EMISSION AND EMISSIONS FACTORS IN TRANSPORTATION

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- Oxides of carbon CO_2, CO, CH_4 are significant problem
- Last 250 years only constant growth
- Total emission 2012 was 6.526 mil.metric tons CO2
- In period 1960-2007 emssions was 10 time more than two century before
- Traffic and transport participate 19,6 – 21 % on total emission (in different country)
- EU-27 planed to reduce from 130 on 95 gCO2/km till 2020 and 80-95% till 2050, based 2010

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Year	Imissions CO_2 (ppmv)			Mass fraction (%) CO_2 (ppm)	Mass CO_2 in atmosphere (t)
1750	A		278	422.2	2.173E+12
1960	B		310	470.8	2.423E+12
2014 (Mart)	C		399	581,7	2.993E+12
2100	D	(i)	541	821.7	4.228E+12
		(ii)	970	1473.2	7.581E+12

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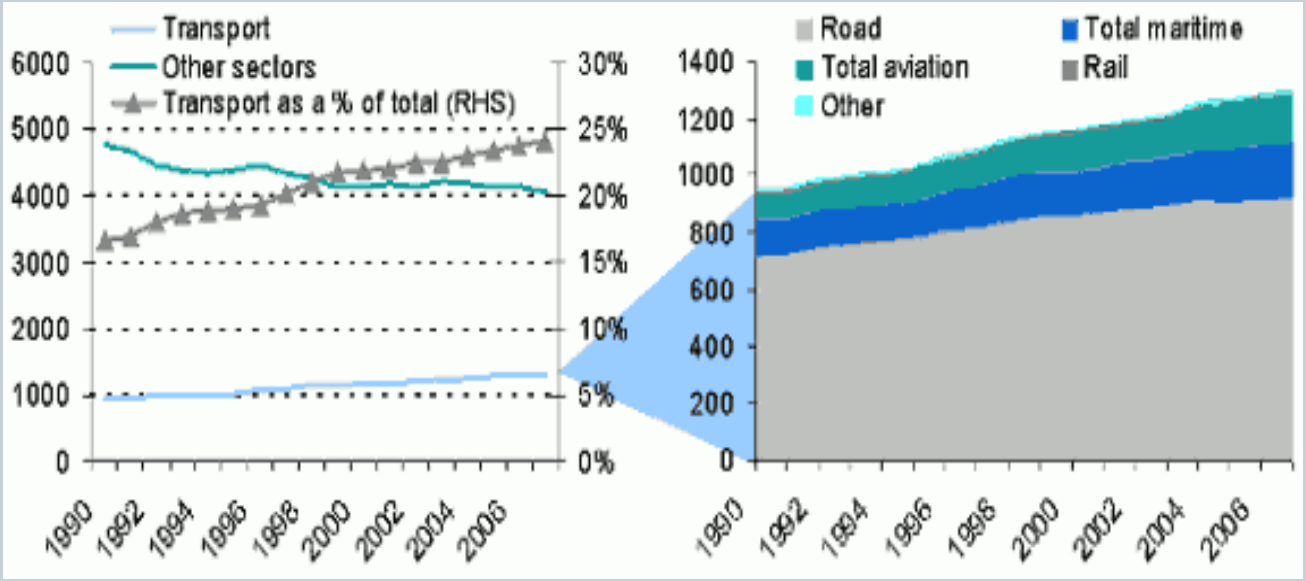

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- Different goal and strategies:
- *ZEV – Zero Emission Vehicle*),
- *NZEV* – Near *ZEV near minimum*
- *EZEV* – Equivalent minimum emissions.
- linking and optimization of transport chains, improved planning processes, increase actual payload, minimizing downtime, increase the fuel efficiency of the vehicle, reduces the intensity of the carbon

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- Reduction emssion- Reduction transport cost
- EU-27 make all mode 3.821,5 billions tkm/2011, more than 25% from 1995
- In road transport 13% (0,86+8,42) bigger prices
- Road transport have 0,23 USD/tkm/1734/2011
- In railway transport 9,3% to 22,6% bigger prices
- Railway have 0,03 to 0,04 USD/tkm/420/2011

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Added cost / Mode	Accident	Air polution	Greenhouse efect	Noise	Total USD/tkm
Road truck	0,59	0,08	0,15	0,04	0,86
Clasic train	0,17	0,01	0,02	0,04	0,24
Shuttle train	0,17	0,01	0,02	0,04	0,24
Intermodal train	0,17	0,02	0,02	0,04	0,25
Double-stack train	0,17	0,01	0,02	0,04	0,24

- **Important to identify pollutants**
- Group 1. contaminants detailed methodology is *based on specific emission factors*, which includes a variety of traffic conditions (city or out of city driving, highway driving) and engine speeds,
- Group 2 pollutants whose emissions are estimated based on fuel consumption (results very similar group 1)
- Group 3 contaminants in applied analysis levels 1 and/or 2, and Group 4 contaminants that are part of the total emissions of NMVOC (Non-Methan Volatiles Organic Compaund).

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- Emission factor (Ef) is expressed in different units (gCO2/truck-train, g-kg-tCO2/km, g-kg-tCO2/tkm, kgCO2/TEU, kgCO2/kg diesel, etc.) x period
- Ef can used as a "STANDARD“ are consistent with the IPCC principles/2006 or via LCA (Life Cycle Assessment), More better
- In road traffic Ef depends on many factors: type of vehicle, type of road, capacity, modes of driving, fuel quality (weight or volume), the consumption of the sub-categories (Conventional, Euro and the EURO IV and EURO V-VI), the number of vehicles, the average distance traveled.....ecc

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Mass (t)	% km empty										
	0%	5%	10%	15%	20%	25%	30%	35%	40%	45%	50%
10	81,0	84,7	88,8	93,4	98,5	104,4	111,1	118,8	127,8	138,4	151,1
11	74,8	78,2	81,9	86,1	90,8	96,1	102,1	109,1	117,3	127,0	138,6
12	69,7	72,8	76,2	80,0	84,3	89,2	94,7	101,1	108,6	117,5	128,1
13	65,4	68,2	71,4	74,9	78,9	83,4	88,5	94,4	101,3	109,5	119,3
14	61,7	64,4	67,3	70,6	74,2	78,4	83,2	88,7	95,1	102,7	111,8
15	58,6	61,0	63,8	66,8	70,3	74,2	78,6	83,7	89,7	86,8	105,3
16	55,9	58,2	60,7	63,6	66,8	70,5	74,6	79,5	85,1	91,7	99,7
17	53,5	55,7	58,1	60,8	63,8	67,2	71,2	75,7	81,0	87,2	94,7
18	51,4	53,5	55,8	58,3	61,2	64,4	68,1	72,4	77,4	83,3	90,4
19	49,6	51,5	53,7	56,1	58,8	**61,9**	65,4	69,5	74,2	79,8	86,5
20	48,0	49,8	51,9	54,2	56,8	59,7	63,0	66,9	71,4	76,7	83,0
21	46,6	48,3	50,3	52,5	54,9	57,7	60,9	64,5	68,8	73,9	80,0
22	45,3	47,0	48,8	50,9	53,3	55,9	59,0	62,5	66,5	71,4	77,2
23	44,2	45,8	47,6	49,6	51,8	54,3	57,2	60,6	64,5	59,1	74,7
24	43,2	44,7	46,4	48,3	50,5	52,9	55,7	58,9	62,7	67,1	72,4
25	42,3	43,8	45,4	47,3	49,3	51,7	54,3	57,4	61,0	65,2	70,3
26	41,5	42,9	44,5	46,3	48,3	50,5	53,1	56,0	59,5	63,6	68,5
27	40,8	42,2	43,7	45,4	47,3	49,5	52,0	54,8	58,1	62,1	66,8
28	40,2	41,5	43,0	44,6	46,5	48,6	51,0	53,7	56,9	60,7	65,3
29	39,7	41,0	41,4	44,0	45,7	47,8	50,1	52,7	55,8	59,5	63,9

- In water transport, many questions, also:
- is done upstream or downstream river/chanel
- size of barges (male 90 TEU, 208 TEU medium, large 500 TEU)
- What is the larger barge and sail downstream emission factor is smaller, small barge upstream emission factor is biger

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Ship	weight	Emission factor
Tanker	0 - 60000 + dwt	5,7 - 45,0
Tanker for Chemical materials	0 - 20000 + dwt	8,4 - 22,2
LPG tankeri	0 - 49,999 + m^3	9 - 43,5
LNG tankeri	0 - 200.000 m^3	11,9 - 14,5
General goods	0 - 9.999+ dwt + TEU	11,9 - 19,8
Ship with cooling	All	12,9
Container	8000 + TEU	12,5
Container	5000 - 7999 TEU	16,6
Container	3000 - 4999 TEU	16,6
Container	2000 - 2999 TEU	20,0
Container	1000 - 1999 TEU	32,1
Container	0 - 999 TEU	36,3
Ro-Ro	2000 + lm	49,5
Ro-Ro	0 - 1999 lm	60,3

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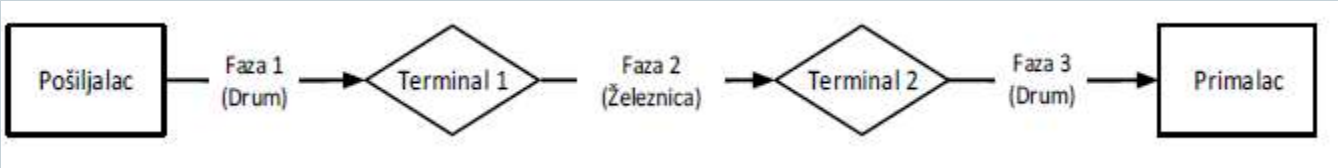

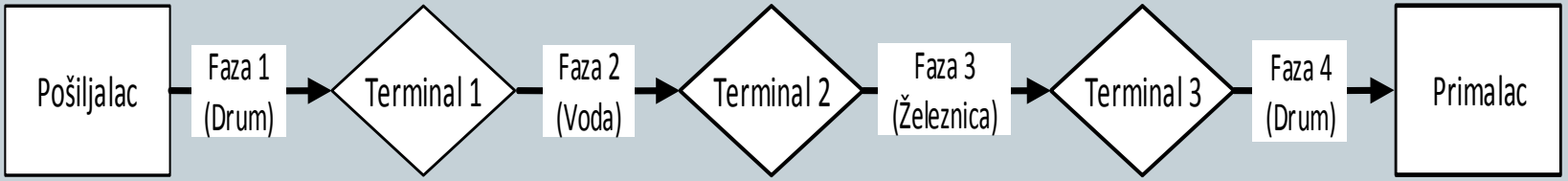

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- Rail transport, also many questions:
- type of traction (diesel, electric) 75% and diesel fueled 25% of the lines in most European countries. SRB.3809 km sa elektro vučom 1279 km (33%).
- length and gross weight of the train (train weight 1500 brt.tona consumes 17.6 (Wh/brtkm), 1000 brt.tona consumes 21.0 (Wh/brtkm), 600 brt.tona consumes 26.7 (Wh/brtkm) (NTM Rail, 2008)
- type of locomotive and consumption, type of cargo, the spatial position of the railroad, the existing transportation restrictions, the number of states and fridge circuits

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Bi Modal technology Road-Railway-Road	Mode	Distance in road transportu (% total distance)			
		5%	**10%**	15%	20%
	Railway (average)	24.0	**26.0**	28.0	30.0
	Electro train (average EU)	21.2	**23.3**	25.2	27.6
	Disel train	25.9	**27.8**	29.7	31.6
	Ro-Ro - Železnica	38,3	**39,5**	40,8	42,0

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Intermodal Technology	Transport vehicles	Distance truck in total transport distance %			
		5%	10%	15%	20%
Truck/Barža		**32,6**	34.1	35.7	37.2
Drum/Water technology in short distance	RoRo-Truck	**49,7**	50.3	51.0	51.6
	RoRo-Rail	**38.3**	39.5	40.8	42.0
	Small tanker (till 844 t)	**22.1**	24.2	26.3	28.4
	Big tanker (till 18371 t)	**7.9**	10.7	13.6	16.4
	Small bulk whicle (till 1720 t)	**13.6**	16.1	18.7	21.2
	Big bulk vehickle (14201 t)	**9.8**	12.5	15.3	18.0
	Small container ship (till 2500 TEU)	**15.9**	18.4	20.8	23.2
	Big contener ship (20000 TEU)	**14.0**	16.6	19.1	21.6
	Other vehicles on short distance	**18.3**	20.6	22.9	25.2

- **CONCLUSION**

- Gases that produce the greenhouse effect (Co2,CH4)
- ARTEMIS (Appendix 4, CO2 Emission Estimation Methodology for Road Transport, 2008),
- STREAM (Study on The transport Emissions of All Modes), EcoTransIT, GHG Protocol, NTM (Road methodology in 2007, 2008 and NTMWater NTM NTMRail 2008 et al.)
- Base standard ISO 14064:2006.
- COPERT IV model of the European environment Agency with three methods TIER 1-3 [7].

- high correlation between emissions and fuel characteristics with HTV of diesel fuel.
- With increasing capacity and reducing the actual distance traveled in an empty condition, a significant reduction in CO2 emissions that can be characterized by a negative exponential distribution.
- For detailed assessment shows the structure of the transport chain, technology, logistics provider, with the degree of separation by type of vehicle, etc.,
- Must supported by solid data base on the technical characteristics of the technological elements, change the factors that are variable and which are used in the assessment, with mandatory comparison of the technologies, forms and directions.

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- THANK YOU FOR YOUR ATTENTION
- ANY QUESTION PLEASE