Air pollution from ships

Christer Ågren
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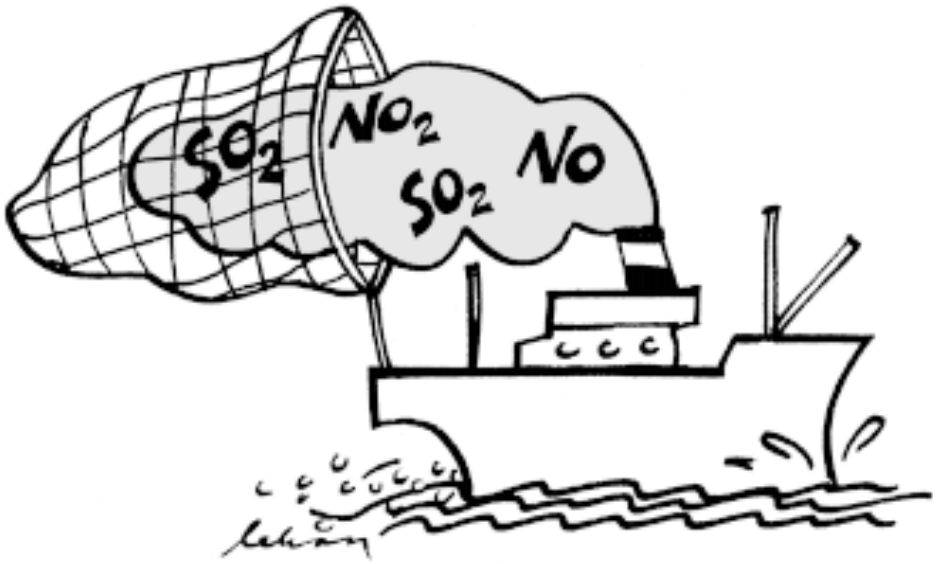

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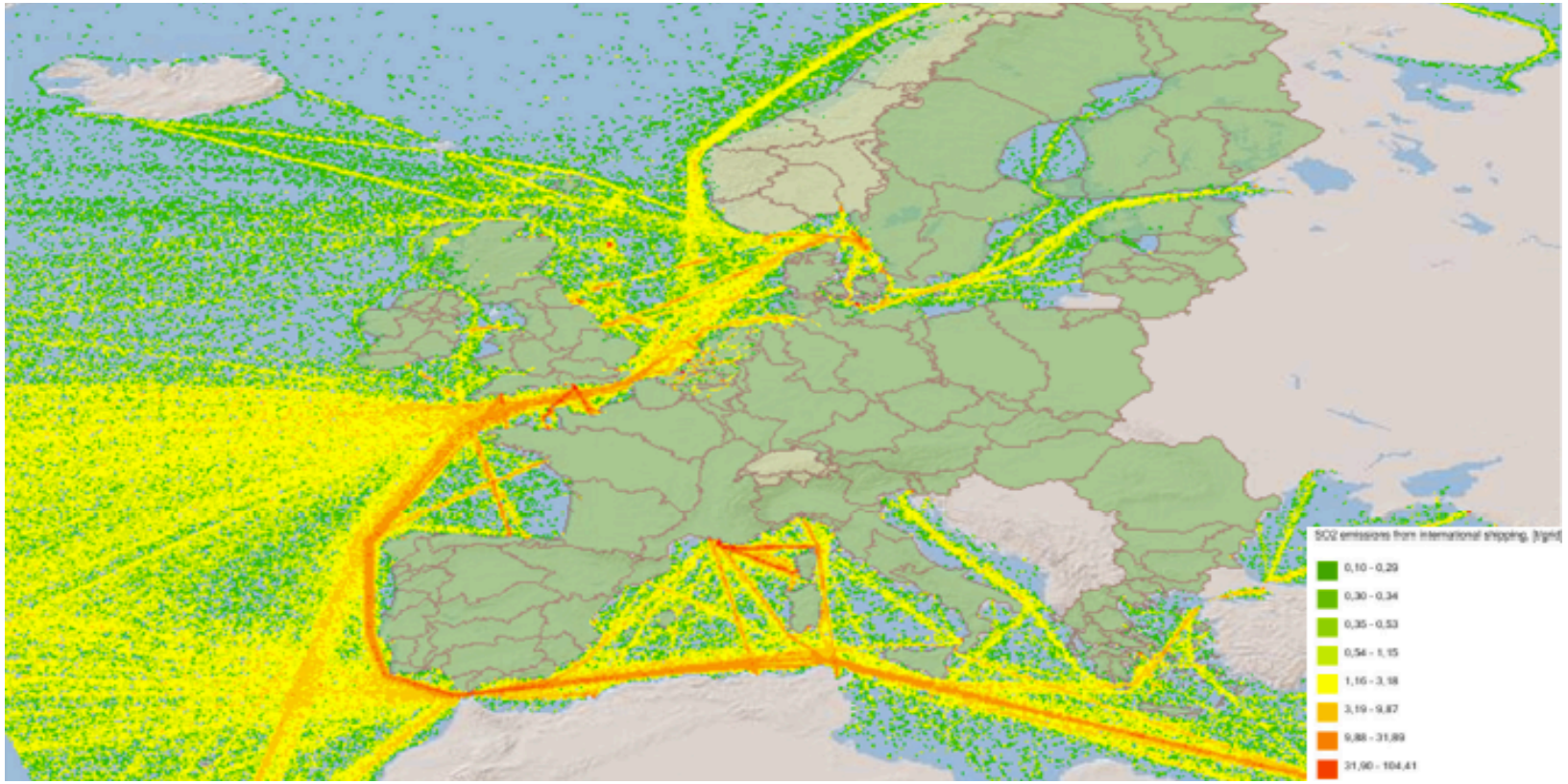
Ship emissions occur close to land

Globally, 70-80% of ship emissions take place within 400 km from shore



In the North Sea, 90% of emissions take place within 90 km from shore

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Causing 50,000 deaths a year

In Europe, air pollutant emissions from international shipping is estimated to cause some 50,000 premature deaths per year.

Tiny airborne particles (PM) cause premature death through lung and heart disease.

Source: J. Brandt et al, CEEH, Denmark (2011)

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Ship emissions are a major cause of eutrophication and acidification

Examples of countries with a high proportion of air pollutant fallout from ship emissions (2013)

NOx-N	
Norway	28%
Sweden	26%
Denmark	26%
Portugal	24%
Ireland	23%
Netherl.	19%
Finland	18%
Spain	18%
UK	18%
Italy	15%

SO_2-S	
Portugal	26%
Denmark	24%
Netherl.	22%
Ireland	20%
Norway	19%
Spain	18%
Sweden	17%
France	15%
UK	13%
Italy	13%

Source: EMEP (2015)

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Developments in the International Maritime Organisation (IMO)

Initiative 1988, resulted 1997 in MARPOL Annex VI,
which entered into force on 19 May 2005:

- **Global cap: 4.5% S in bunker fuels**
- **SOx-ECAs max 1.5% S (Baltic: May-06 & North Sea: Nov-07)**
- **Weak NOx-standards for new (post-2000) engines**

Discussions on strengthening of Annex VI started mid-2005.
Revised MARPOL Annex VI adopted 9 October 2008:

- **Reasonably good on SO_2 – but not on NOx**
- **NOx-emissions will continue to increase…**

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Revised MARPOL Annex VI

- **Entry into force 1 July 2010**
- **New global sulphur limits:**
  - 3.50% 1/1 2012
  - 0.50% 1/1 2020 (possibly 2025; subject to review 2018)
- **New SOx-ECA sulphur limits*:**
  - 1.00% 1/7 2010
  - 0.10% 1/1 2015
- **Stricter NOx standards for new engines**
  - Tier II standard (-16-22%) 1/1 2011
  - Tier III standard (-80%) from 2016 in NOx-ECAs only

(*Note: Alternatives such as scrubbers or LNG allowed.)

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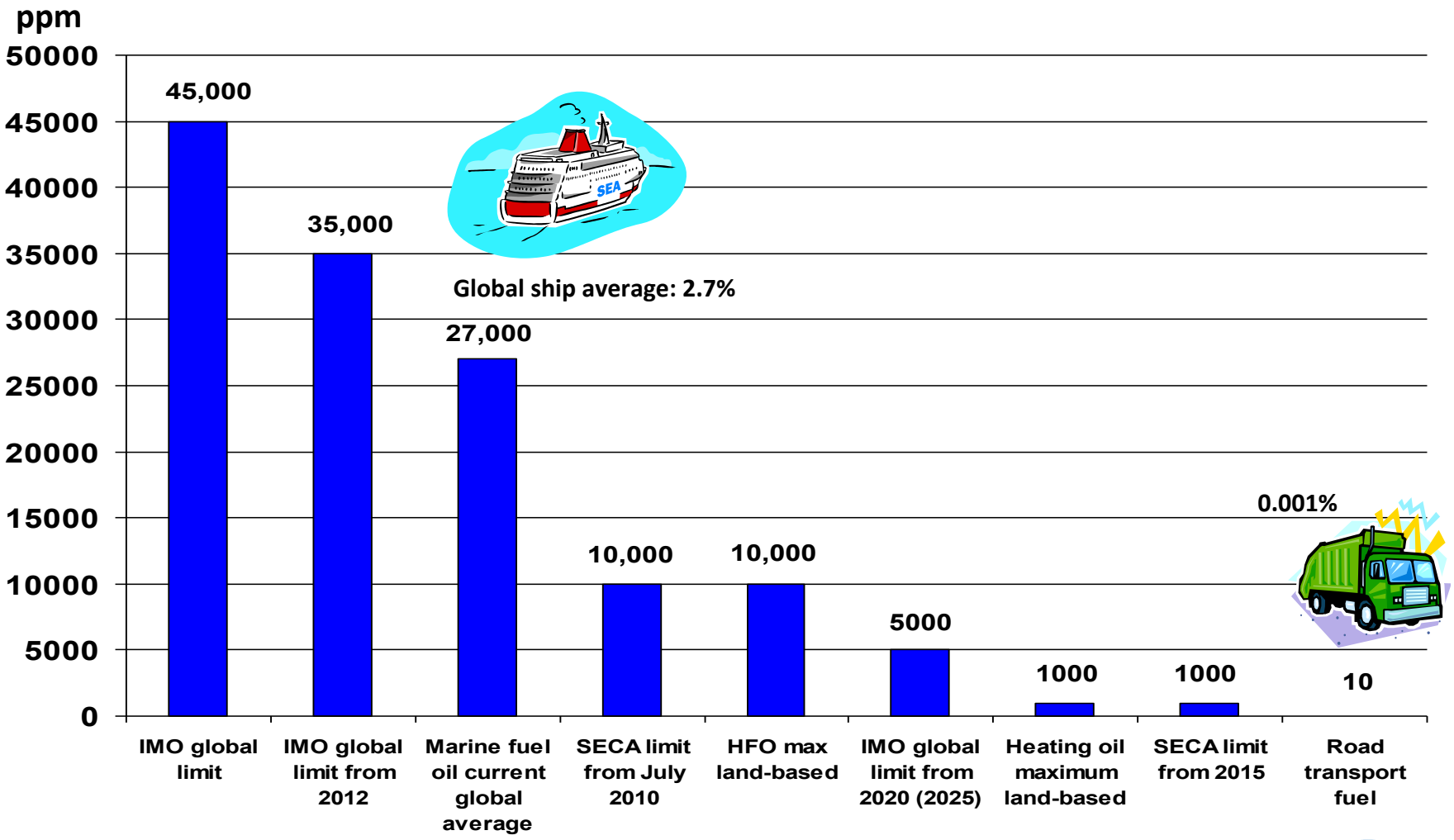
Sulphur content of various fuels



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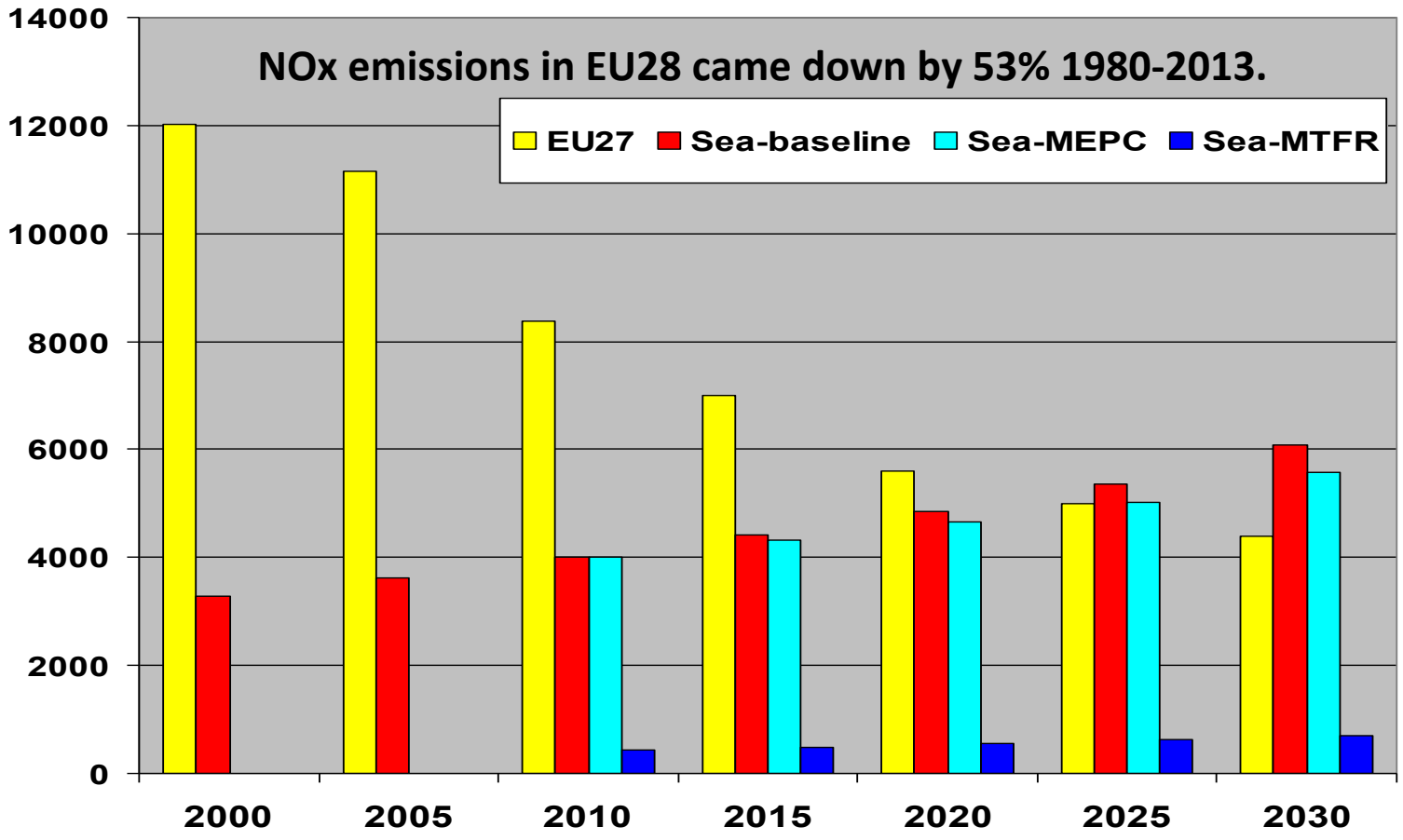
Land-based NOx-emissions are going down - those from ships are increasing



Sources: IIASAs GAINS-model (2010) and EMEP (2012; 2015)

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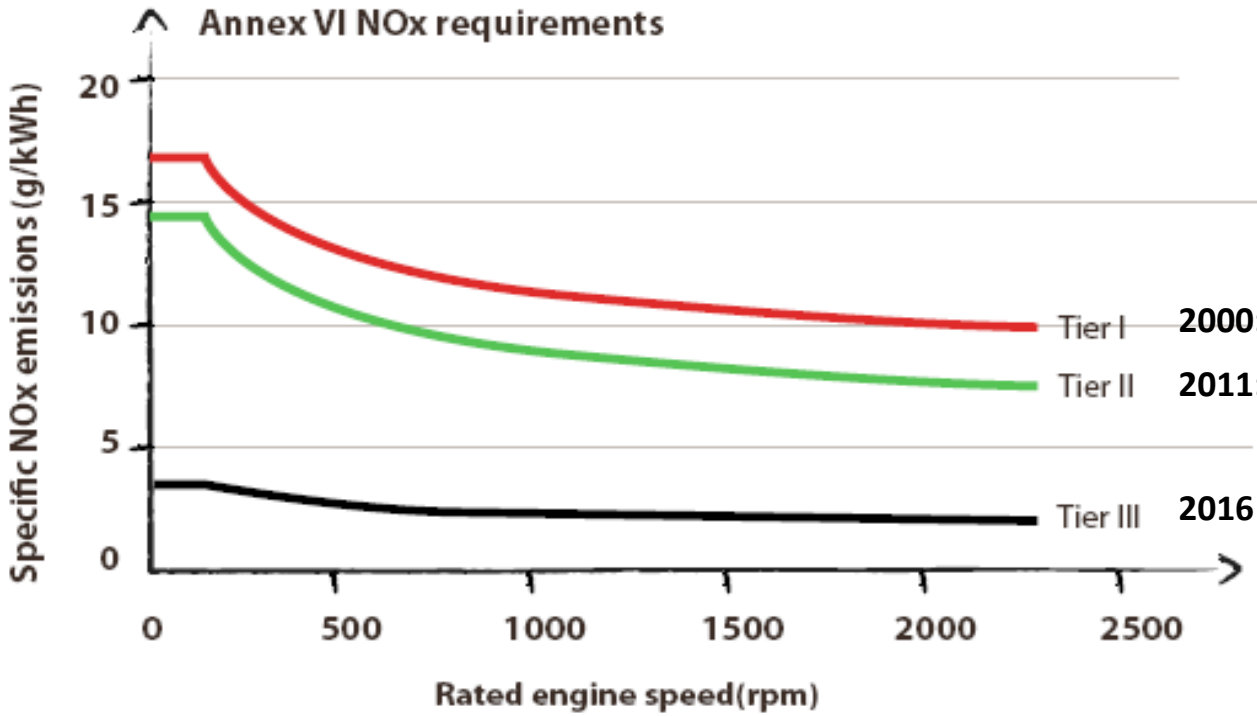
IMO NOx-standards for new ship engines



2000: 17-9,8 g/kWh

2011: 14,4-7,7 g/kWh

2016 (NOx-ECAs): 3,4-2 g/kWh

Compare to EU-standards (Euro VI) for new heavy duty diesel engines in trucks and buses set at 0.4 g/kWh as from 2013.

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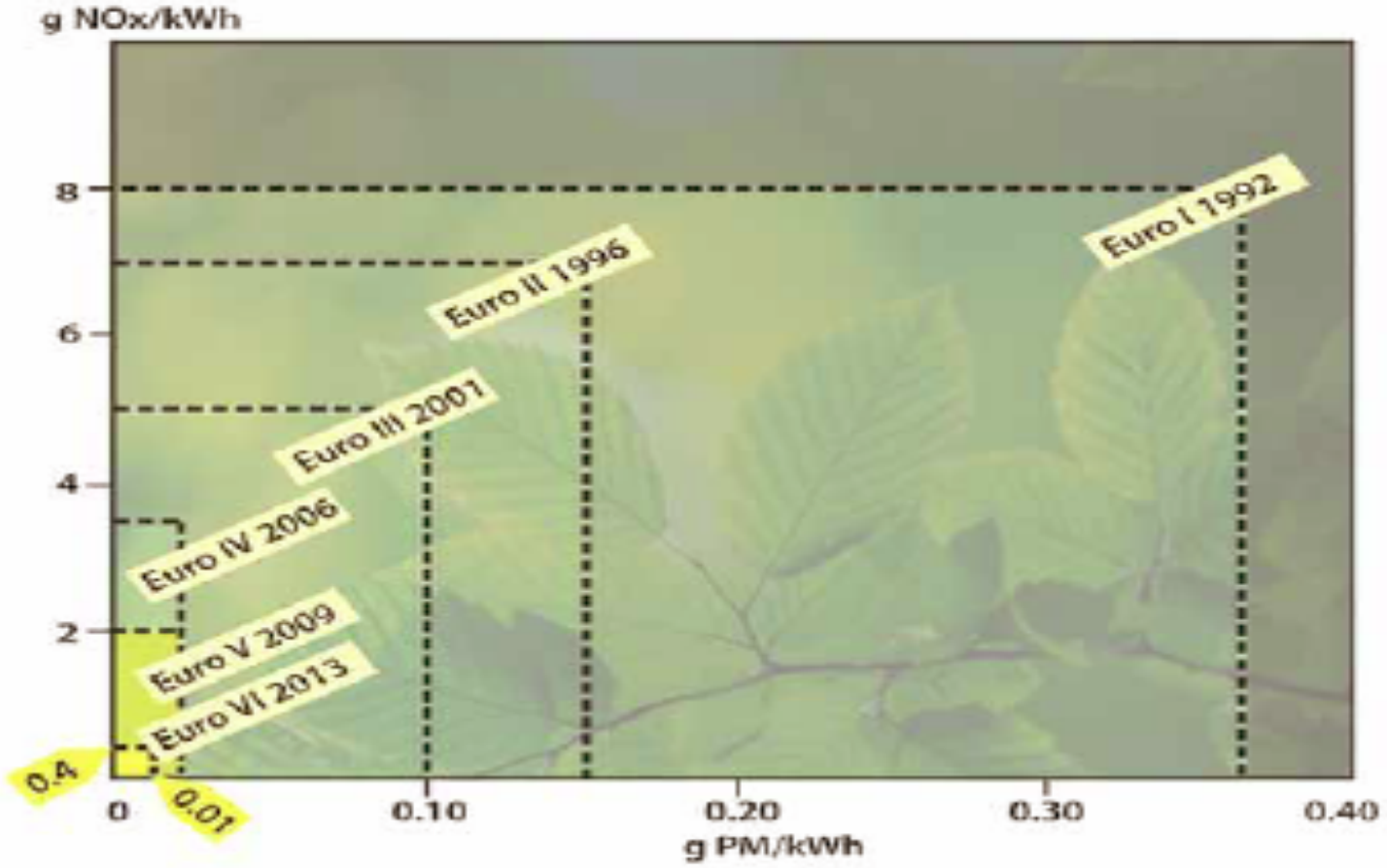
Comparison: EU standards for HDV diesel engines 1992-2013



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NOx controls for shipping – new study

- New study by IVL Swedish Environmental Research Institute and CE Delft, commissioned by Transport & Environment (to be released 15 June)
- Focus on NOx-ECA and/or other policy instruments
- Covers the Baltic Sea and the North Sea
- Projections up to 2040 with/without NECA

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Contents of the NOx study

- Policy review and analysis of NOx-ECA
- Abatement techniques (feasibility, reduction potentials, costs)
- Emission inventory and baseline projections with & without NOx-ECA
- Analysis and selection of additional/alternative policy instruments
- Emission projections with additional/alternative policy instruments

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NOx-abatement measures

Some of the main NOx-abatement options for ships:

- **Exhaust gas after-treatment** (e.g. SCR)
- **Combustion modifications** (e.g. EGR, water injection)
- **Fuel switch** (e.g. to LNG or methanol)
- **Reduced fuel consumption** (e.g. slow steaming)

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The three most promising policy instruments analysed

1) **NOx levy & fund:** Ships pay per kg NOx emitted in the sea area; revenue used to fund the uptake of NOx abatement measures in the sector.

2) **NOx levy**: Ships pay per kg NOx emitted in the sea area; revenue goes to member states.

3) **Speed reduction:** Ships reduce speed by 15% in the area, or pay a NOx levy (e.g. ferries); revenue into fund.

Levy rates of €1, €2 or €3 per kg NOx were investigated.

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Some conclusions from the study

- Baseline (BAU) projection indicate a slight NOx reduction (-14% 2015-2040) (Optimistic assumptions?)
- A NOx-ECA from 2021 would significantly cut NOx in the longer term (-63% 2015-2040), but not so much short-term (-37% 2015-2030)
- Significant short- and long-term reductions possible through the use of economic instruments, especially levy & fund (-74% 2015-2030)
- A levy & fund could cut NOx by around 400,000 tonnes/yr throughout the 2020s. This equals current total annual land-based emissions from SE, DK and FI combined.

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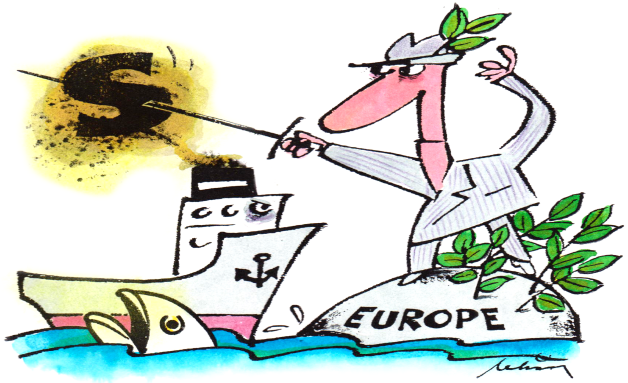
Measures to cut ship emissions

- Designate all European seas as Emission Control Areas
- Emission charges to cut NOx from existing ships
- Global 0.5% sulphur standard from 2020

- Improved emissions monitoring and compliance control
- Lowered speeds
- Emission standards for PM
- Develop and adopt an EU marine fuels quality directive



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