



Fran-Scan Hi-Cube Intermodal Corridor (G2, P/C 450)



ROYAL INSTITUTE
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Railway Group

Purpose

- To identify opportunities, challenges and logistic effects of operating higher railway loading gauges in Europe





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Presentation Outline

PART 1: INTERMODAL COORDINATION

PART 2: WAGONLOAD COORDINATION

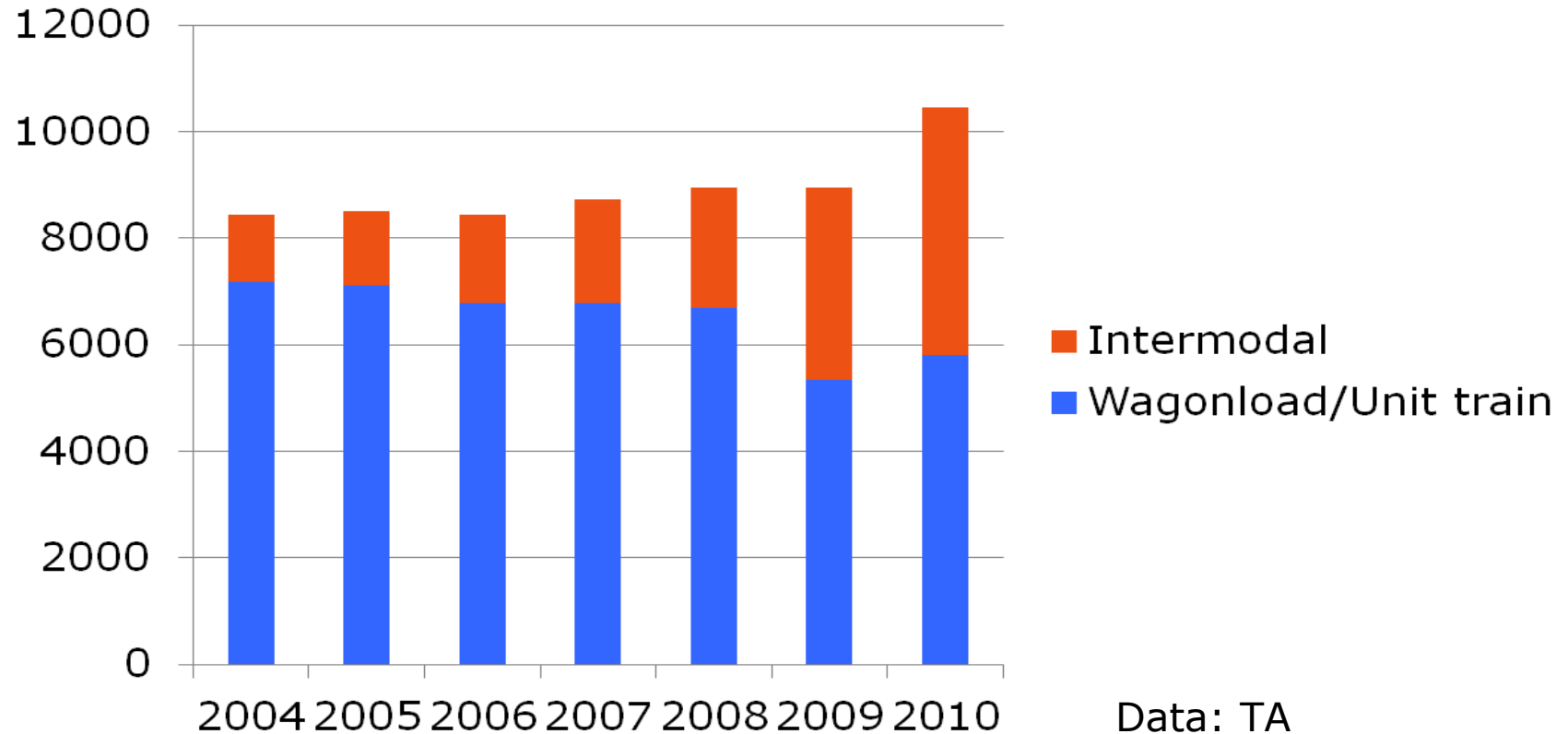
PART 3: WAGONLOAD DEVELOPMENT

PART 4: SUMMARY



Intermodal Transportation Growth

Swedish cross-border rail freight tonnage excluding iron ore (1000 tons)



∴ Cross-border intermodal transportation is growing rapidly.





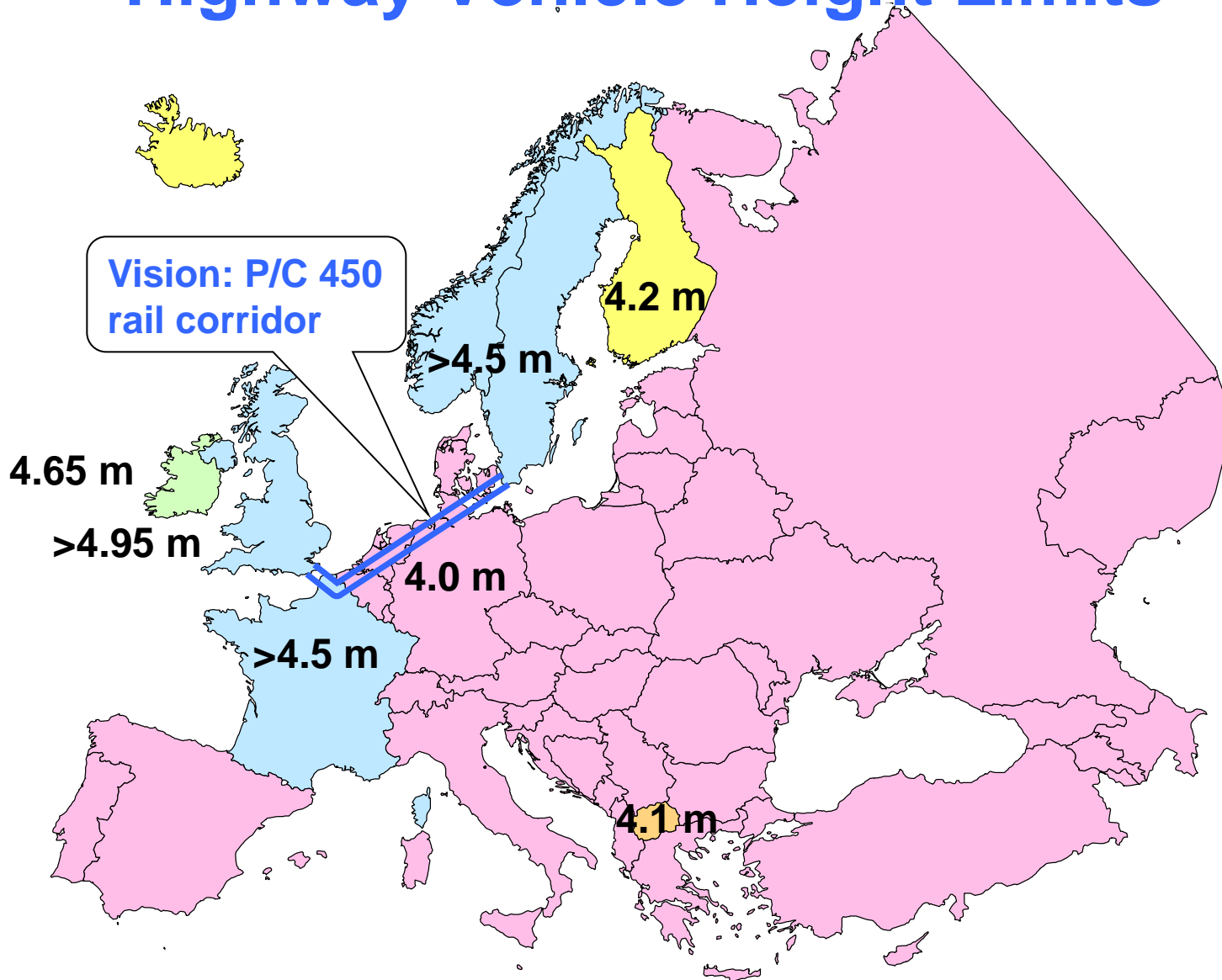
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Standard and Hi-Cube Intermodal Loads

Victoria Skeidsvoll



Highway Vehicle Height Limits



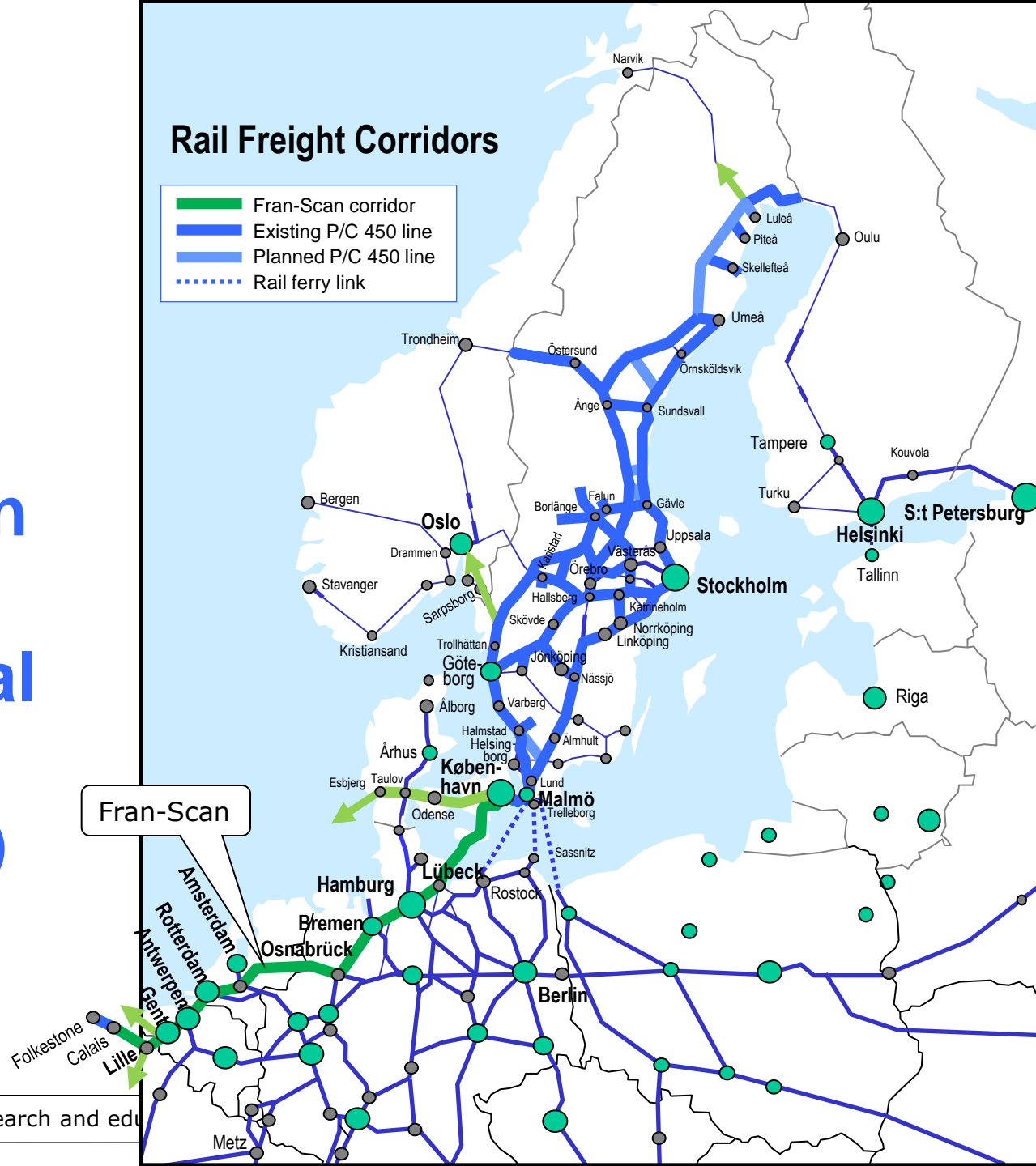


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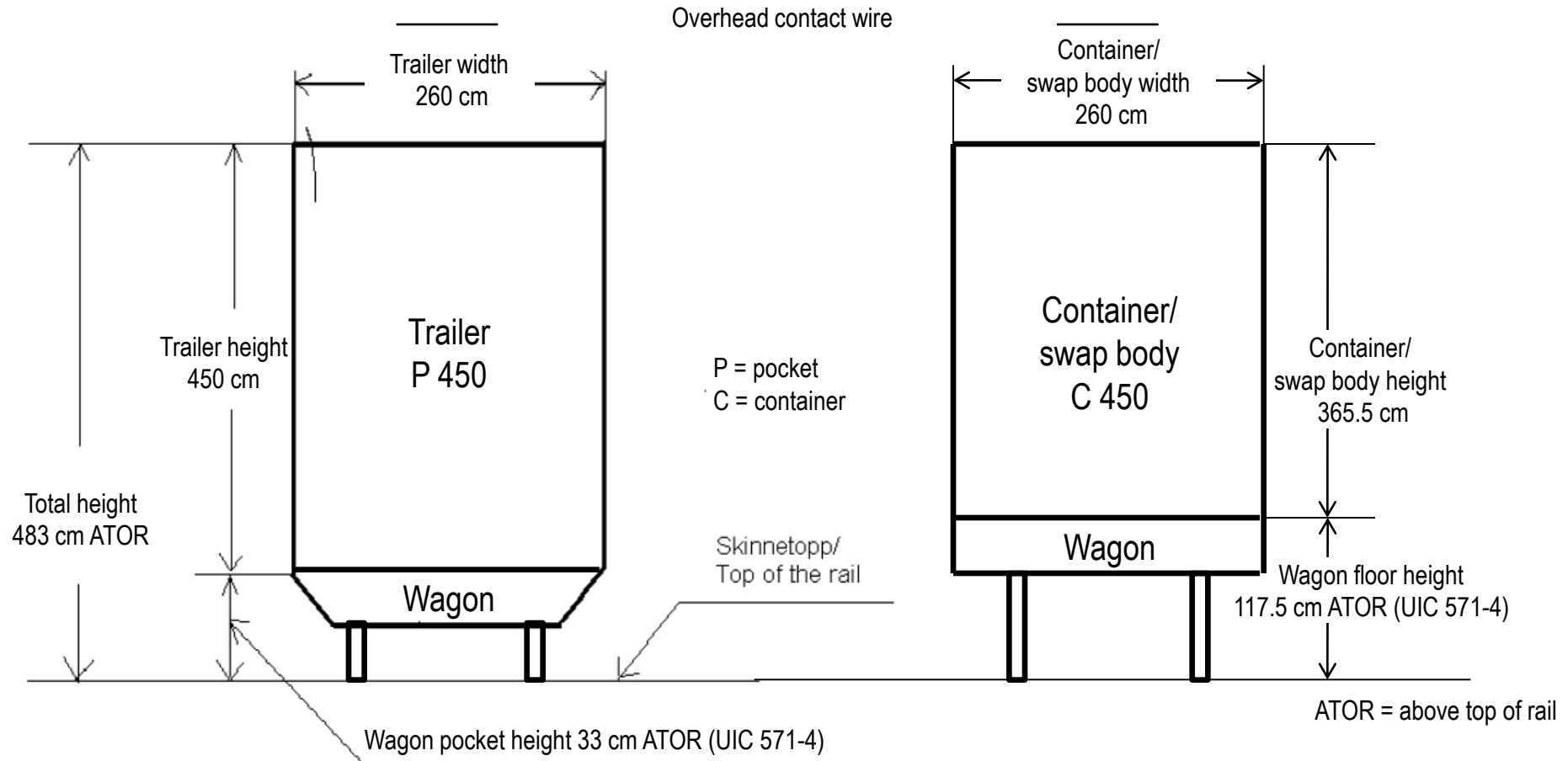
Fran-Scan Hi-Cube Intermodal Corridor (P/C 450)

Rail Freight Corridors

- █ Fran-Scan corridor
- █ Existing P/C 450 line
- █ Planned P/C 450 line
- ⋯ Rail ferry link



Intermodal Gauge P/C 450





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Sample Intermodal Pocket Wagons

Green Cargo

Ruud



270 mm pocket height, Sdggmrs



270 mm pocket height, Sdggmrss



Sample Intermodal Flat Wagons

Gareth Bayer

Anders Jansson



820 mm floor height, Sffggmrrss (FKA)

1155 mm frame height, Sgnss





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Intermodal Load Heights in P/C 450

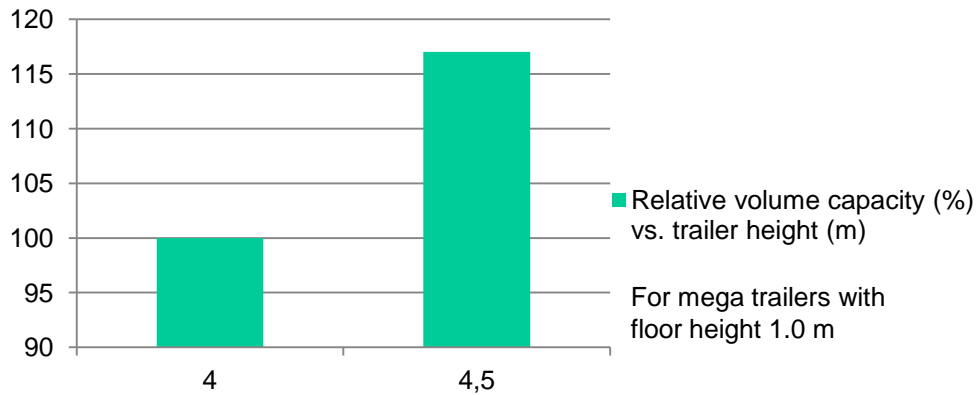
Wagon floor height ATOR	Wagon type, examples	Max. container/swap body height within P/C 450
1.175 m	UIC 571-4	3.655 m
1.170 m	Sdgms	3.660 m
1.155 m	Sdggmrss, Sdgmns, Sgnss	3.675 m
1.150 m	Sdggmrss-t	3.680 m
0.825 m	Sffggmrrss	4.005 m
0.820 m	Sffggmrrss (FKA)	4.010 m
Wagon pocket height ATOR	Wagon type, examples	Max. semitrailer height within P/C 450
0.330 m	UIC 571-4	4.500 m
0.310 m	Sdgms	4.520 m
0.270 m	Sdggmrs, Sdggmrss, Sdgmns	4.560 m

ATOR = above top of rail

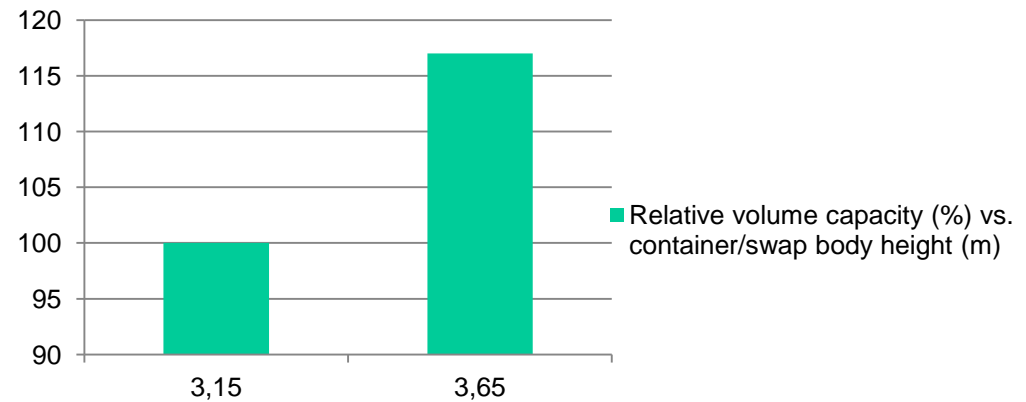


Volume Capacity Increase

Relative volume capacity (%) vs. trailer height (m)



Relative volume capacity (%) vs. container/swap body height (m)



∴ +17 % larger unit volume capacity with intermodal gauge P/C 450 than with P/C 400.



Railway Intermodal Gauges

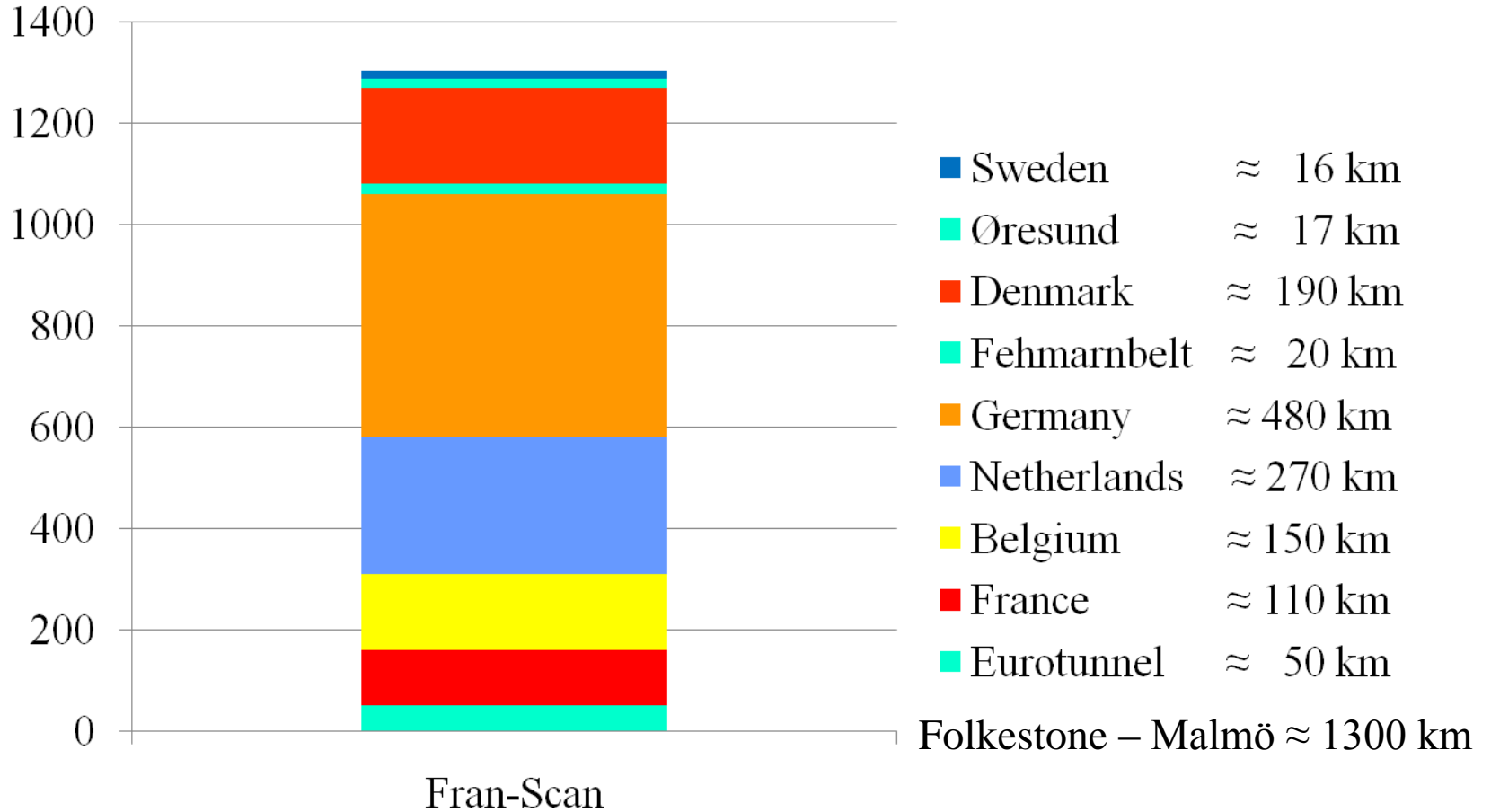
Interunit 2011
(modified)

Fran-Scan

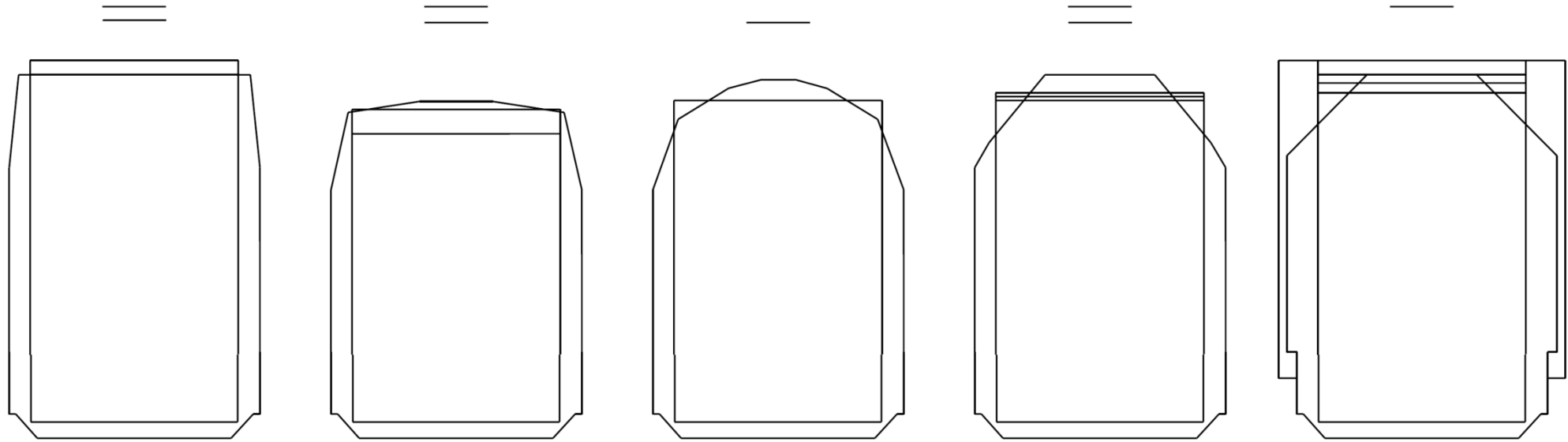
- P450
- P432
- P422
- P410
- P400
- P380
- P359
- No code



Approximate Distances



Present Corridor Loading Gauges



Eurotunnel

Øresund

GC

P/C 450

Betuwe

GC

P/C 432

France

GB1

P/C 385

P/C 359

Development: Øresund planning for SE-C,
Denmark for a tall gauge,
Femern for SE-C and P/C 450.

Belgium

GB-M6

P/C 400

Denmark

Germany

Netherlands

G2

P/C 410

P/C 405

P/C 400

Sweden

A, C

P/C 450

P/C 432

P/C 422

P/C 410



Loading Gauges

Corridor segment	Loading gauge, height
Norway	<i>M, 4.595 m</i>
Sweden	<i>SE-C, 4.83 m</i> <i>SE-A, 4.65 m</i>
Øresund bridge	<i>P/C 450, 4.83 m</i>
Denmark	<i>G2, 4.65 m</i>
Fehmarnbelt link	<i>SE-C, 4.83 m</i>
Germany	<i>G2, 4.65 m</i>
Netherlands	<i>G2, 4.65 m</i>
Betuwe line	<i>GC, 4.65 m</i>
Belgium	<i>GB-M6, 4.602 m</i>
France	<i>GB1, 4.32 m</i>
Eurotunnel	<i>5.75 m</i>

∴ Sufficient height of loading gauge SE-C and Eurotunnel for P/C 450





Vertical Clearance Requirements to OHL

OHL = overhead line

- Overhead line construction tolerance: 30 mm
- Contact wire dynamic movement: 50 mm
- Electrical minimum clearance (EBO, VDE 0115-1):
 - 25 kV 220 mm
 - 15 kV 150 mm
 - 3 kV 50 mm
 - 1.5 kV 35 mm
- Vehicle dynamic movement (TSI WAG): 50 mm
- Track ballast tamping allowance: 50 mm

⇒ Total clearance 215 mm to 400 mm needed to OHL.



Loading Gauges and OHL Heights

OHL = overhead line

Corridor segment	Loading gauge, height	OHL voltage	Total clearance needed	OHL height needed for P/C 450	OHL normal height
Norway	<i>M, 4.595 m</i>	15 kV	0.33 m	5.16 m	5.5 m
Sweden	<i>SE-C, 4.83 m</i> <i>SE-A, 4.65 m</i>	15 kV	0.33 m	5.16 m	5.5 m
Øresund bridge	<i>P/C 450, 4.83 m</i>	25 kV	0.40 m	5.23 m	5.33 m
Denmark	<i>G2, 4.65 m</i>	25 kV	0.40 m	5.23 m	5.3 m, 5.5 m
Fehmarnbelt link	<i>SE-C, 4.83 m</i>	25 kV	0.40 m	5.23 m	5.3 m
Germany	<i>G2, 4.65 m</i>	15 kV	0.33 m	5.16 m	5.3 m, 5.5 m
Netherlands	<i>G2, 4.65 m</i>	1.5 kV	0.215 m	5.045 m	5.5 m
Betuwe line	<i>GC, 4.65 m</i>	25 kV	0.40 m	5.23 m	5.5 m
Belgium	<i>GB-M6, 4.602 m</i>	3 kV	0.23 m	5.06 m	5.3 m
France (north)	<i>GB1, 4.32 m</i>	25 kV	0.40 m	5.23 m	5.5 m
Eurotunnel	<i>5.75 m</i>	25 kV	0.40 m	5.23 m	6.3 m

∴ Sufficient clearances to normal OHL heights for P/C 450.



Lift-on Lift-off Loading

CargoNet

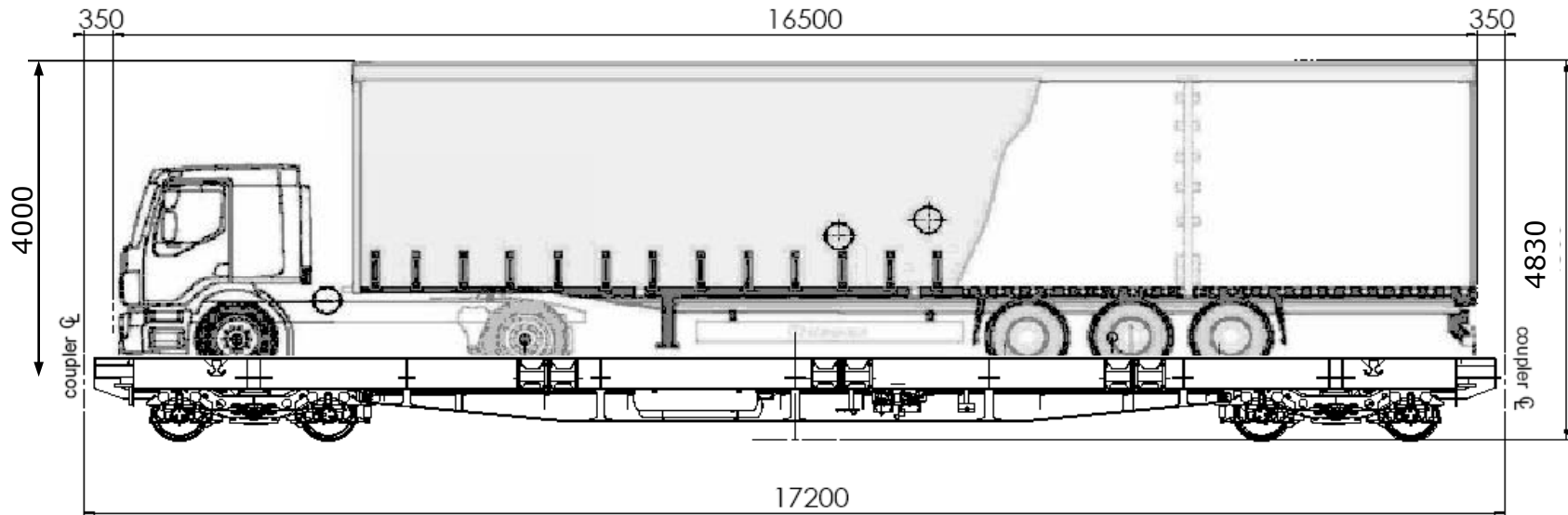
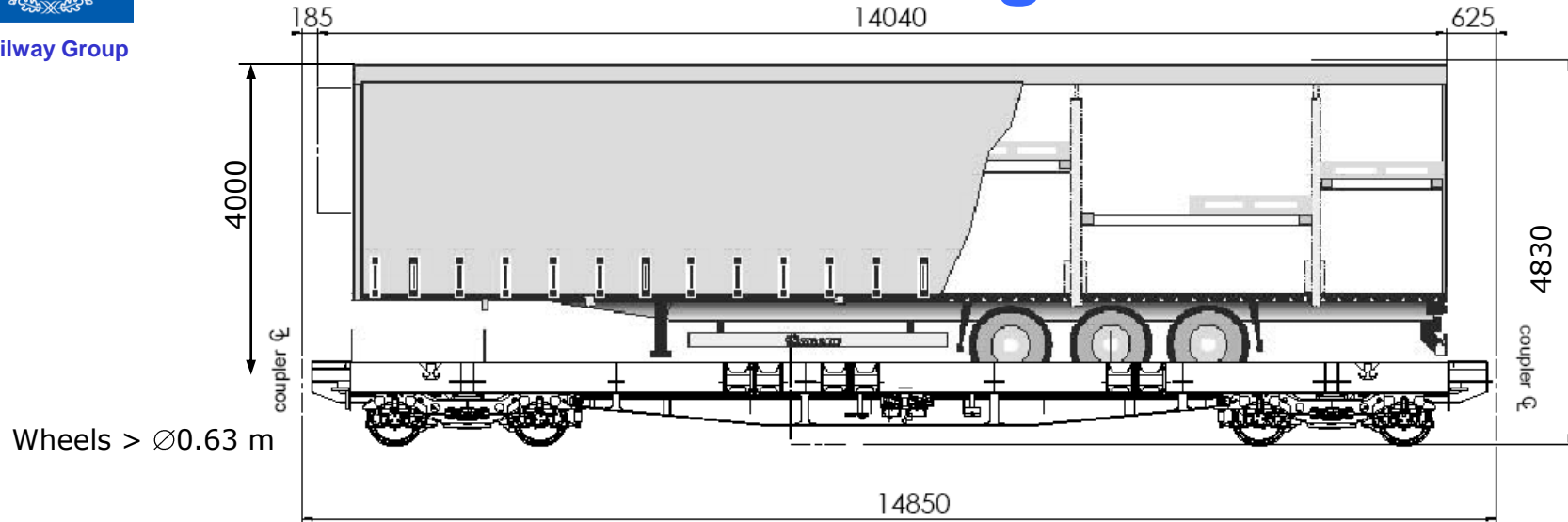


- Lift-on lift-off requires load unit reinforcements.
- Few semitrailers are reinforced (<10 %).



Roll-on Roll-off Wagons in P/C 450

Trailer Train



Other Loads: Construction Equipment

Anders Karlsson



1268 mm floor height, Rs

Other Loads: House Sections and Lumber

Bengt Dahlberg

Peter Norberg

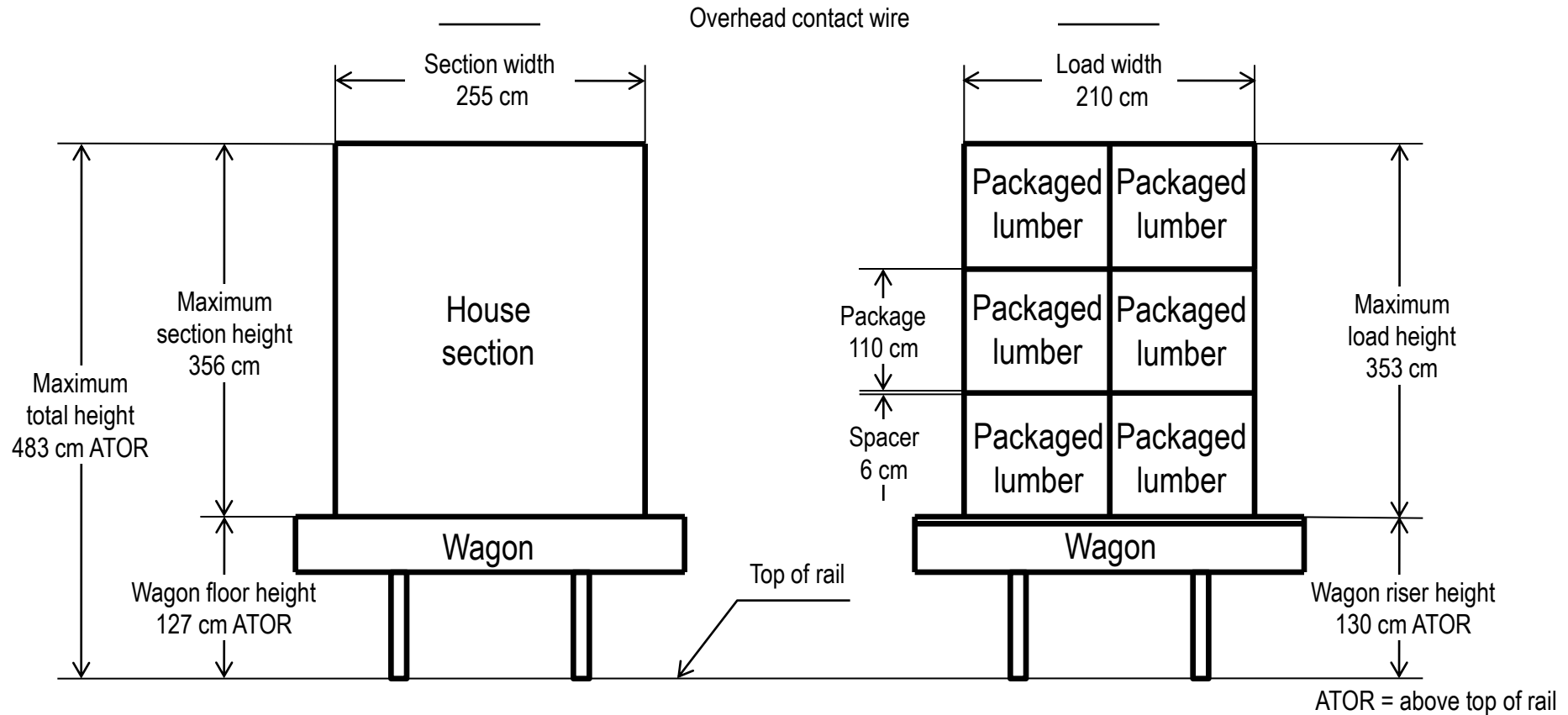


1268 mm floor height, Rs

1235 mm floor height, Rns



House Sections and Lumber in P/C 450



∴ Lumber can be stacked 1 package higher (+50 %) in intermodal gauge P/C 450 than in P/C 400.



Lumber: Three Packages High (+50 %)

Ulf Jaarne

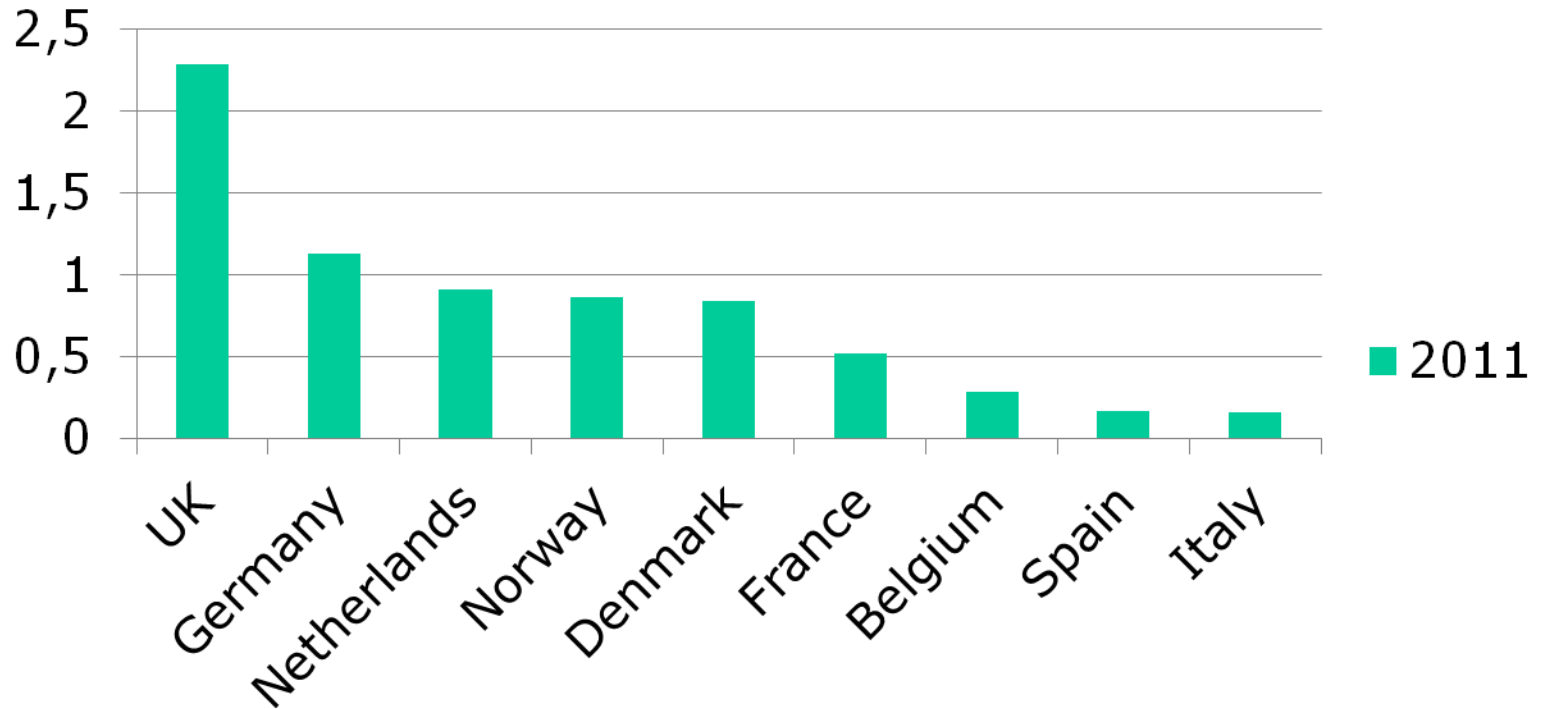


1305 mm riser height, Sgns



Swedish Softwood Lumber Export to the Main European Markets

Million cubic meters



Statistics Sweden, Swedish Forest Industries Federation





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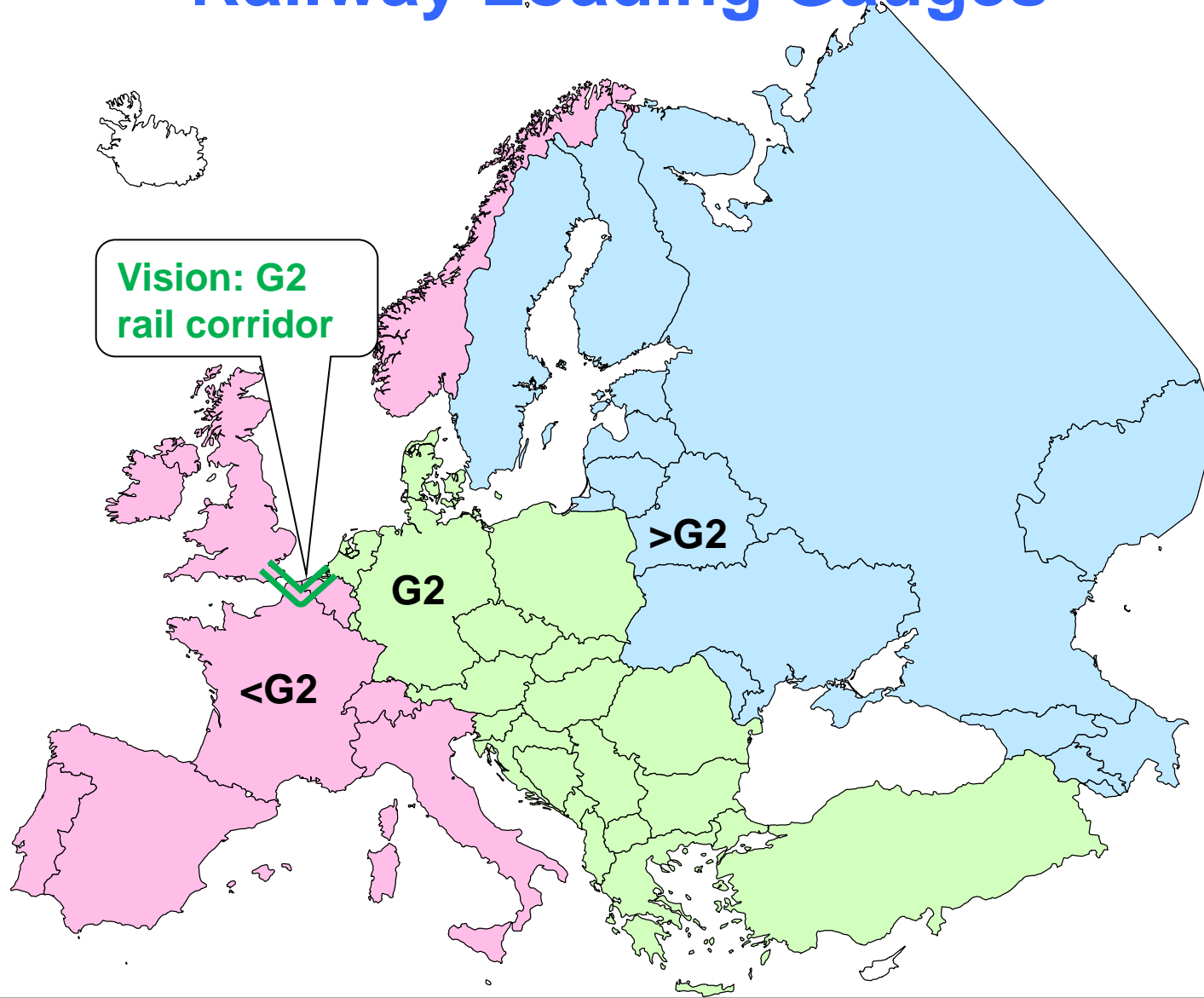
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Railway Loading Gauges



Loading Gauge G2

- Central and eastern Europe use the G2 gauge.
- HS1 and Eurotunnel are cleared for the G2 gauge.

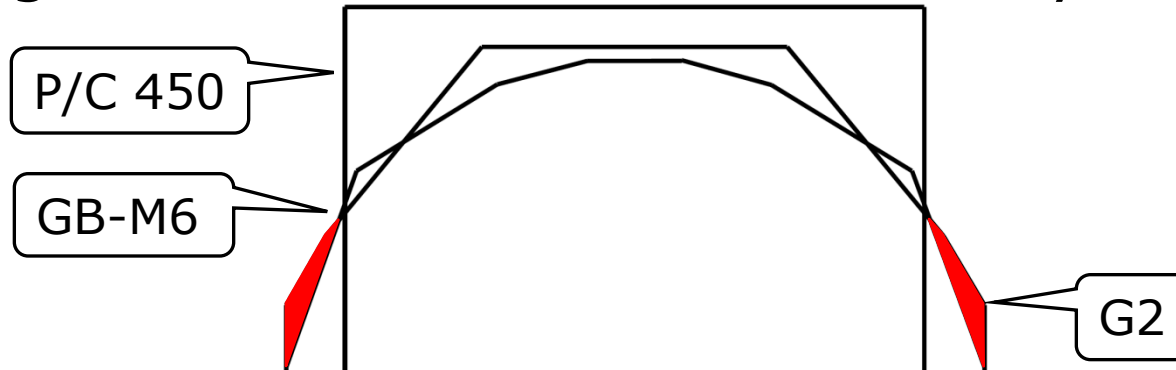


- How to connect?

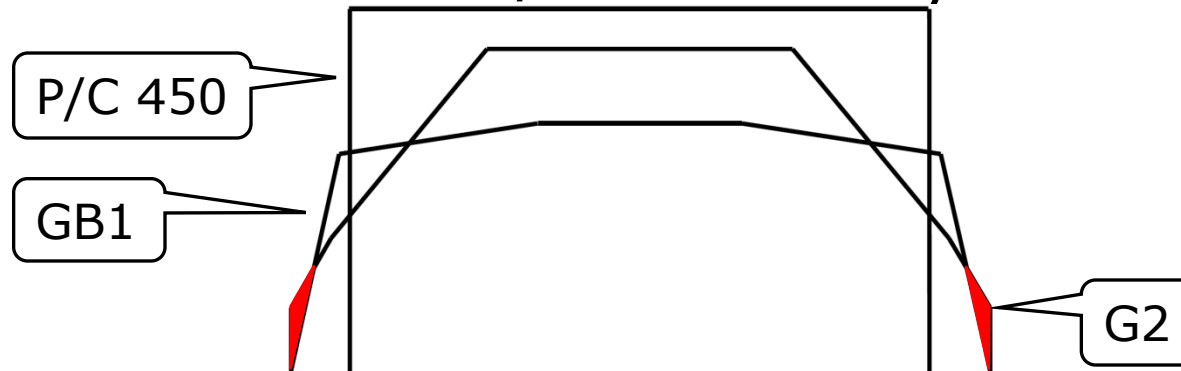


Clearing a Path for G2 to Britain

- Belgium: GB-M6 and P/C 450 nearly envelop G2.



- France: GB1 and P/C 450 nearly envelop G2.



∴ Minor additional gauge enlargement would open London, Folkestone, northern France and Belgium to the larger wagons of central and eastern Europe.



Sample Enclosed Wagons

Transwaggon



Transwaggon



G1 gauge, Habbiins 14 wagon
IL 22.6 m, IW 2.83 m, V 173 m³

G2 gauge, Habiis 11 wagon
IL 21.838 m, IW 2.83 m, V 186.3 m³

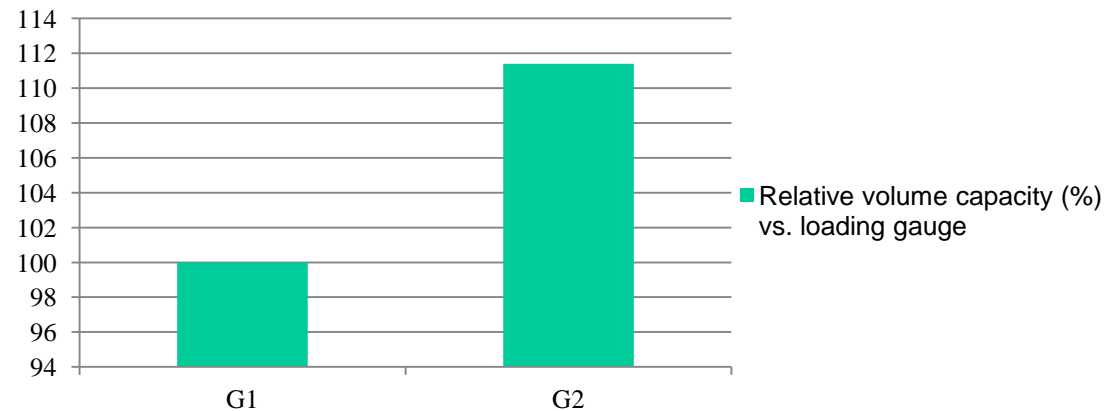
Note: V denotes total volume capacity.



Volume Capacity Increase

- Volume capacity comparison of Habbiins 14 (G1) and Habiis 11 (G2), per meter of inside length.

Relative volume capacity (%)
vs. loading gauge



∴ +11 % larger wagon volume capacity with loading gauge G2 than with G1.





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Maximising Loading Gauge Height

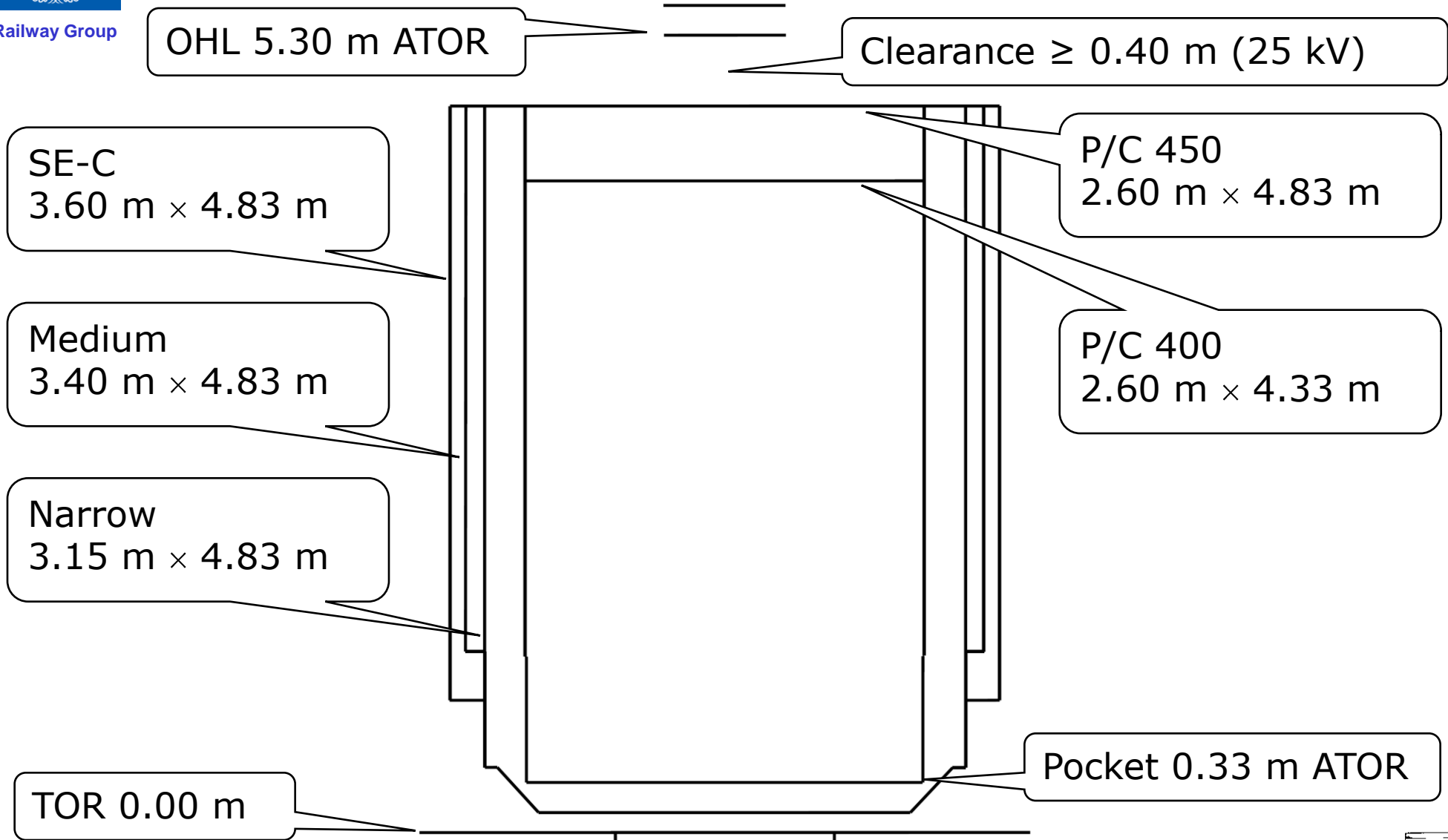
OHL = overhead line

Corridor segment	OHL normal height	OHL voltage	Total clearance needed	Loading gauge height possible
Norway	5.5 m	15 kV	0.33 m	5.17 m
Sweden	5.5 m	15 kV	0.33 m	5.17 m
Øresund bridge	5.33 m	25 kV	0.40 m	4.93 m
Denmark	5.3 m, 5.5 m	25 kV	0.40 m	4.90 m
Fehmarnbelt link	5.3 m	25 kV	0.40 m	4.90 m
Germany	5.3 m, 5.5 m	15 kV	0.33 m	4.97 m
Netherlands	5.5 m	1.5 kV	0.215 m	5.285 m
Betuwe line	5.5 m	25 kV	0.40 m	5.10 m
Belgium	5.3 m	3 kV	0.23 m	5.07 m
France (north)	5.5 m	25 kV	0.40 m	5.10 m
Eurotunnel	6.3 m	25 kV	0.40 m	5.90 m

∴ Loading gauge height 4.90 m possible under normal OHL height.

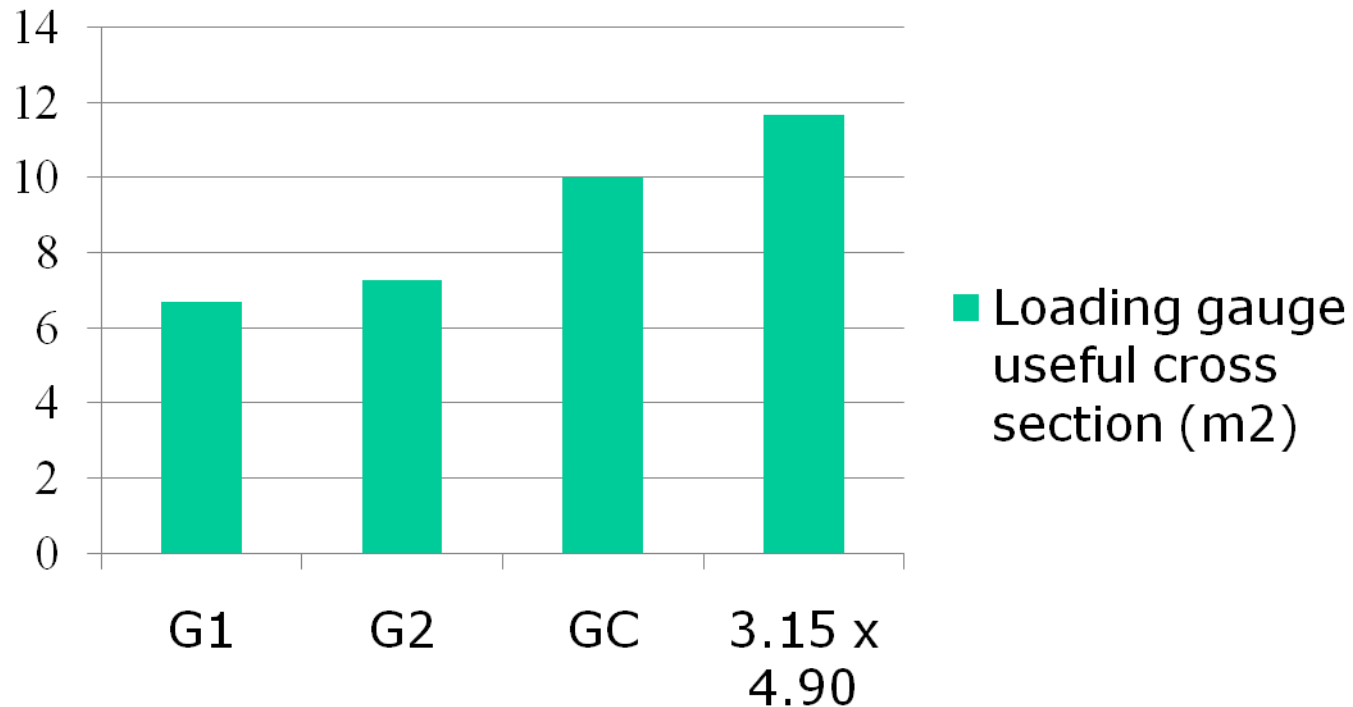


Desired Flat-Top Loading Gauges



Loading Gauge Comparison

Loading gauge useful cross section (m²)



Note: Largest inscribed rectangle above floor height, 1.2 m.



Opportunities of a Larger Gauge

Kockums Industrier

Kockums Industrier



133 m³ volume, Hiqqrrs-vw wagon



158 m³ volume, SECU container



Opportunities of a Larger Gauge

Frederik Tellerup



Michael Nilsson



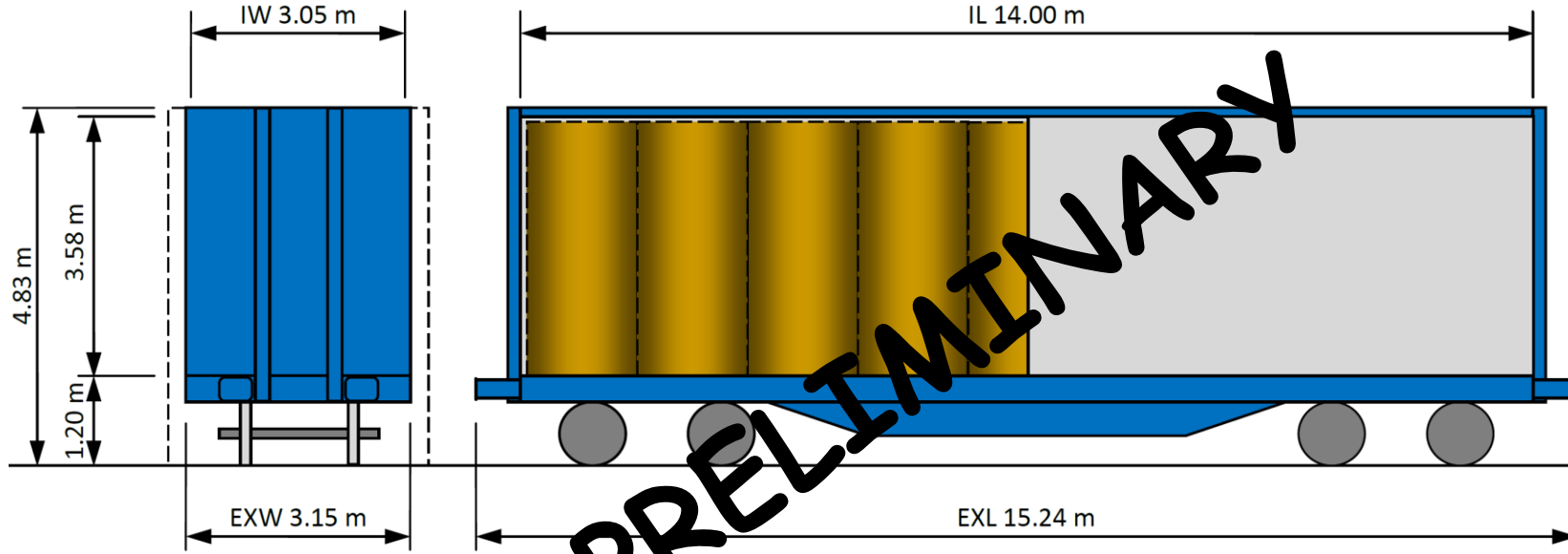
5 seats across, X53 unit

3.45 m width, X55 unit

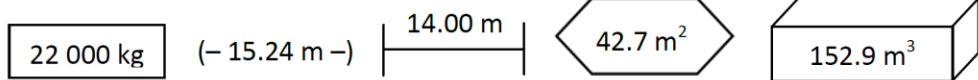


For Paper Export

Haimnss



	A	B	C	D	E
S	42 t	50 t	58 t	68 t	78 t
SS	42 t	50 t	58 t		

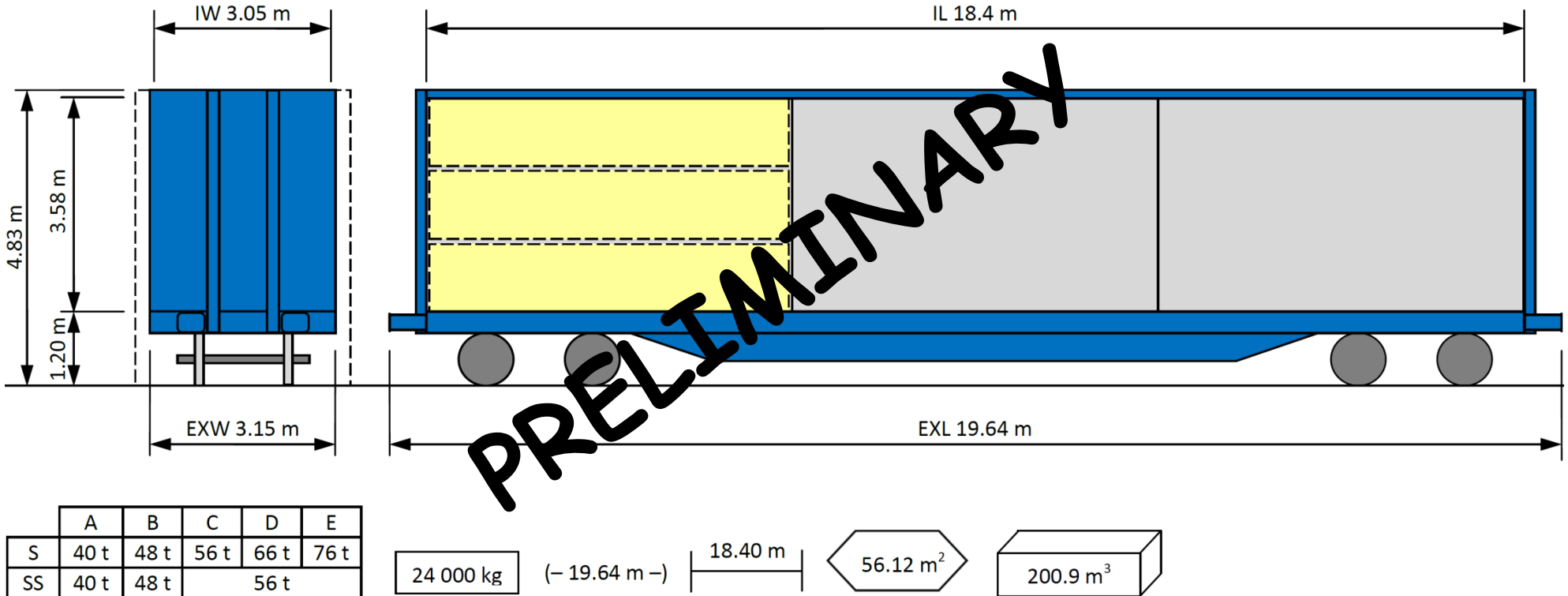


∴ 152 m³ rectangular volume in ≈15.2 m length, gauge 315×483.



For Paper and Lumber Export

Habins

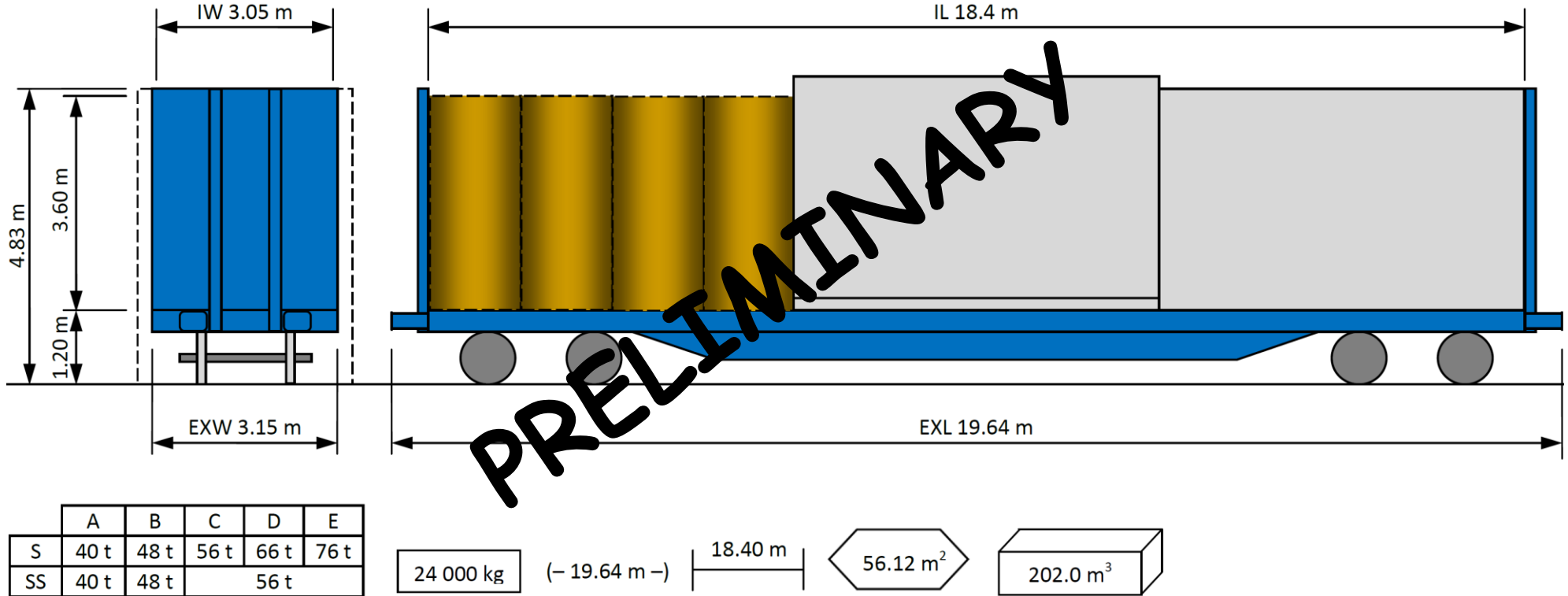


∴ 200 m³ rectangular volume in ≈19.6 m length, gauge 315×483.



For Paper and Lumber Export

Sinss



∴ 3.56 m (140") paper rolls can be carried by rail, gauge 315×483.





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Conclusions

- P/C 450 intermodal gauge (2.6 m×4.83 m) enables:
 - 4.50 m high semitrailers, loaded by lift-on lift-off
 - 4.00 m high semitrailers, loaded by roll-on roll-off
 - 1.15 m high lumber packages, loaded three tall.
- P/C 450 fits within the Swedish C loading gauge.
- Overhead line normal heights are sufficient for P/C 450 Norway – France – Eurotunnel – Folkestone.
- Minor expansion would enable G2 gauge to London.
- 3.15 m×4.83 m flat-top enables 3.56 m paper rolls





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Next

- Survey clearances on Fran-Scan connecting lines:
 - Vännäs – Boden
 - Luleå – Narvik





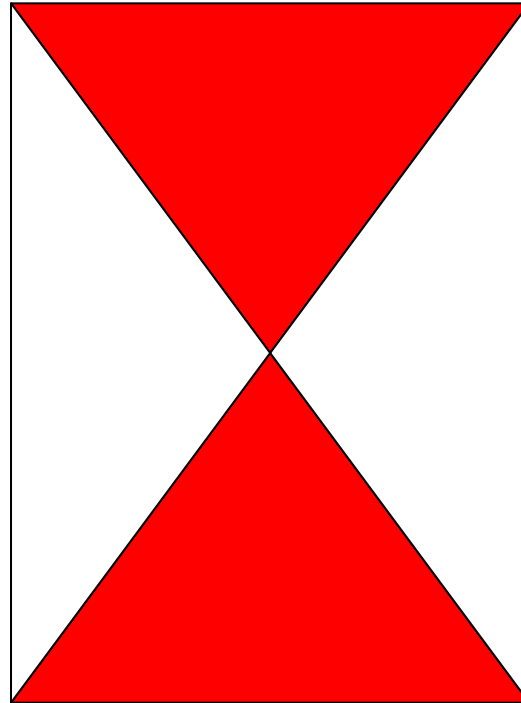
Recommendations

- Show the applicable P/C intermodal gauges in all railway network statements: JBV✓, ØSB✓, DB✓
- Implement P/C 450 initially on Fran-Scan connecting lines:
 - Esbjerg – København 2015
 - Trelleborg – Malmö 2015
 - Hallsberg – Mjölby
 - Alnabru – Skälebol, Drammen – Kil
- Implement in the Fran-Scan corridor:
 - P/C 450: København – Hamburg – Lille – Calais
 - G2: Rosendaal – Lille – Calais





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Thank you!

