

# ROAD VERSUS SHORT SEA SHIPPING: COMPARING EMISSIONS AND EXTERNAL COSTS

Kris Vanherle  
Eef Delhaye

# Outline

- Introduction
- Methodology
- Results
- Conclusions

# Introduction

- Objective: “fair comparison”:
  - Same origin-destination
  - Real world freight flows
  - Taking into account every segment of the route
    - Ferry’s
    - Feeder transport



# Introduction

- Objective: “fair comparison”:
  - Same origin-destination
  - Real world freight flows
  - Taking into account every segment of the route
  - considering real world transport equipment deployed

# Introduction



Lloydsnr.	9355460
YOB	2006
vesseltype	Container ship
length	139.6 m
GRT	8.246 ton
DWT	11.159 ton
installed main engine power	8400 kW
main engine type	4 stroke
installed auxiliar engine power	2x 437 kW
auxiliar engine type	4 stroke



Lloydsnr.	9259501
YOB	2004
vesseltype	ro-ro
length	199.8 m
GRT	32.289 ton
DWT	-
installed main engine power	20.070 kW
main engine type	2 stroke
installed auxiliar engine power	7.330 kW
auxiliar engine type	4 stroke



Lloydsnr.	9155107
YOB	1997
vesseltype	Container
length	195.7 m
GRT	29.115 ton
DWT	40.010 ton
installed main engine power	23.920 kW
main engine type	2 stroke
installed auxiliar engine power	4.140 kW
auxiliar engine type	4 stroke

# Introduction

- Objective: “fair comparison”:
  - Same origin-destination
  - Real world freight flows
  - Taking into account every segment of the route
  - Considering real world transport equipment deployed
  - Real world load factors
- Emission calculation:
  - Totals for whole route
  - Per tkm (crow’s flight)

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# Methodology

- Input & assumptions:
  - Only direct emissions considered
  - Input data supplied by race participants
    - ROAD: distances & speeds, fuel consumption, ...
    - SSS: sailing times, engine load, fuel consumption, ...

# Methodology

- Calculation ROAD:
  - REMOVE – COPERT IV methodology
    - Truck type
    - Emission abatement technology (EURO standards)
    - Load factor
    - Road gradient
    - Speed
  - Calculation with model approach + correction to fit with reported fuel consumption figures (10-18% deviation)

# Methodology

- Calculation SSS:
  - EMMOSS formula's:
    1. Energy consumption (kWh) = time (h) X installed engine power (kW) X engine load (%)
    2. Fuel consumption (kg) = energy consumption (kWh) X energy density (kg/kWh) X yield
    3. Emissions (kg) = fuel consumption (kg) X emission factor (kg/kg) X correction factor

# Methodology

- Calculation SSS:
  - Calculation with model approach + correction to fit with reported fuel consumption figures (5% deviation)
  - including ferry's (ROAD)

# Methodology

- External costs SSS:
  - Only emissions
  - Monetary value attributed to emissions
  - Taking into account emission dispersion
- External costs ROAD:
  - Emissions: same approach as SSS
  - Other cost components (congestion, accidents, noise, infrastructure): indicator values from literature

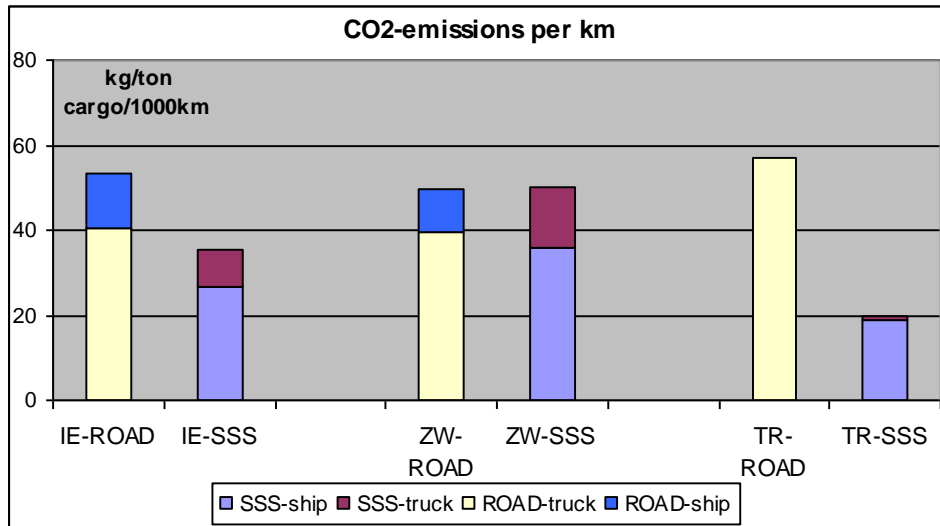
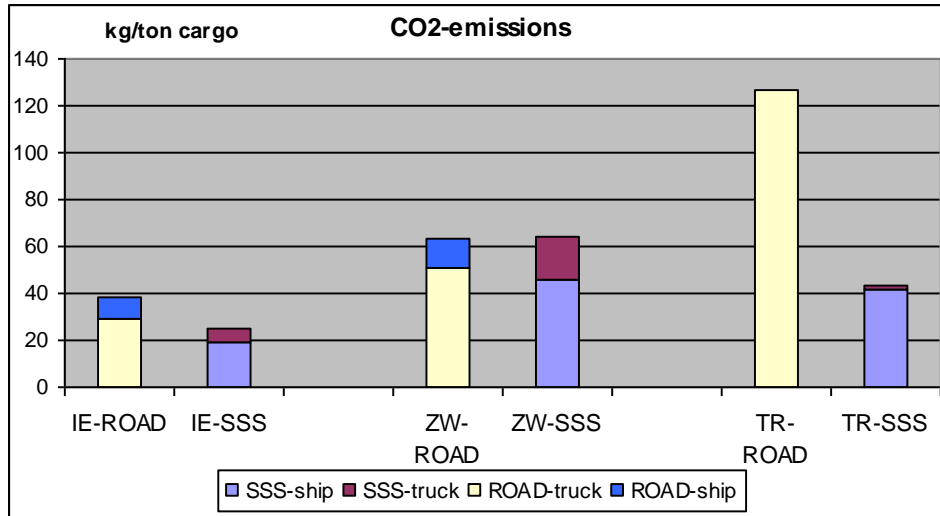
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# Results

- Results for CO<sub>2</sub>, SO<sub>2</sub>, NO<sub>x</sub> en PM (particulate matter)
- Emissions per ton load for whole route
- Emissions per ton load per km (crow's flight)
- Differentiating between transport modes
- Totals for external costs

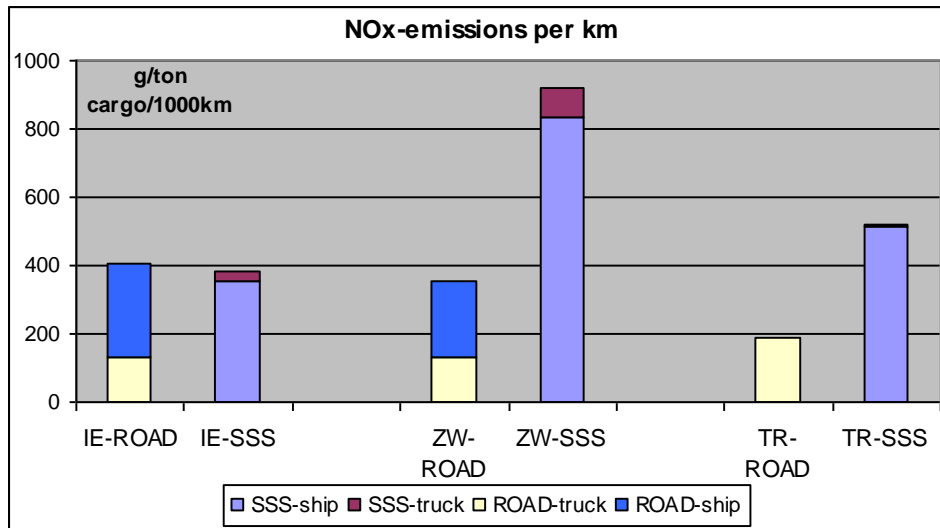
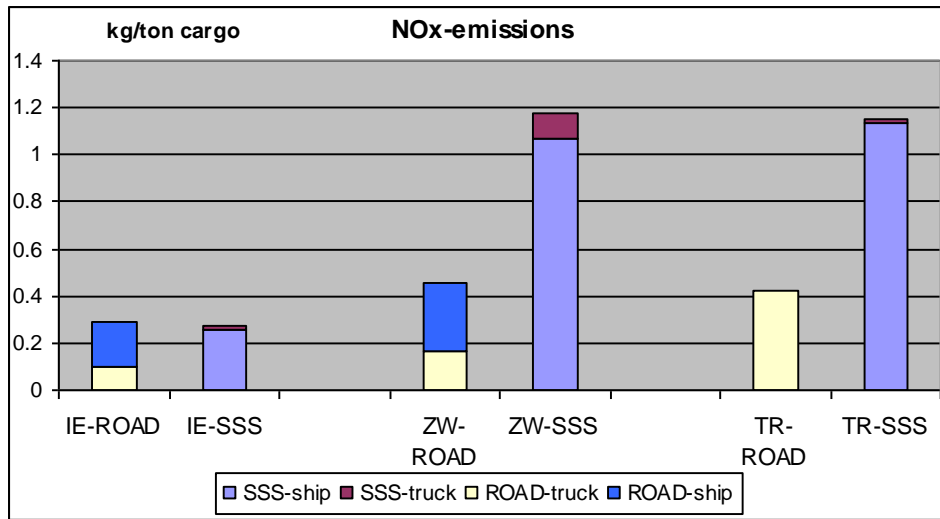
# Results: CO2



# Results: CO2

- SSS performce better than road
- SSS: economies of scale
  - Distance
  - Vessel size
- SSS: roro less efficient compared to lolo and container
- ROAD: similar results for 3 routes

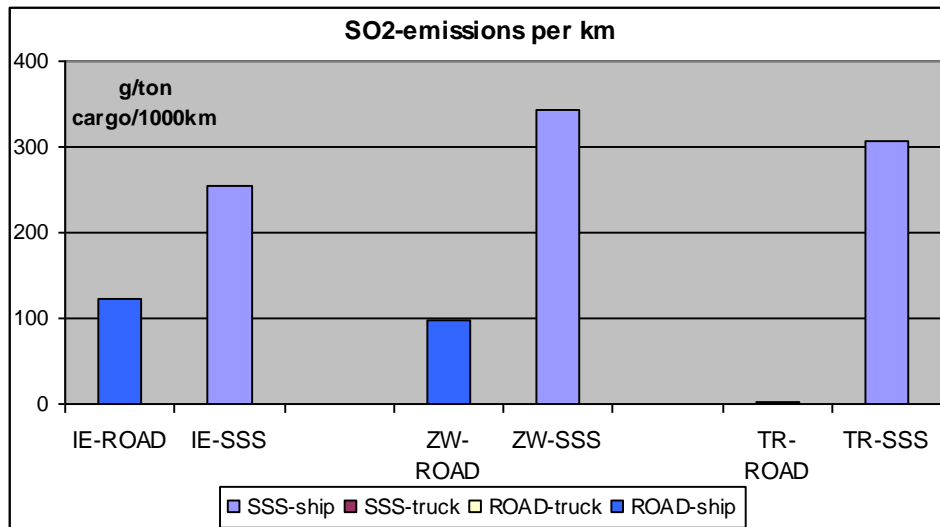
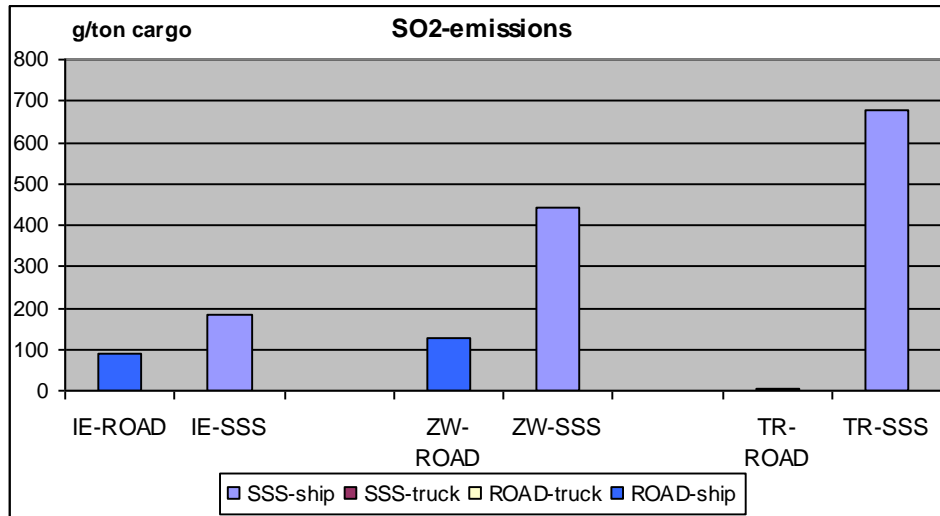
# Results: NOx



# Results: NOx

- ROAD performs better than SSS
- Environmental regulation
  - ROAD: EURO-standards
  - SSS: MARPOL Annex VI
- Nuance: EURO V → factor 2.5 better than current fleet average

# Results: SO2

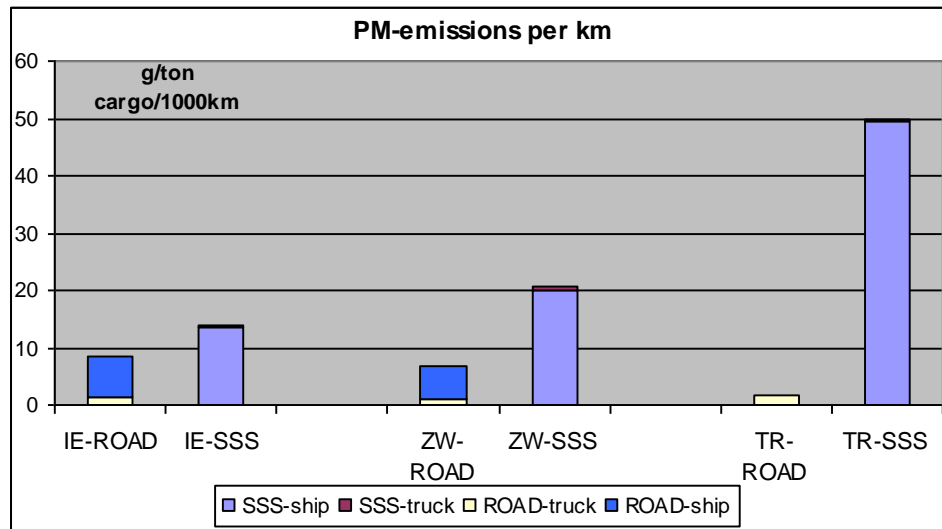
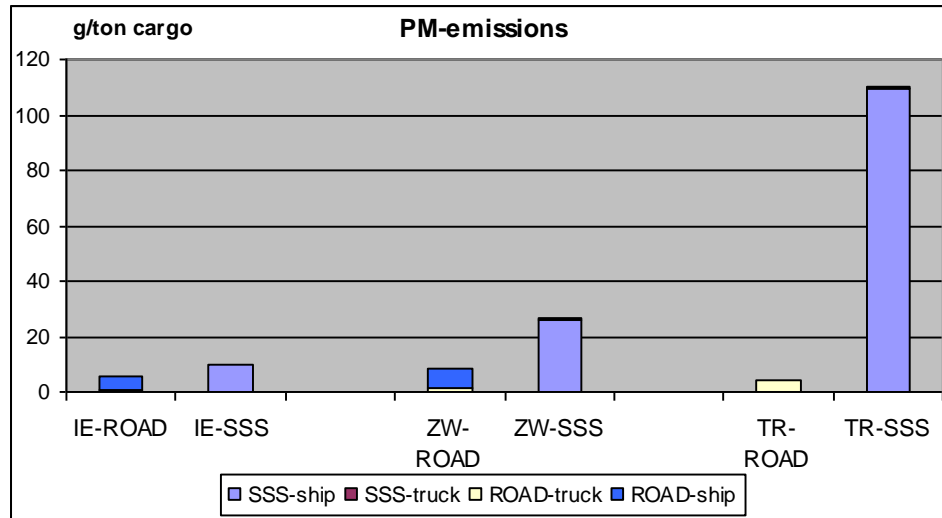


# Results: SO<sub>2</sub>

- ROAD performs much better than SSS
- Environmental regulation
  - ROAD: 10 ppm S (0.001%)
  - SSS: SECA: 1.5%;  
other: +/- 2.7%

**→ in SECA's: difference of factor 1500**

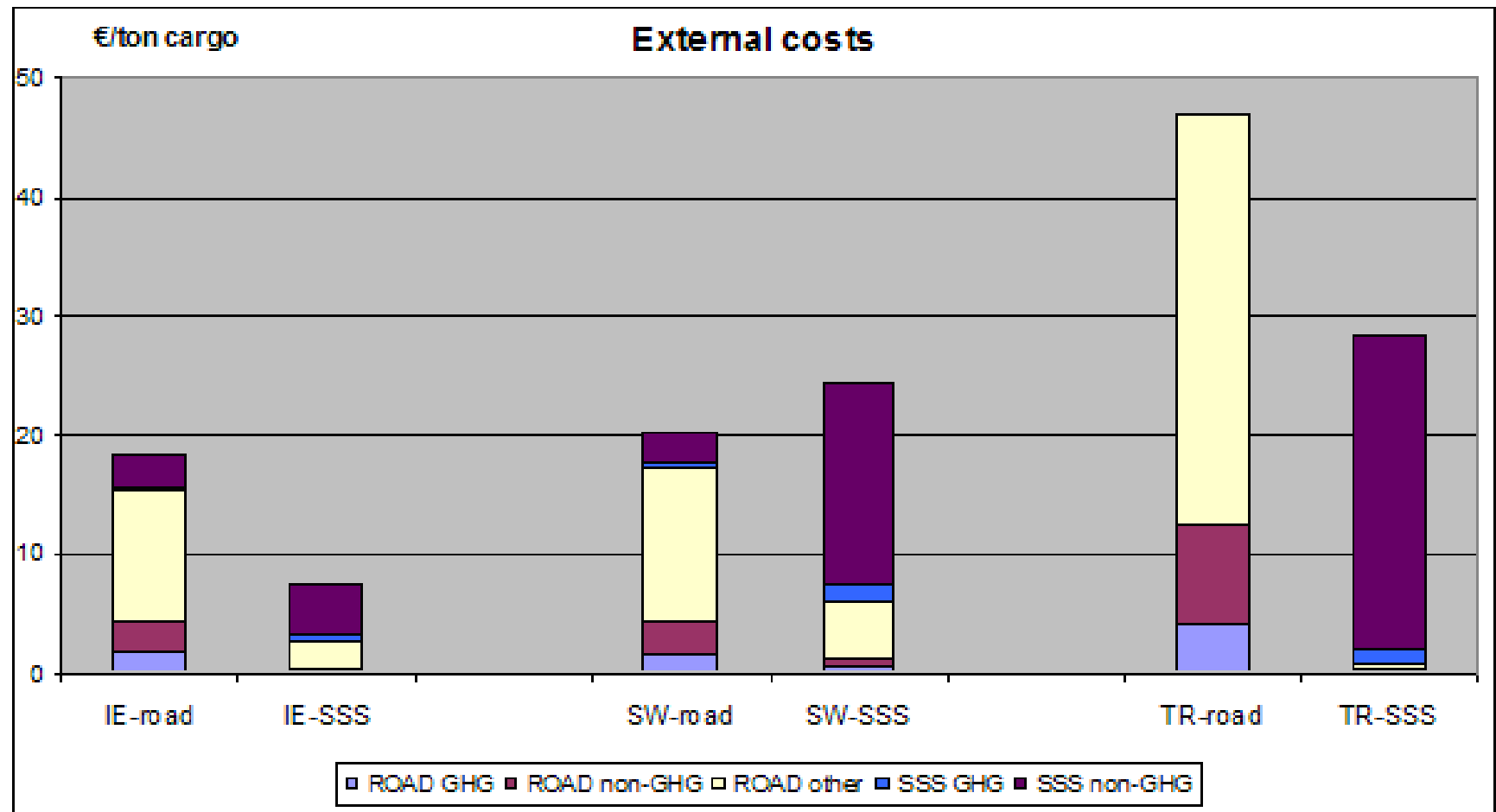
# Results: PM



# Results: PM

- ROAD performs better than SSS
- Consequence of high S-content of maritime fuels
- High emissions for Turkey SSS-route due to use of heavy fuel
- Nuance: EURO V → factor 3.5 better compared to current fleet average

# Results: External costs













# Results: External costs

- SSS performs better than ROAD, except for Sweden route
- Non-emission external costs are more important for ROAD
- Non-greenhouse gas emissions are more important than greenhouse gas emissions in terms of external costs

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# Conclusions

	<b>SSS</b>	<b>ROAD</b>
<b>CO2</b>		
<b>NOx</b>		
<b>SO2</b>		
<b>PM</b>		
<b>External costs</b>		

# Conclusions

- No clear « winner »
- Large differences between the cases considered
- Stringent emission legislation for road transport has been effective (EURO standards, S-content)
- Despite political focus, the road sector has not been successful to further reduce CO<sub>2</sub>, causing SSS to perform better

# Conclusions

- Environmental legislation SSS:
  - Low ambition in the past
  - Future: proposal IMO dd 04/2008
- Proposal IMO dd 04/2008:
  - S-content:
    - SECA: 1.5% → 0.1% (in 2015)
    - Rest: +/- 2.7% → 0.5% (in 2020)
  - NOx: reduction in 3 steps;  
reductions up to 80%

# Conclusions

- SSS is catching up, but for some pollutants, a large gap remains
- Potential for further reduction of transport emissions lies with SSS:
  - Engine technologies
  - Exhaust gas treatment technologies
  - Shore side electricity
  - New fuels and propulsion technologies





# Thank you



Transport & Mobility Leuven

[kris.vanherle@tmleuven.be](mailto:kris.vanherle@tmleuven.be)

+32 16 31 77 38