supergreen

The SuperGreen project

Benchmarking of Corridors

Indrek Ilves, Procter and Gamble

Benchmark Green Corridors

Corridor selection

Ranked and selected corridors

KPIs and methodology

Defined KPIs and the methodology

Benchmark Green Corridors
(Two Deliverables)

D2.4-1

- Description of current status of selected corridors
- Future expectations for selected corridors

COMPLETED (15/12/2010)

D2.4-2

- Calculation and evaluation of Key Performance Indicators

ON-GOING (by 15/04/2011)

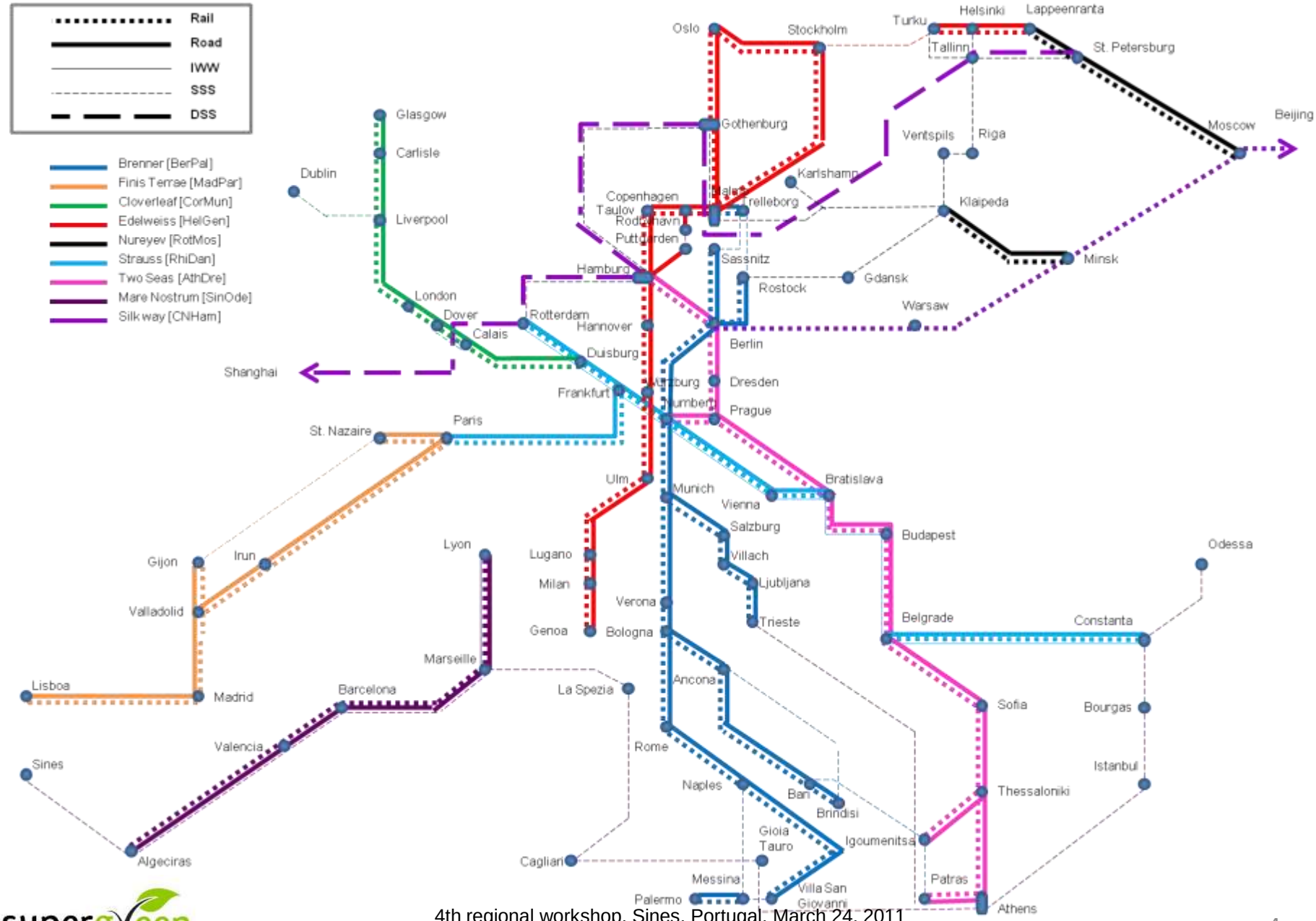
- Four regional workshops

Description of corridors

(Example corridor matrix of Two Seas)

Mode : 1= rail, 2= road, 3=SSS, 4=DSS, 5=IWW, 6= rail+road, 7=rail+SSS, 8=rail+road+IWW, 9=IWW+rail

Node name	Node id	Igoumenitsa	Patras	Athens	Thessaloniki	Sofia	Budapest	Bratislava	Vienna	Prague	Nurnberg	Dresden	Berlin	Hamburg
Igoumenitsa	18													
Patras	19													
Athens	20		6											
Thessaloniki	91	2		6										
Sofia	50				6									
Budapest	51					6								
Bratislava	52						6							
Vienna	92							6						
Prague	53							6						
Nurnberg	54									6				
Dresden	55									6				
Berlin	5											6		
Hamburg	56												6	


Rail
Road
IWW
SSS
DSS
Brenner [BerPal]
Finis Terrae [MadPar]
Cloverleaf [CorMun]
Edelweiss [HelGen]
Nureyev [RotMos]
Strauss [RhiDan]
Two Seas [AthDre]
Mare Nostrum [SinOde]
Silk way [CNHam]
Oslo
Stockholm
Turku
Helsinki
Lappeenranta
Tallinn
St. Petersburg
Moscow
Beijing
Ventspils
Riga
Karlshamn
Klaipeda
Minsk
Gothenburg
Copenhagen
Taulov
Rodbyhavn
Puttgarden
Rostock
Gdansk
Warsaw
Berlin
Sassnitz
Hamburg
Glasgow
Carlisle
Dublin
Liverpool
London
Dover
Calais
Rotterdam
Hannover
Duisburg
Frankfurt
Dresden
Prague
Shanghai
St. Nazaire
Paris
Ulm
Munich
Vienna
Bratislava
Budapest
Salzburg
Villach
Ljubljana
Trieste
Lugano
Milan
Verona
Genoa
Bologna
Lyon
Gijon
Irun
Valladolid
Lisboa
Madrid
Barcelona
Marseille
La Spezia
Ancona
Rome
Naples
Bari
Brindisi
Sines
Valencia
Algeciras
Cagliari
Gioia Tauro
Messina
Palermo
Villa San Giovanni
Igoumenitsa
Patras
Athens
Thessaloniki
Sofia
Belgrade
Constanta
Odessa
Bourgas
Istanbul

Data Collection and Tools

- The first round of data collection has been completed
  - Identified needs of green technologies, ICT solutions and/or policy interventions over the corridors
  - General data, e.g. identified freight volumes and distances
- EcoTransIT World has been chosen as an emission calculator

Calculation and evaluation of KPIs

Started end of November 2010

Two phases:

- Assessment of KPIs at the level of transport chains using the corridor under examination
  - Guidelines and a questionnaire for data collection on transport chains through interviews has been developed
  - Brenner Corridor has been tested as a pilot case
  - Pilot results consulted with stakeholders in Antwerp and Malmo
  - Evaluation and calculation of KPIs for the other corridors
- Aggregating transport chain level KPIs at the corridor level

Assessment of KPIs at transport chain level

For each selected corridor ->

Step 1: Identification of the critical corridor segment
Step 2: Cargo flows along the critical segment
Step 3: Selection of typical cargoes
Step 4: Selection of typical transport chains (10-15)
Step 5: Description of vehicles used
Step 6: Evaluation of selected KPIs on typical transport chains

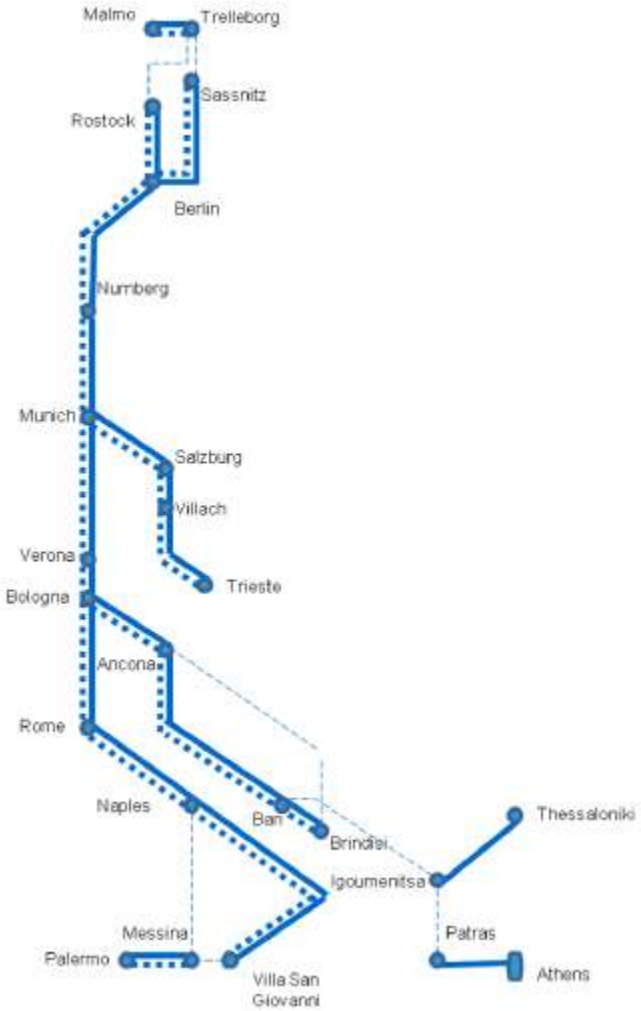
Assessment of KPIs at transport chain level ii

- Evaluation of KPIs is based on interviews with shippers, 3PLs, TSPs, Freight Villages, etc…

- e-mail with brief explanation of project and activity to perform
- phone call to ask information about the availability for the interview
- e-mail with the predesigned questionnaire to fill in
- phone call(s) to collect information and data

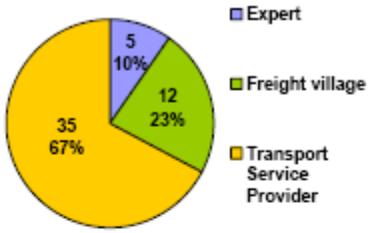
- Using EcoTransIT World for estimating emissions on identified transport chains

Pilot case Brenner

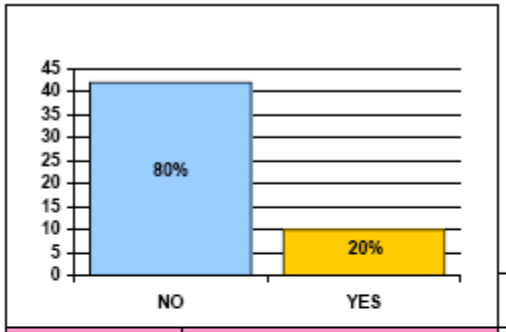


Pilot case Brenner ii

Interviews:



Contacted Companies	
Type of Contact	Total
Expert	5
Freight village	12
Transport Service Provider	35
Total	*52*



Data provided		Type of Contact: Expert	Freight village	Transport Service Provider	Total
No	Confidential data			4	4
	Difficulty to provide data	2	3	6	11
	Not available to provide data		2	12	14
	Starting operational phase		5		5
	Not Useful - Corridor not covered		1	5	6
	Fee requested	1		1	2
	Total	3	11	17	42
Yes	Only KPIs	2			2
	Transport chain+KPIs		1	7	8
	Total	2	1	7	10
	Total	5	12	35	52

Pilot case Brenner iii

TC no	Origin – Destination	Mode	Annual volume (t)	Key Performance Indicators (KPIs)												
				Cost EUR/tkm	Delivery time (h)	Emissions				Reliability	Frequency (If possible no per year)	ICT applications	Cargo Security	Cargo Safety	Congestion	Bottlenecks
						CO2 eq	NOx	SOx	PM10							
1	Verona – Naples	Train	61000	-	12	17,61	0,02	0,09	0,006	92%	260	100%	0%	0%	8%	4
2	Verona – Nurnberg	Train	500000	0,8	9	14,87	0,01	0,05	0,004	50%	260	100%	0%	0%	50%	3
3	Verona – Nurnberg	Train	2700000	0,05	9	14,87	0,01	0,05	0,004	100%	572	100%	0%	0%	50%	3
4	Verona – Berlin*	Road	1100	0,07	25	71,86	0,51	0,08	0,013	50%	2600	0%	0%	0%	50%	1
5	Rome – Nurnberg*	Road	32000	0,05	48	62,08	0,47	0,07	0,013	80%	104	100%	0%	0%	4%	2
6	Rome – Palermo*	SSS	1.500	0,04	24	16,99	0,25	0,12	0,018	100%	52	100%	0%	0%	0%	0
7	Roma – Palermo*	Road	<100	1	48	61,64	0,46	0,07	0,013	25%	52	100%	0%	0%	100%	1
8	Verona – Trelleborg	Train - SSS	13000	0,035	50	10,62	0,01	0,02	0,002	98,80%	624	100%	0,50%	2%	0%	1
9	Bari – Athens*	Road - SSS	10000	0,036	72-96	27,28	0,18	0,08	0,008	95%	52	100%	<0,5	0%	0%	1
10	Bari – Thessaloniki*	SSS - Road	3000	0,028	72-96	42,11	0,29	0,10	0,011	95%	26	100%	<0,5	0%	0%	0
11	Trieste – Munich	Train	81000	-	12	12,53	0,01	0,04	0,003	85%	416	100%	1%	1%	5%	2
12	Trieste – Salzburg	Train	652500	-	8	9,49	0,01	0,05	0,003	90%	208	100%	1%	1%	10%	1
13	Trieste – Villach	Train	135600	-	4	16,36	0,02	0,09	0,006	95%	364	100%	1%	1%	5%	1
14	Berlin – Thessaloniki	Road - SSS	437	0,092	76	27,11	0,19	0,06	0,006	99%	104	0%	<1%	1%	5.88%	2
15	Bari - Berlino	Road	24000	0,05	72	46,51	0,11	0,05	0,004	99%	1040	100%	0%	0%	2%	0
16	Bari - Athens	Road	8500	0,05	24	47,83	0,12	0,05	0,004	99%	520	100%	0%	0%	0%	0

Aggregation of KPIs - Brenner

	Relative cost €/ton-km	CO2 g/ton-km	NOx g/ton-km	SOx g/ton-km	PM g/ton-km	Reliability % of OTD	Frequency x per week	ICT applications % of transport	Cargo Security % of incidents	Cargo Safety % of incidents	Congestion % of time	Bottlenecks Rating
Malmoe-Trelleborg												
Trelleborg-Sassnitz												
Trelleborg-Rostock	0.035	10.619	0.015	0.029	0.002	98.80	12.00	100	0.50	2.00	0	1
Sassnitz-Berlin												
Rostock-Berlin	0.035	10.619	0.015	0.029	0.002	98.80	12.00	100	0.50	2.00	0	1
Berlin-Nurnberg	0.047	36.004	0.091	0.047	0.004	96.79	19.84	96	0.08	0.10	2	0
Nurnberg-Munich	0.162	16.313	0.029	0.047	0.004	90.36	10.40	100	0.02	0.02	48	3
Munich-Salzburg	0.000	12.537	0.017	0.042	0.003	85.00	8.00	100	1.00	1.00	5	2
Salzburg-Villach	0.000	9.938	0.016	0.046	0.003	89.21	4.63	100	1.00	1.00	9	1
Villach-Trieste	0.000	10.487	0.017	0.049	0.004	90.42	5.13	100	1.00	1.00	9	1
Munich-Verona	0.162	16.356	0.029	0.049	0.004	90.91	8.25	100	0.01	0.02	46	3
Verona-Bologna	0.051	36.199	0.156	0.077	0.007	90.62	6.79	99	0.02	0.02	5	2
Bologna-Rome	0.050	32.139	0.174	0.086	0.008	88.17	3.36	100	0.00	0.00	7	3
Rome-Palermo	0.040	16.977	0.256	0.125	0.018	100.00	1.00	100	0.00	0.00	0	0
Rome-Naples	1.000	17.669	0.030	0.092	0.006	91.91	3.99	100	0.00	0.00	8	4
Naples-Villa San Giovanni	1.000	61.678	0.466	0.074	0.013	25.00	0.01	100	0.00	0.00	100	1
Villa San Giovanni-Messina	1.000	61.678	0.466	0.074	0.013	25.00	0.01	100	0.00	0.00	100	1
Messina-Palermo	1.000	61.678	0.466	0.074	0.013	25.00	0.01	100	0.00	0.00	100	1
Naples-Messina												
Bologna-Ancona	0.051	45.915	0.113	0.054	0.004	99.00	18.50	97	0.08	0.08	2	0
Ancona-Bari	0.050	46.512	0.111	0.054	0.004	99.00	20.00	100	0.00	0.00	2	0
Bari-Patras	0.050	47.833	0.120	0.060	0.004	99.00	10.00	100	0.00	0.00	0	0
Ancona-Igoumenitsa	0.092	27.120	0.195	0.057	0.006	99.00	2.00	0	1.00	1.00	6	2
Ancona-Brindisi												
Bari-Igoumenitsa	0.028	42.089	0.291	0.104	0.011	95.00	0.50	100	0.50	0.00	0	0
Bari-Brindisi	0.036	27.277	0.181	0.089	0.008	95.00	1.00	100	0.50	0.00	0	1
Brindisi-Patras	0.036	27.277	0.181	0.089	0.008	95.00	1.00	100	0.50	0.00	0	1
Igoumenitsa-Thessaloniki	0.053	36.341	0.254	0.086	0.009	96.87	1.20	62	0.73	0.47	2	1
Igoumenitsa-Patras												
Patras-Athens	0.046	42.574	0.135	0.067	0.005	97.02	5.54	100	0.25	0.00	0	0
Corridor average:	**0.209**	**31.409**	**0.159**	**0.066**	**0.007**	**85.87**	**6**	**94**	**0.32**	**0.36**	**19**	**1.26**

Corridor characteristics

Corridor average speed:	**64.43**	km/h
Annual number of shipments:	**9061**	no
Annual freight volume estimation:	**4224**	tons (000's)
Annual transport work:	**2520.67**	tkm (million)

Assumed total freight volume in the corridor: over 50 milion tons

Aggregation of KPIs - Analysis

- Weaknesses:
  - No consistent input data on transport chain level (mixture of qualitative and quantitative KPI values)
  - Conversion of qualitative indicators to quantitative indicators is required
  - Different type of transport chain examples and size of consignments
  - Small number of examples compared to the total annual freight volume in the corridor
- Strength:
  - Allows to show KPIs in one number
- We recommend to use ranges of KPI values as benchmarks for corridors!

Benchmarks for Brenner

	Intermodal	Road	Rail	SSS*
CO2 (g/tkm)	10.62-42.11	45.51-71.86	9.49-17.61	16.99
SOx (g/tkm)	0.02-0.10	0.05-0.08	0.04-0.09	0.12
Cost (€/tkm)	0.028-0.092	0.05-0.06	0.05-0.80	0.04
Reliability **	95-99	60-99	60-95	100
Frequency	26-624	52-2600	208-572	52

Nureyev

TC no	Origin – Destination	Mode	Annual volume (t)	Key Performance Indicators (KPIs)												
				Cost EUR/tkm	Delivery time (h)	Emissions (g/tkm)				Reliability	Frequency (If possible no per year)	ICT applications	Cargo Security	Cargo Safety	Congestion	Bottlenecks
						CO2 eq	NOx	SOx	PM10							
1	Hamburg-Moscow	IT	600 000	0,179 eur	120	33,36	0,34	0,15	0,02	90%	360	100%	0,1%	1 %	10%	2
2	Hamburg-Moscow	IT	300 000	0,158 eur	168	16,02	0,13	0,03	0,01	90%	360	100%	0,1%	1%	10%	2
3	Hamburg-Moscow	IT	1 000 000	0,152 eur	120	28,71	0,28	0,12	0,01	90%	360	100%	0%	1%	30%	2
4	Hamburg-St.Petersburg	SSS	125 000	-	120	5,65	0,12	0,07	0,01	90%	156	100%	0,1%	1%	10%	2
5	Rotterdam-Helsinki	SSS	1 000 000	0,051 eur	72	10,48	0,23	0,14	0,02	90%	360	100%	0,1%	1%	10 %	1
6	Hamburg-Helsinki	IT	2 000 000	0,099 eur	28,5	13,43	0,24	0,13	0,02	90%	360	100%	0,1%	1%	10%	1
7	Gothenburg-Rotterdam	SSS	230 000	-	48	10,46	0,23	0,14	0,02	90%	156	100%	0%	1%	1%	0
8	Rotterdam-Moscow	IT	1 000 000	0,130 eur	96	25,82	0,28	0,12	0,01	80%	156	100%	0%	0%	40%	1
9	Hamburg-Helsinki	SSS	230 000	0,064 eur	60	10,15	0,23	0,14	0,02	90%	360	100%	0,1%	1%	10%	1
10	St.Petersburg-Helsinki	SSS	190 000	-	24	15,60	0,26	0,14	0,02	99,9%	52	0%	0%	0%	0%	0

Qualitative indicators are marked in red

Benchmarks for Nureyev

	Intermodal	Road	Rail	SSS
CO2 (g/tkm)	13.43-33.36	-	-	5.65-15.60
SOx (g/tkm)	0.03-0.13	-	-	0.07-0.14
Cost (€/tkm)	0.10-0.179	-	-	0.05-0.06
Reliability	80-90	-	-	90-99.9
Frequency	156-360	-	-	52-360

Cloverleaf

TC no	Origin – Destination	Mode	Annual volume (t)	Key Performance Indicators (KPIs)											
				Cost EUR/tkm	Delivery time (h)	Emissions (g/tkm)				Reliability	Frequency (If possible no per year)	ICT applications	Cargo Security	Cargo Safety	Congestion	Bottlenecks
						CO2 eq	NOx	SOx	PM10							
1	Rugby-Carlisle	Rail	194,000	n/a	8	18.45	0.016	0.014	0.0014	97%	312	0	0	0	37.50%	3
2	Midlands-Glasgow	Rail	78,000	0.05	10	18.46	0.016	0.014	0.0014	98%	156	0	0	0	5%	0
3	Duisburg-Midlands	Rail	68,000	0.095	20	13.14	0.017	0.021	0.0018	90%	156	0	0	0	20%	1
4	Midlands-Glasgow	Rail	480,000	n/a	8	18.46	0.016	0.014	0.0014	98%	364	own	0	0	40%	2
5	Dusiburg-London	Road	112,350	0.06	10	68.81	0.505	0.091	0.0153	80%	4680	own	3%	1-2%	20-25%	3
6	London-Glasgow	Road	n/a	n/a	12	n/a	n/a	n/a	n/a	90%	n/a	own	1%	1%	20-25%	4

Qualitative indicators are marked in red

Benchmarks for Cloverleaf

	Intermodal	Road *	Rail	SSS
CO2 (g/tkm)	-	68.81	13.14-18.46	-
SOx (g/tkm)	-	0.091	0.014-0.021	
Cost (€/tkm)	-	0.06	0.05-0.09	-
Reliability	-	80-90	90-98	-
Frequency	-	4680	156-364	-

* One transport chain evaluated

Mare Nostrum

TC no	Origin – Destination	Mode	Annual volume (t)	KPIs											
				Cost EUR/tkm	Delivery time (h)	Emissions (g/tkm)				Reliability	Frequency (If possible no per year)	ICT applications	Cargo Security	Cargo Safety	Congestion	Bottlenecks
						CO2	NOX	SOX	PM10							
1	East of Suez /West of Gibraltar - Port Said/Beirut/Malta/ Gioia Tauro - West of Gibraltar /East of Suez	DSS	10 Million Tonnes	Not reported	Not reported	15.22	0.4	0.22	0.035	If delay is caused during loading/ unloading.	Not reported	Ship tracking at origin/destination	>1%	>1%	Loading/Unloading delays.	No weather problems reported.
2	Port Said/Beirut/Malta/ Gioia Tauro – all Mediterranean ports	SSS	<= 1 Million Tonnes	0.0025-0.0035	55	27.26	0.7	0.4	0.058	If delay is caused during loading/ unloading.	52	Ship tracking at origin/destination	>1%	>1%	Loading/Unloading delays.	No weather problems reported.
3	Istanbul - Trieste - Istanbul (literature data & interview)	SSS	100000 trailers	0.012	54	33.09	0.86	0.3	0.06	If a delay due to weather is caused, then: 10% delay (4 hours)	365	Ship tracking at origin/destination	>1%	>1%	Loading/Unloading roro requires 12 hrs in average	Rough sea at the entrance to the Adriatic Sea from the Ionian Sea.
3	Barcelona - La Spezia – Barcelona	SSS	<= 1 Million Tonnes	30% cheaper than road transport	Same as for road	27.26	0.7	0.4	0.058	If delay is caused during loading/ unloading.	183	Ship tracking at origin/destination	>1%	>1%	Loading/Unloading delays.	No weather problems reported.
4	Piraeus/Istanbul - Gioia Tauro (or Malta, or Taranto) - Barcelona/Valencia – Piraeus/Istanbul	SSS	<= 1 Million Tonnes	0.0025-0.0035	55	27.26	0.7	0.4	0.058	Not reported	52	Ship tracking at origin/destination	>1%	>1%	Loading/Unloading delays.	No weather problems reported.

Qualitative indicators are marked in red

Benchmarks for Mare Nostrum

	Rail	Road	DSS	SSS
CO2 (g/tkm)	-	-	15.22	27.26-33.09
SOx (g/tkm)	-	-	0.22	0.30-0.40
Cost (€/tkm)	-	-	-	0.0025-0.012
Reliability	-	-	-	-
Frequency	-	-	-	52-365

Strauss

TC no	Origin – Destination	Mode	Annual volume (t)	Key Performance Indicators (KPIs)												
				Cost EUR/tkm	Delivery time (h)	Emissions (g/tkm)				Reliability	Frequency (If possible no per year)	ICT applications	Cargo Security	Cargo Safety	Congestion	Bottlenecks
						CO2	NOx	SO2	PM							
1	Rotterdam – Duisburg	IWT	Not reported	0.0207	Not reported	24.407	0.314	0.157	0.0104	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported
2	Rotterdam - Großkotzenburg am Main	IWT	Not reported	0.0169	Not reported	24.408	0.314	0.1579	0.0104	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported
3	Rotterdam - Duisburg	IWT	Not reported	0.4378	Not reported	24.40	0.314	0.1579	0.010	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported
4	Rotterdam – Basel	IWT	Not reported	0.2192	Not reported	24.135	0.314	0.157	0.0104	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported
6	Linz – Nuremberg	IWT	Not reported	0.0279	Not reported	24.43	0.31	0.16	0.01	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported
	Százhalombatta, Hungary - Korneuburg, Austria	IWT	Not reported	0.0136	Not reported	24.40	0.31	0.16	0.010	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported
	Rotterdam - Enns, Austria	IWT	Not reported	0.0056	Not reported	24.40	0.31	0.16	0.010	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported
	Izmail, Ukraine - Linz, Austria	IWT	Not reported	0.0037	Not reported	26.63	0.41	0.17	0.012	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported
	Rotterdam - Linz, Austria	IWT	Not reported	0.0057	Not reported	55.93	0.86	0.36	0.025	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported

Benchmarks for Strauss

	Intermodal	Road	Rail	IWT
CO2 (g/tkm)	-	-	-	24.14-55.93
SOx (g/tkm)	-	-	-	0.157-0.360
Cost (€/tkm)	-	-	-	0.004-0.44
Reliability	-	-	-	-
Frequency	-	-	-	-

Examples of indicative CO2 emission factors

Published Emission Factors for Heavy Articulated Truck

organisation	gCO_2/tonne-km	assumptions about vehicle loading
NTM	59	60% utilisation
IFEU	66	average
Tremove	77.2	
DEFRA	82	> 32t GVW/27% empty running/59% load factor
INFRAS	91	
ADEME	109	max load 25t/21% empty running/57% load factor

Source: Alan McKinnon

Examples of indicative CO2 emission factors i

Published Emission Factors for Rail Freight Movement (gCO_2/ tonne-km)

organisation	all rail freight	diesel-hauled	electric-hauled
ADEME	7.3	55	1.8
NTM	15	21	14
AEA Technology	20		
DEFRA	21		
INFRAS	22.7	38	19
TRENDS	23		
Tremove	26.3		
IFEU		35	18
McKinnon/EWS		18.8	

Source Alan McKinnon

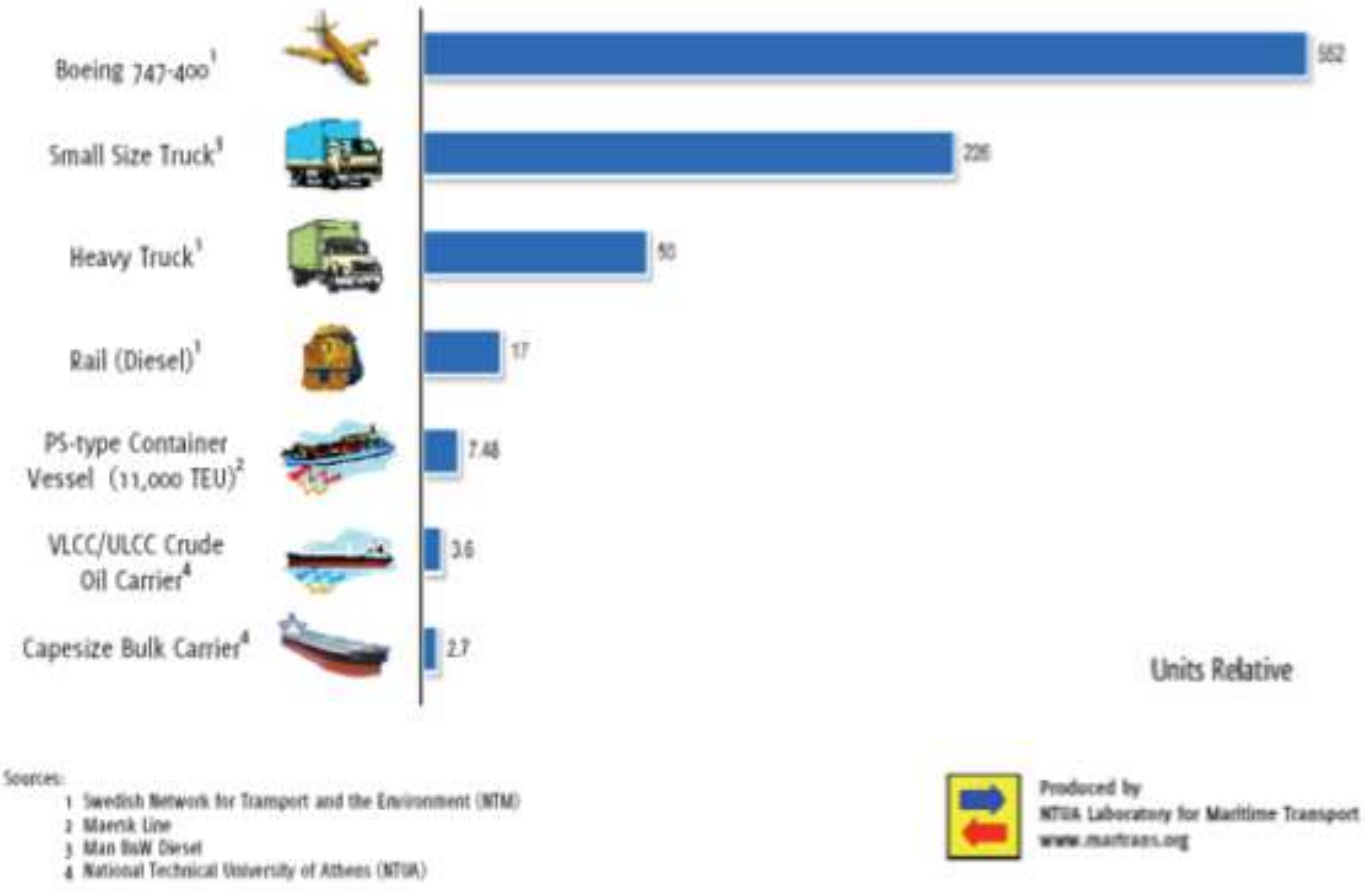
Examples of indicative CO2 emission factors ii

Published Emission Factors for Maritime Transport

	gCO_2/tonne-km	Source
Bulk ship		
Small tanker (844 tonnes)	20	DEFRA
Large tanker (18371 tonnes)	5	DEFRA
Small (solid) bulk vessel (1720 tonnes)	11	DEFRA
Large (solid) bulk vessel (14201 tonnes)	7	DEFRA
Container vessels		
Small container vessel (2500 tonnes)	13.5	DEFRA
Larger container vessel (20000 tonnes)	11.5	DEFRA
Average deep-sea container vessel	8.4	BSR/Clean Cargo
(assuming mean 11 tonne load per TEU)		
Deep-sea tanker (120,000 tonnes)	5	NTM
All Maritime	**14**	**TRENDS**

Source: Alan McKinnon

Examples of indicative CO2 emission factors ii



Finalization of the task

- Finalization of the benchmarking report
  - using six corridors for testing purposes
- Interpret the results: why difference in KPIs? What are the main factors? What do they mean?
- Dig into raw data
- Connect with other WPs (WP3: technologies, WP4: ICT)

THANK YOU!

Indrek Ilves
ilves.i@pg.com