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Analysis of policy measures to reduce ship emissions in the context of the NECD

Main characteristics of the study

- Joint study of IIASA, MET.NO, ENTEC
- Revised emission inventories for 2000
  - 5 sea regions
  - 12-mile zone and international waters
  - Ferries, cargo ships
  - EU-flags and others
- SO_2, NO_x, PM2.5, VOC, CO_2
- Compilation of emission control measures and costs
- Source-receptor relationships
- Policy scenarios
- Interim report available on the Internet

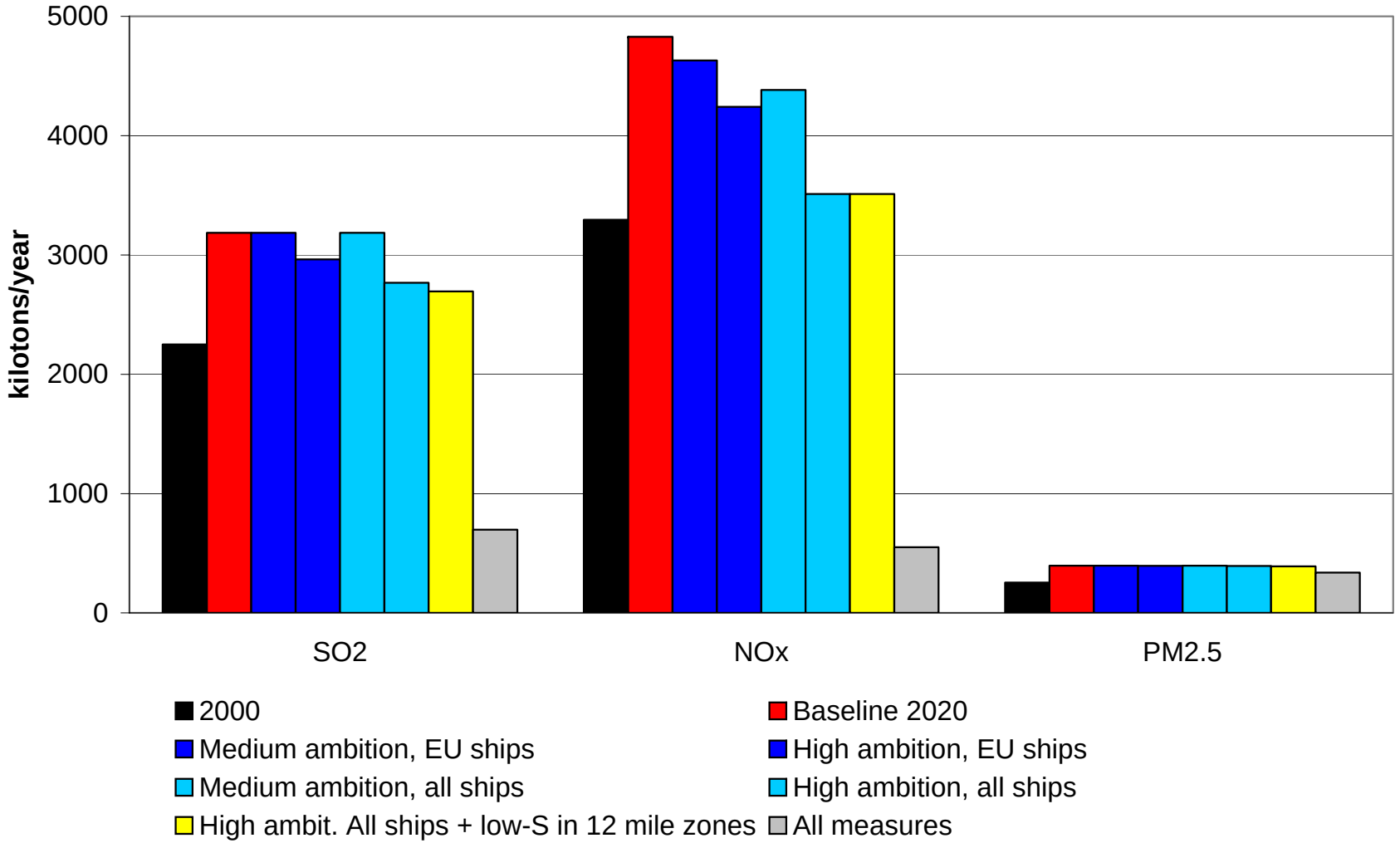
Emission control measures
considered in the analysis

Measure	% emissions reduction (-) / increase (+) per vessel			
	SO_2	NO_X	PM	VOC
Basic internal engine modifications (IEM) for 2-stroke slow speed only	0%	-20%	0%	0%
Advanced internal engine modifications	0%	-30%	0%	0%
Direct water injection	0%	-50%	0%	0%
Humid air motors	0%	-70%	0%	0%
Exhaust gas recirculation[1]	-93%	-35%	>-63%[2]	±[3]
Selective catalytic reduction (2.7% residual oil)	0%	-90%	0%	0%
Sea water scrubbing	-75%	0%	- 25%[4]	±
Fuel switching 2.7->1.5% S residual oil fuel	-44%	±	-18%	±
Fuel switching 2.7->0.5% S residual oil fuel	-81%	±	-20%[5]	±
Low S marine diesel 0.5->0.1 % S	-80%	±	±	±

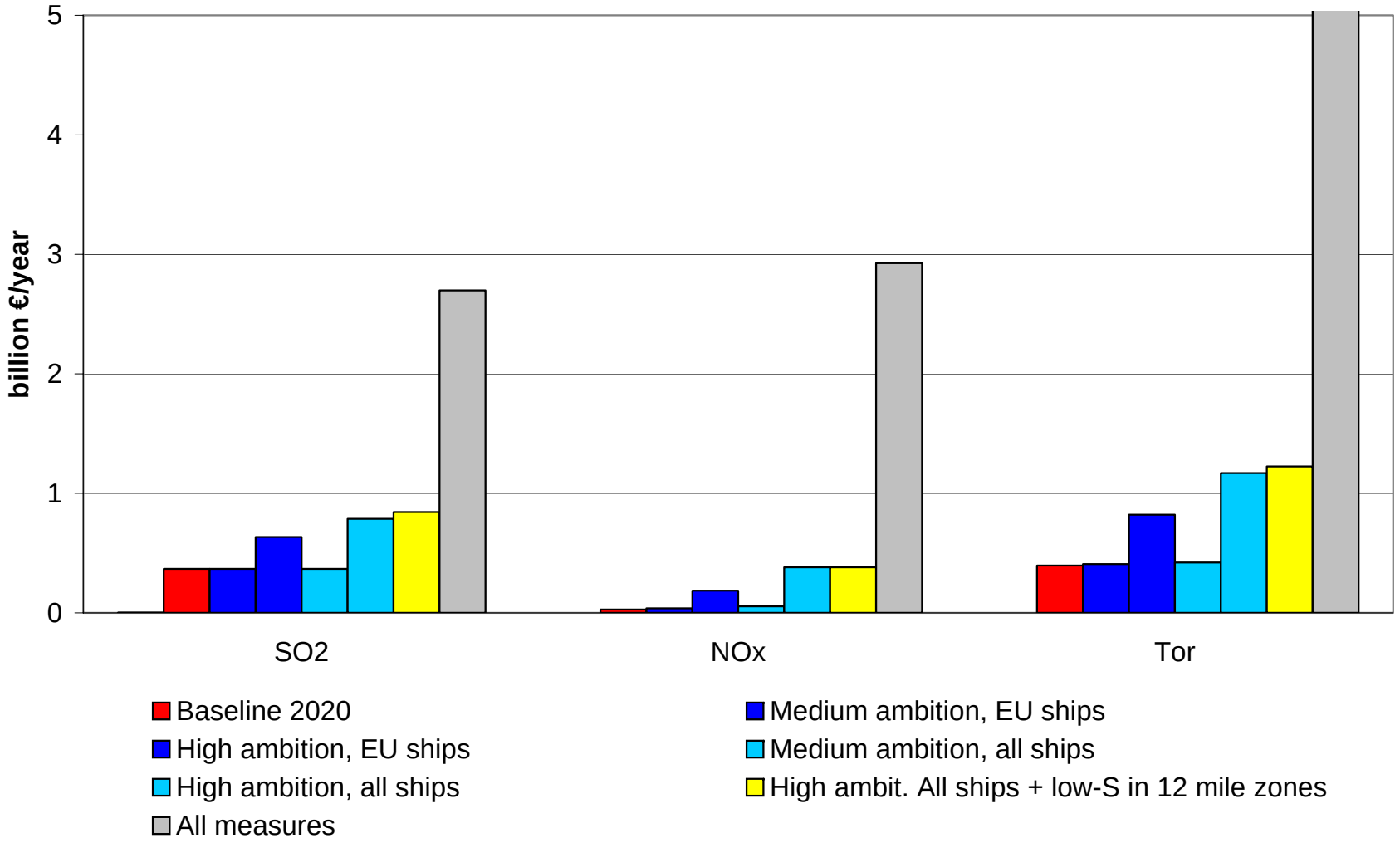
Emission control scenarios

- Baseline
  - **SO_2:** Sulphur content as in the EU Marine Fuel Directive:
    1.5% S fuel for all ships in North Sea and Baltic Sea;
    1.5% S fuel all passenger ships in other EU seas;
    0.1% S fuel at berth in ports.
  - **NO_x:** MARPOL NOx standards for ships built since 2000
- "Medium" ambition
  - **SO_2:** as baseline
  - **NO_x:** Slide valve retrofit on all slow-speed engines pre-2000
    Internal engine modifications for all new engines post-2010
- "High" ambition
  - **SO_2:** 0.5% S fuel or scrubbing equivalent (2g SO2/kWh) in North Sea and Baltic, and for passenger vessels everywhere
  - **NO_x:** Slide valve retrofit on all slow-speed engines pre-2000
    Humid air motors for all new engines post-2010

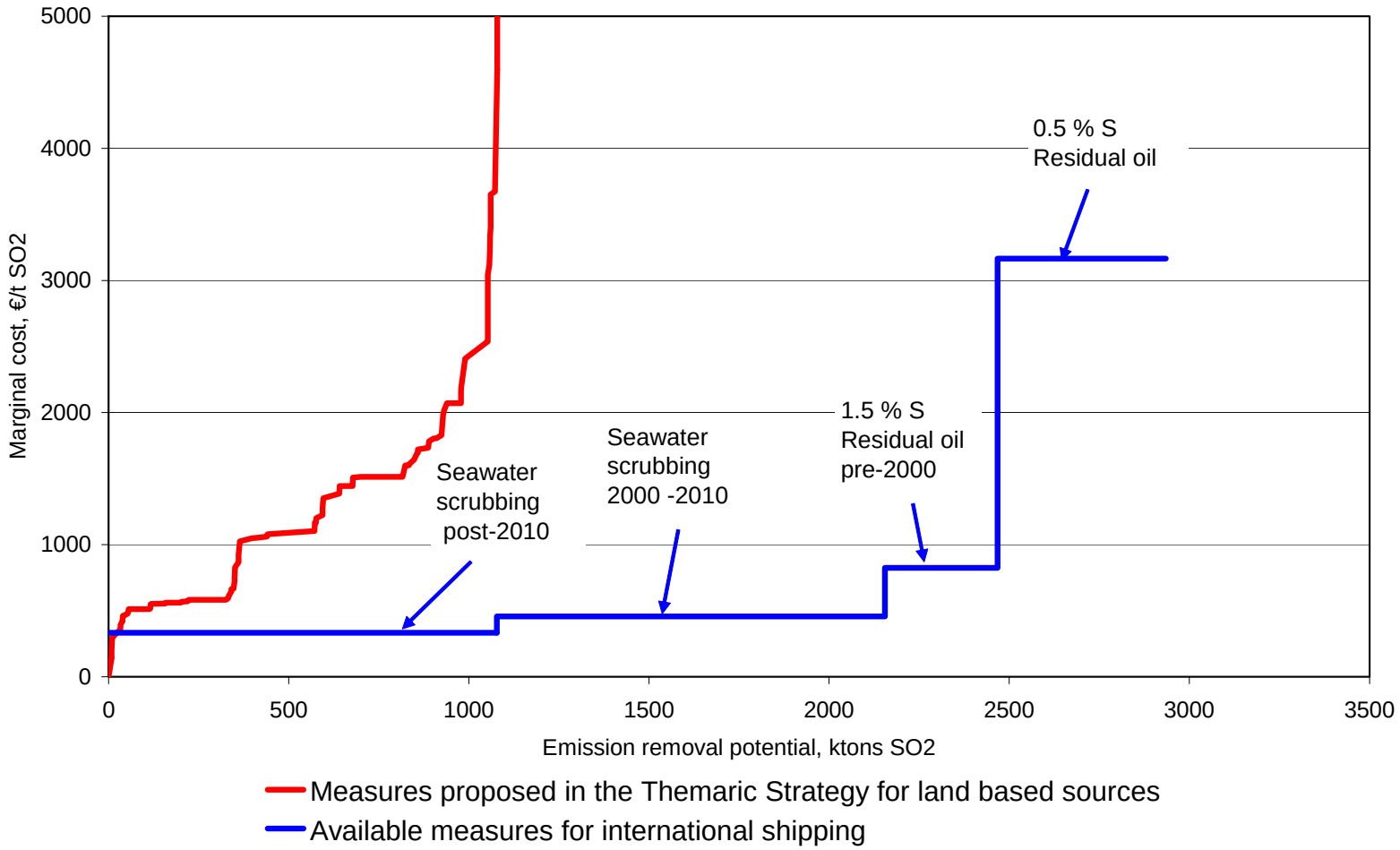
Emission scenarios for ships for 2020



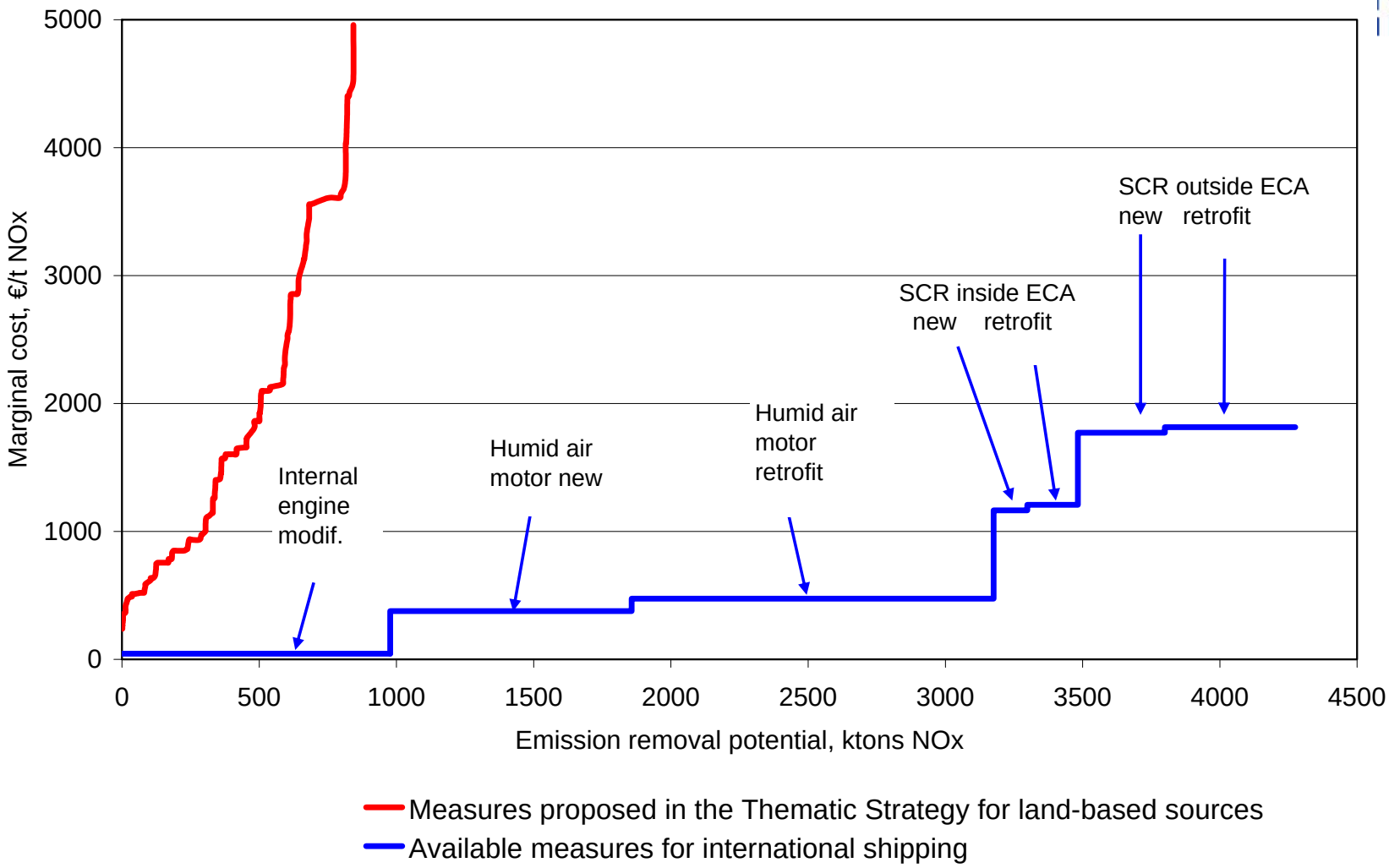
Emission control costs of the scenarios



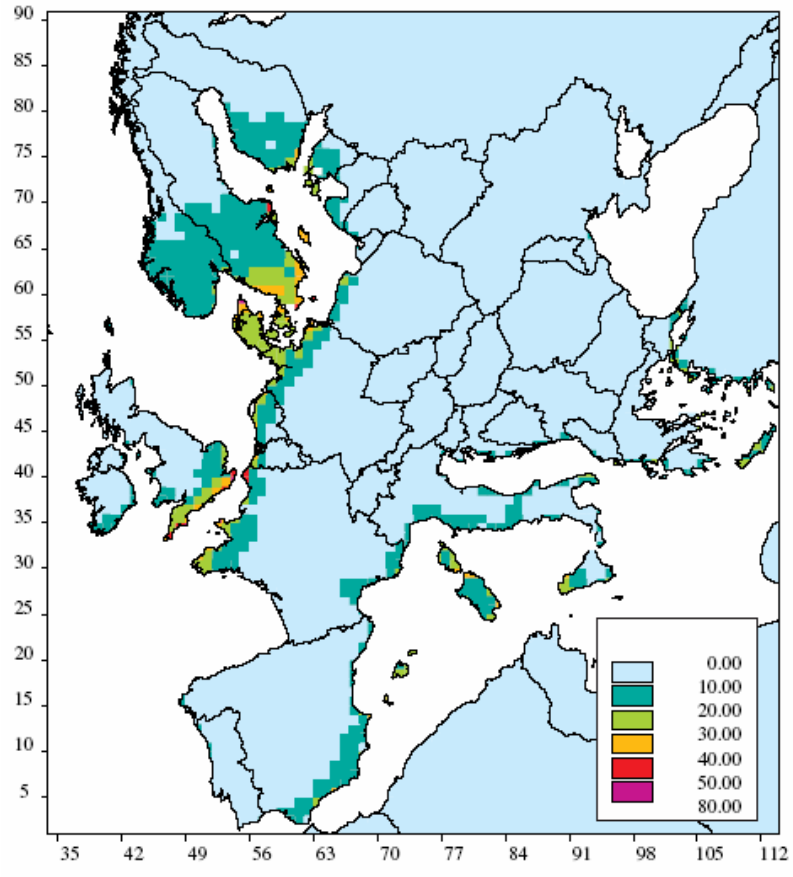
SO_2 cost curves for ships and land-based sources 2020

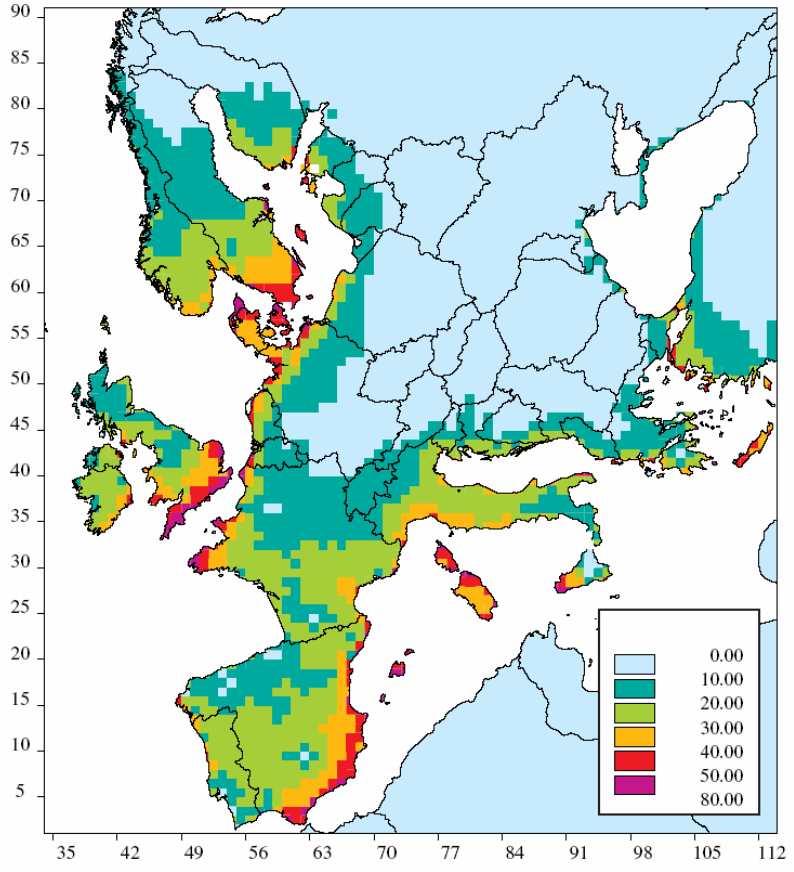


NO_x cost curves for ships and land-based sources 2020

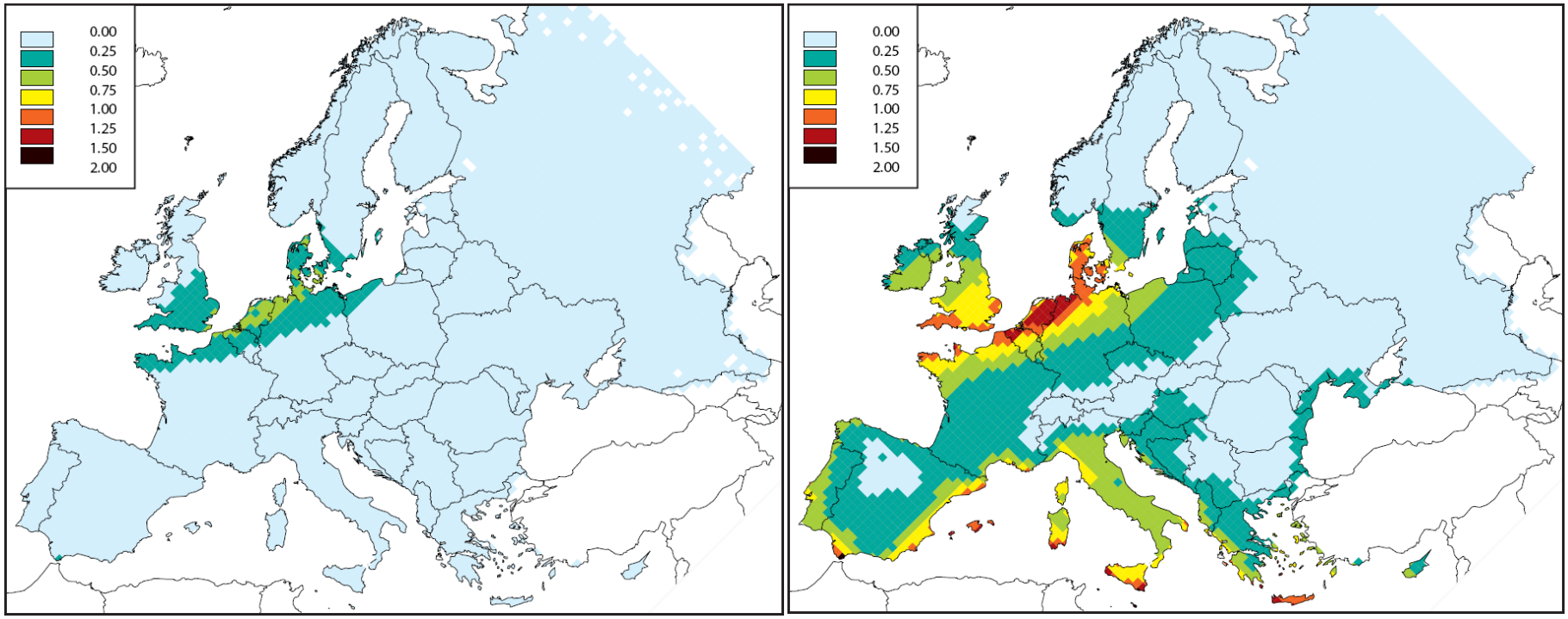


Contribution made by ships to sulphur deposition
2000 and 2020 CLE (in percent)





Gains in statistical life expectancy from the PM2.5 reductions from the ship measures (months)



High ambition all ships + low S in 12 mile zones

All measures

Preliminary conclusions

- Increase in transport volumes will compensate effects of recent agreements on ship emission control
  - By 2020, emissions between CLE and TSAP of land-based sources
  - Increasing share of sulphur deposition originating from ships: in coastal regions, increase from 20% today to 50% in 2020
- Identified technologies can reduce ship emissions by 80 to 90% at costs € 5.2 billion/year
- Cost-effectiveness depends on locations
- 80 percent of emissions emitted outside of 12-mile zones
- Input data for full cost-effectiveness analysis are now available

Further work

- Interim report available at: http://forum.europa.eu.int/Public/irc/env/cafe_baseline/library?l=/thematic_strategy/contract_emissions&vm=detailed&sb=Title
- Additional scenarios will be analyzed, including the effect of controls on shipping on costs of TSAP targets
- Final report ready by end of April 2007