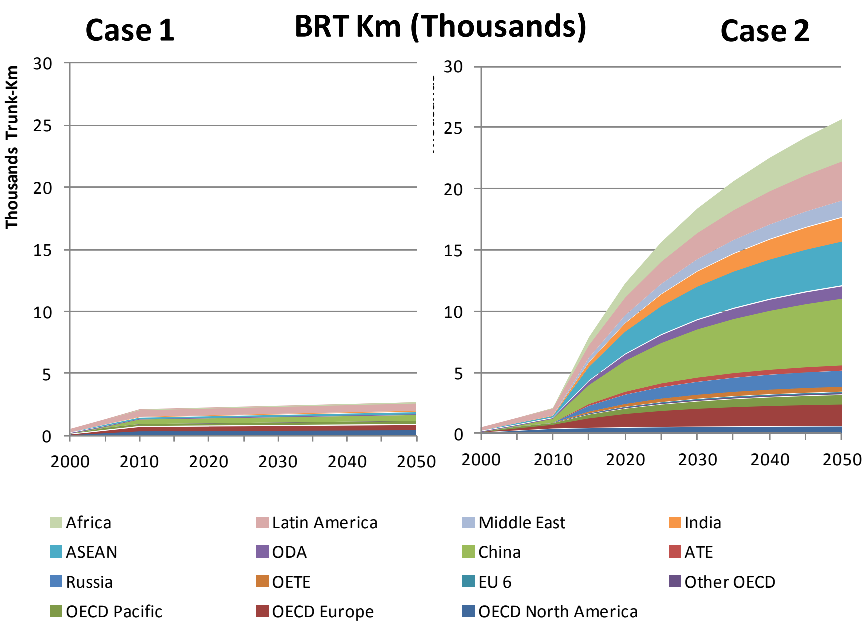
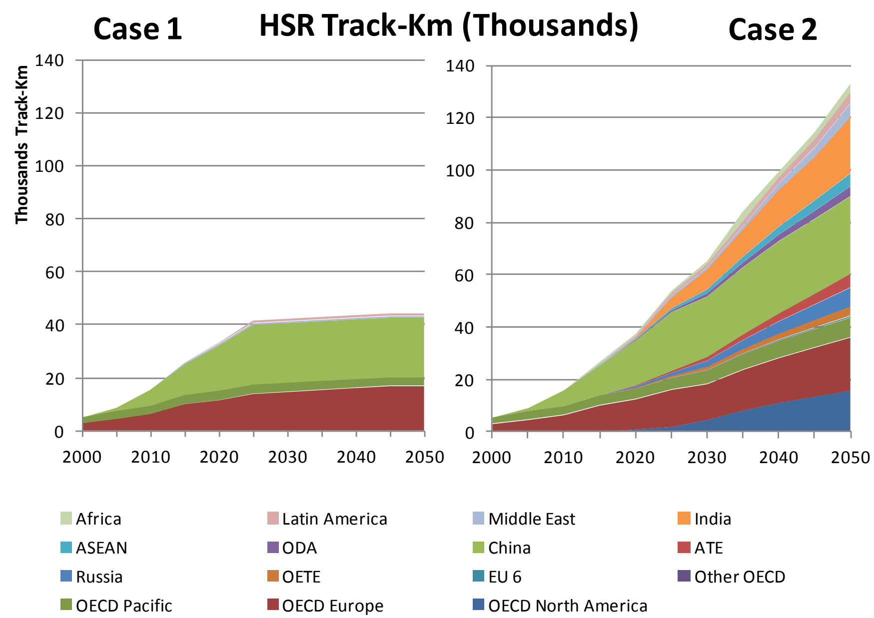
Role of investments to achieve 2DS

Shifts in investments to bus and rail infrastructure are cost effective compared to present spending





10-fold increase in BRT: ~USD 400 billion (0.5% road investments in 4DS)

115 000 km new HSR: ~USD 4 trillion (5% road investments in 4DS)

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