C4R

Capacity for Rail

SP2 Requirements toward the freight system of 2030-2050

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SEVENTH FRAMEWORK PROGRAMME

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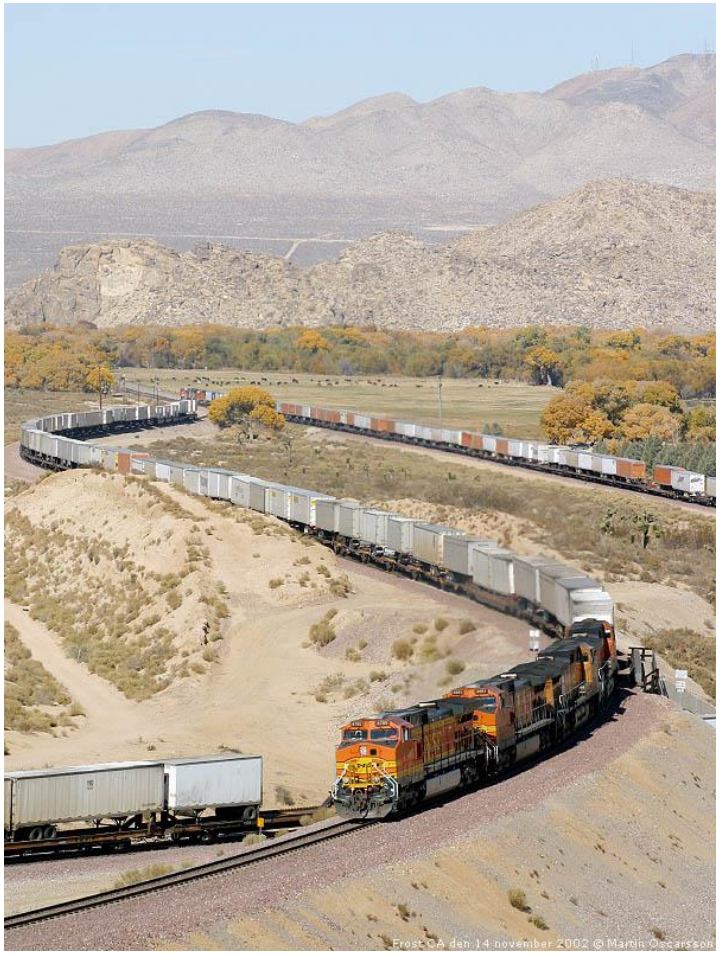

Demand for rail freight 2030/2050

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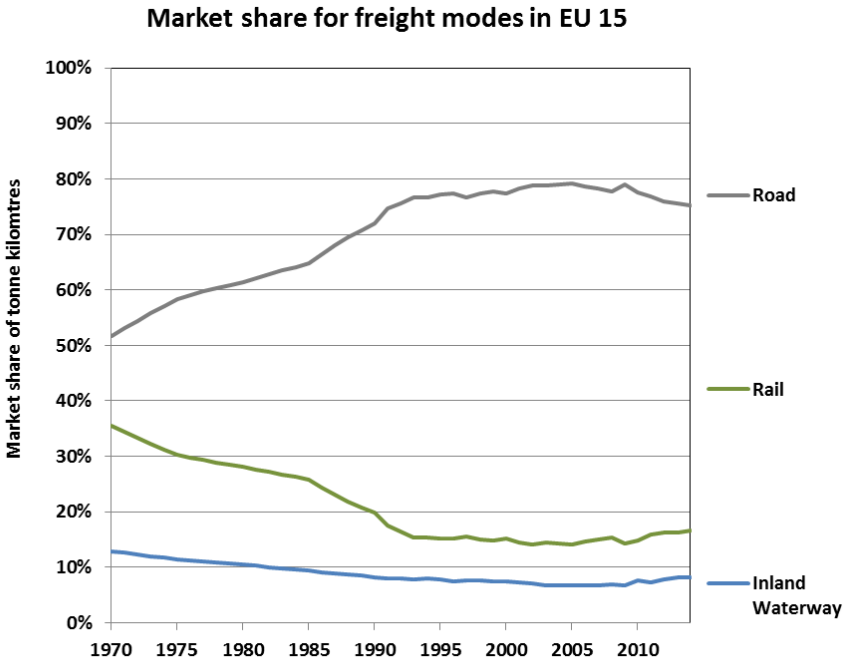
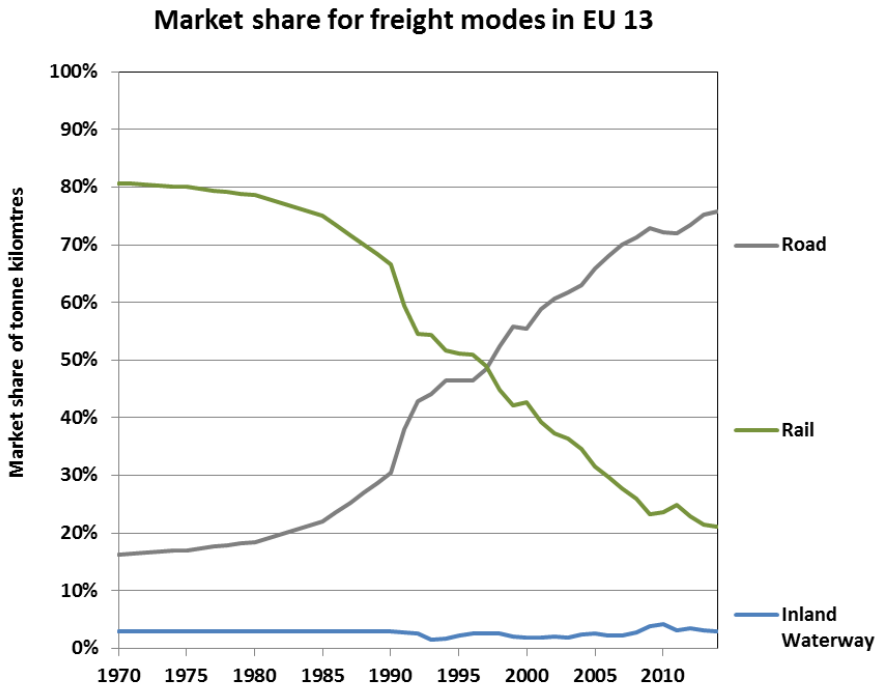
Rail market share development

West



East



Demand for rail freight 2030/2050

The EU target - what does it mean?
For freight transportation by rail and truck in EU

2010 2,300 billion tonne-km

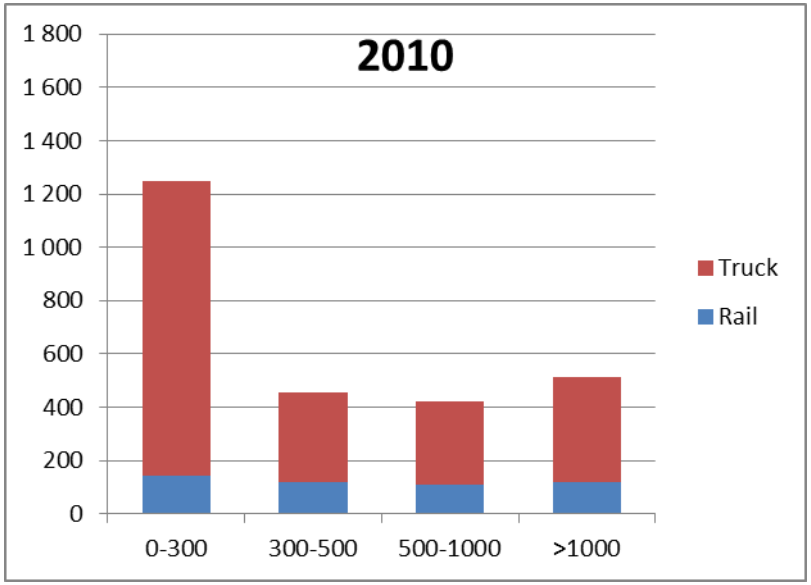
53% of transports in EU is >300 km

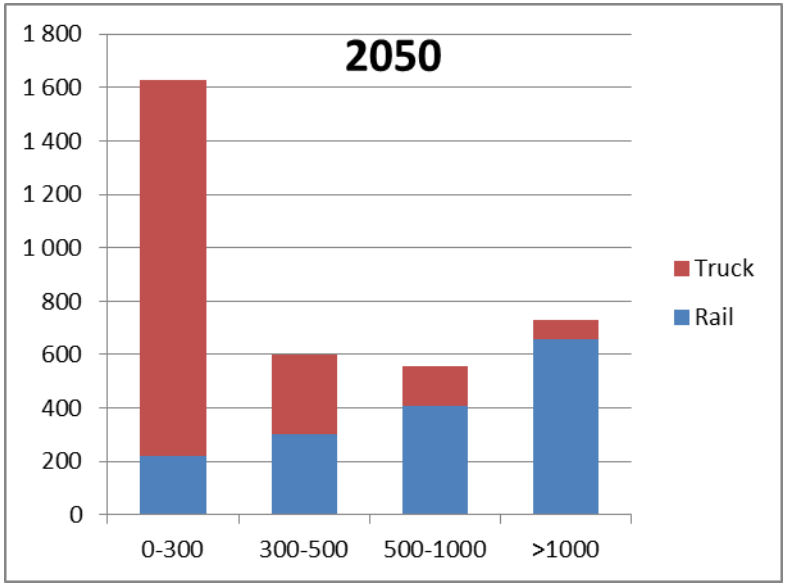
Market share for rail is 25% on distances >300 km

2050 total 3,500 billion tonne-km

Increase of approx. 50%

Market share for rail increases from 25% to 60% on distances >300km





Source: Processing of data from Transtools in TOSCA and at KTH

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Customer requirements:

Environment

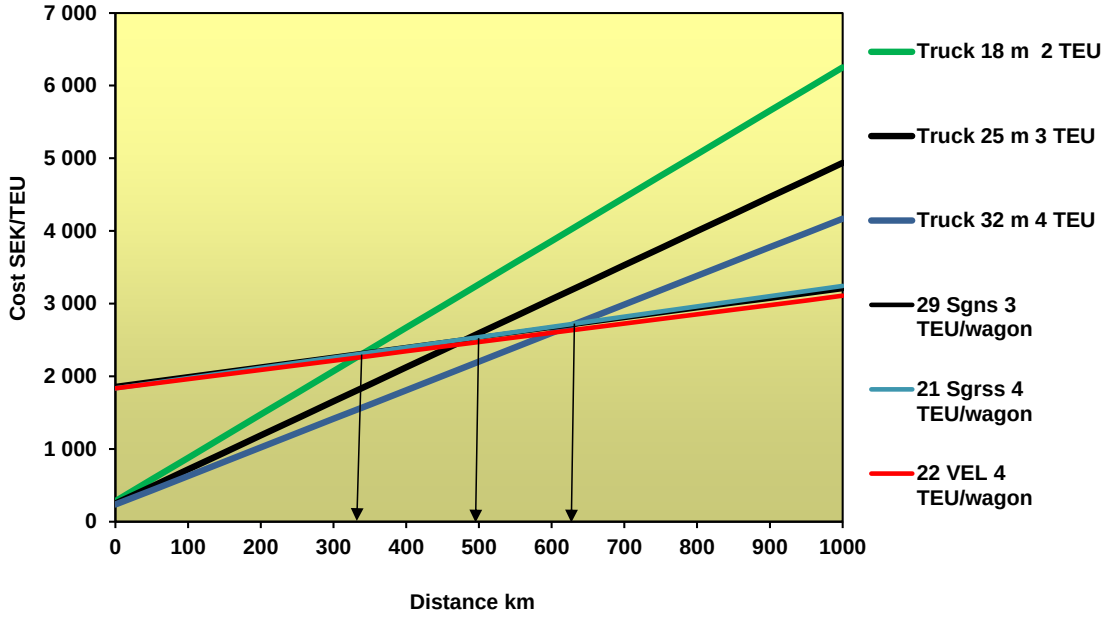
- **Quality**
- **Cost**

Future customer requirements

Longer and heavier trucks

- In some countries:
  18m -> 24 m
- In Sweden: 60 ->74ton
  25m->34m

Cost for inter modal - direct trucking



To compete rail must be even more effective:

- Longer and heavier trains and wagons
- More competitive inter modal

Technical development

Wagons: Short term: Incremental development Long term: System change

Incremental development:

- Higher axle load 22,5 →25 ton
- Higher speed 100 →120 km/h
- Higher gauge
- End of train device (EOT)
- LL-brakes
- Lighter wagons

System change:

- Higher axle load 22,5 →25-30 ton
- Higher speed 100 →120-160 km/h
- Higher and wider gauge
- Electro pneumatic (EP) brakes
- Disc brakes
- Automatic couplers

Capacity - traction

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Use existing locos better

Locos with higher axle load

Locos with 6 axles

Use Duo-locos

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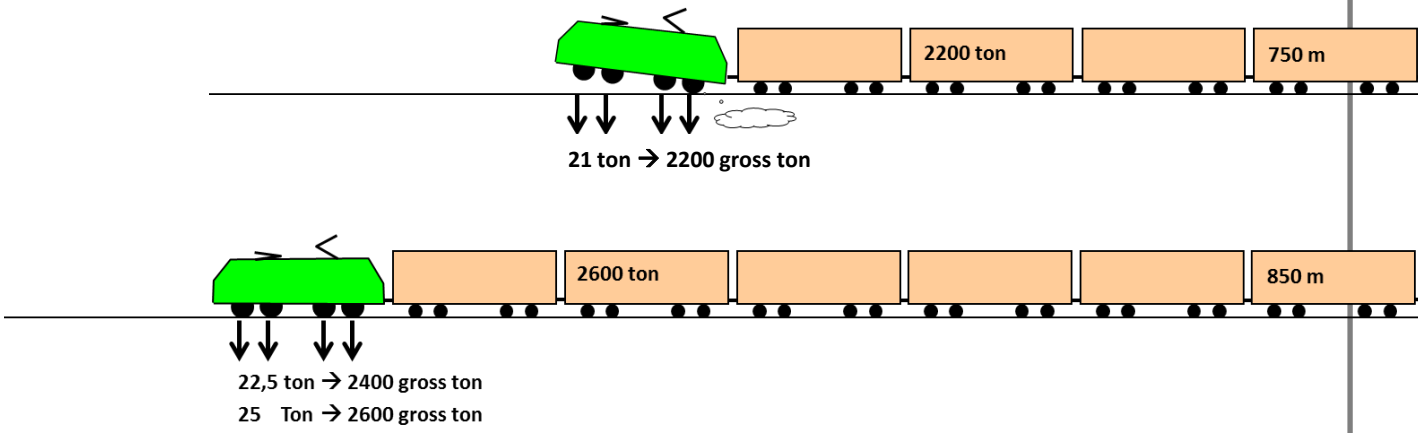
Capacity - traction



Locomotives: Do we need higher effort or adhesive weight?

- Modern electric locos are developed for passenger service that means 5-6 MW, 200 km/h and 21 tons axle load
- For freight higher axle load is essential to handle heavier trains – normal 22,5 ton or same as the wagons
- 6-axle locomotives is also an option for higher adhesive weight

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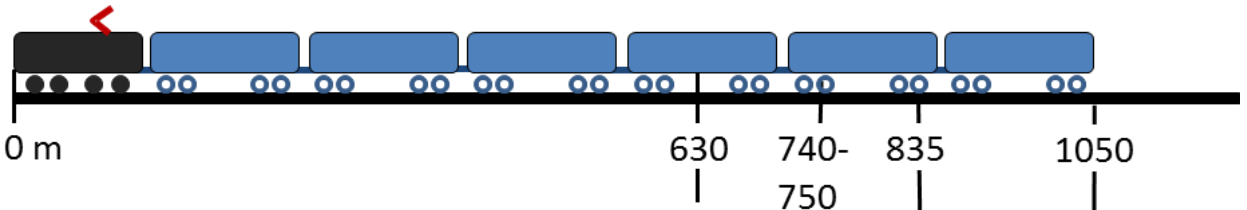
Long freight train in EU

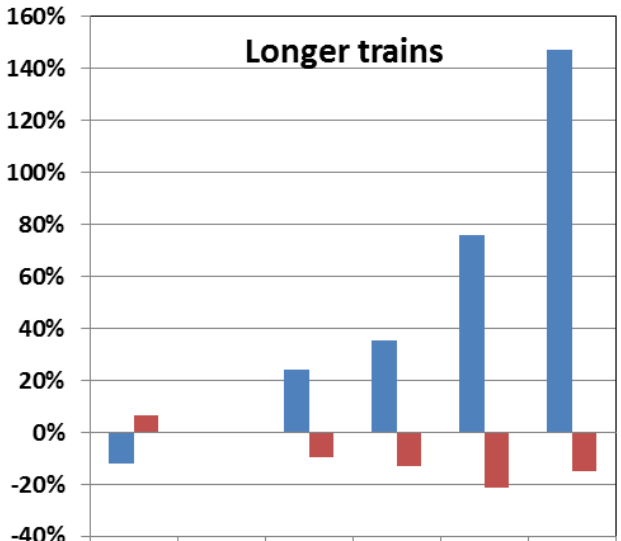
- Get as much as possible out of one engine=1050m



630 older standard in Scandinavia
740 TSI min and TEN-T, 750 in many countries
835 Hamburg-Copenhagen today 850 in France
1050 TSI max Öresund/Fehmarn Belt and France 2018

- An intermodal train weights approx 2 tons/meter
- A modern 4-axle electric loco can haul 2 200 gross tons
- 1000 m wagon rake = 1000x2= 2 000 tons + marginal = 2 200 tons
- 1000 m wagon rake + loco+ marginal = 1050 m
- Optimal length in Europe = 1050 m
- 2 x 750 m = 1500 is an alternative

Capacity and cost

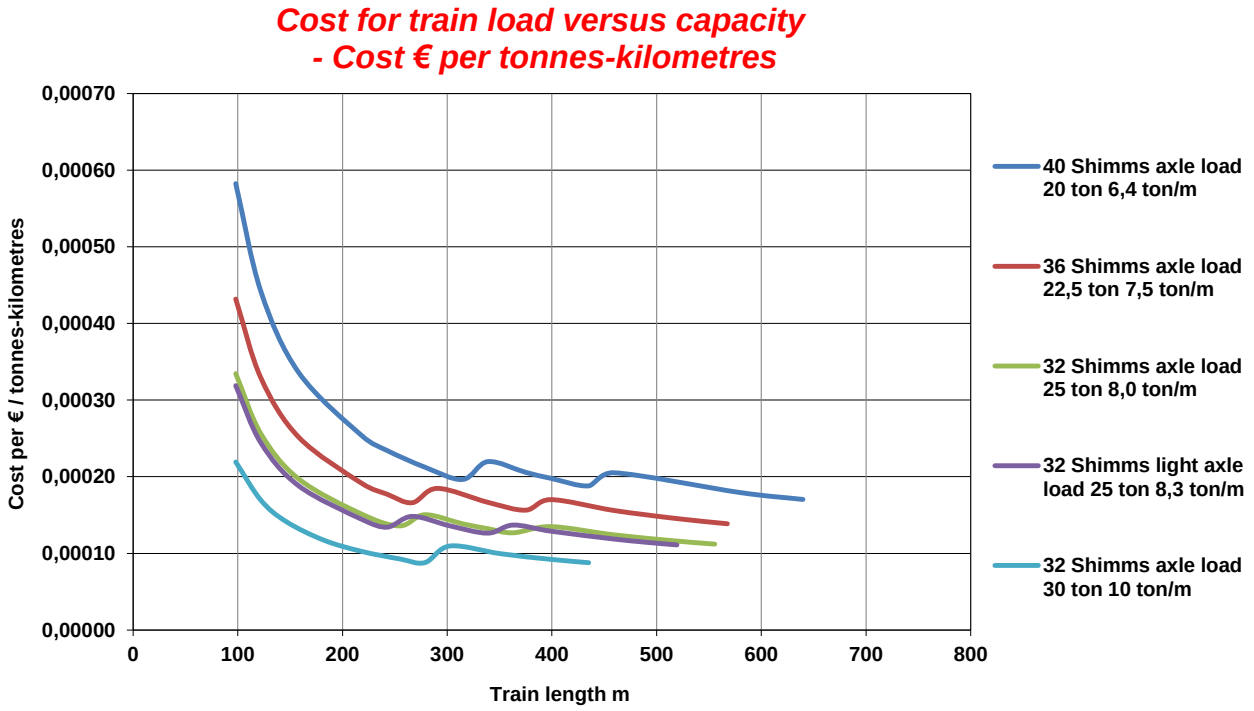


Train length m	550	630	750	835	1050 1 loco	1500 2 loco
Capacity tonnes/train	-12%	0%	24%	35%	76%	147%
Cost €/tonneskm	7%	0%	-9%	-13%	-21%	-15%

Longer trains

- Longer trains are often possible with limited investments in infrastructure
- Longer trains means higher capacity and lower transport cost
- 630 → 1050 m capacity +76% cost – 21% per tonneskm
- With one loco more economic operation
- There is a need of unified braking rules in Europe

Capacity and cost

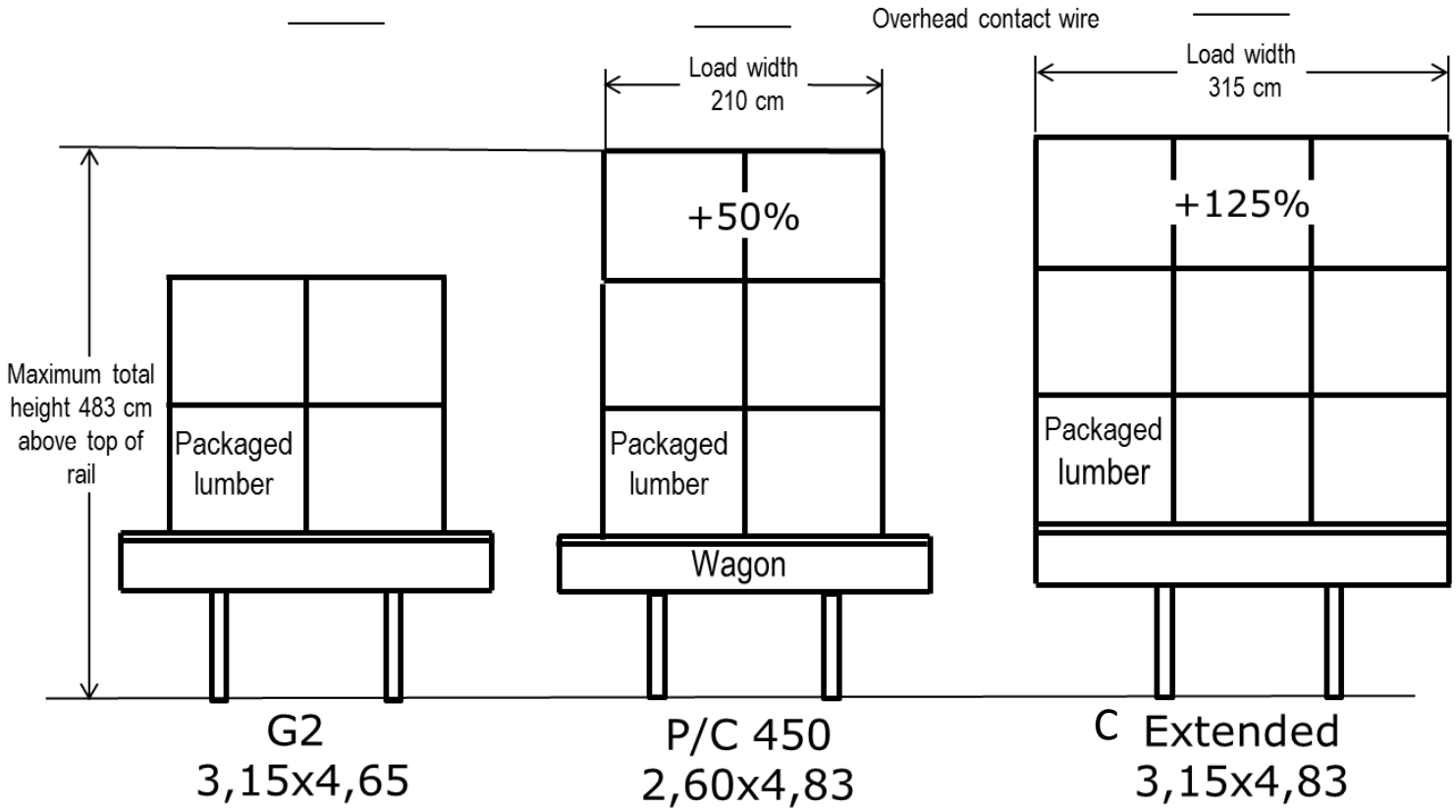


Higher axle load

- Same gross weight approx. 3,200 tonnes train load
- Axle load 20 – 22,5 – 25 – 30 tonnes
- Axle load 25 tonnes with light weight wagon: less tare → more payload
- Higher axle load → fewer wagons for same payload → shorter train

Loading gauge

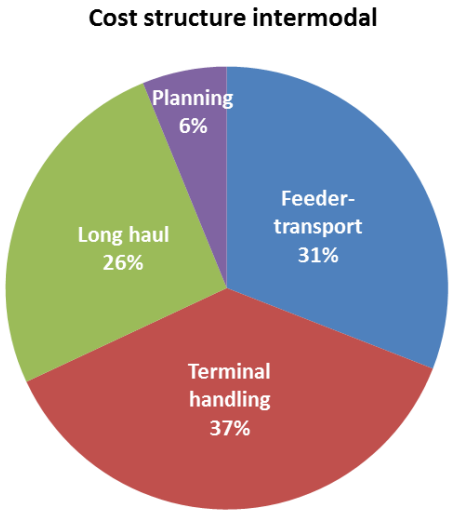
Use of higher and wider loading gauge



Today´s terminals

Inter Modal – terminal handling is crucial

- Terminal costs have a high share of the total transport cost
- Terminals must be built for reach-stackers with big areas with high axle load
- The terminal cannot be electrified – diesel engines are needed to shunt the train
- Tracks has to be built to park the wagons
- Endpoint traffic on long distances – no network



Paradigm shift in intermodal

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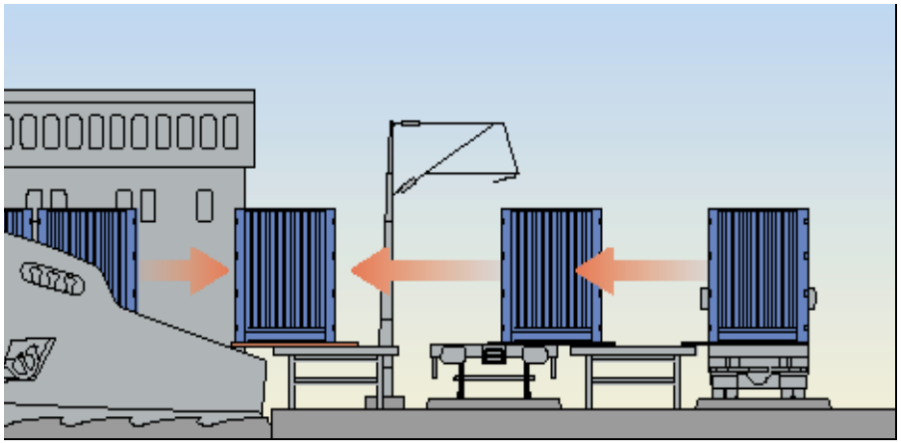
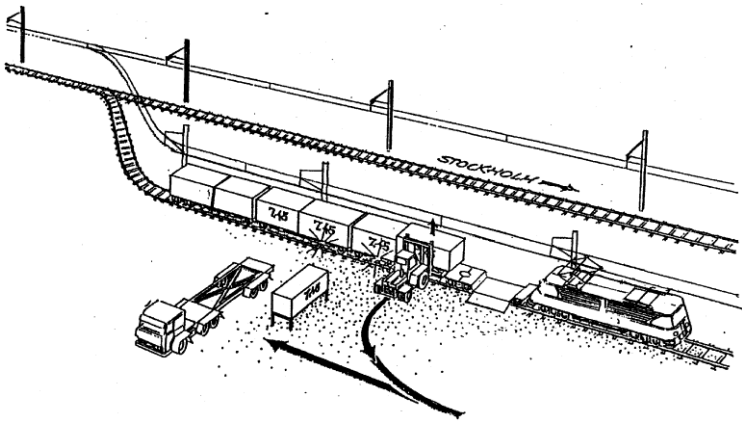
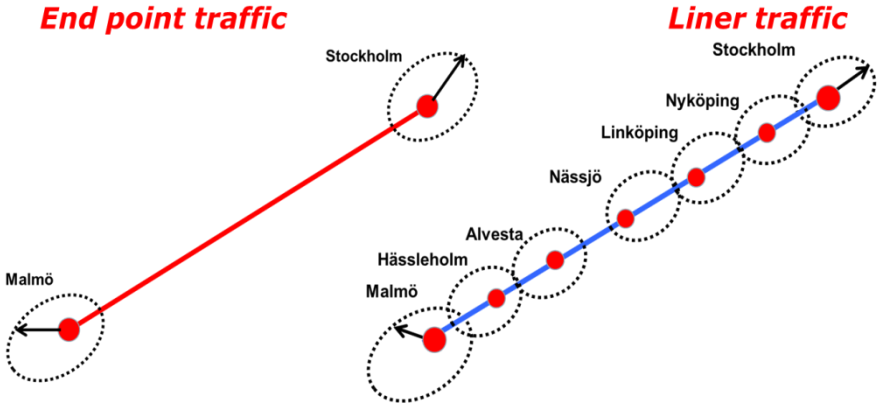
Horizontal transfer under catenary



Liner traffic stops at sidings



Intermediate terminals



Shorter feeder transports

Roll-on roll off for trailers

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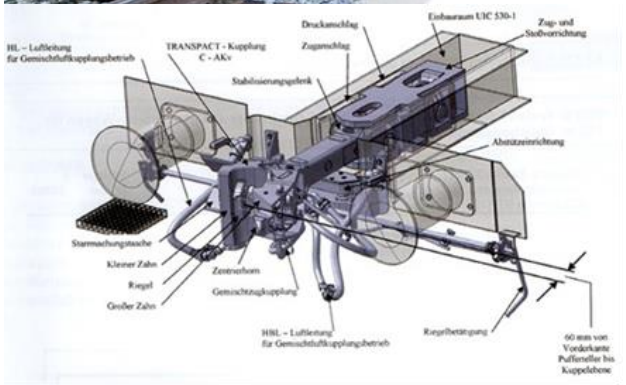
Inter Modal – roll on roll off of trailers

- Most trailers are not equipped to be lifted
- If the trailers could be rolled off and on all trailers could be handled
- Then the terminals has to be dimensioned only for the trailers axle load
- The terminal can be very compact and cheap
- This means lower logistic costs for customers and society

Traffic and operational development

Possibilities to develop Wagon Load

- Handle group of wagons instead of single wagons
- Production in cooperation with trainload
- Booked network and capacity management
- Higher axle load, meter load and wider gauge
- Concentration of marshalling yards and liner feeder trains
- Automatize of marshalling
- Automatic couplers

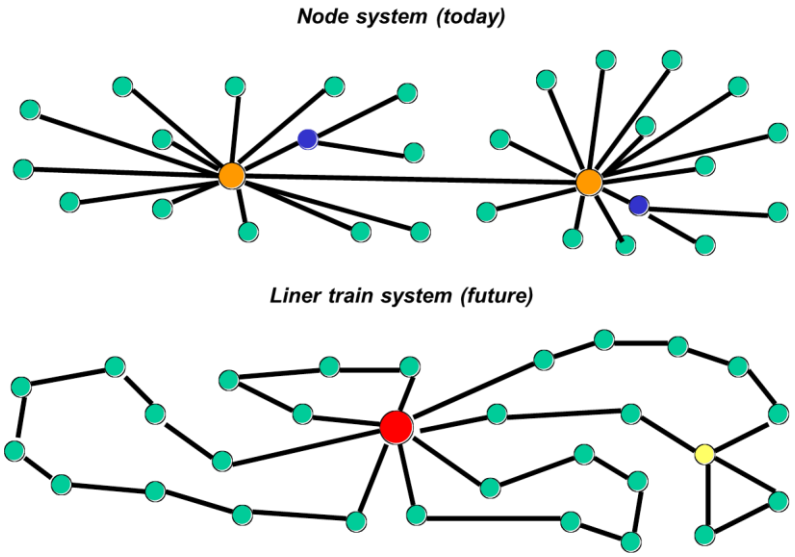


Traffic and operational development

Capacity for Rail

Linear operation and Duo-locos

- Linear trains can be more effective than hub and spoke systems
- Sometimes the long distance train also can distribute wagons
- With duo-locos it also possible to shunt wagons at un-electrified tracks
- One duo-loco can replace one electric loco and one diesel loco
- In long term it will also be possible to not electrify yards and sidings

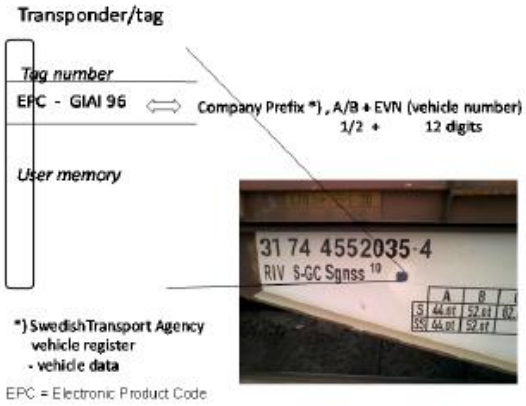


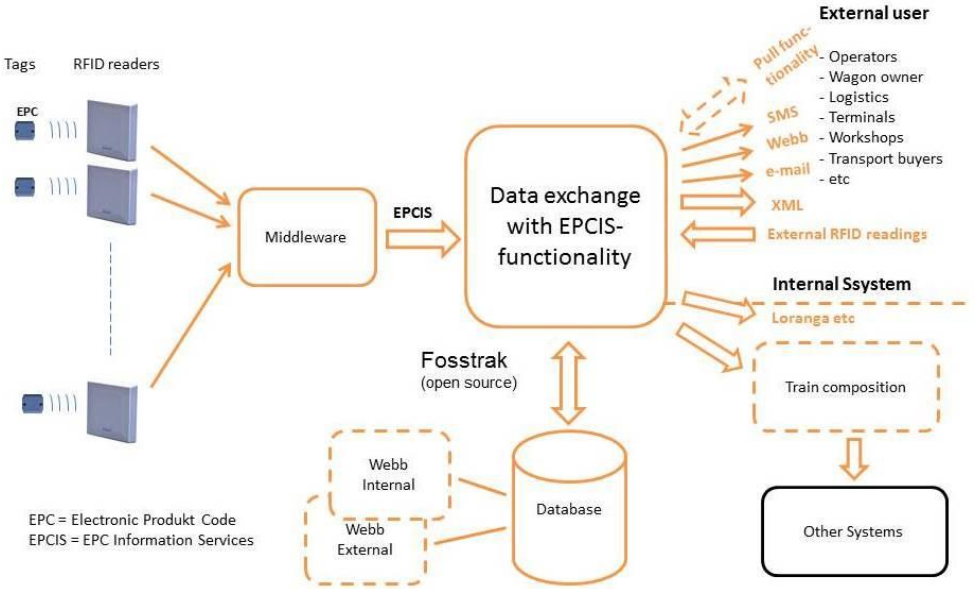
Traffic and operational development

Capacity for Rail

Tracking, tracing and monitoring

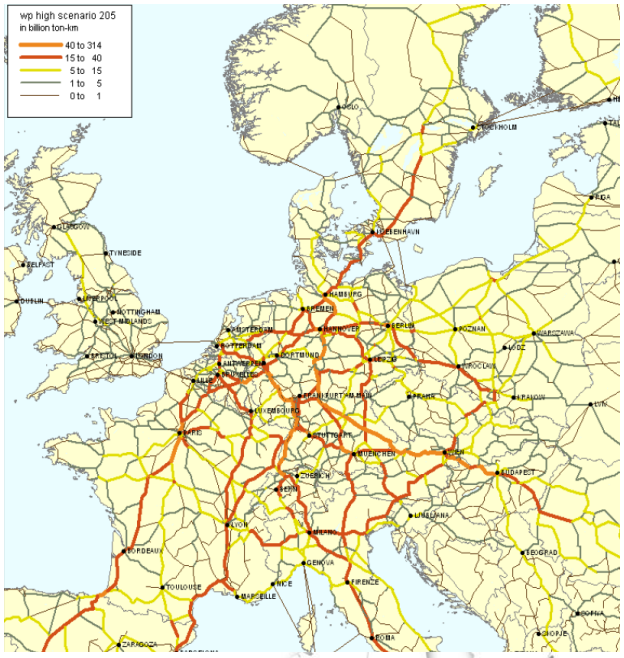
- Location through satellites or cellular mobile communication
- RFID and internet in combination for information from trains in real time
- On board or way side monitoring for freight
- Monitoring can also be used for infrastructure health control
- Intelligent rail is technically possible but not at all fully used in the rail system

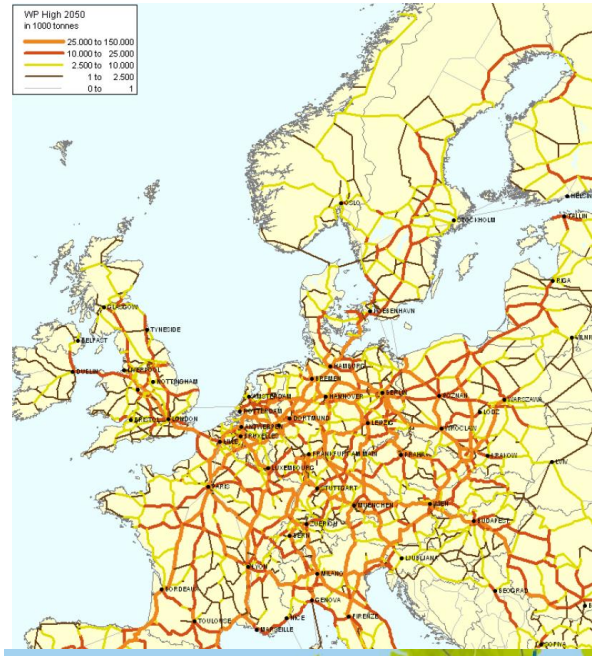




Demand and rail network 2030/2050

White paper forecast 2050
In tonne-km
Source: D-rail





White paper forecast 2050
In tonne
Source: D-rail

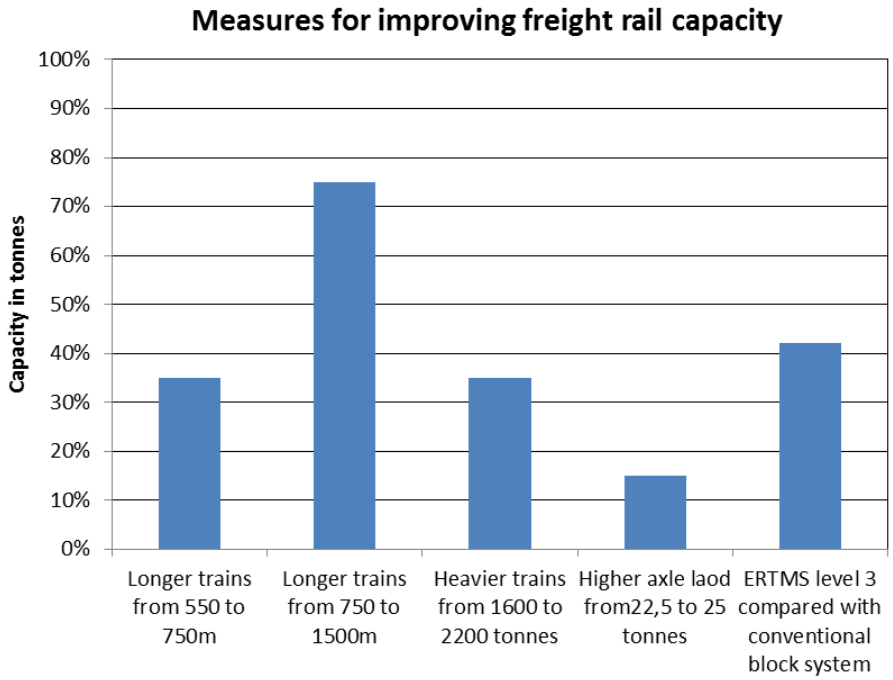
Rail Freight Corridors 2015
Established 2013-2015

High Speed Network 2025
Existing and planned
Source: UIC

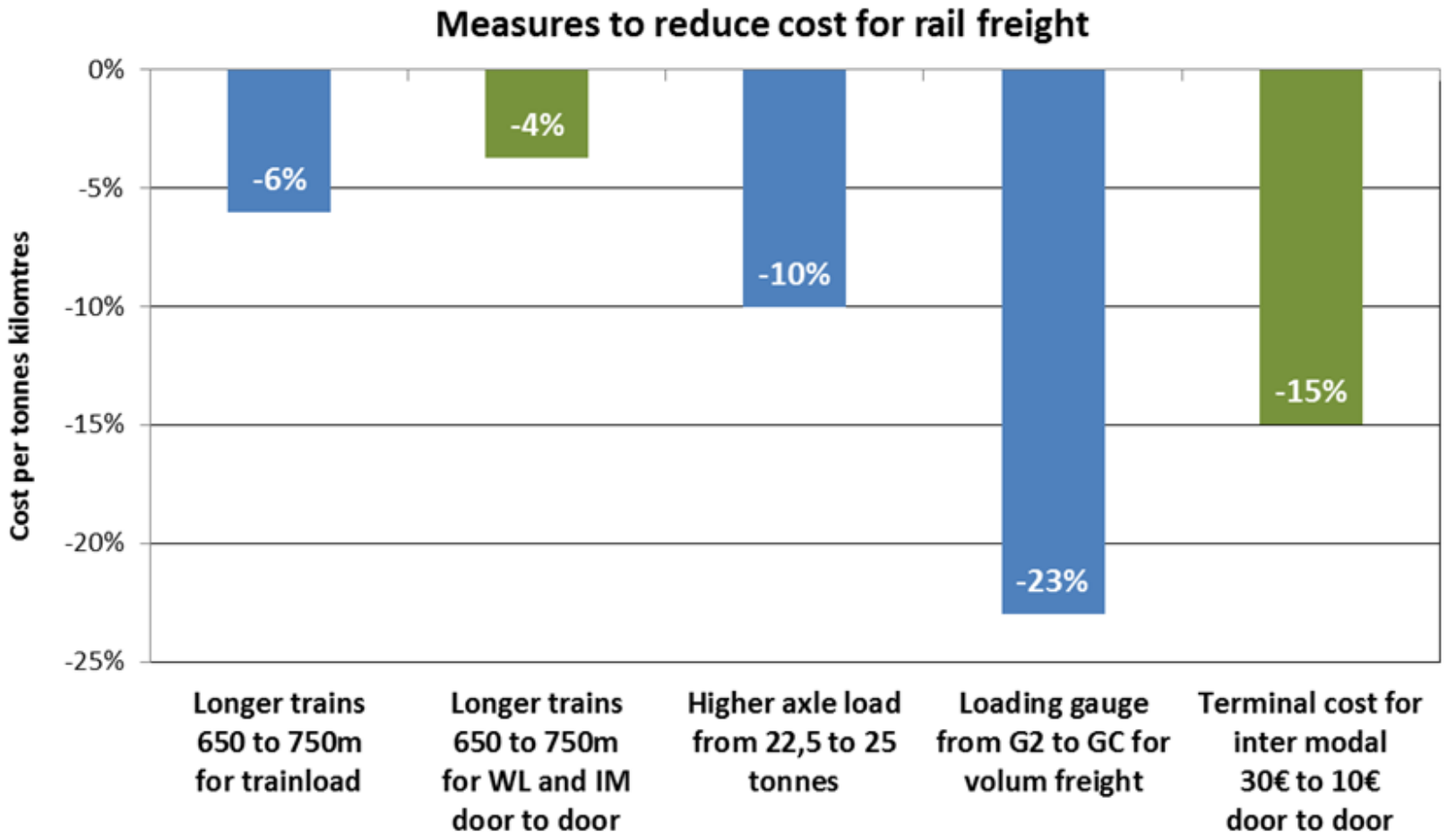
Capacity for rail freight 2030/2050

Capacity can be improved in many ways

- Longer and heavier trains
- Higher axle load and higher speed
- Better signaling system
- HSR will free capacity for freight and regional trains on conventional lines
- Dedicated freight lines is an option when RFC is fully utilized



Costs for rail freight 2030/2050



Efficient freight rail freight 2030/2050

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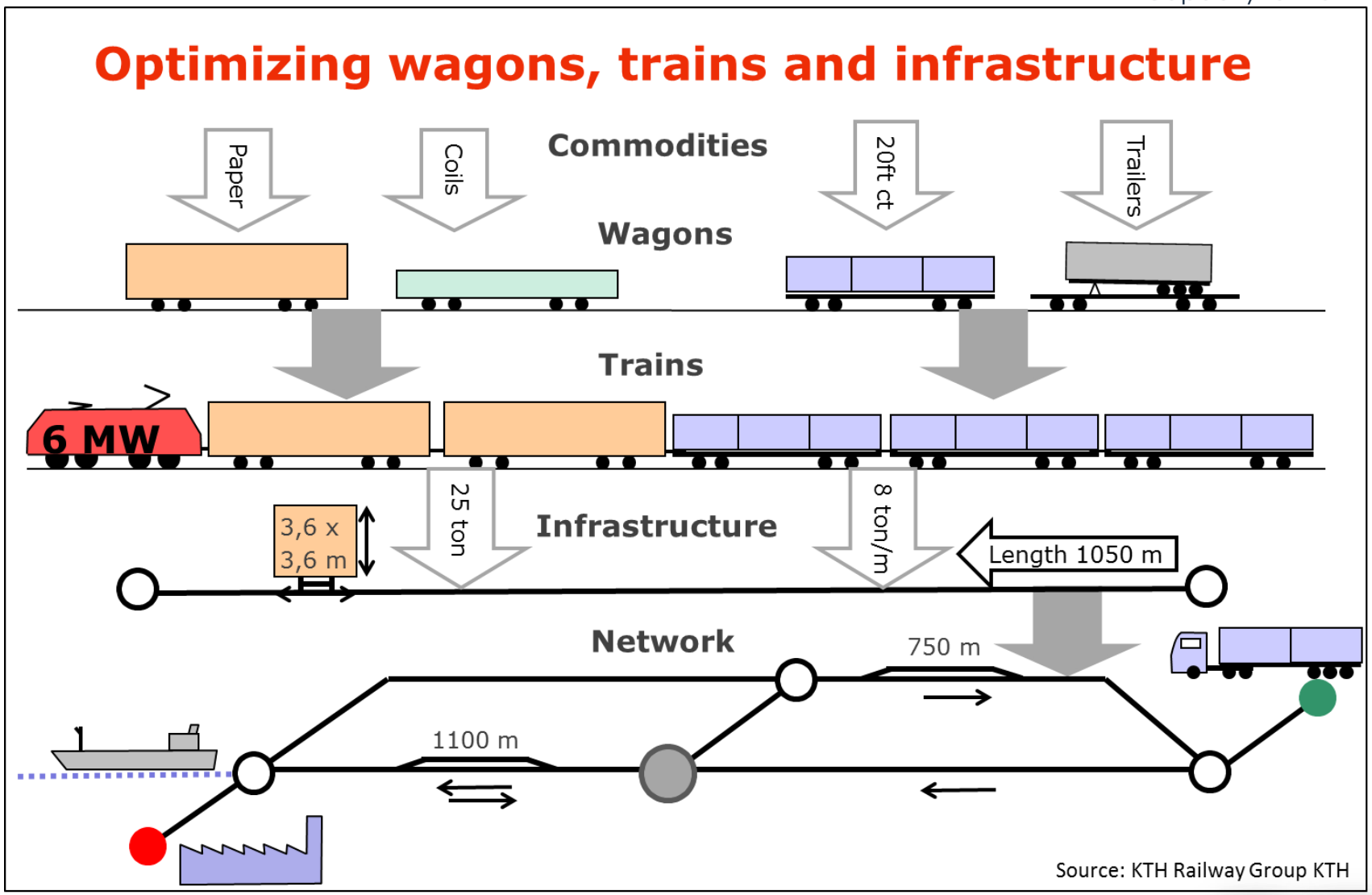

Executive summary

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Conclusions to establish a competitive rail system 2030/2050

- **Today´s trend for freight are not in line with EU target – there is a strong need for further technical development as well as market orientation of rail freight**
- **The wagons: Incremental development in short term: Better length utilization and EOT. System change in long term: Automatic couplers and EP-brakes**
- **Wagons, trains and infrastructure: Wider gauge, higher axle load and higher speed. Longer trains with one loco 750-1000 m with two locos 2x750=1500m**
- **Locomotives: Higher axle load with track-friendly bogies is a possibility to handle heavier and longer trains**
- **ERTMS L2 must be completed with shorter block lengths to gain capacity – important to develop and implement ERTMS L3 with low cost for freight**
- **The future network for HSR may free capacity for freight if slots will be reserved on the conventional network – important with high performance on RFC**
- **Rail can make a real contribution to mobility and to avoid the climate change if EU target will be implemented and rails potential fully utilized**

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Thank you for your kind attention

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Appendix

Equipment	**Common standard 2010**	**Incremental change* 2030**	**System change***
Wagons			
Running gear	Different	50% Track-friendly	All track-friendly
Brakes	Cast brakes	LL brakes	Disc brakes
Brake control	Pneumatic	Radio controlled EOT	Fully electronic
Couplers	Screw couplers	Automatic couplers on some trains	Automatic couplers on all trains
Max Speed	100 km/h	120 km/h	120-160 km/h
Max Axle load	22.5 tonnes	25 tonnes	30 tonnes
Floor height lowest	1,200 mm	1,000 mm	800 mm
IT-system	Way-side	Some in wagons	All radio controlled
Locomotives			
Tractive effort kN	300	350	400
Axle load	20 tonne	22,5 tonne	25 tonne
Propulsion	Electric	Some duo-locos	All duo-locos
Fuel	Diesel	LNG/Diesel	LNG/electric
Drivers	Always drivers	Some driverless	All driverless
Trains			
Train lengths in RFC	550-850 m	740-1050 m	1050-2100 m
Train weight	2,200 tonnes	4,400 tonnes	10,000 tonnes

*) Adapted to market needs in each product and line

Appendix

Equipment	**Common standard 2010**	**Incremental change* 2030**	**System change* 2050**
Infrastructure			
Rail Freight Corridors	18,000km	25,000km	50,000km
Signalling systems	Different	ERTMS L2 in RFC	ERTMS L3 in RFC
Standard rail weight	UIC 60 kg/m	70 kg/m	70 kg/m
Speed. ordinary freight	100 km/h	100-120 km/h	120 km/h
Speed, fast freight	100 km/h	120-160 km/h	120-160 km/h
Traffic system			
Wagonload	Marshalling - feeder	Marshalling – feeder Some liner trains	Automatic marshalling Liner trains – duo-loco
Trainload		Remote controlled	All remote controlled
Intermodal	Endpoint-trains	Endpoint-trains Liner trains with stops at siding	Endpoint-trains Liner trains fully automated loading
High Speed Freight	National post trains	International post and parcel trains	International post and parcel train network
IT /monitoring systems			
	Some different	Standardized	Full control of all trains and consignments

*) Adapted to market needs in each product and line