



Environmental effective Transports - HCT

Good for the environment, driver shortage & productivity

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2020-01-23 HCT -Helsinki

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- Technology & Vehicle combinations
- Field tests
- Type vehicles
- Laws and regulations

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Volvo Group Trucks Technology

Lena Larsson Environmental effective Transports - HCT

4 23 Januari, 2020

VOLVO
VOLVO GROUP

The right vehicle combination for the mission



- Transport mission
- Utilization
- Operational environment

- Laws
- Regulations

➔ Correct vehicle combination

The best way to predict the future is to create it

Look in your crystal ball



OR Work with productivity

- CO₂ Emissions & Fuel consumptions
- Transport efficiency
 - Load capacity, drivability, maneuverability, Up-time etc.
- Driver productivity
- Infrastructure productivity
- Road wear
- Bridge wear
- Traffic safety



Best way to predict the future is to create it



Mittia 2009

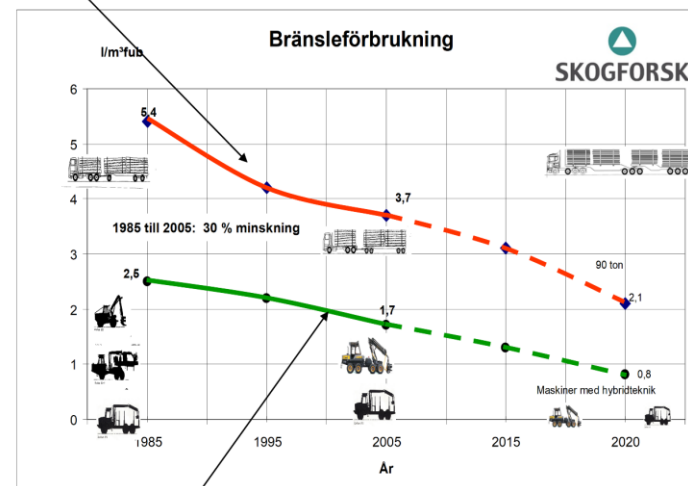
Volvo Group Trucks Technology

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9 23 Januari, 2020

CO₂ and fuel consumption reduction possibilities with up to 40% by 2020 within the Swedish Forest Industry

Bruttovikten på lastbilar ökade från 51 ton till 60 ton åren 1990-95



Större lastkapacitet på skotarna
Hydrostatisk drift
Engreppsskördare

30% 1985-2005, 40% Skogforsk target 2005-2020

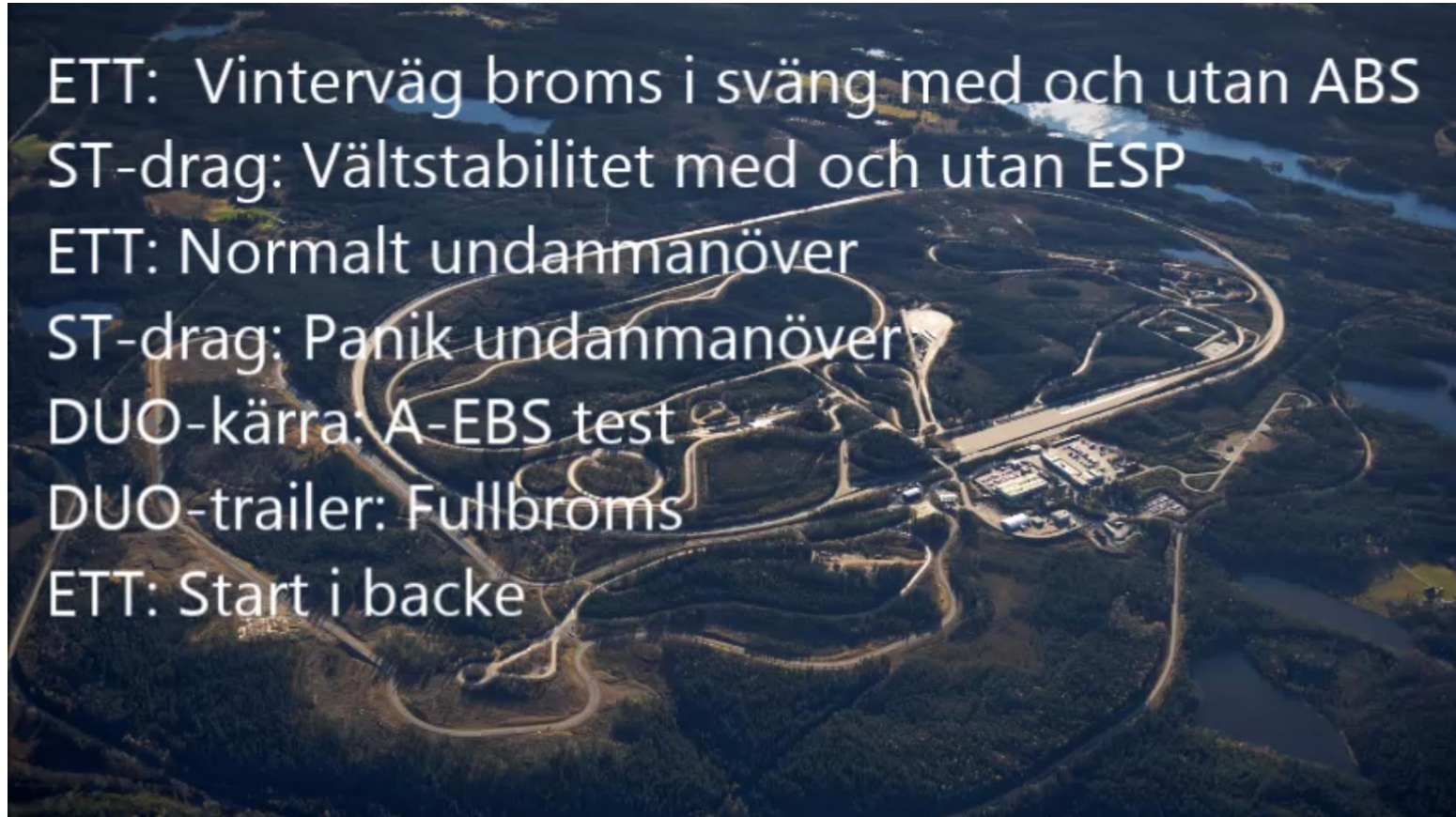
Source: Skogforsk nr 624 2006 Löfroth & Rådström

The Way to go

- New Fuel
- Efficient Engines
- Hybrid technology
- New machinery
- ECO driving
- Larger Working machines
- En Trave Till (One Pile More)
- Better Logistics

Säkerställa trafiksäkerhet

Teoretiska studier och praktiska prov



History

Volvo HCT field test combinations Sweden

2007 Project start

2009 ETT G1 (90 tonnes/30m)

2009 ST-Haul & Crane G1 (74 tonnes/24m)

2012 DUO-Trailer G1 (80 tonnes/32,5m)

2014 ETT G2 (90 tonnes/30m)

ST-crane G2 (74 tonnes/24m)

2015 DUO-CAT G1 (66 tonnes/27,5m)

DUO-Trailer G2 (80 tonnes/32,5m)

2016 ST-Haul G2 (74 tonnes/24m)

2017 DUO-trailer G3 (70 tonnes/32,5m)

2019 DUO-trailer G4 (80 tonnes/32,5m)

2020 AUTOfreight G1 (80 tonnes/31m)

NOW _____

2020 ETT-G3 (90-100 tonnes/32m)

2020 DUO-CAT G2 (70 tonnes/28m)

International increased capacity

2005 Portugal 60 tonnes /25,25 m wooden products

2008 Tjeckien 48 tonnes 25,25 on special permit

2013 Netherlands 60 tonnes 25,25m

2013-10 Finland 76 tonnes 25,25m

2014 Denmark long term test 60 tonnes 25,25m
up to 2030

2014-09 Norway 60 tonnes 25,25m

2014-04 Argentina 75 tonnes 30,25m

2015-06 Sweden 64 tonnes 25,25m

2016-01 Spain 60 tonnes 25,25m on special permit

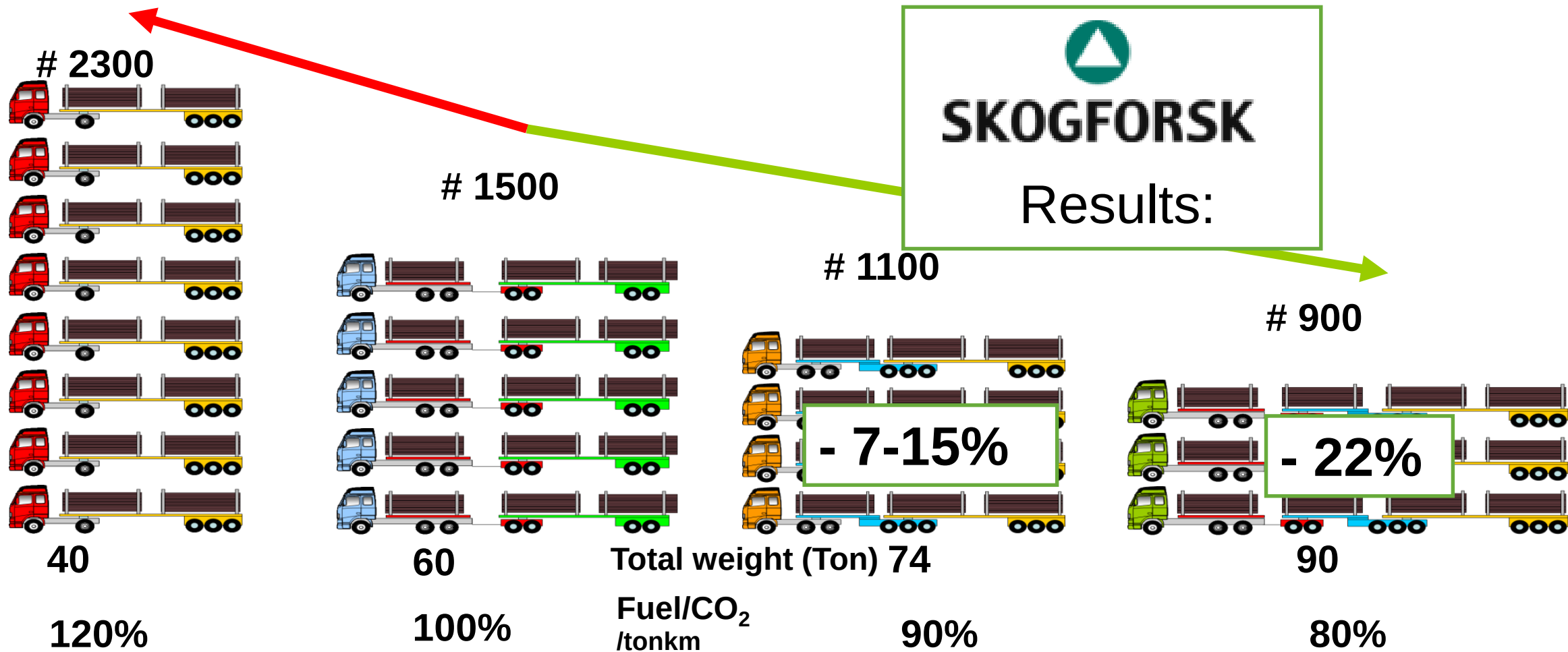
2016-01 Germany 40/44 tonnes 25,25m

2017-03 Brazil 91/74 tonnes (91 ton max 60m/h)

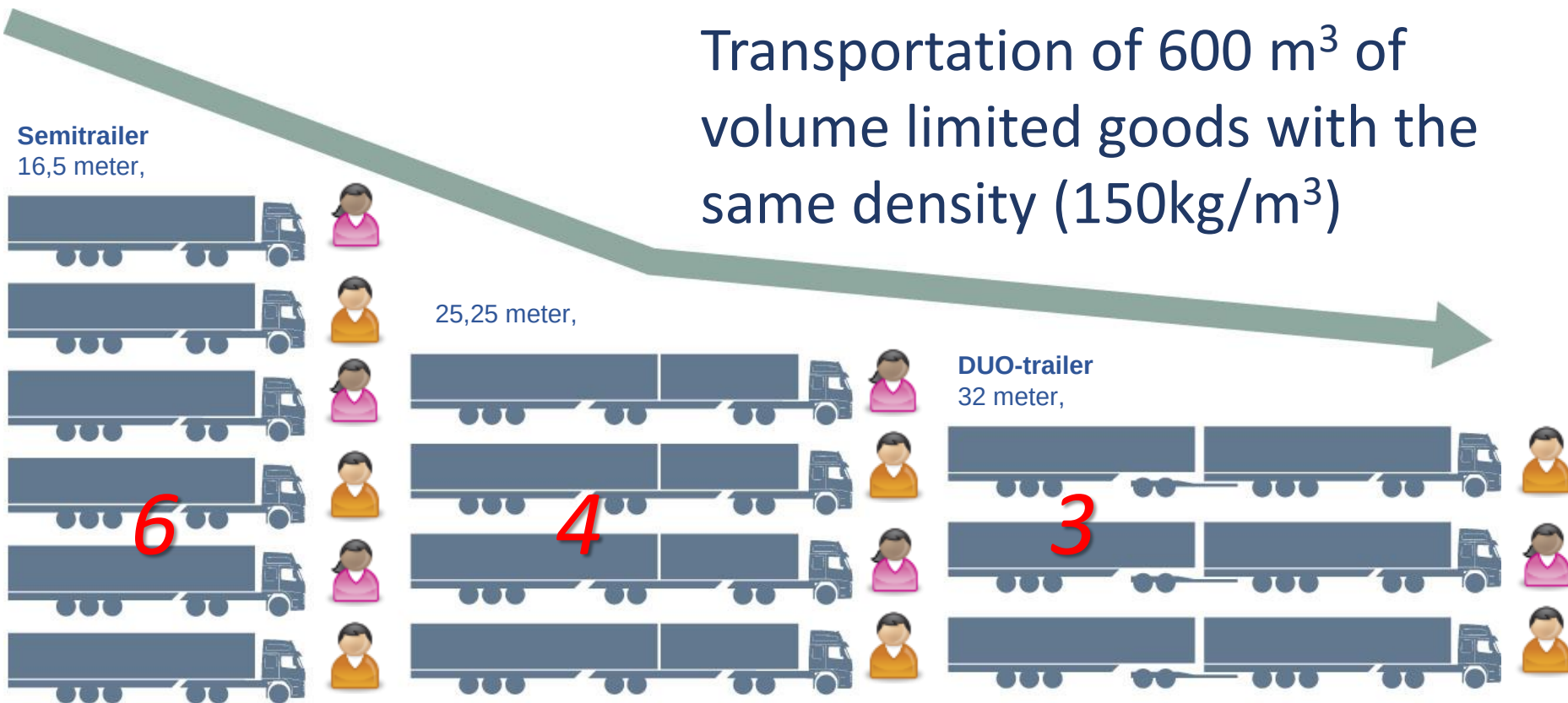
2018-07 Sweden 74 tonnes 25,25m

2019-01 Finland 34,5m HCT and 23m for truck & semitrailer

CO₂ emissions from road transports



Transportation of 600 m³ of volume limited goods with the same density (150kg/m³)



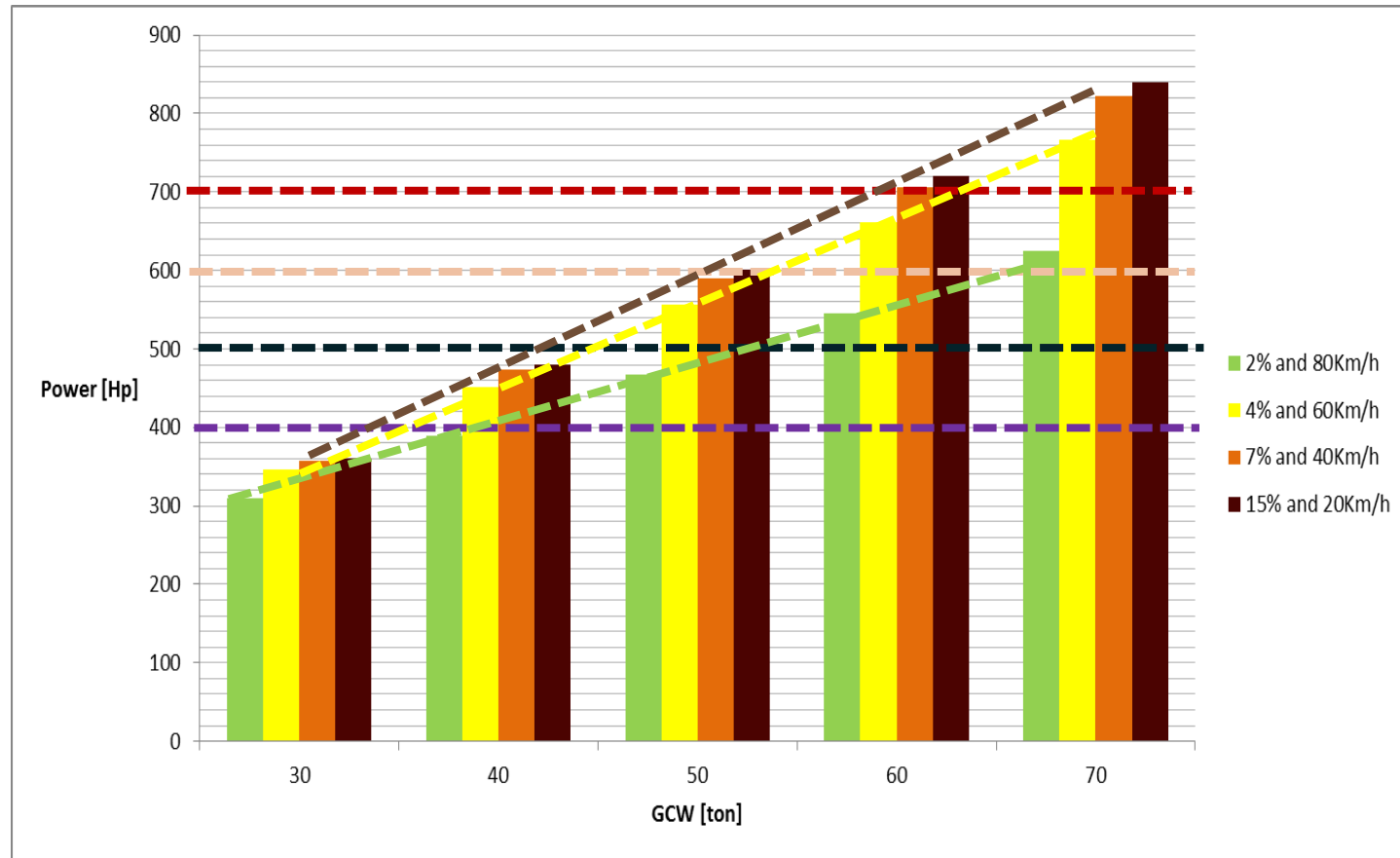
Load/vehicle:	100% 100 m ³	150% 150 m ³	200% 200 m ³
Diesel :	100% 3,5 ml/m ³ km	85% 3 ml/m ³ km	73% 2,5 ml/m ³ km
CO₂ :	100% 10,5 g/m ³ km	85% 9 g/m ³ km	73% 7,5 g/m ³ km
Road use:	100% 499 m	74% 368 m	60% 296 m
Nr of Vehicle & Drivers:	100% 6	67% 4	50% 3

HP needed for gradability

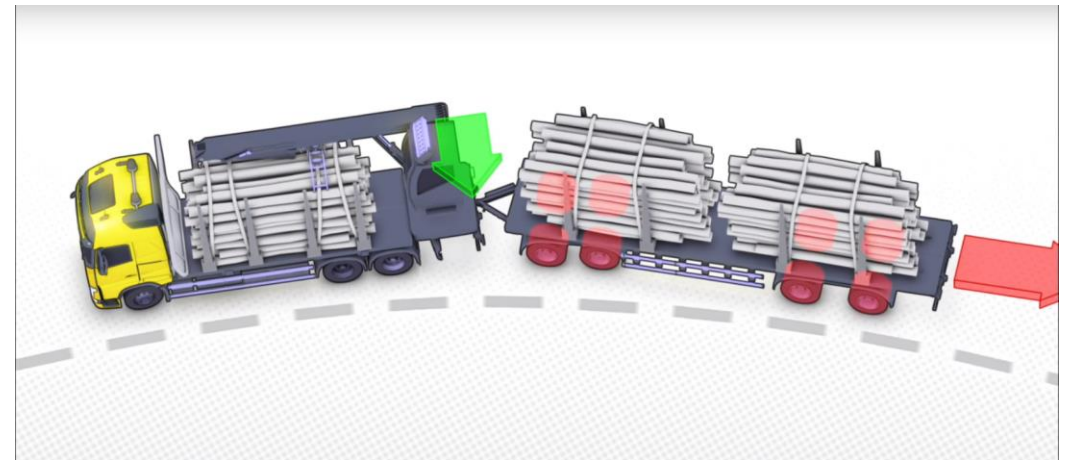
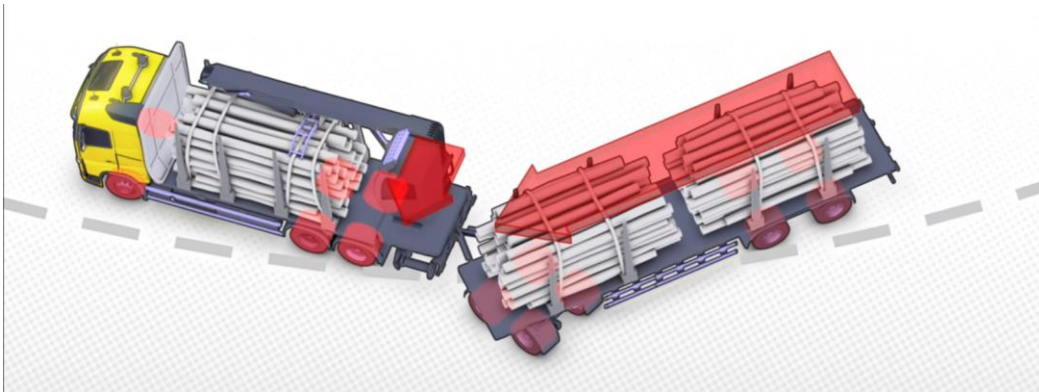
Keep speed at dry asphalt , no wind.

Examples;

- 80km/h at 2% slope
 - 40ton ~ 400hp
 - 60ton ~ 540hp
 - 70ton ~ 620hp
- 60km/h at 4% slope
 - 40ton ~ 450hp
 - 60ton ~ 650hp
 - 70ton ~ 770hp
- 40km/h at 7% slope
 - 40ton ~ 470hp
 - 60ton ~ 700hp
 - 70ton ~ 820hp
- 20m/h at 15% slope
 - 40ton ~ 490hp
 - 60ton ~ 720hp
 - 70ton ~ 840hp

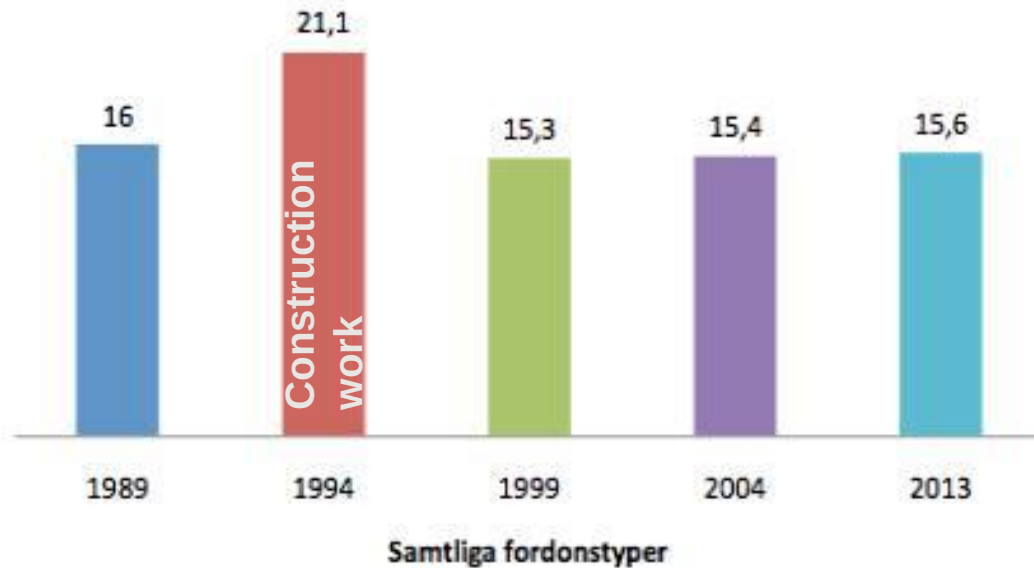


Stretch brake

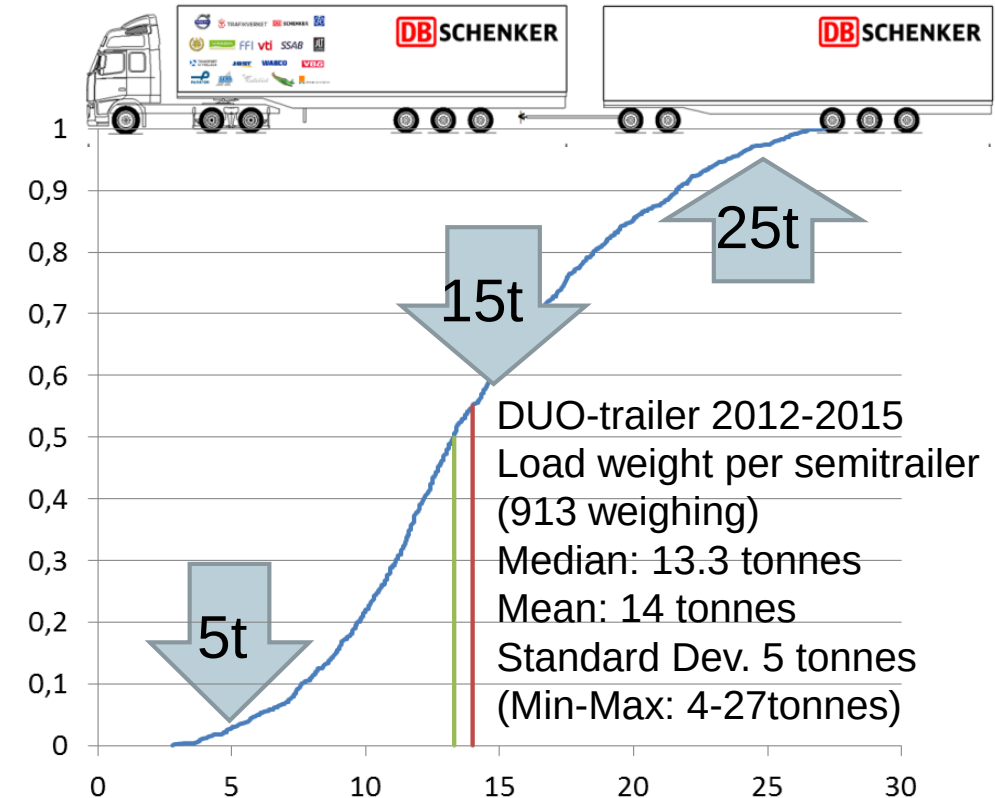


Representative loads in semitrailers

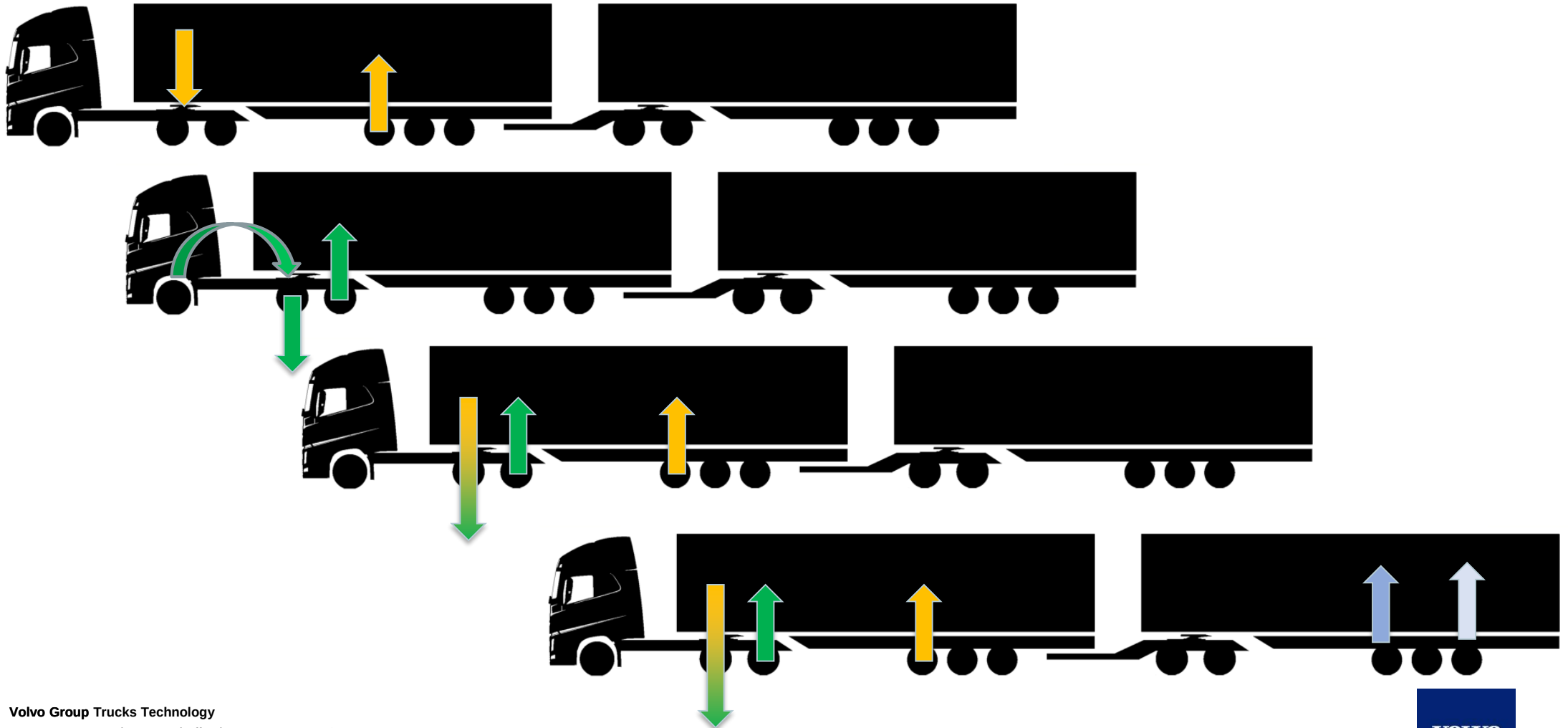
Average load (tonnes/semitrailer)
Border Sweden - Norway



VTI TF2015 session 33 Ramböll

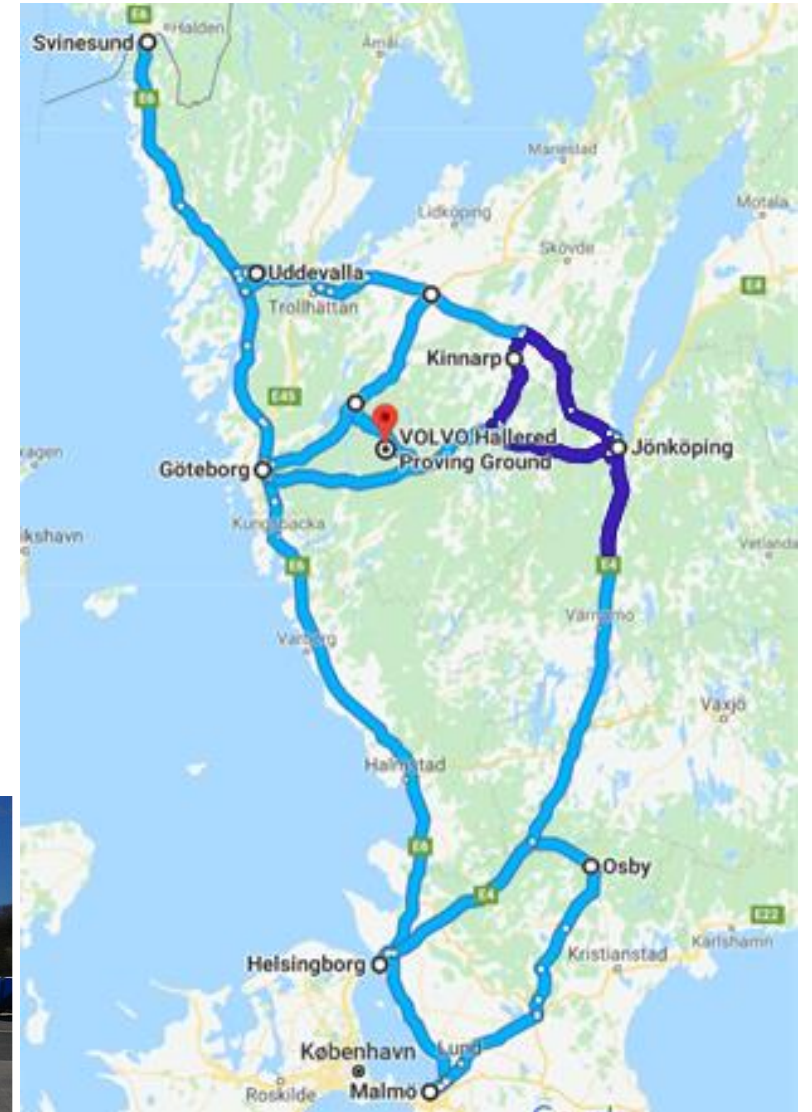


Transfer load to driven axles & lift axles not needed



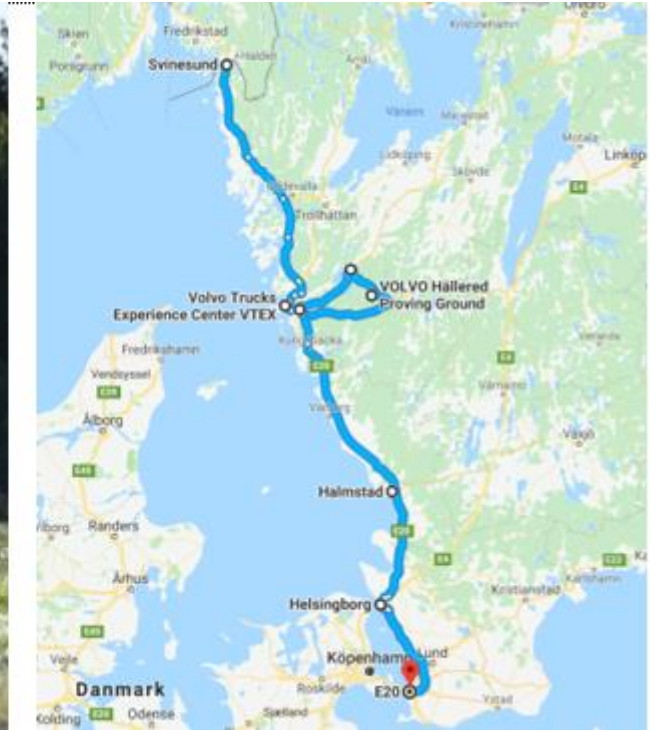
Length permission DUO-CAT with Kinnarps

- Ongoing
 - Between Kinnarps factory in Skillingaryd, Jönköping & Kinnarp
- Applied to
 - Moss in Norge
 - Danmark



Permission DUO-trailer

- We drive:
 - Malmö –Göteborg
 - Göteborg -Borås



Lenght development

Sweden

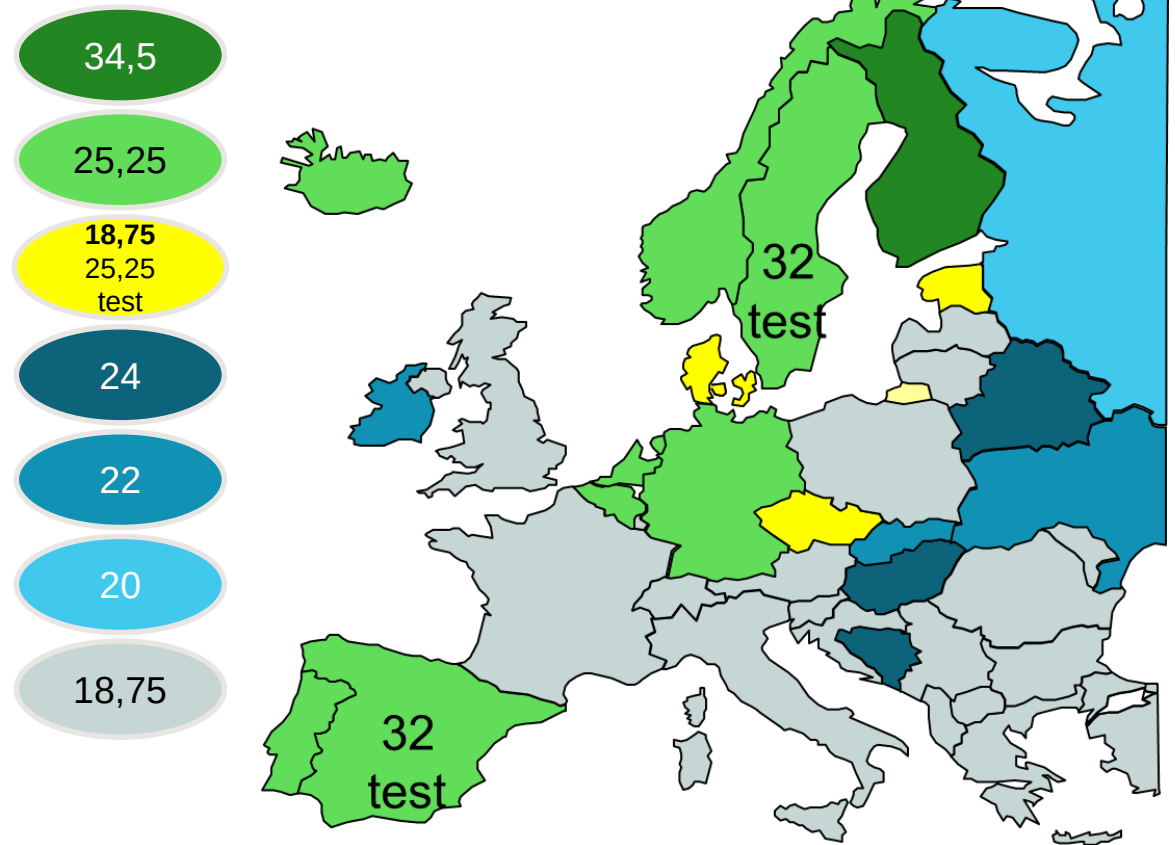
→ 1968 free lenght
(up to 30m)

1972 → 24m

1997 → 25,25m

2021-2025 34,5m

Europe 2019-09-01



Lenght Europe 2019-09-01

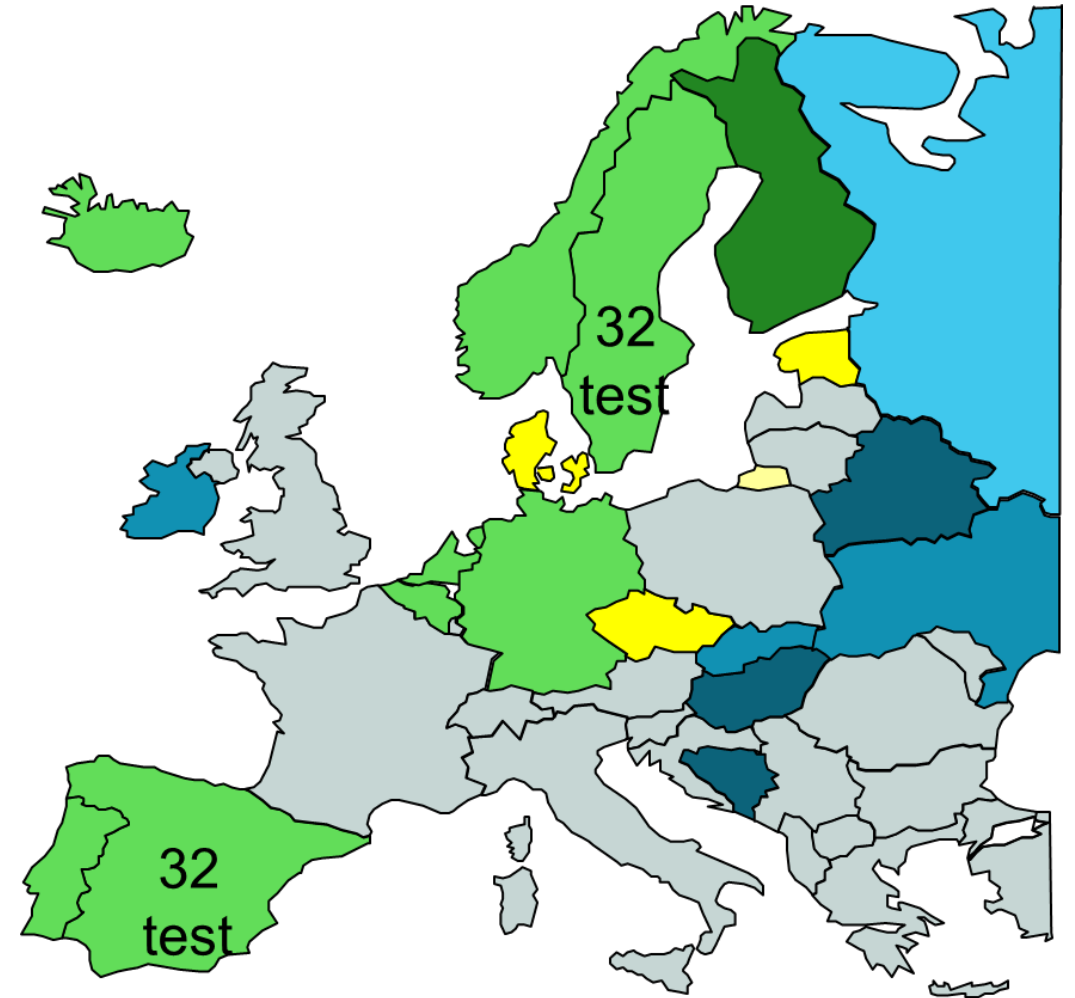
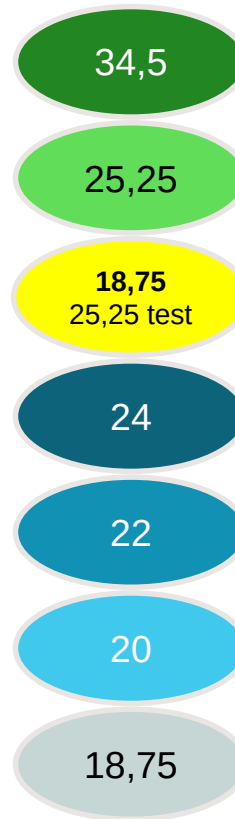
Test > 25,25m

Ongoing:

- Sweden 32m
- Spain 32m

Plans

- Norway 32m
- The Netherlands 32m

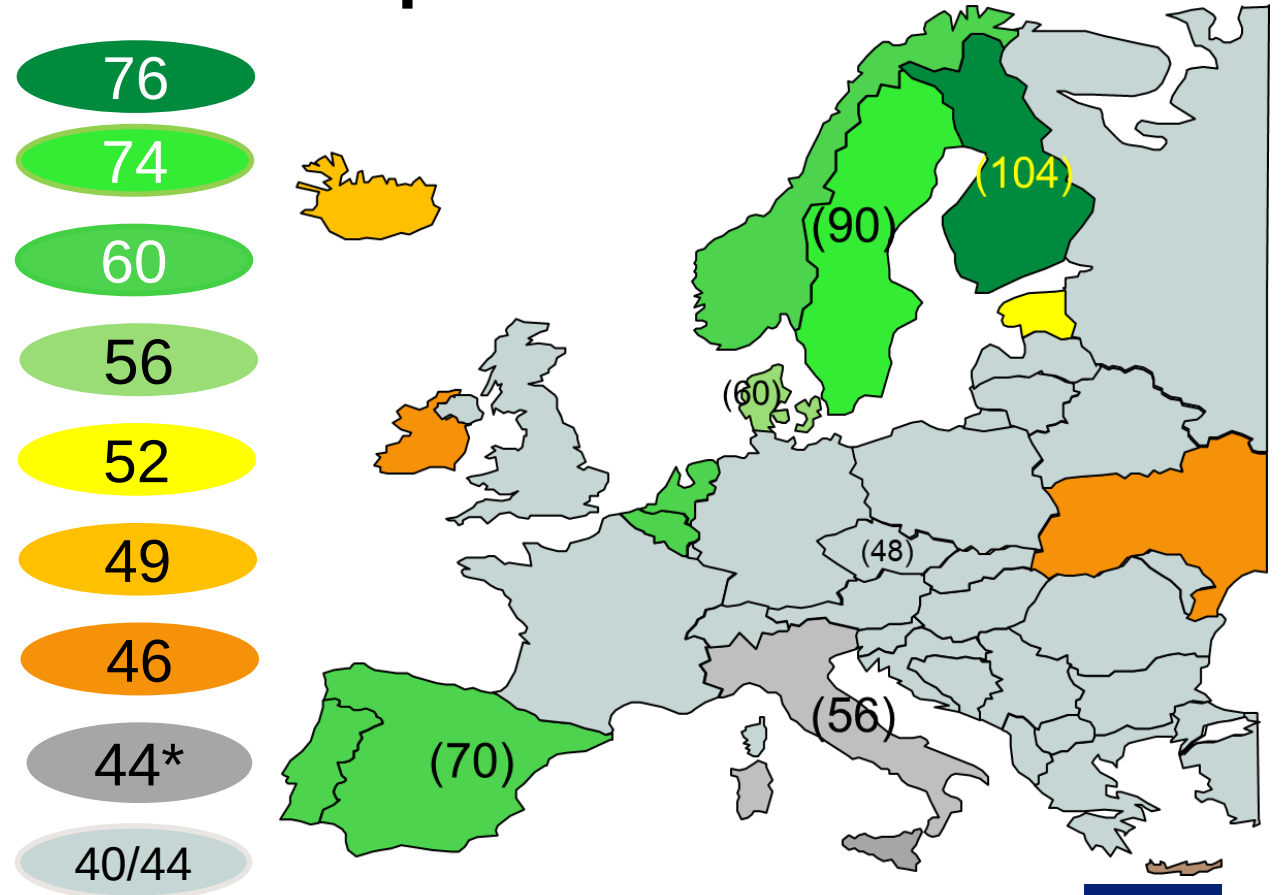


Weight development

Sweden

1966 →	37ton BK3
1974 →	51,4ton BK2
1990 →	56ton BK1
1993 →	60ton BK1
2015 →	64ton BK1
~2018 →	74ton BK4
2025-2030 corridors	90-100ton

Europe 2019-09-01



Weight Europe 2019-09-01

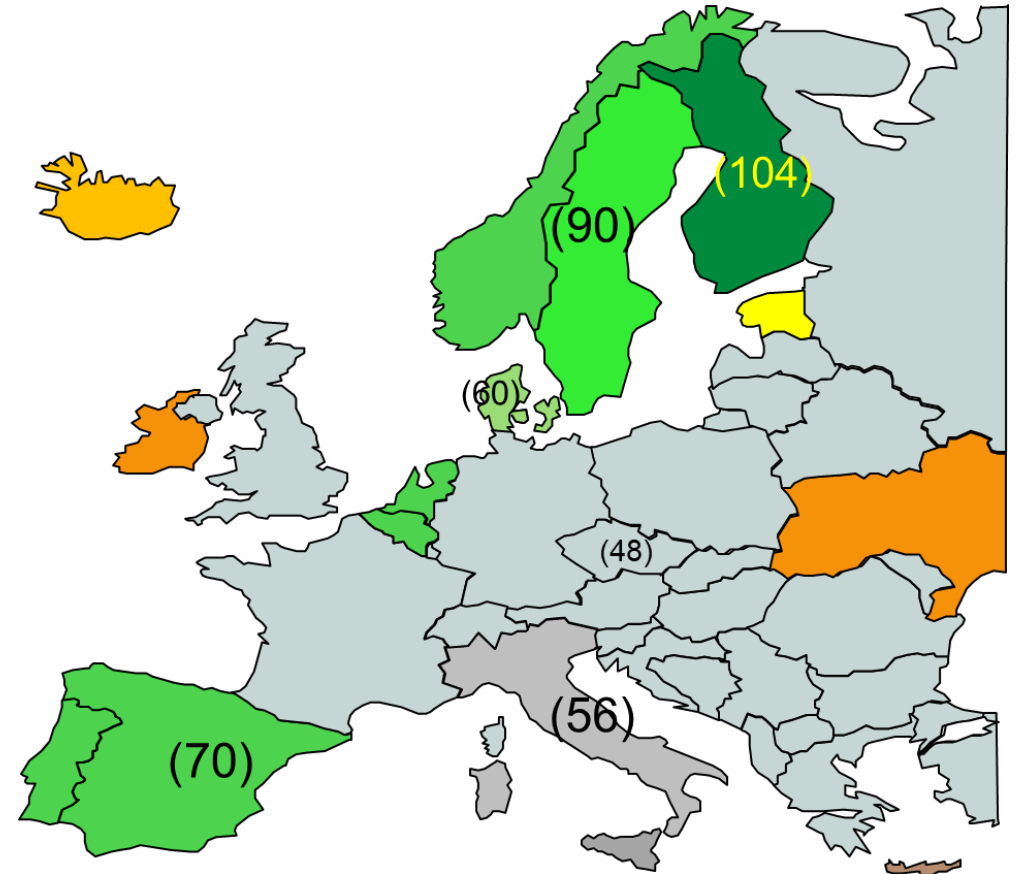
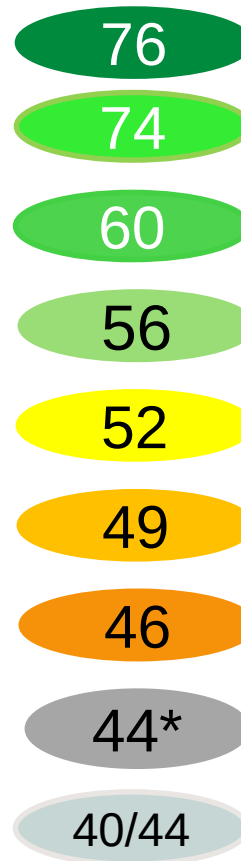
Tests > 60 / 74 / 76 tonnes

Ongoing:

Spain	70 tonnes
Sweden	90 tonnes
Finland	104 tonnes

Plans:

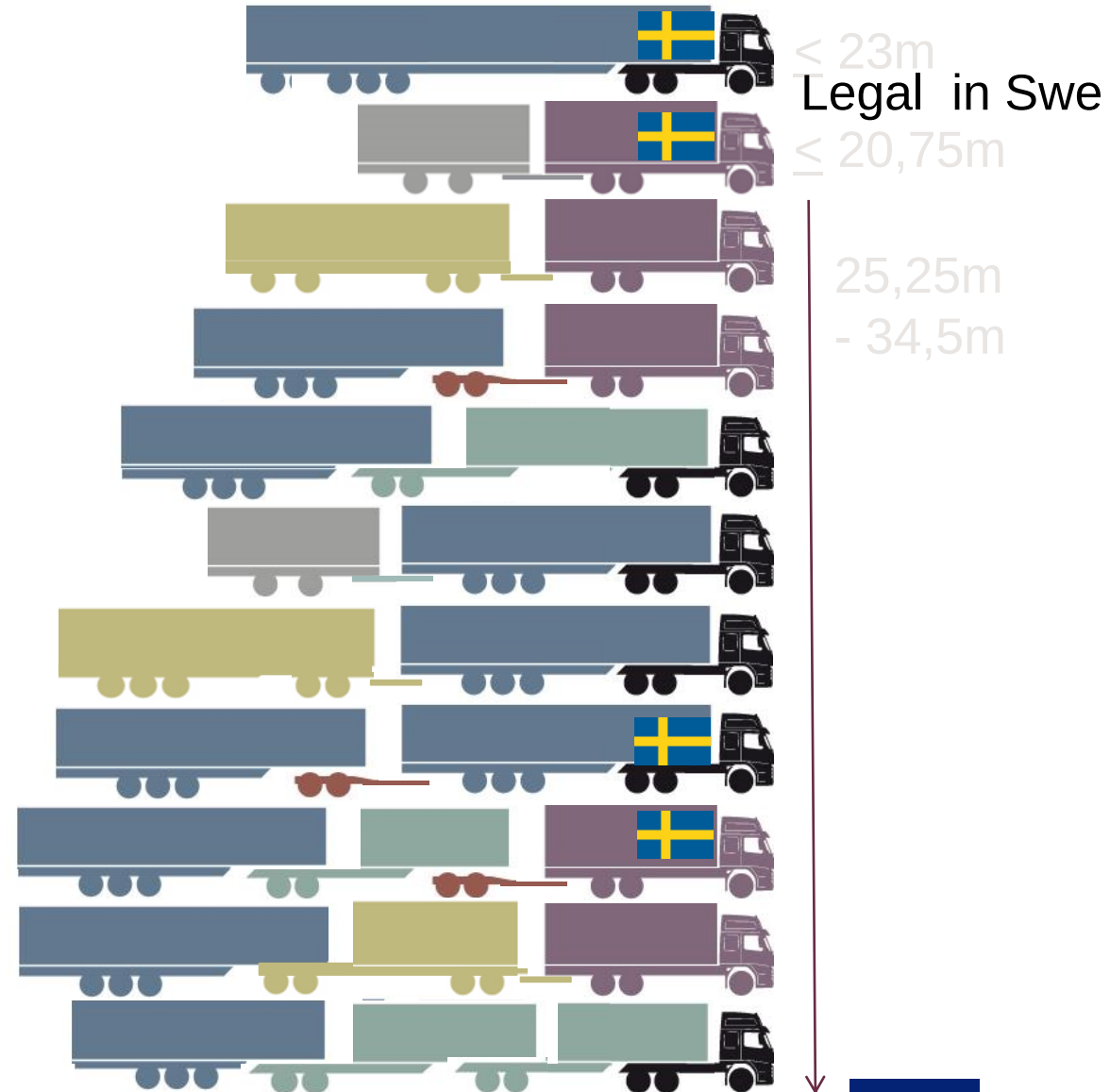
Norway	74 tonnes
Sweden	100 tonnes
Netherlands	72 tonnes



Long combinations in Finland 2019 (Proven by test) Legal/ Tested in Sweden

Truck and:

1. Semitrailer
 2. CAT
 3. Full trailer
 4. Dolly + semitrailer
 5. Link + semitrailer
 6. Semitrailer + CAT
 7. Semitrailer + full trailer
 8. Semitrailer + dolly + semitrailer (DUO-trailer)
 9. Dolly + link + semitrailer (ETT/ maxvolym)
 10. Fulltrailer + semitrailer
 11. link + link + link/semitrailer.
- CAT + CAT



HCT: Finland 2019-01-21

Bra regelverk – lätt att förstå

- Axelgruppträck (infördes 2013) 21 ton på driven boggi och 27 ton på driven triple (2axlar med dubbelmontage), 4 axlar max 30 ton, 5 axlar max 36 ton
- Axlar får lyftas för att andra krav skall kunna uppfyllas:
 - Framkomlighet -manövrerbarhet (max 12 ton per axle vid max 30km/h)
 - Traction – start och körbarhet vid halt väglag
- Min % av bruttovikten på drivna axlar: 25% vinterförhållanden (15% under & 20% över 68 ton sommarförhållanden)
 - Fordon längre än 28m: 25% vid vinterförhållanden får nås med, tillsattsdrift, snökedjor och sandningsutrustning.
- Min 20% av bilens bruttovikt skall vara på bilens styrda axlar (min 9% av kombinationens bruttovikt vid bruttovikter ≥ 68 ton)
 - 76 ton 9% → min 6,87 ton och Last-/Dragbil med 3 axlar 28 ton 20% → min 5,6 ton samt med 4 axlar 35 ton 20% → min 7 ton
- Svängkrav 120 grader /12,5m yttre och 4m innre radie samt ett yttre svep på 0,8m, (om mindre yttre svep får innerradie reduceras till 3,7m)
 - Löpaxlar får vara styrbara upp till max 40km/h
- Kombinationer längre än 28m: Båda sidorna skall vara synbara för föraren genom hela svängen, höger & vänster. (Kamera är OK)
- Det finns stabilitet krav för filbyte och kontinuerlig sväng. (De godkända typfordonen har en tabell med axel och kopplings mått man skall hålla sig inom)
- EBS, AEBS & ESP skall finnas.
- Föraren skall kunna se axelvikten på alla axlar. (Mekanisk fjädrad framaxel undantagen)



Gross weight curves Swe & Fin Extended 2018-12-04

Finland

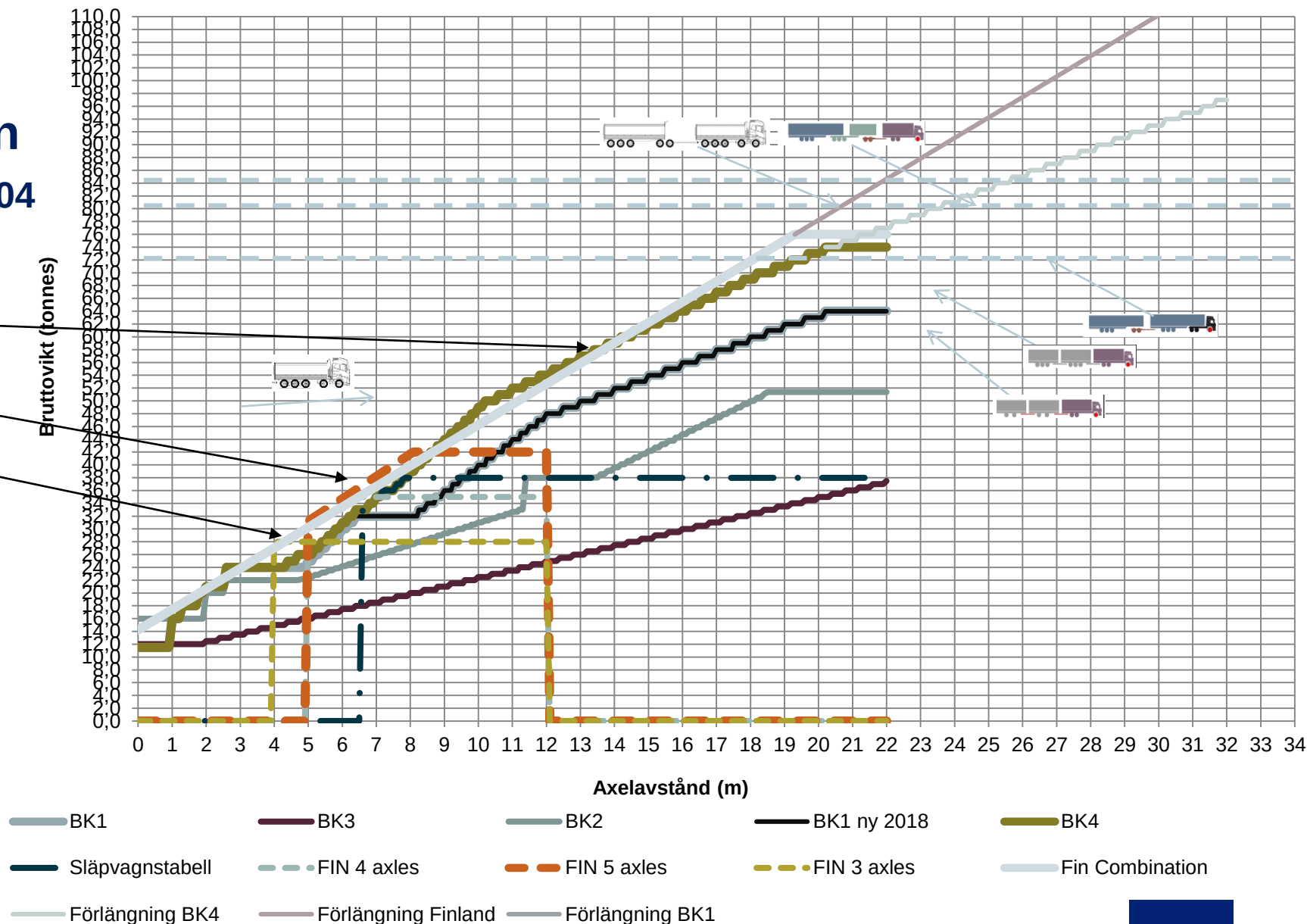
- General ($\leq 76\text{t}/19,3\text{m}$)
- 5 axle truck
- 3 axle truck

Sweden

- BK4 ($\leq 74\text{t} / 20,2\text{m}$)
- BK1 ($\leq 64\text{t} / 20,2\text{m}$)
- BK2 ($\leq 51,4\text{t}$)
- BK3

Netherlands

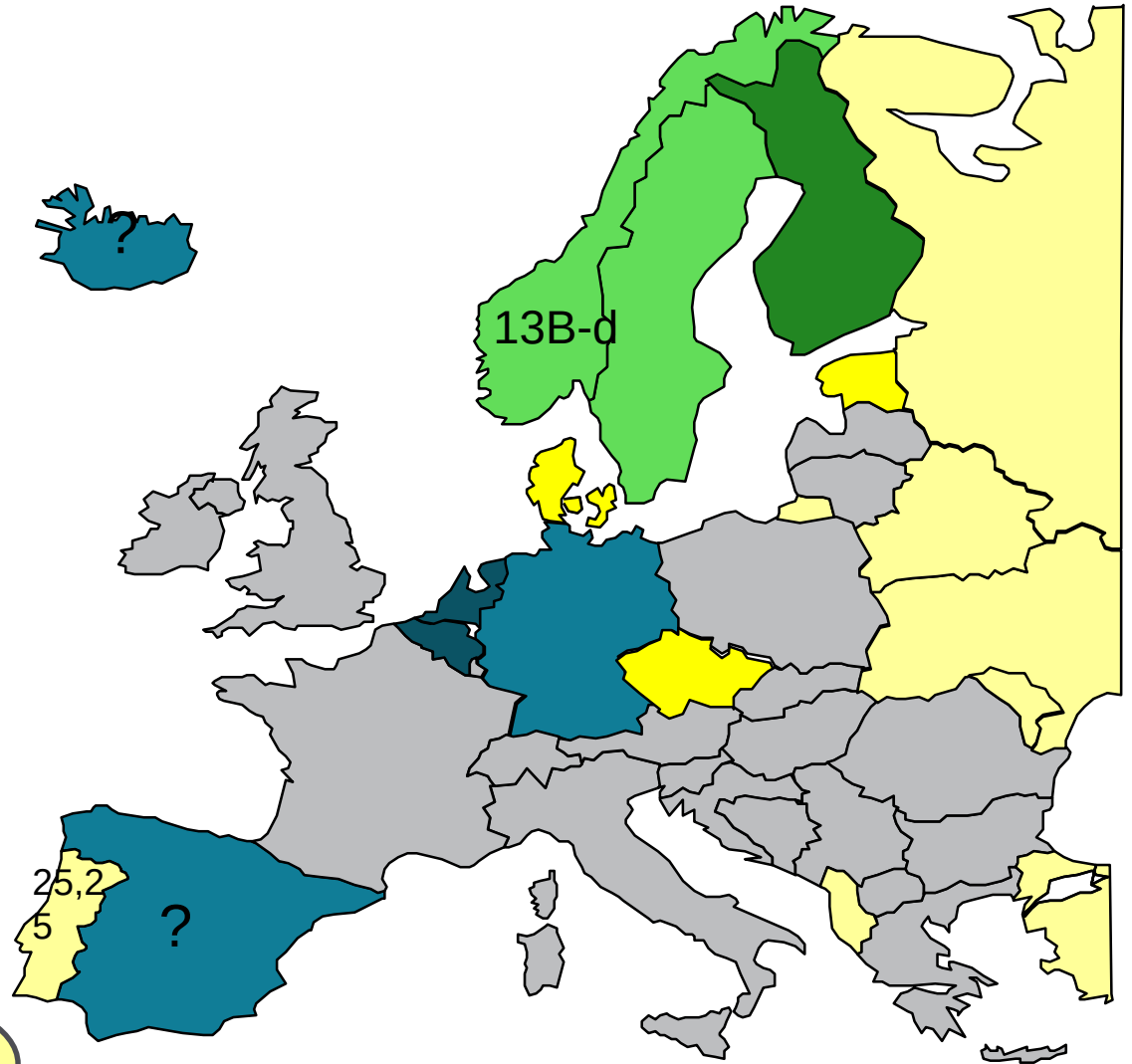
- 5 axle truck 50tonnes



Turning rules on road 2019

EMS, 18,75 - 25,25 - 34,5 Europe

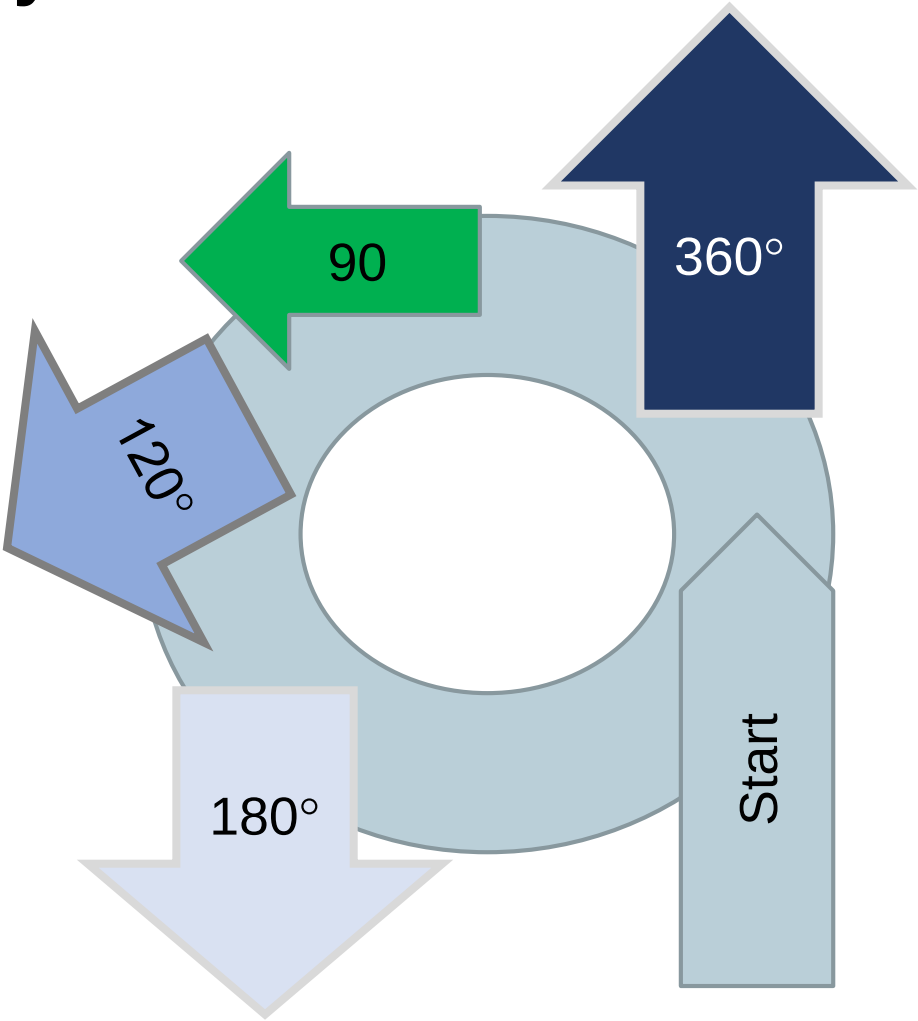
34,5	120deg -12,5m -4,0m - 0,8m
25,25	180deg -12,5m -2,0m • 180deg -13m - 2,0m Norway B-D
25,25	360deg - 14,5 - 6,5m
25,25	360deg -12,5m -5,3m
25,25	360deg -12,5m -2.0m Finland old
18,75	360deg -12,5m -5,3m
25,25 test	N/A



Framkomlighets krav / Passability demands

Status januari 2020

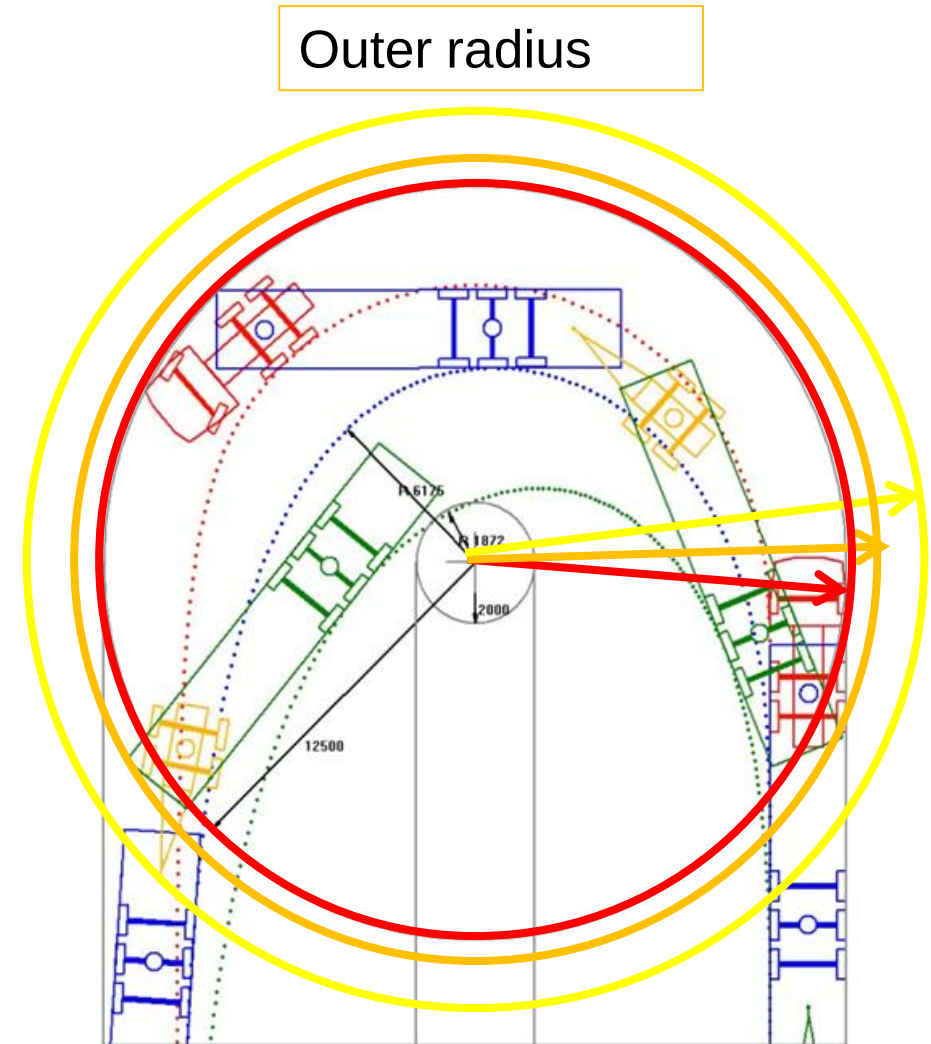
Country	Max length	Type	Turn
	m		Degree
Finland	34,5		120
Finland	34,5		120
Finland old	25,25		360
Finland old	16,5/18,75		360
Sweden	25,25		180
Norway	25,25	MV 1&2	180
Norway	25,25	MV 3	180
Netherlands	25,25		360
Belgium	25,25		360
96/53 EC	EMS 16,5/18,75		360
Germany	25,25		360
Spain	25,25		360
Iceland	25,25		360
Denmark	25,25	Test -no demand :	
Czech Repub	25,25	Test -no demand :	
Estonia	25,25	Test -no demand :	



Framkomlighets krav; svep

Ytter radie & Inner radie

Country	Max length m	Type	Turn Degree	Outer Radius m
Finland	34,5		120	12,5
Finland	34,5		120	12,5
Finland old	25,25		360	12,5
Finland old	16,5/18,75		360	12,5
Sweden	25,25		180	12,5
Norway	25,25	MVT1&2	180	12,5
Norway	25,25	MVT3	180	13
Netherlands	25,25		360	14,5
Belgium	25,25		360	14,5
96/53 EC	EMS 16,5/18,75		360	12,5
Germany	25,25		360	12,5
Spain	25,25		360	12,5
Iceland	25,25		360	12,5
Denmark	25,25	Test -no demand	set	
Czech Republ	25,25	Test -no demand	set	
Estonia	25,25	Test -no demand	set	

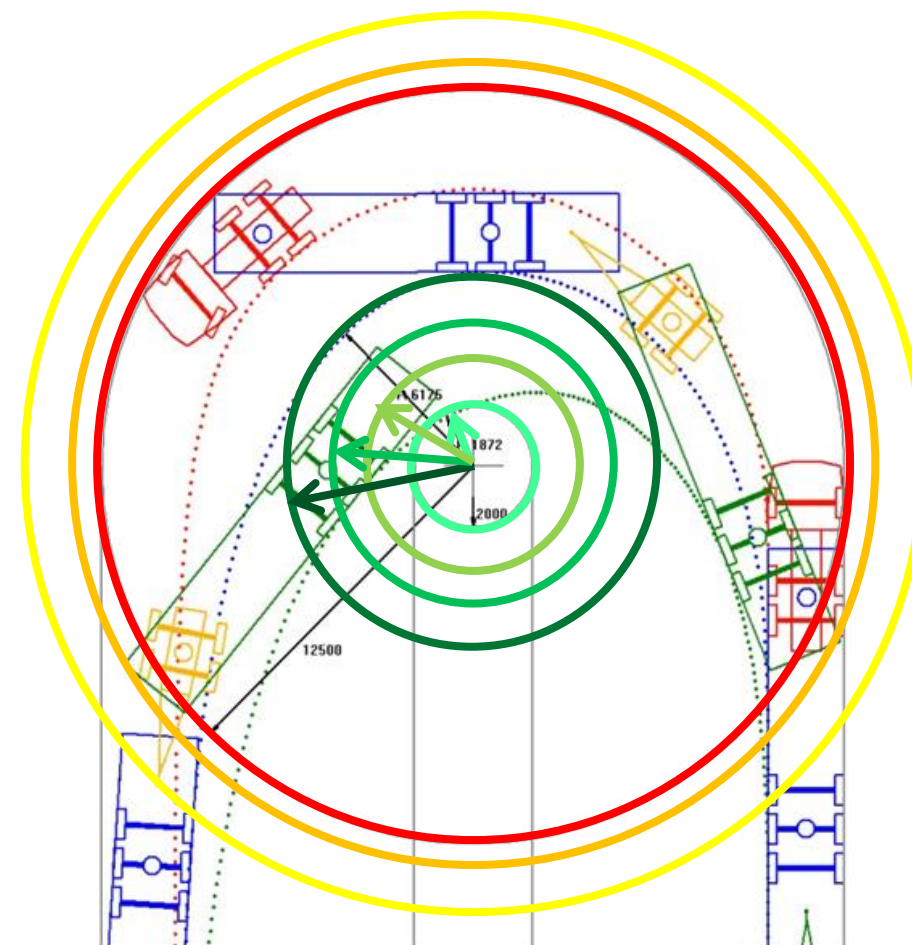


Inner radius

Framkomlighets krav; svep

Ytter radie & Inner radie

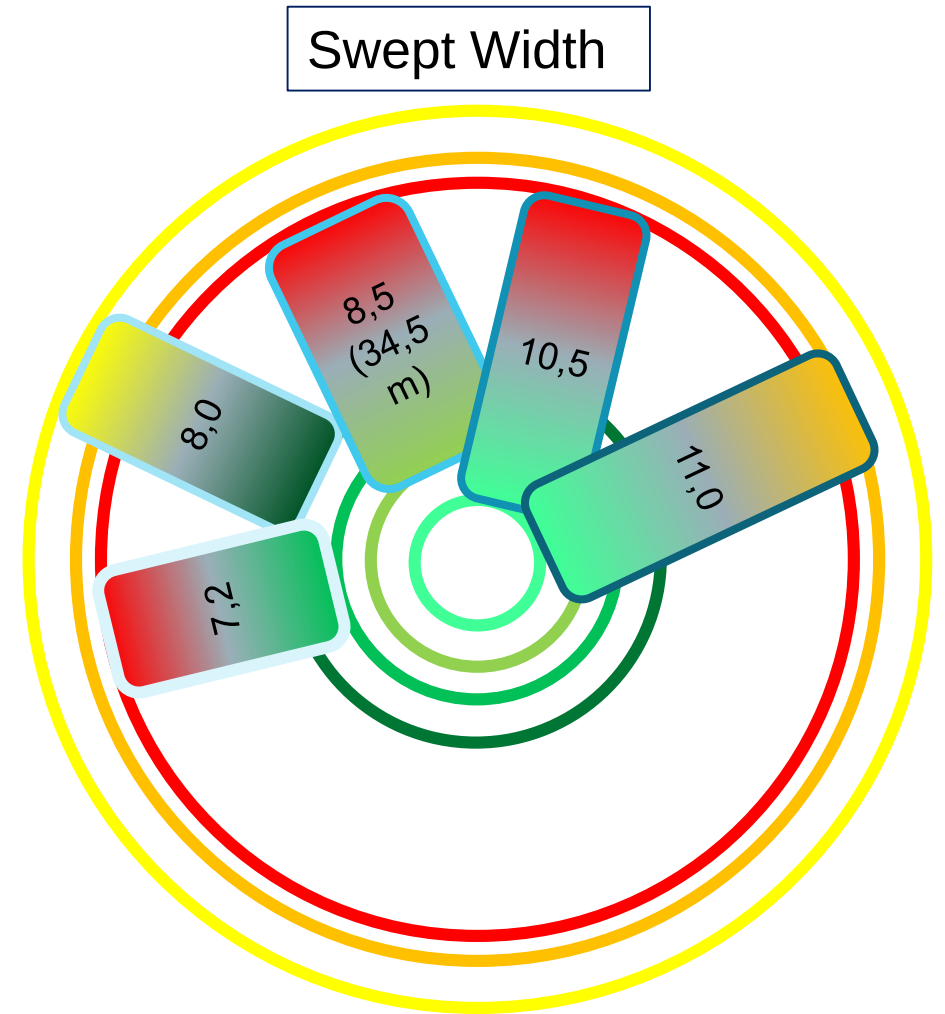
Country	Max length m	Type	Turn Degree	Outer Radius m	Inner Radius m	Outer swing m
Finland	34,5		120	12,5	4	0,8
Finland	34,5		120	12,5	3,7	0
Finland old	25,25		360	12,5	2	
Finland old	16,5/18,75		360	12,5	5,3	
Sweden	25,25		180	12,5	2 ?	
Norway	25,25	MVT1&2	180	12,5	2	
Norway	25,25	MVT3	180	13	2	
Netherlands	25,25		360	14,5	6,5	
Belgium	25,25		360	14,5	6,5	
96/53 EC	EMS 16,5/18,75		360	12,5	5,3	
Germany	25,25		360	12,5	5,3	
Spain	25,25		360	12,5	5,3	
Iceland	25,25		360	12,5	5,3	
Denmark	25,25	Test -no demand set				
Czech Repub	25,25	Test -no demand set				
Estonia	25,25	Test -no demand set				



Framkomlighets krav; svep

Ytter radie & Inner radie

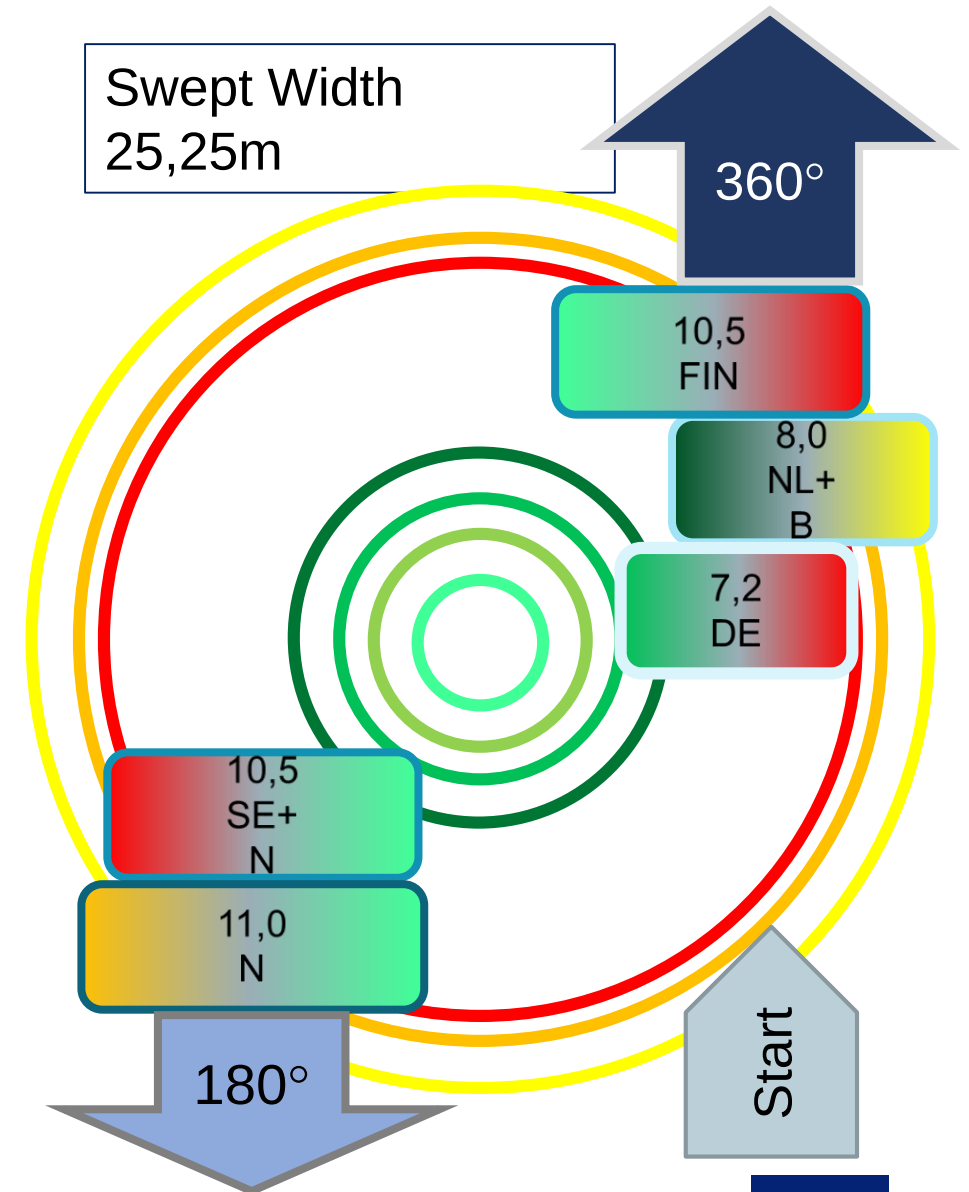
Country	Max length	Type	Turn	Outer Radius	Inner Radius	Outer swing	Swept width
	m		Degree	m	m	m	m
Finland	34,5		120	12,5	4	0,3	8,5
Finland	34,5		120	12,5	3,7	0	8,8
Finland old	25,25		360	12,5	2		10,5
Finland old	16,5/18,75		360	12,5	5,3		7,2
Sweden	25,25		180	12,5	2 ?		10,5
Norway	25,25	MVT1&2	180	12,5	2		10,5
Norway	25,25	MVT3	180	13	2		11
Netherlands	25,25		360	14,5	6,5		8
Belgium	25,25		360	14,5	6,5		8
96/53 EC	EMS 16,5/18,75		360	12,5	5,3		7,2
Germany	25,25		360	12,5	5,3		7,2
Spain	25,25		360	12,5	5,3		7,2
Iceland	25,25		360	12,5	5,3		7,2
Denmark	25,25	Test -no demand set					
Czech Repub	25,25	Test -no demand set					
Estonia	25,25	Test -no demand set					



Framkomlighets krav; svep

Ytter radie & Inner radie

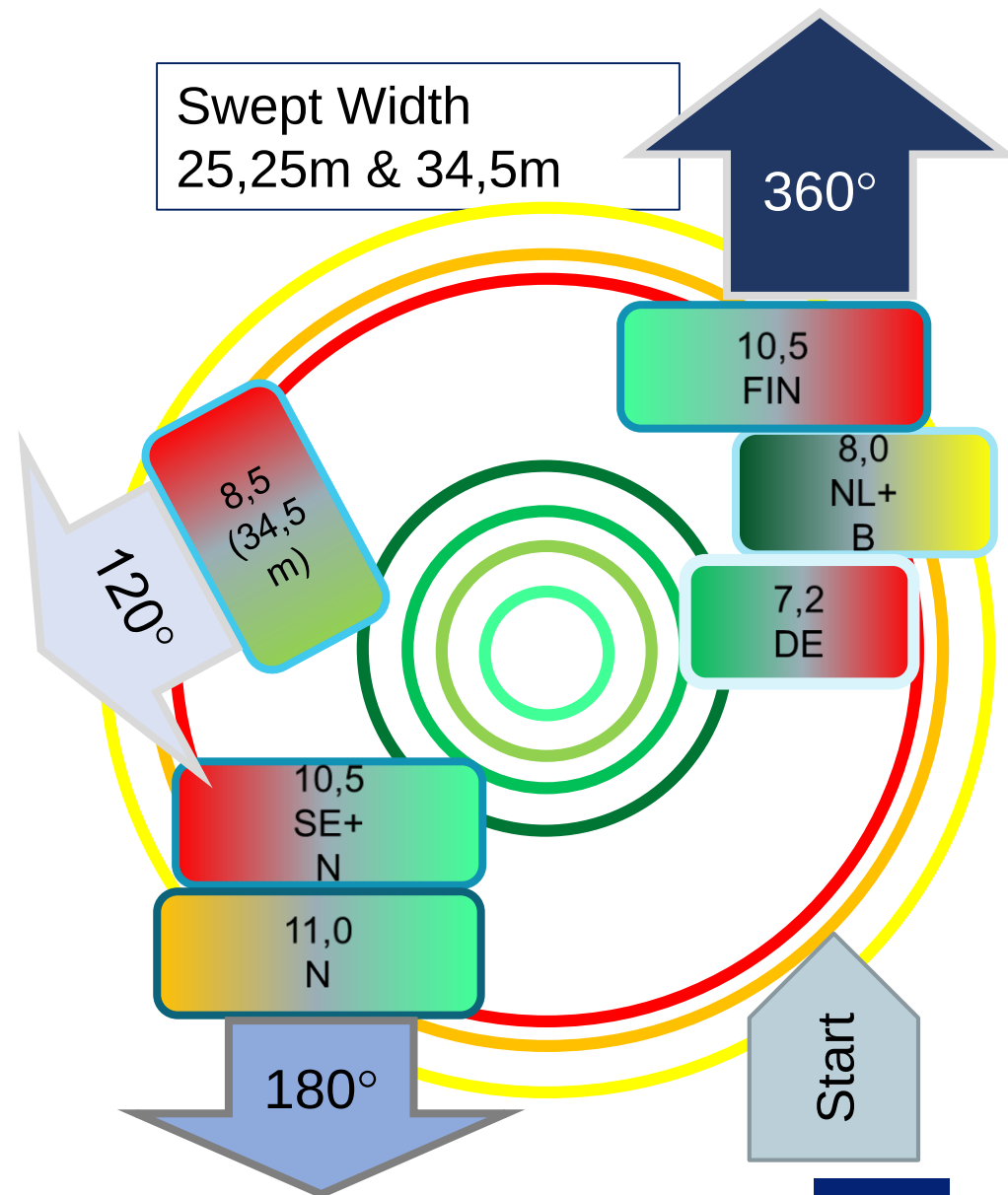
Country	Max length m	Type	Turn Degree	Outer Radius m	Inner Radius m	Outer swing m	Swept width m
Finland	34,5		120	12,5	4	0,8	8,5
Finland	34,5		120	12,5	3,7	0	8,8
Finland old	25,25		360	12,5	2		10,5
Finland old	16,5/18,75		360	12,5	5,3		7,2
Sweden	25,25		180	12,5	2 ?		10,5
Norway	25,25	MVT1&2	180	12,5	2		10,5
Norway	25,25	MVT3	180	13	2		11
Netherlands	25,25		360	14,5	6,5		8
Belgium	25,25		360	14,5	6,5		8
96/53 EC	EMS 16,5/18,75		360	12,5	5,3		7,2
Germany	25,25		360	12,5	5,3		7,2
Spain	25,25		360	12,5	5,3		7,2
Iceland	25,25		360	12,5	5,3		7,2
Denmark	25,25	Test -no demand set					
Czech Repub	25,25	Test -no demand set					
Estonia	25,25	Test -no demand set					



Framkomlighets krav; svep

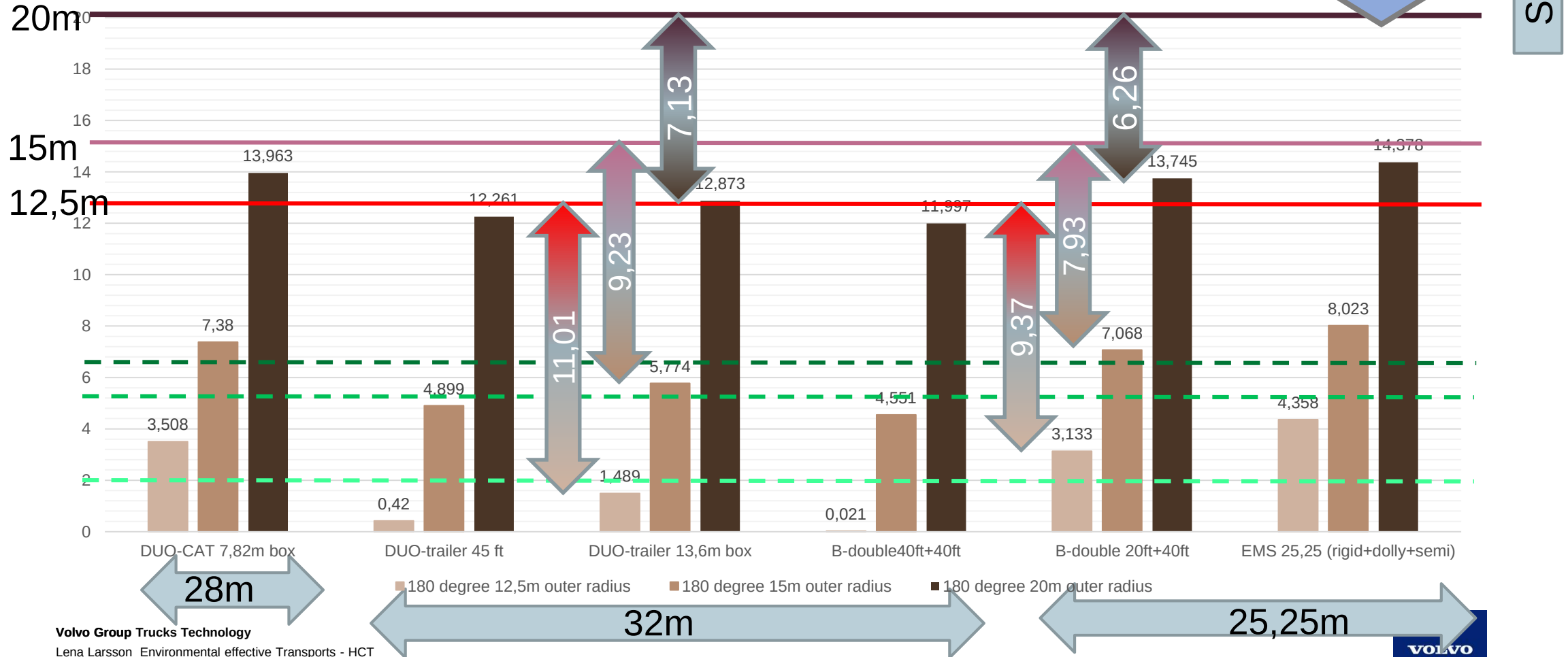
Ytter radie & Inner radie

Turning rules	Max length m	Type	Turn Degree	Outer Radius m	Inner Radius m	Outer swing m	Swept width m
Finland	34,5		120	12,5	4	0,8	8,5
Finland	34,5		120	12,5	3,7	0	8,8
Finland old	25,25		360	12,5	2		10,5
Finland old	16,5/18,75		360	12,5	5,3		7,2
Sweden	25,25		180	12,5	2 ?		10,5
Norway	25,25	MVT1&2	180	12,5	2		10,5
Norway	25,25	MVT3	180	13	2		11
Netherlands	25,25		360	14,5	6,5		8
Belgium	25,25		360	14,5	6,5		8
96/53 EC	EMS 16,5/18,75		360	12,5	5,3		7,2
Germany	25,25		360	12,5	5,3		7,2
Spain	25,25		360	12,5	5,3		7,2
Iceland	25,25		360	12,5	5,3		7,2
Denmark	25,25	Test -no demand set					
Czech Repub	25,25	Test -no demand set					
Estonia	25,25	Test -no demand set					



Svep bredd beroende på ytterradie och fordon vid 180° sväng, Svenska fordon

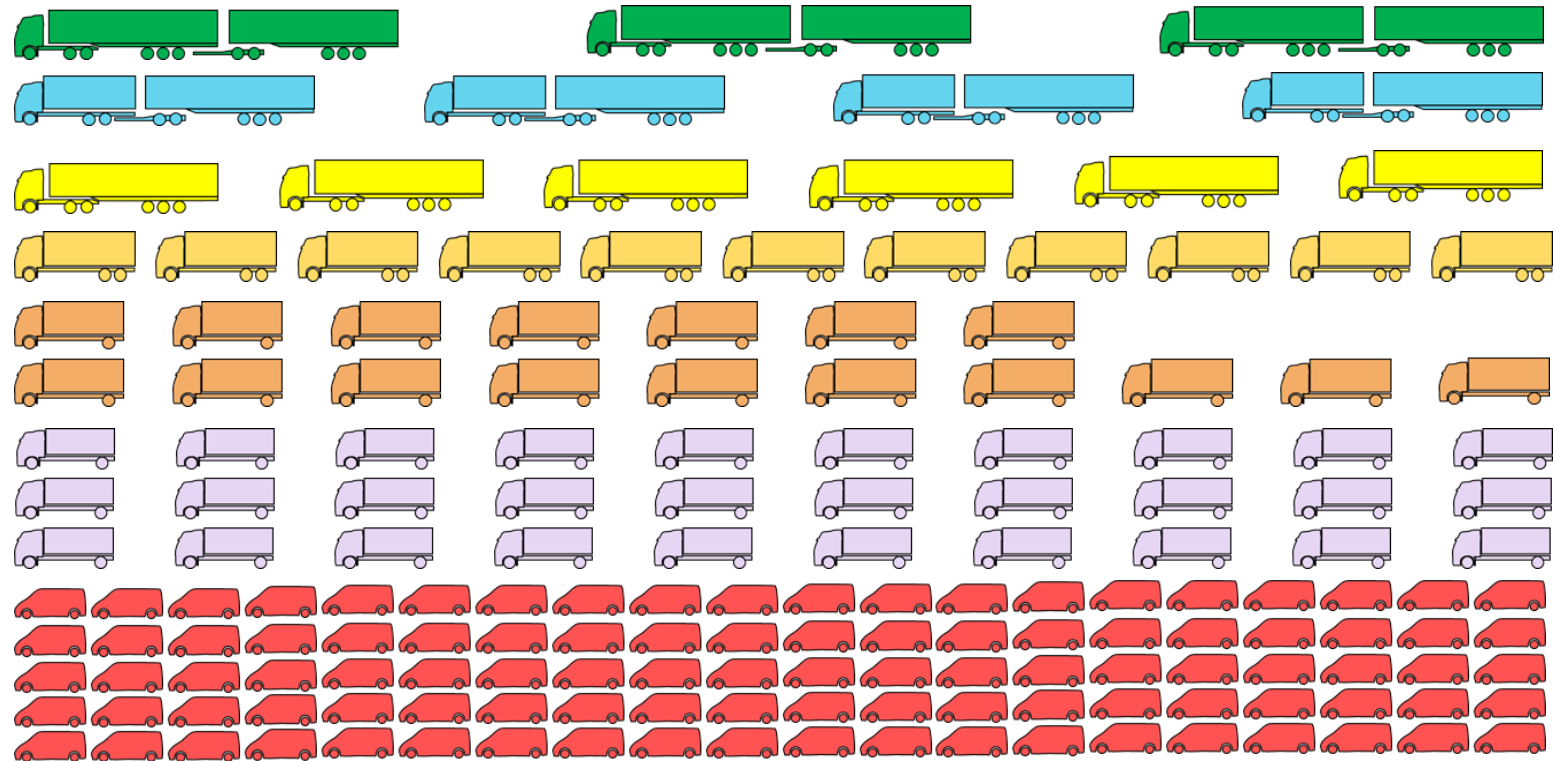
Inner radius & swept 180 degree [m]



Jämförelse HCT “DUO-trailer” – Vanliga fordonskombinationer / fordon

Transport av 200 pallar* mellan Malmö och Göteborg

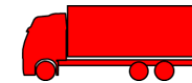
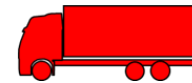
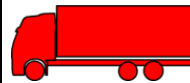
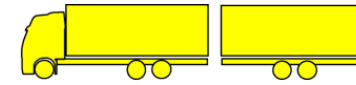
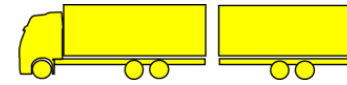
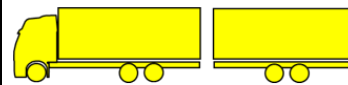
Trucks Drivers	Total space on road	Fuel	Fuel Index	CO ₂ / Pallet	Maximum authorized vehicle weight	EU driving licence
No	meter	ml/tkm	40 t base	kg	tonnes	categorie
3	294	14	72%	7	(76-90)	CE
4	364	15	80%	8	60	CE
6	492	19	100%	10	40	CE
11	836	28	150%	14	26	C
17	1275	34	180%	17	18	C
30	2220	47	250%	25	12	C1E
100	7100	94	500%	48	3,5	B



Comparison of combination

Capacity needed for the transport of 240 m³ furniture

Trucks Drivers	Vehicle Length	Total space on road	Load	Fuel	Fuel Index	Fuel/ Volume	EU driving licence
<i>No</i>	<i>meter</i>	<i>meter</i>	<i>m3</i>	<i>l/100 km</i>	<i>18,75 m Base</i>	<i>ml/m3km</i>	<i>categorie</i>
2	27,5	187	120	41	83%	3,4	CE
3	18,75	254	80	33	100%	4,1	CE
6	10	456	40	25	152%	6,3	C



1. Efficiency comparison of **standard EU combinations** vs **HCT combinations** *boundary conditions for comparison*

 33 p 16,5 meters /

 18 p  18 p 18,75 meters

 33 p  18 p 25,25 meters

 18 p  33 p 25,25 meters

 18 p  18 p  18 p 27,5 meters

 33 p  33 p 32 meters

 33 p  18 p  18 p 34 meters

**Standard
EU comb.**

EMS 1

**HCT
comb.**

- Fuel consumption in comparison calculated previously in the project
- P = pallet
- Recommended safety distance between trucks: 67 meters
(*"3 second rule", 80 km/h = 22,22 m/s → 22.22m/s*3s≈67 m*)
 - 3 seconds 67m
 - 2seconds 44m
- The indexes for comparison is set to 100 for the standard combinations

2. Efficiency comparison of **standard EU combinations** vs **DUO-Trailer combinations (HCT)** *carrying 132 pallets*

4x comb. á 16,5m = 132 pallets of cargo / 267m road space

3 sec 67 m

2 sec 44 m



Truck/driver index: 100

Road space index: 100

Fuel consumption index: 100

2x comb. á 32m = 132 pallets of cargo / 131m road space



Truck/driver index: 50

Road space claim: 59/63

Fuel index: 73

HCT pros

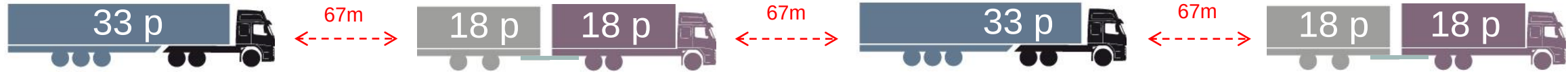
- ✓ 50% less drivers
- ✓ 41% less road space occupied
- ✓ 27% reduction in fuel consumption

3. Efficiency comparison of **standard EU combinations** vs **ETT combinations (HCT)**

carrying 138 pallets

2x comb. á 16,5m + 2x comb. á 18,75m = 138 pallets of cargo / 271,5m road space

3 sec 67 m
2 sec 44 m



Truck/driver index: 100

Road space index: 100

Fuel consumption index: 100

2 truck comb. á 34m = 138 pallets of cargo / 135m road space



Truck/driver index: 50

Road space index: 60/63

Fuel consumption index: 75

HCT pros

- ✓ 50% less drivers
- ✓ 40% less road space occupied
- ✓ 25-30% reduction in fuel consumption

4. Efficiency comparison of standard EU combinations vs DUO-CAT combinations (HCT) carrying 108 pallets

3x 18,75m comb. = 108 pallets of cargo / 190,25m road space



3 sec 67 m
2 sec 44 m

Truck/driver index: 100
Road space index: 100
Fuel consumption index: 100



2x 27,5m comb. = 108 pallets of cargo / 122m road space



Truck/driver index: 66
Road space index: 73 / 76
Fuel consumption index: 80



HCT pros

- ✓ 33% less drivers
- ✓ 27% less road space occupied
- ✓ 20% reduction in fuel consumption

