



Environment & Energy in Ships 2015
Piraeus, 22-24 May 2015



NTUA

Reduction of fuel consumption and emission of pollutants of ships in an economically sound way: from micro- to macro-level

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Three major problems:

- **Economic development**
- **Reduction of resource consumption**
- **Protection of the environment**



Trilemma

Fuel consumption  **Emission of pollutants**

Direct economic effects:

- **Cost of fuel**
- **Increased port fees and penalties due to pollution**

Indirect economic effects (due to measures for reduction of pollutants):

- **Use of more expensive fuels**
- **Installation of pollution abatement equipment**

The Centre of Excellence in Ship Total Energy-Eissions-Economy

Established: 1 February 2010

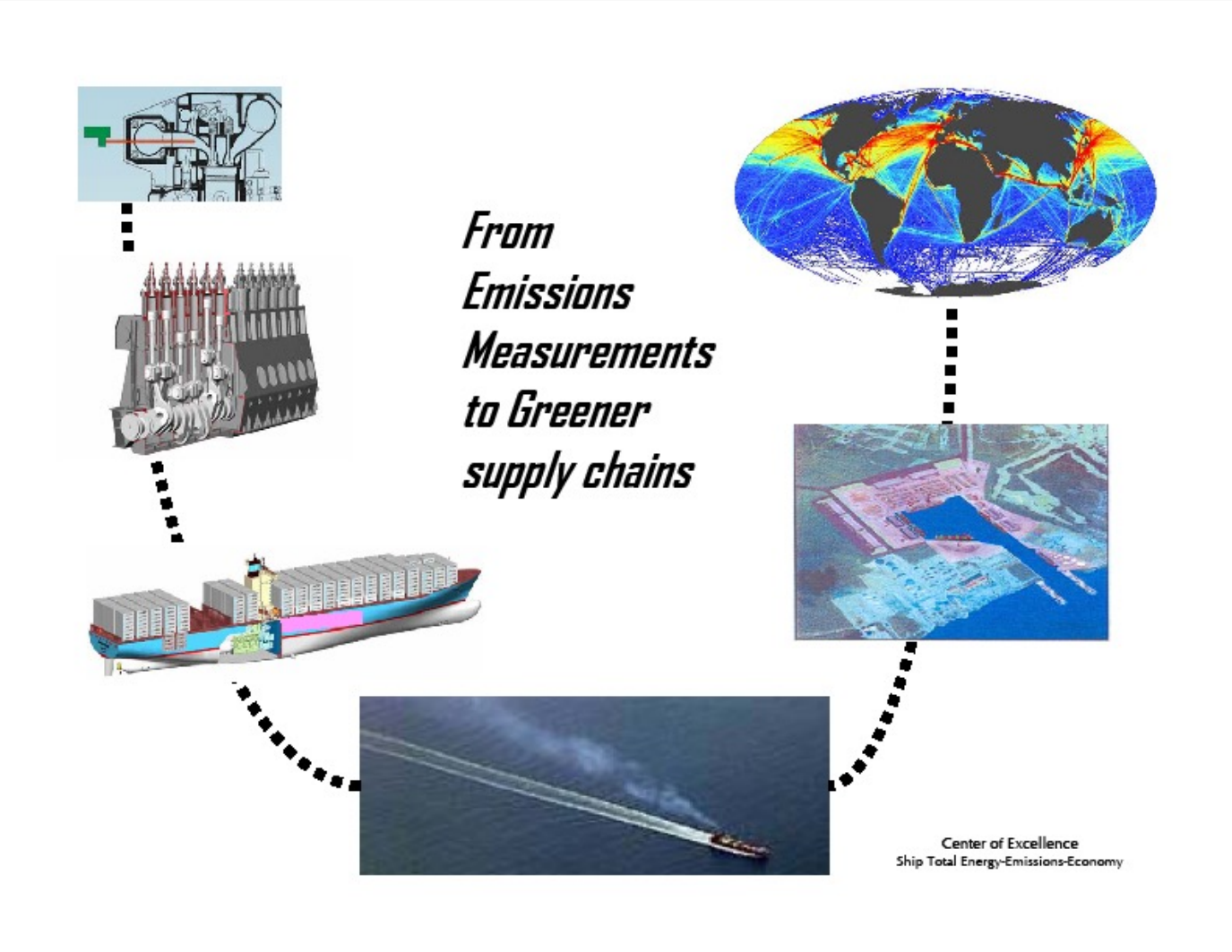
Scope

Research and development contributing to the reduction of fuel consumption and emissions of pollutants in an economically sound way.

Two broad categories of measures:

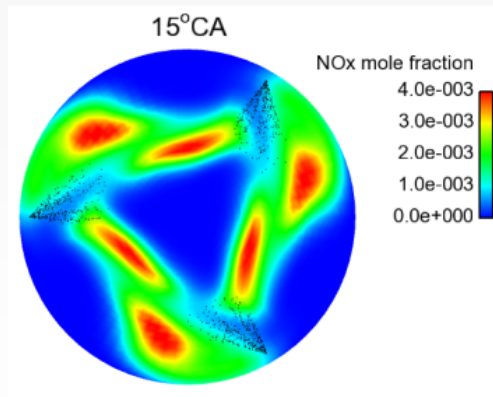
- Technological (micro-level)
- Managerial (macro-level)

Schematic representation of the project

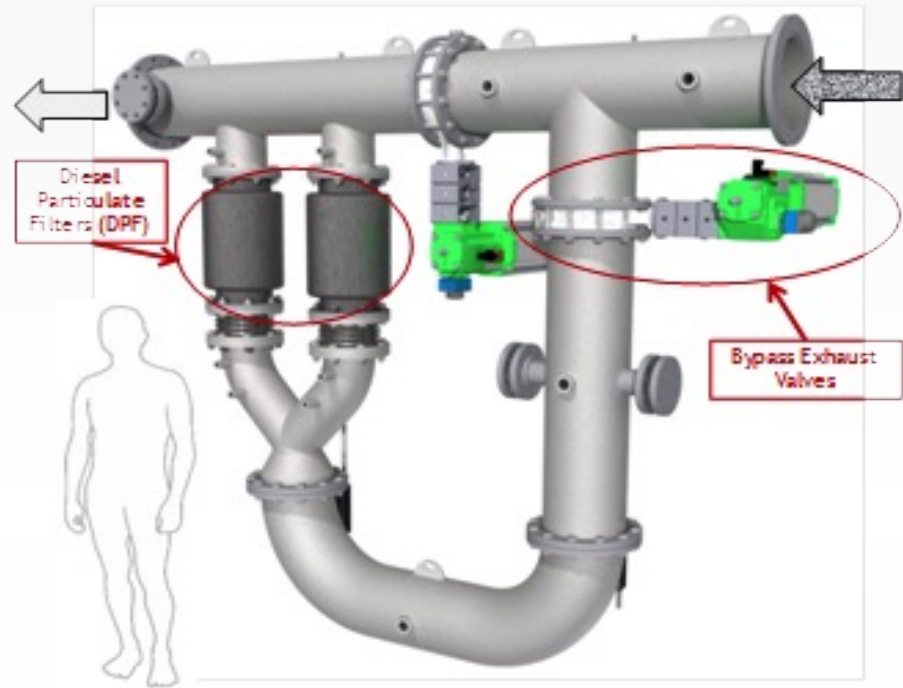


Technological measures

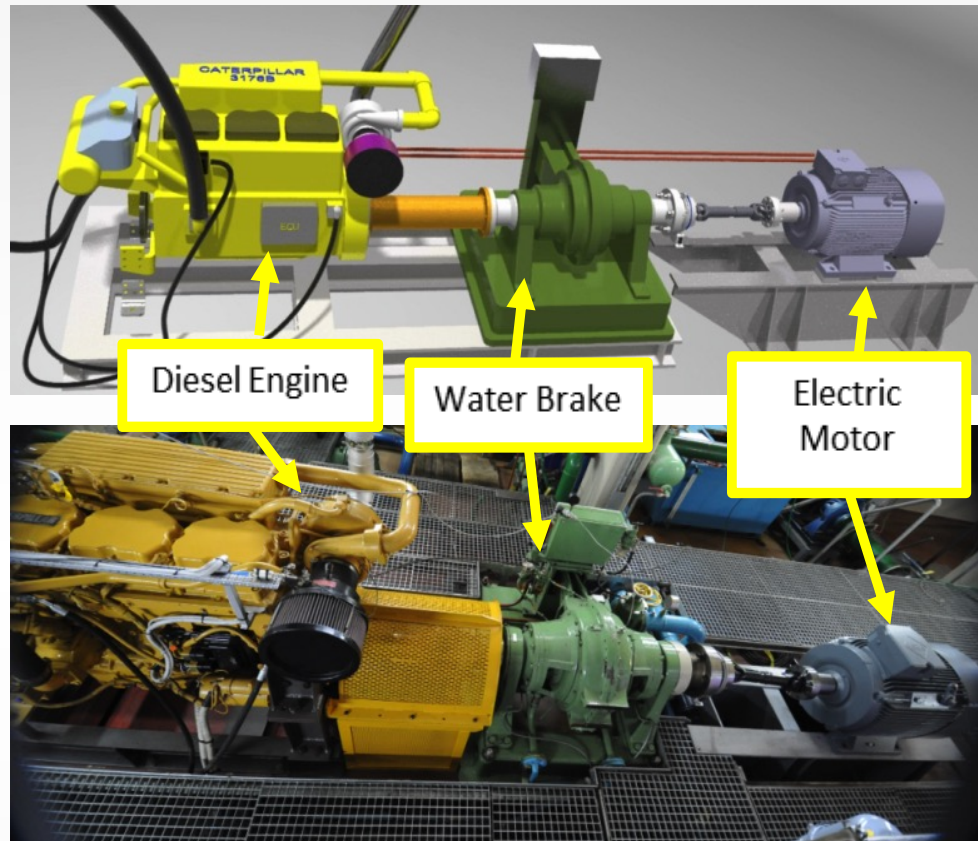
- **Process simulation and validation through measurements.**
- **Process improvement, integration and optimization with respect to fuel consumption and emission of pollutants.**
- **Development and evaluation of new processes for reduction of fuel consumption and emission of pollutants.**



Combustion simulation
 Kaiktsis et al.
 Division of Marine Engineering,
 NTUA



Exhaust gas treatment unit
 Kyrtatos et al.
 Laboratory of Marine Engineering, NTUA



Hybrid Integrated Propulsion Powertrain
Papalambrou et al.
Laboratory of Marine Engineering, NTUA

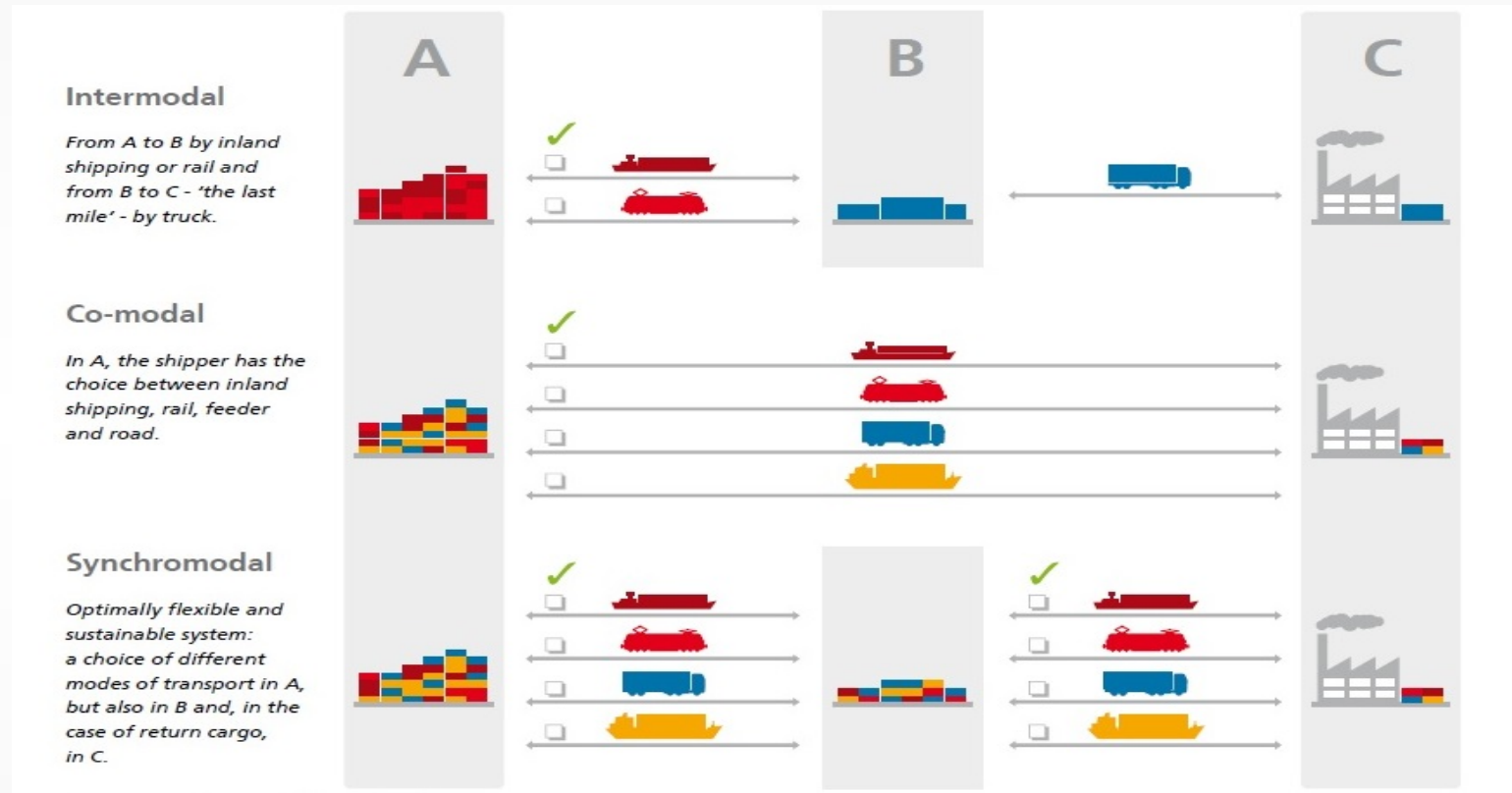
Managerial measures

- **Modelling of emissions along intermodal supply chain, at the strategic and the operational level for:**
 - **individual ships**
 - **other components of the supply chain.**
- **Development of realistic solutions that will reduce supply chain emissions and at the same time will enhance international trade.**
- **Development of a map of relevant policy alternatives and measures, in an attempt to facilitate recommendations at policy level.**

Life Cycle Analysis

The Concept of Synchro – Modal Transportation

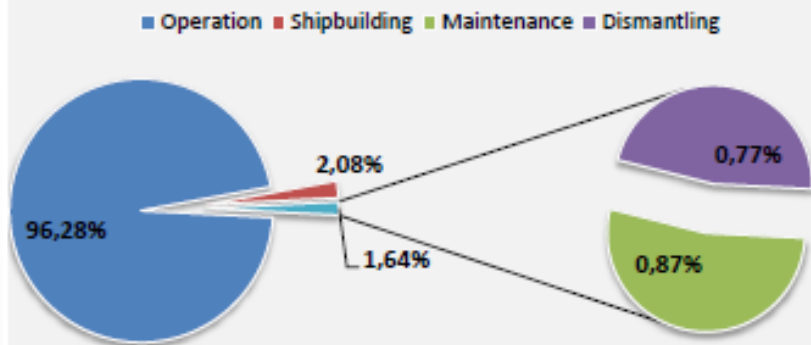
- From Co Modal To Inter Modal and Synchro Modal



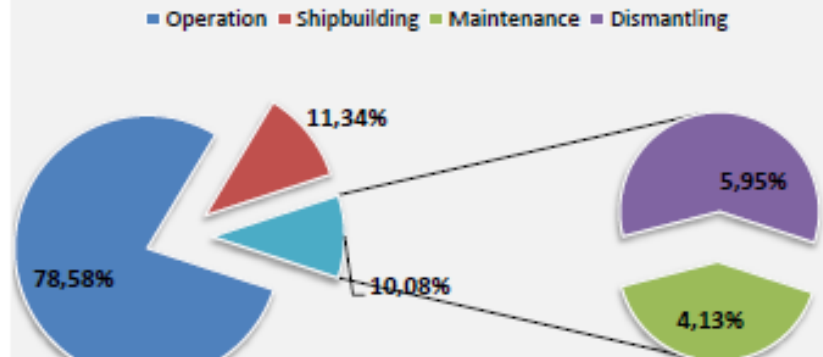
Kapetanis, Psaraftis, et al.
Laboratory for Maritime Transport, NTUA

Emissions		Operation	Shipbuilding	Maintenance	Recycling	Total Life Cycle
CO ₂	tons	1,06E+06	2,29E+04	9,62E+03	8,51E+03	1,10E+06
CO	tons	3,17E+03	4,53E+02	8,16E+01	7,72E+02	4,48E+03
CH ₄	tons	2,81E+01	4,06E+00	1,48E+00	2,13E+00	3,58E+01
NO _x	tons	3,04E+04	1,28E+02	9,20E+01	1,07E+02	3,07E+04
PM (all)	tons	2,45E+03	2,29E+01	8,69E+00	2,25E+01	2,51E+03
SO ₂	tons	1,57E+04	1,02E+02	7,39E+01	1,28E+02	1,60E+04
VOC	tons	-	2,00E+01	5,78E+01	2,99E-01	7,81E+01

CO₂ - Life Cycle Emissions



CH₄ - Life Cycle Emissions



Emissions from a Life-Cycle perspective
 Ventikos, Chatzinikolaou
 Laboratory for Maritime Transport, NTUA

Acknowledgements

**The financial support provided by the
Lloyd's Register Foundation
is gratefully acknowledged.**

For more information:

www.lrf-ntua-coe.gr

Thank you for your attention