

Potential of modal shift to rail transport

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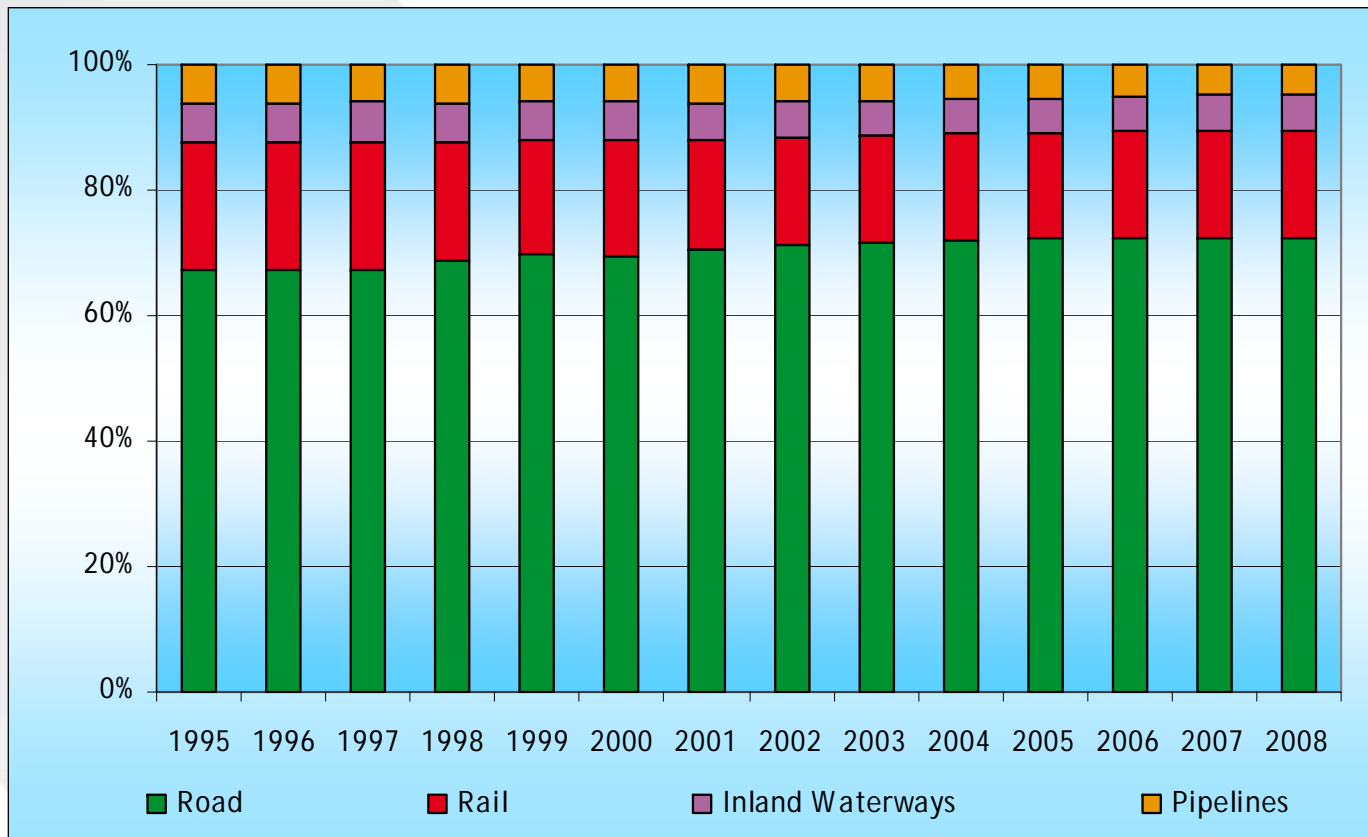
▶ Outline

- Context
- Modal shares and relative emissions
- Methodology
- Capacity analysis
- Case studies
- Literature survey
- GHG reduction potential of modal shift to rail
- 2050 perspective
- Rebound effects
- Conclusions and recommendations

▶ Context

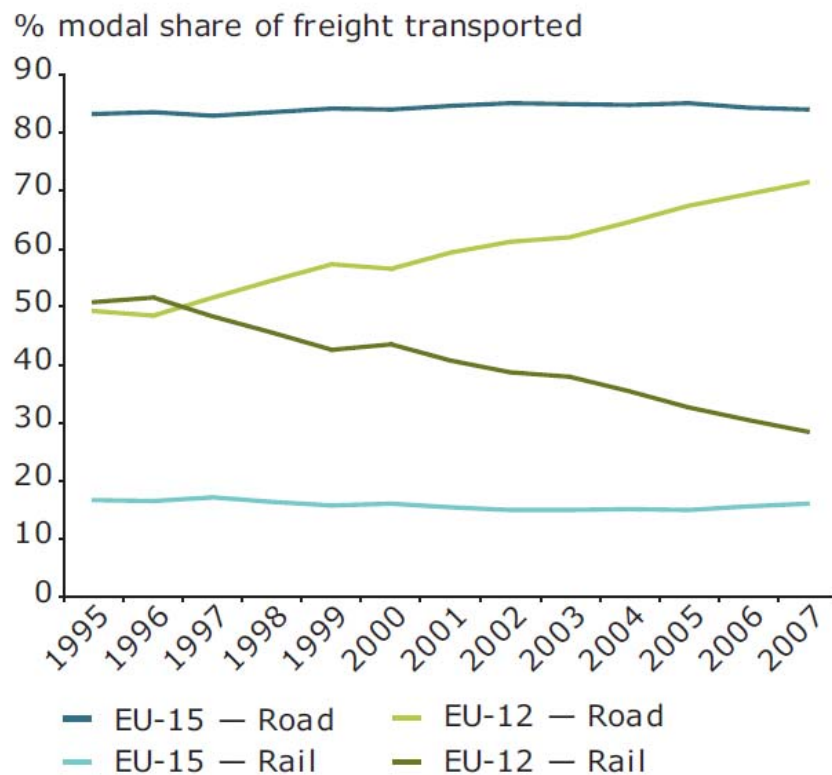
- White Paper on Transport
- Roadmap 2050 for decarbonising transport
- Various policy areas:
 - Pricing policy (Eurovignet, Rail Infrastructure Charging, Energy Taxation)
 - Infrastructure policy (TEN-T, cohesion funds)
 - Regulation (CO₂ regulation, megatrucks, cabotage, speed, etc.)
 - Rail policy (interoperability, harmonisation, market structure)

▶ Modal split of freight transport (EU-27)



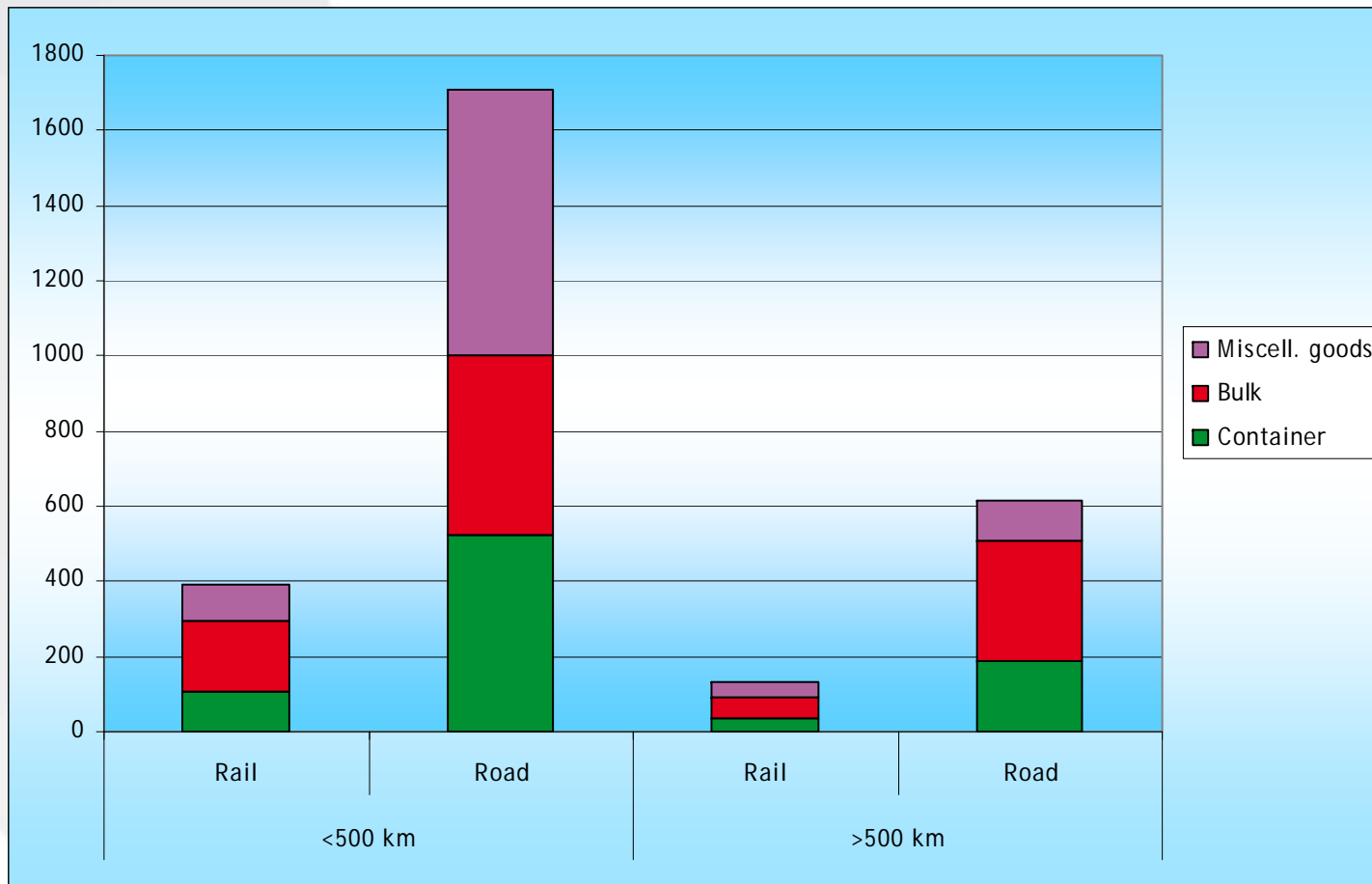
Sea shipping and trucks < 16 t excluded

▶ Comparison of trend in the EU-15 and EU-12



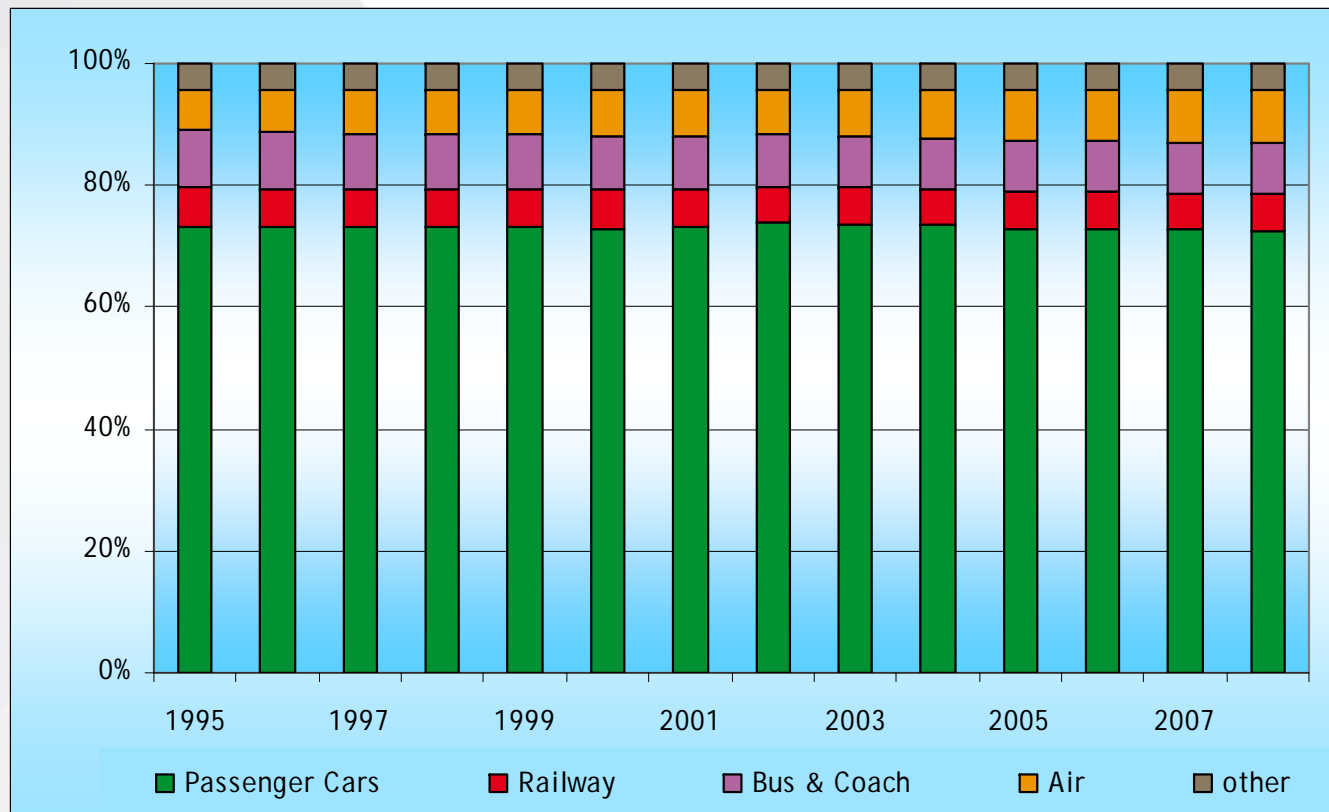
Source: Eurostat, 2009.

▶ Projected transport volumes per freight transport mode and market segment (billion tonne-km in 2020)



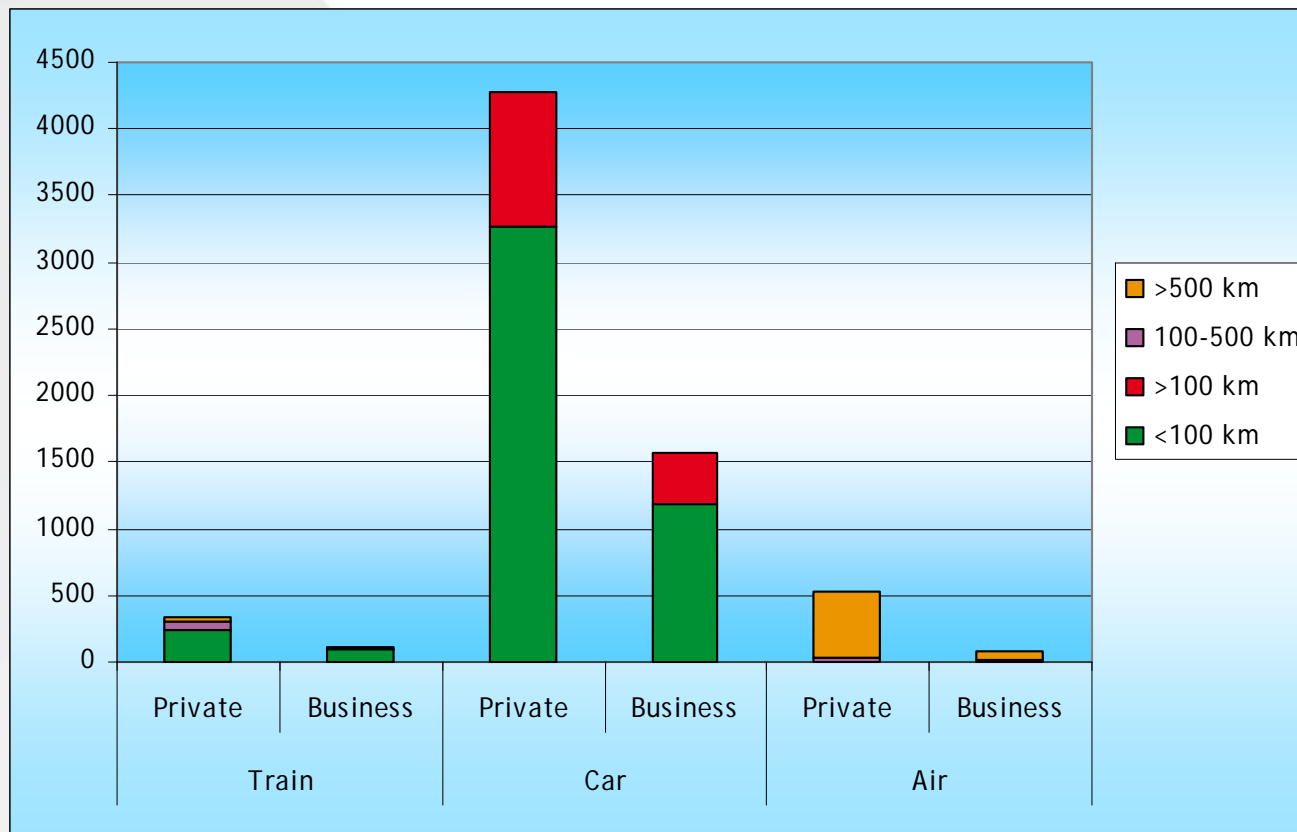
Sea shipping and trucks < 16 t excluded

▶ Modal split of passenger transport (EU-27)



Intercontinental aviation excluded

- Projected transport volumes per passenger transport mode and market segment (billion pass-km in 2020)



Intercontinental aviation excluded

▶ Comparison of emissions from single modes
(estimates based on SULTAN tool)

Freight (g/tkm) - HGV < 16 t excluded

Type of good	2020				2050			
	<500 km		>500 km		<500 km		>500 km	
	Rail	Road	Rail	Road	Rail	Road	Rail	Road
<i>Container</i>	13	131	10	98	6	116	5	87
<i>Bulk</i>	12	84	10	78	5	74	4	68
<i>Miscell. goods</i>	13	141	10	105	6	124	5	93

Passenger (g/pkm)

Transport mode		2020			2050		
		<100 km	100-500 km	>500 km	<100 km	100-500 km	>500 km
Train		46	31	25	16	11	4.7
Car (private use)		88	80		72	65	
Car (business use)		150	159		122	129	
Aviation		231		237	182		110

▶ Methodology

Three approaches for estimating modal shift potential:

- Infrastructure capacity analysis
- Assessment of existing studies on overall modal shift potential
- Analysis of illustrative case studies

Calculation of GHG impacts:

- Combining the results of the three approaches
- Using average GHG emissions per tkm per distance class
- Well-to-wheel
- For road freight: only large trucks
- Transport to/from terminals and detour effects included

▶ Infrastructure capacity analysis

Two different levels of analysis:

- **Geographical basis:** the EU-27, EU-15, EU-12, and Europe which adds to EU-27, Croatia, Norway, Switzerland and Turkey.
- **Hierarchical level:** Primary network, which corresponds to ERIM network, and Secondary network, represented by the rest of the network.

Three years: 2020, 2030 and 2050.

▶ Two different supply scenarios for capacity analysis

1. Base scenario: current network
2. Upgraded scenario: it takes into account the planned development, where the main component is the TEN-T implementation program:
 - The development of the primary network at the expenses of secondary network
 - The shift from single track lines to double or more tracks lines, which is seen both in the primary and secondary network

Network length development in 2020 and 2030 in the upgraded scenario

Aggregate	2008			2020			2030		
	Total line length (km)	Single track lines (km)	Double track lines (km)	Total length (km)	1 track (km)	2 tracks (km)	Total length (km)	1 track (km)	2 tracks (km)
Europe	230,776	138,842	91,934	230,776	132,407	98,369	230,776	123,553	107,223
EU-27	212,108	122,794	89,314	212,108	116,542	95,566	212,108	107,941	104,167
EU-15	150,569	79,253	71,316	150,569	74,261	76,308	150,569	72,835	77,734
EU-12	61,539	43,541	17,998	61,539	42,281	19,258	61,539	35,556	25,983
Primary	48,464	12,116	36,348	52,341	9,421	42,920	55,482	8,479	47,002
Secondary	182,312	126,726	55,586	178,435	122,985	55,450	175,294	115,074	60,220

Evolution of average capacity use in the base scenario

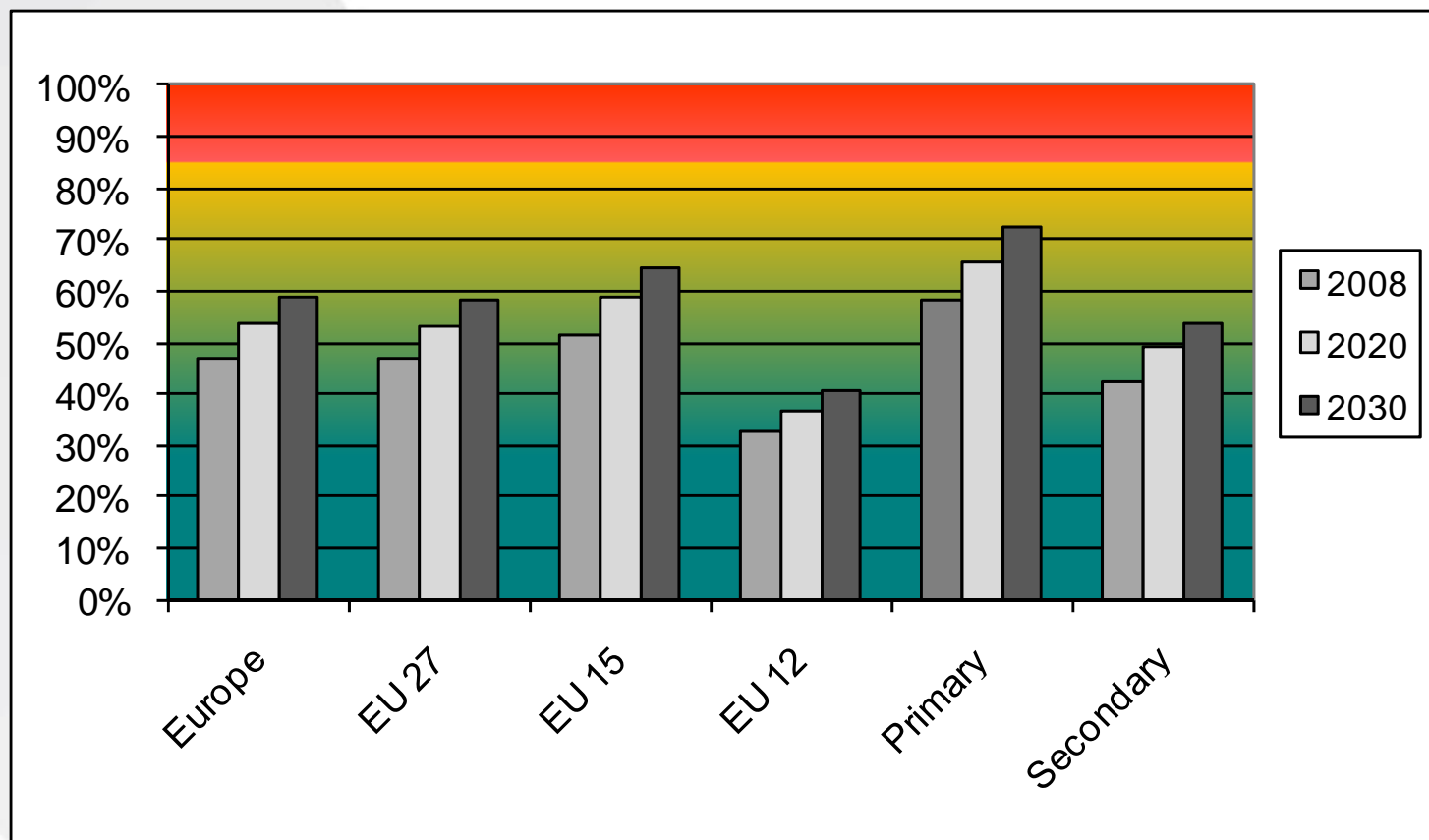
The theoretical capacity of the network (in train-km per year) is calculated by applying a standard daily capacity to each section of the rail network:

- 70 trains/day for single track lines
- 200 trains/day for double tracks lines

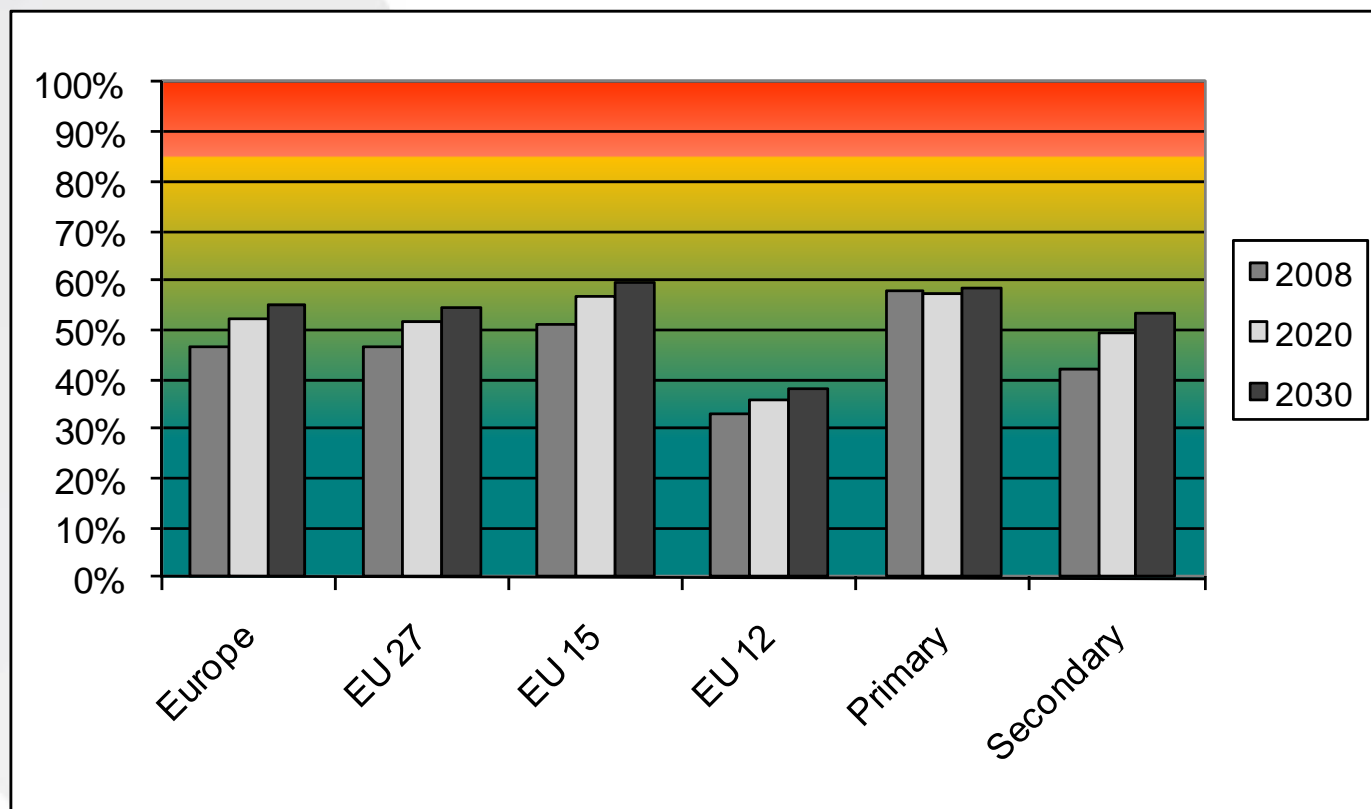
To calculate the capacity use, the theoretical capacity is compared with the traffic demand (= passenger train-km plus the number of freight train-km)

$$\text{Current capacity utilization} = \frac{\text{average number of yearly train-km}}{\text{theoretical capacity of the corresponding line sections}}$$

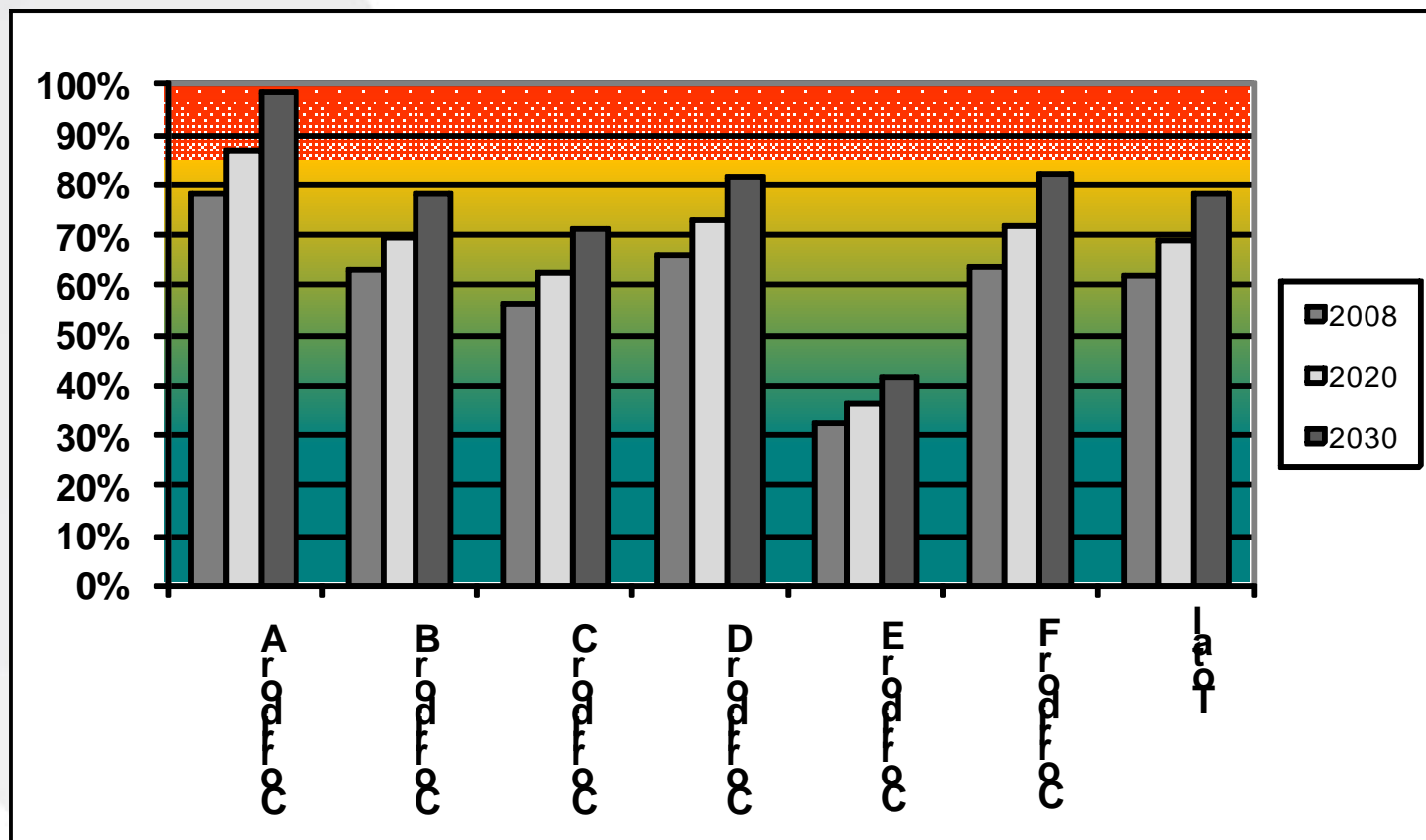
Evolution of average capacity use in the base scenario



Evolution of average capacity use in the upgraded scenario



Evolution of average capacity use on the six main corridors in the upgraded scenario



▶ Conclusion on capacity analysis

Useable capacity in EU-27 upgraded scenario (year 2020)

	Capacity use	Max capacity use ratio
Whole network	52%	
Primary Network	57%	80%
Secondary Network	49%	65%
Corridors (total)	69%	90%

- Current network can accommodate 30 to 40% growth
- Depends on the allocation of freight and passenger transport
- Planned investments and ERTMS on corridors can expand capacity

► Overview of cases

Freight:

- Transport of fresh produce (rail can serve this market very well)
- Modal shift in Switzerland (various policies: 2000-2008 +25% rail)
- Port-hinterland transport (e.g. mandatory modal split for containers: share of road: 60 -> 35%)
- Improved interoperability (capacity increase, e.g. by ERTMS)
- MAUT in Germany and in Austria (few percent shift)

Passenger:

- High-speed rail versus (low-cost) airlines
(up to 3-4 time higher market share for rail in 100-500 km segment)
- Transport to and from train stations (great impact on travel times)
- Rail business card (max. 7% reduction business trips road: 8% increase total rail volume)

▶ Highlights from the cases

- Main growth possible in freight markets with low share of rail:
 - Long distance container market
 - Non-port related long distance transport
 - Products such as chemicals and fresh produce
- Impacts of full internalisation of external cost (freight transport):
 - between 2% and 8% of the current road transport volume
 - corresponding to 10 to 32% growth of rail volume
 - Depends on assumptions and type of scenario
- Cases are hard to extrapolate to the entire market; more like a reality check

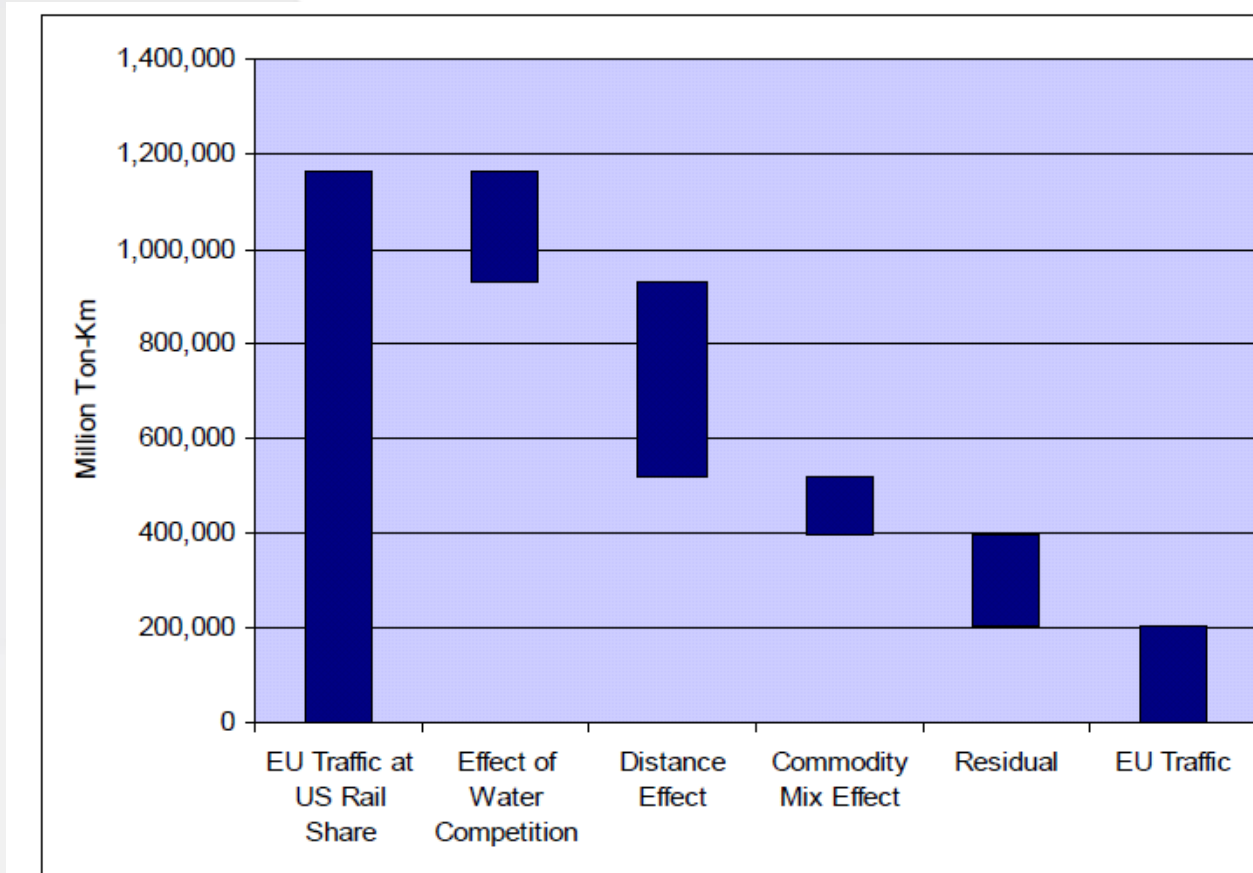
▶ Key drivers & constraints in modal shift to rail

Perspective	Key driver
<i>User</i>	Costs
	Time
	Quality
	Cargo
<i>Supplier</i>	Services and network
	Infrastructure
<i>Society</i>	Accessibility/mobility
	Environment
	Cost

▶ Literature on growth potential rail freight

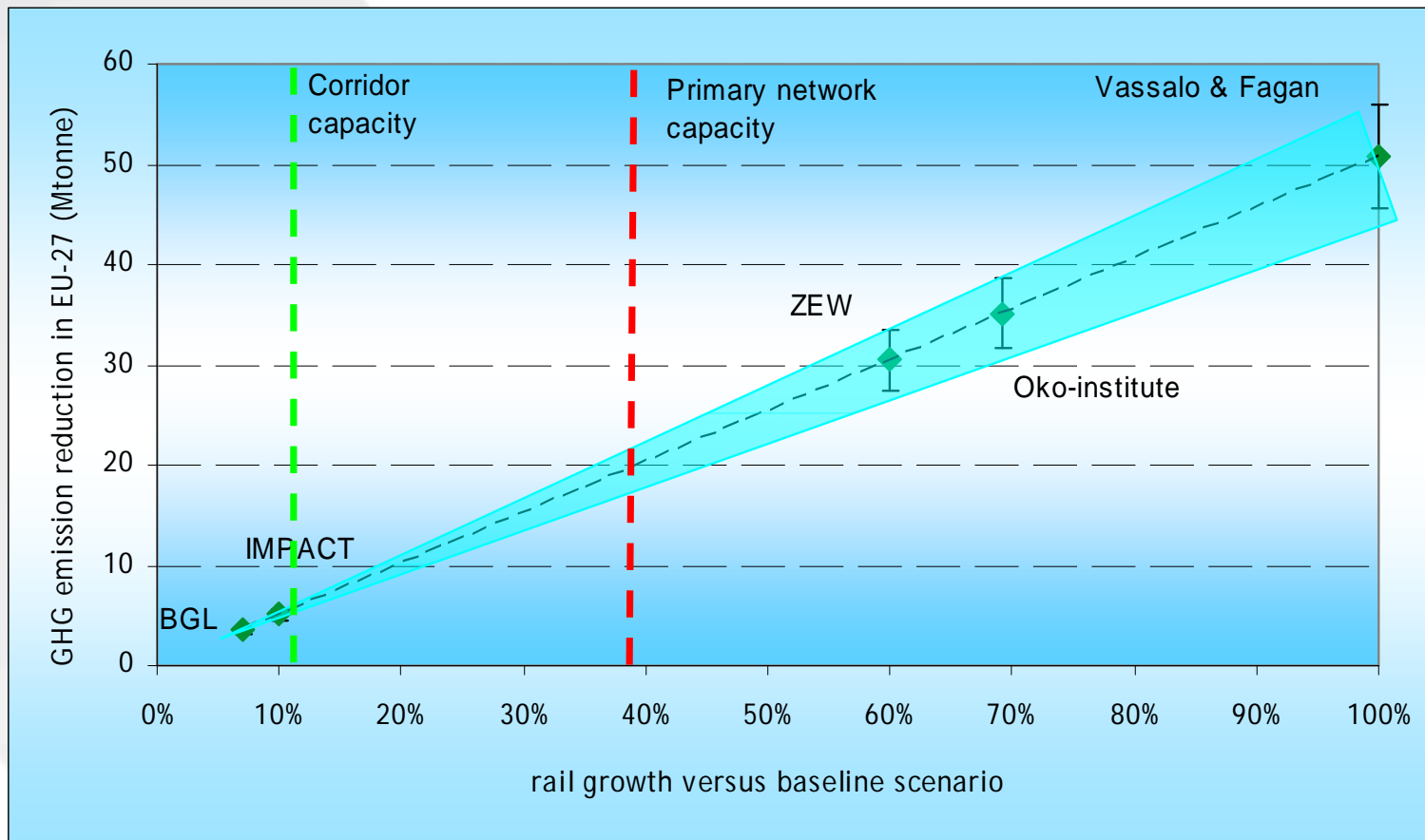
<i>Study</i>	<i>Measures studied</i>	<i>Scope</i>	<i>Rail growth</i>
Vasallo and Fagan (2005)	Full market opening, interoperability, international focus and productivity-enhancing infrastructure	EU	100%
EEA (2008)	a Theoretical potential b Potential from a practical perspective (BGL)	EU	a 90% b 7%
FERRMED (2008)	131-211 billion Euro investment in infrastructure & quality of supply	EU core (66% GDP)	8-15%
NEA (2004a)	TEN network construction	EU	12%
ZEW (2008)	a Road pricing based on MAUT b 24% higher speed	Germany	a 14% b 60%
PRC (2007)	Road pricing based on MAUT	Netherlands	3-4%
IMPACT (2008)	Full internalisation	EU	10%
Significance (2009)	Full internalisation	EU	10-32%
HOP! (2008)	Doubling / tripling of oil price	EU	6%

► Explanation of differences in traffic volumes between US and EU-15 (2000)



Source: Vassallo and Fagan, 2005

GHG reduction from shift road to rail in freight transport (EU-27 in 2020, without rebounds)



▶ GHG reduction from shift to rail in passenger transport (EU-27 in 2020, without rebounds)

Road to rail (based on Öko-Institute study: EEA, 2008)

- Theoretical potential assuming:
 - Upgrading of all rail infrastructure to level of highly populated areas
 - Travel time and costs are reduced to levels of private car transport
- More than a doubling of the modal share of rail: **70 Mton CO₂** reduction (9% of total passenger transport emissions)
- With current + TEN-T network, potential is **2-7 Mtonne CO₂** reduction

Aviation to rail (long distance):

- Assuming HST network growth from 1,800 to 20,000 km
- Market share rail in 100-500 km segment would increase from 5 to 15-20%
- CO₂ reduction of **14-18 Mton** of CO₂ (2% of total passenger emissions)

▶ 2050 perspective

- What-if scenario, based on vision by Siim Kallas, reflected in White Paper's targets:
 - 60% market share in long distance road-rail freight market (38% of total road-rail market)
 - 50% market share in long distance passenger market (27% of total motorised passenger transport)
- CO₂ reduction of **236 Mt** (21% of transport emissions), without rebound effects and changes in load factors
- Required increase in infrastructure capacity: roughly 65-82%
- Rough indication of infrastructure investment: 1,300 to 2,000 billion Euro
- Requires more than infrastructure:
 - highly competitive door-to-door travel times
 - price levels and funding
 - quality levels
- We did not investigate whether this is feasible with policy instruments

▶ Rebound effects

- Policies that can stimulate modal shift have also other GHG effects
- Demand increase and unintended shifts (rail-rail, water-rail, bike-rail)
- Direction and magnitude differs per policy: can be very significant
- Example - HST line:
 - 22-38% of volume is shift from aviation
 - 24-26% induced traffic
 - Other increase from shift from car and regular rail transport

▶ Main conclusions

- Significant potential for a shift to rail transport (up to doubling)
- Data basis for shift in passenger market not well developed
- Primary network capacity allows growth in 2020 compared to baseline (assuming 50-50 allocation):
 - 39% for freight
 - 14% for passenger
- GHG reduction potential with current + TEN-T networks:
 - Freight: 5-20 Mt (2-7% of road + rail freight emissions)
 - Passenger 2-7 Mt (<1% of road + rail passenger emissions)
- High modal shift perspective for 2050 (as in White Paper):
 - Max. 236 Mt, 21% of total (without rebound effects and load factors)
 - 1,300 - 2,000 billion Euro investments
 - Other policy and supply side factors, cost/benefits unclear

▶ Subjects for further study

- Translation to government policies and supply-side measures
- Costs and benefits of the various scenarios and policies
- The climate impact of (rail) infrastructure construction
- Rebound effects and potential impacts on load factors
- Infrastructure financing and efficient allocation of funds

▶ SULTAN reference scenario

