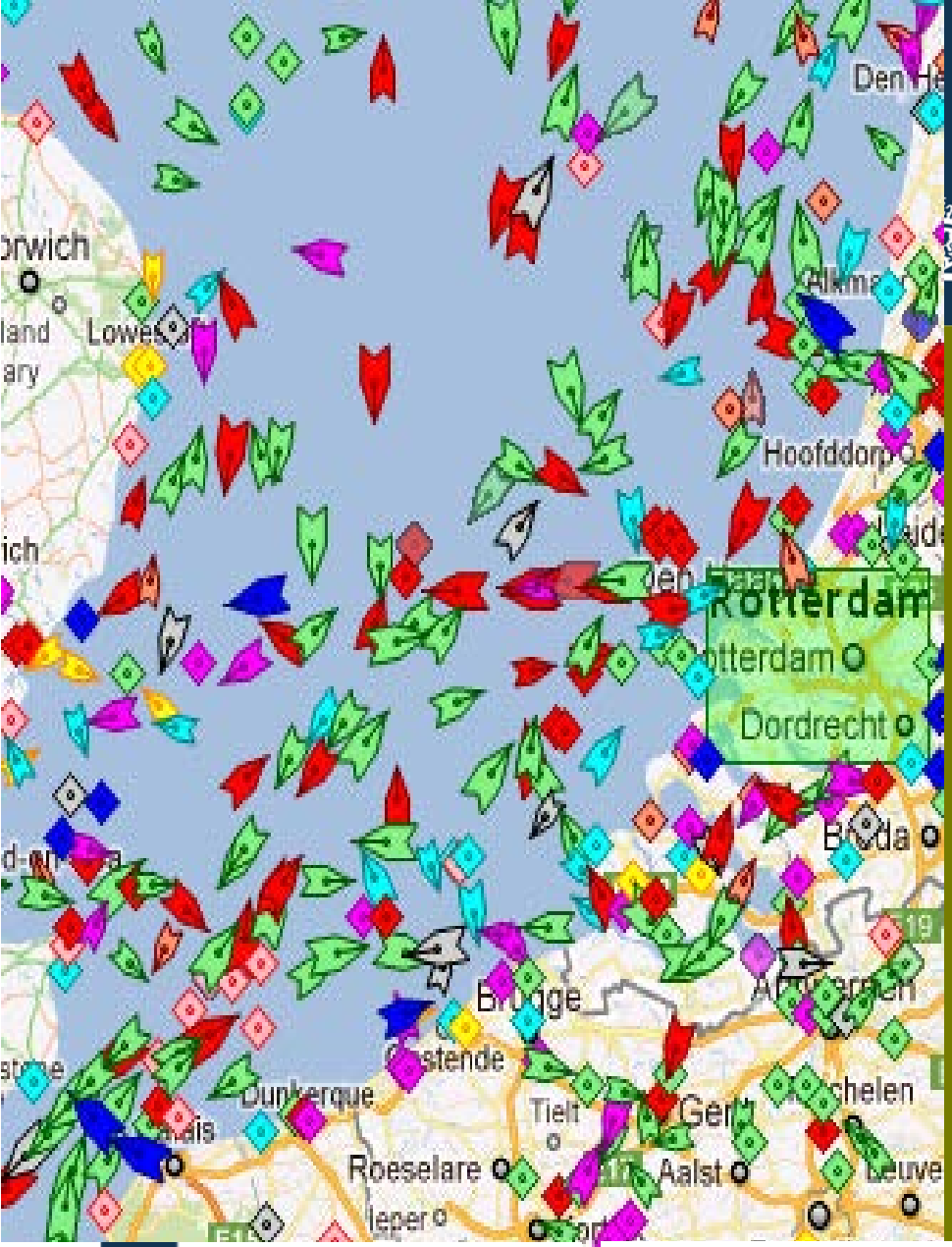

PBL Netherlands Environmental Assessment Agency

Assessment of the environmental impacts and health benefits of a nitrogen emission control area in the North Sea

08 May 2012 | P. Hammingh, M. R. Holland, G.P. Geilenkirchen, J-E Jonson, R.J.M Maas

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Ministry of Health, Welfare and Sport

EMRC

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DCMR milieudienst Rijnmond

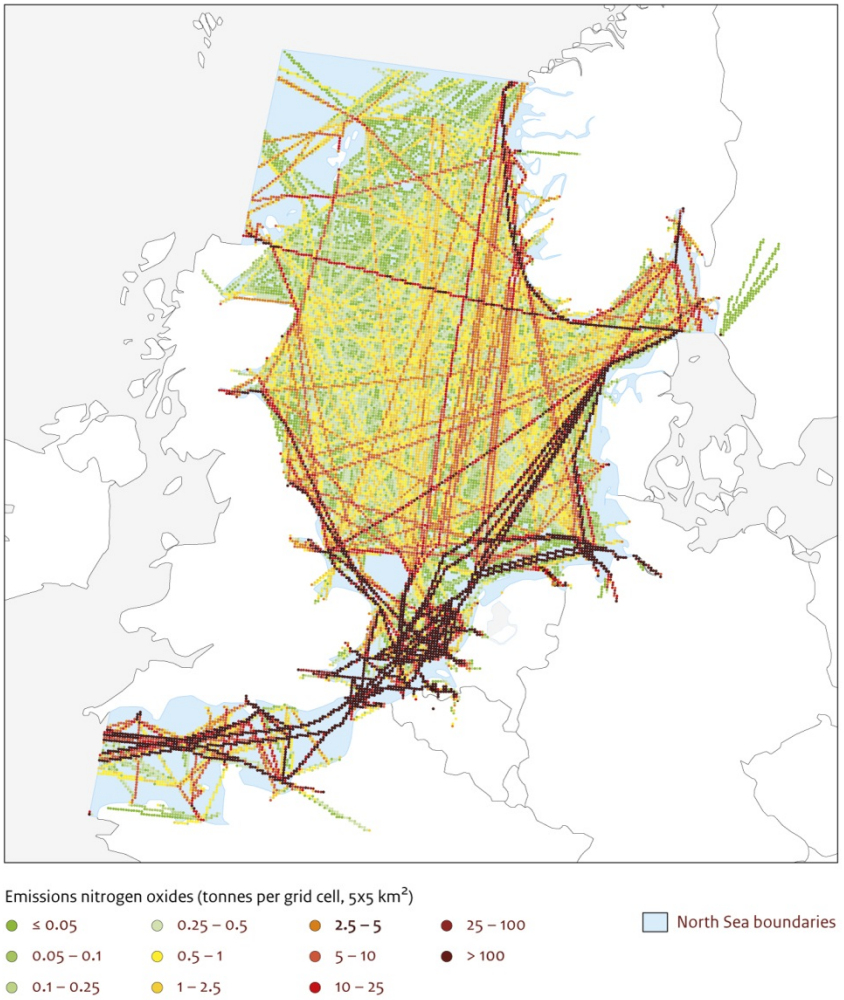
Introduction

- 2008: new IMO regulations for NO_x and SO_x
- 2011, commissioning of an environmental and economic impact assessment for a nitrogen emission control area (NECA) in the North Sea
- Studies set up in accordance with the IMO criteria for designation of an ECA (MEPC 58/23/Add.1, Article 3.1)
- Objectives of this study
  - estimate the contribution of sea shipping and a NECA to air quality, health and ecosystem impacts;
  - cost-benefit analysis of a NECA;
  - compare the cost and benefits of a NECA with land-based emission controls.

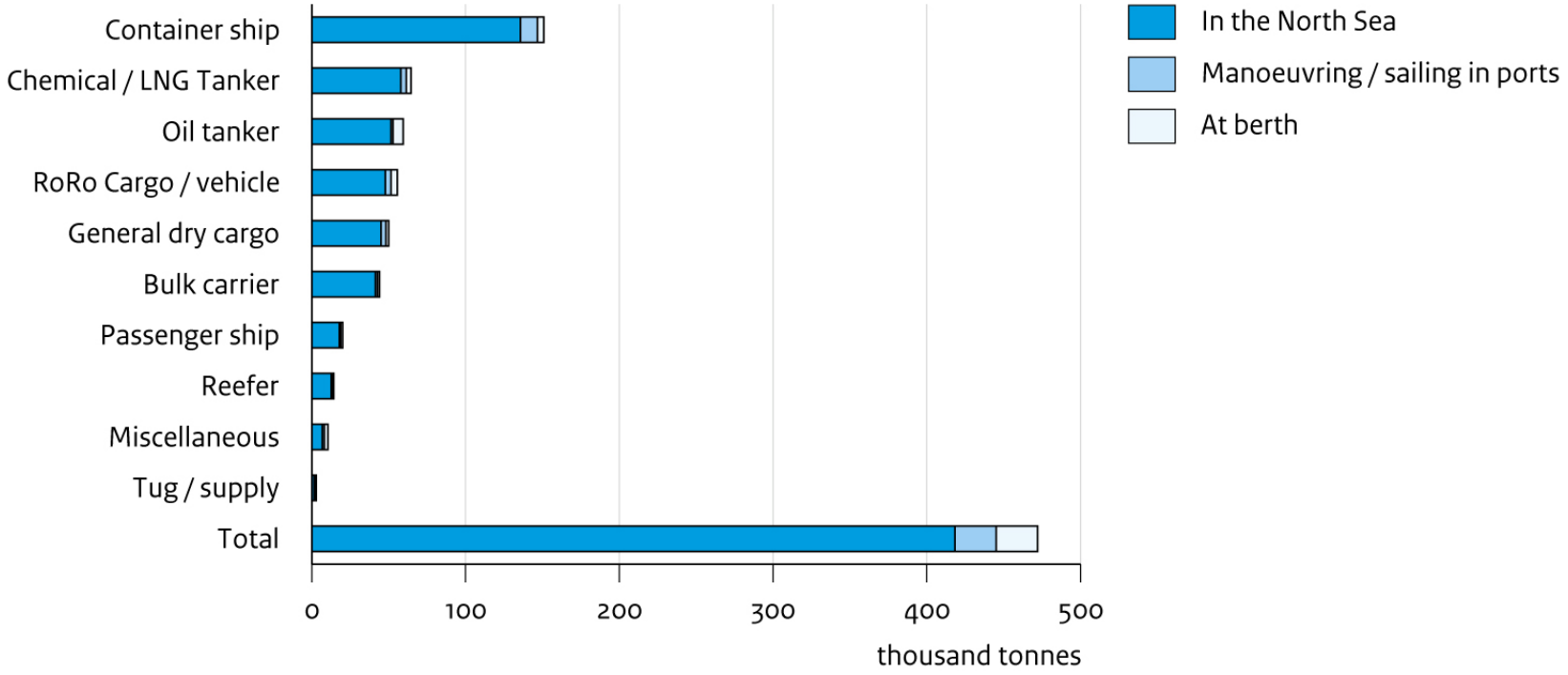
North Sea shipping

- Shipping lanes amongst the busiest in the world;
- 472 and 446 thousand tonnes NO_x in 2009 and 2030, respectively;
- 89% of emissions within 50 NM, (32% < 12 NM, 97% < 100 NM);
- High population densities close to major shipping lanes;

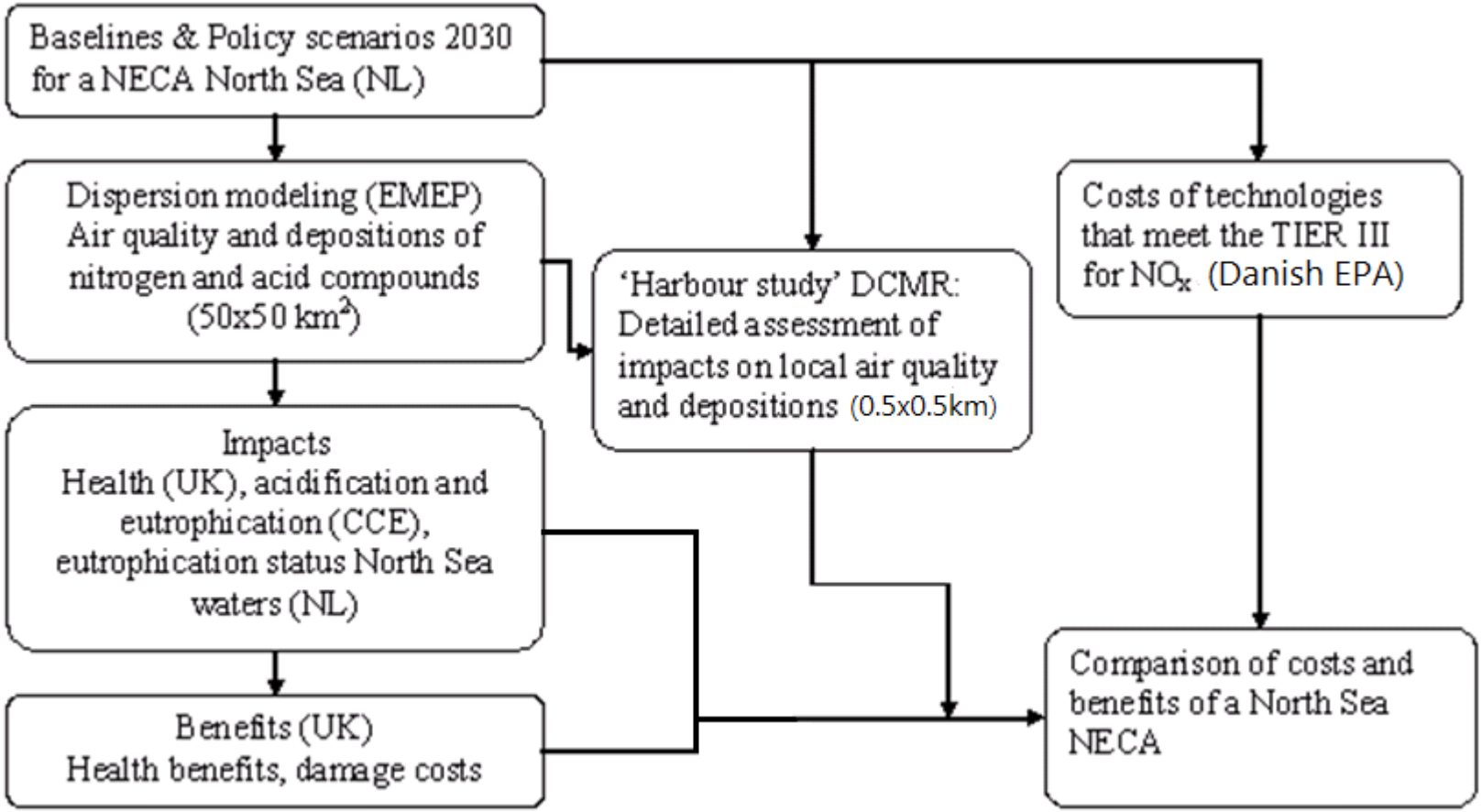
Projected nitrogen oxides emissions in the North Sea, 2030



NO_x emissions per ship type, 2009



Methodology

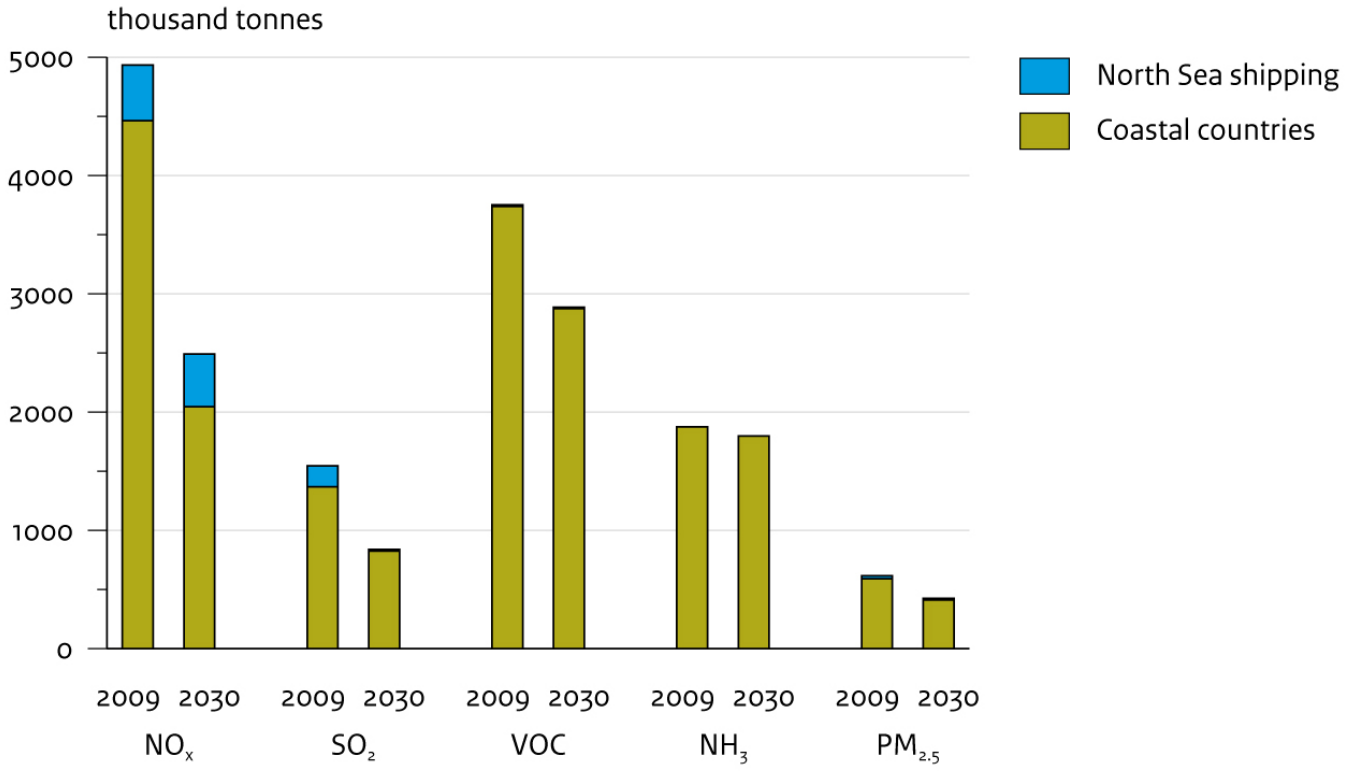


Baseline assumptions, 2009-2030

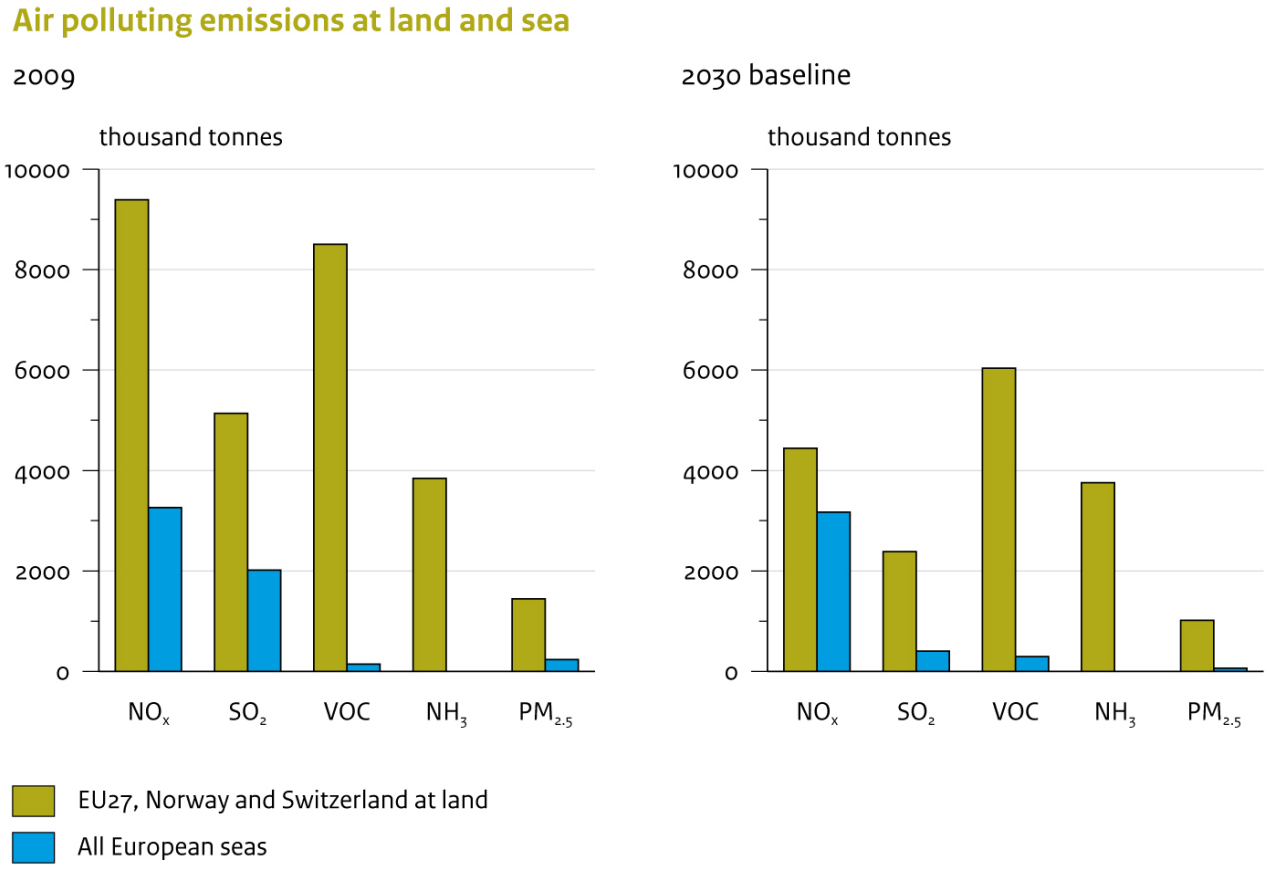
Parameter	Assumptions
Growth of shipping 2009-2030	2.1 %/year average (3.5 % container ships, 1.5 % other ship types)
Efficiency improvements 2009-2030	0.96 %/year (through efficiency of scale, speed reductions and technological and operational improvements)
Share of LNG in 2030	25 % in coastal shipping, 10 % in oil, chemical and gas tankers
Shore-side electricity	applied to 5 % of the ships at berth
Emission standards	current legislation by IMO and EU
Price year / Discount rate	2012 euros, discount rate is 4 %

Emission developments North Sea area

Air pollutant emissions in the North Sea and the coastal countries, 2009 and 2030 baseline



Emissions developments in Europe

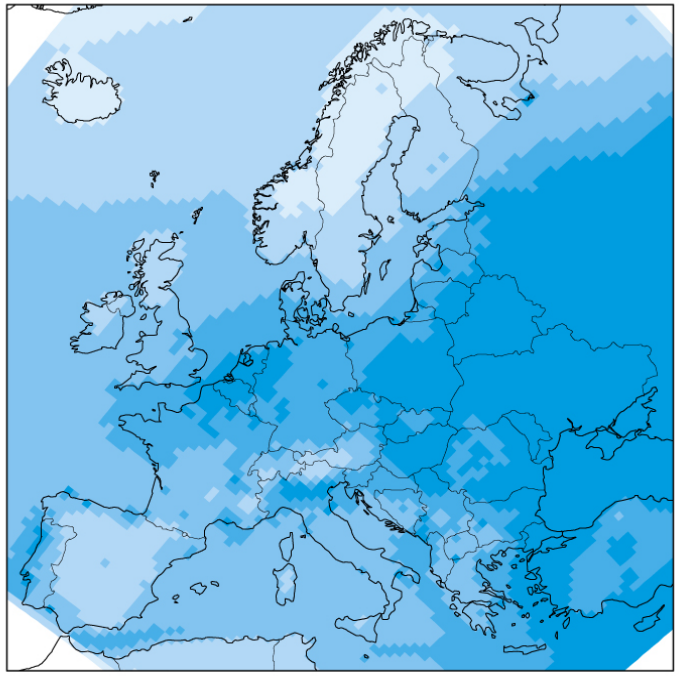


Baseline, scenarios and cases, 2030

Baselines, scenarios and cases	**NO_x standards**	**Nitrogen oxide emissions [thousand tonnes] central case (range)**	**Nitrogen oxides reduction relative to the baseline (thousand tonnes)**
Baseline	Tier I, II	446 (253-676)	-
NECA scenario	Tier I, II, only new ships after 2016 meet TIER III	317 (185-471)	129 (67-205)
MFR Scenario	All ships meet TIER III in 2030	146*	300*
Contribution I	No NO_x emissions from ships	0	446
Contribution II	No NO_x, SO_2, $PM_{2.5}$ and VOC emissions from ships	0	446

Impacts on Particulate matter ($PM_{2.5}$), 2030

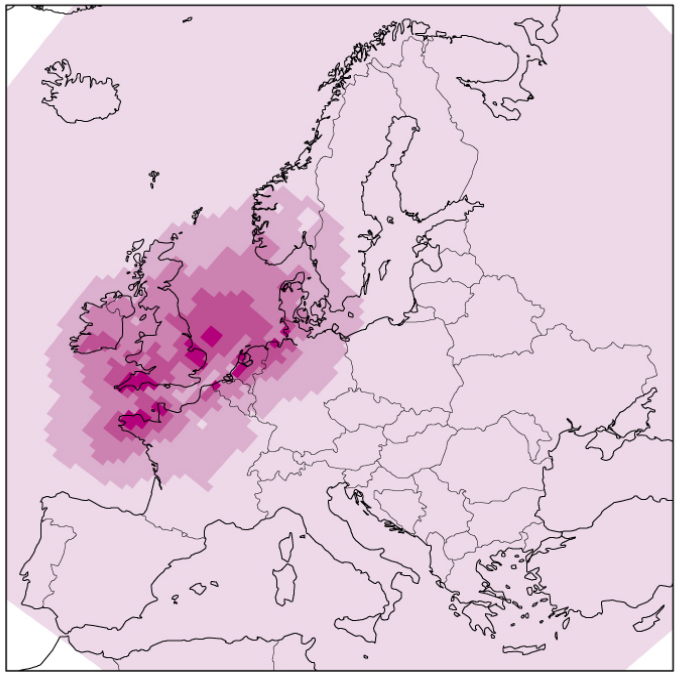
Baseline



Concentration (µg/m³)

- ≤ 1
- 1 – 2
- 2 – 3
- 3 – 4
- > 4

Contribution of NO_x North Sea shipping to $PM_{2.5}$

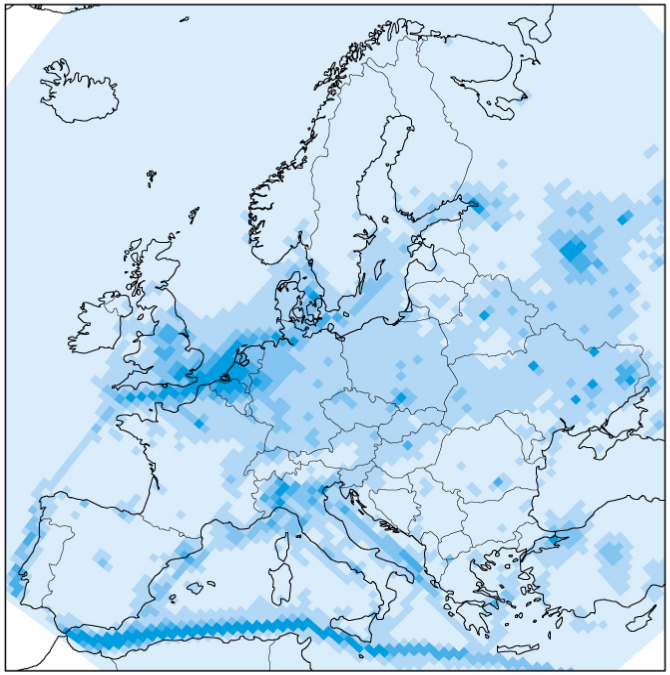


Contribution (%)

- ≤ 1.5
- 1.5 – 3
- 3 – 4.5
- 4.5 – 6
- > 6

Nitrogen dioxide (NO_2), 2030

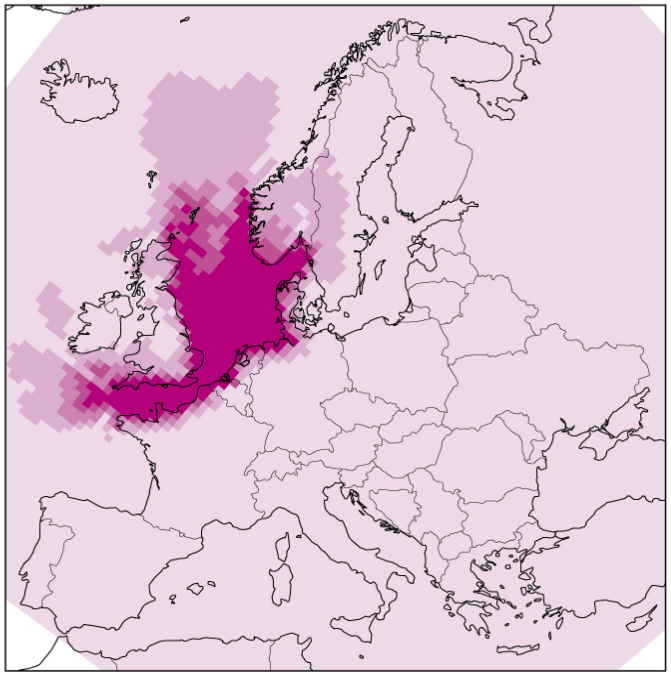
Baseline



Concentration (µg/m³)

- ≤ 2
- 2 – 4
- 4 – 6
- 6 – 8
- > 8

Contribution of NO_x North Sea shipping to NO_2

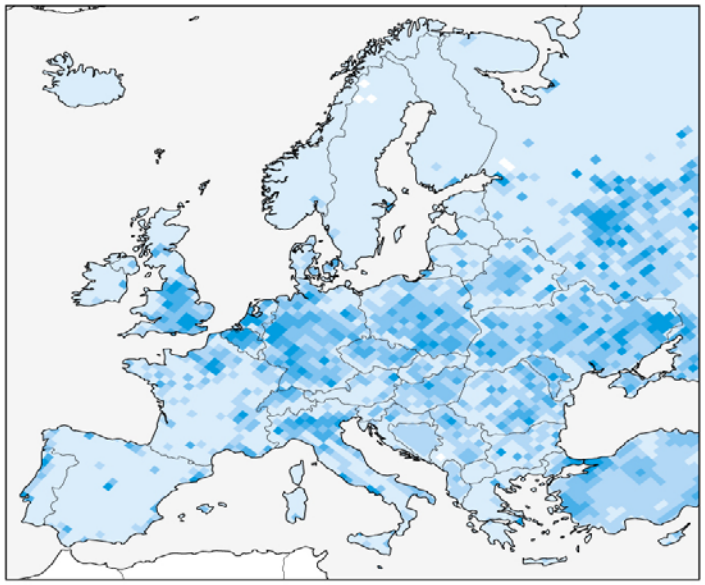


Contribution (%)

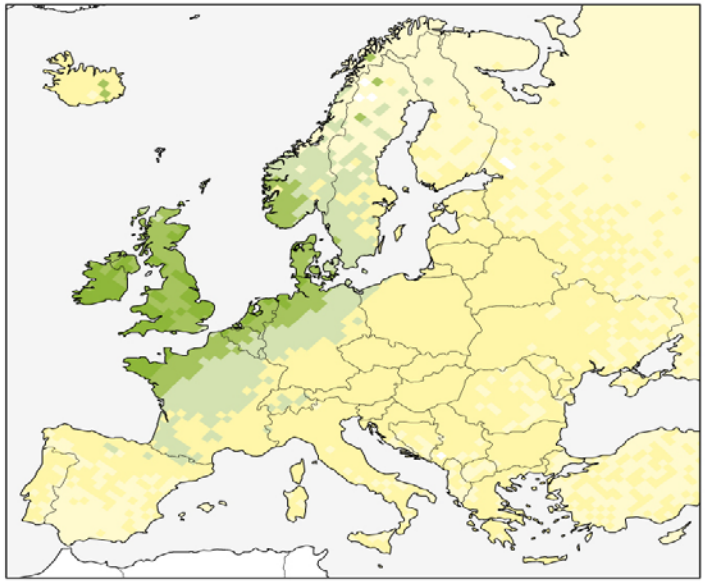
- ≤ 10
- 10 – 15
- 15 – 20
- 20 – 25
- > 25

Health impacts: years of life lost, 2030

Baseline



Potential reduction MFR scenario



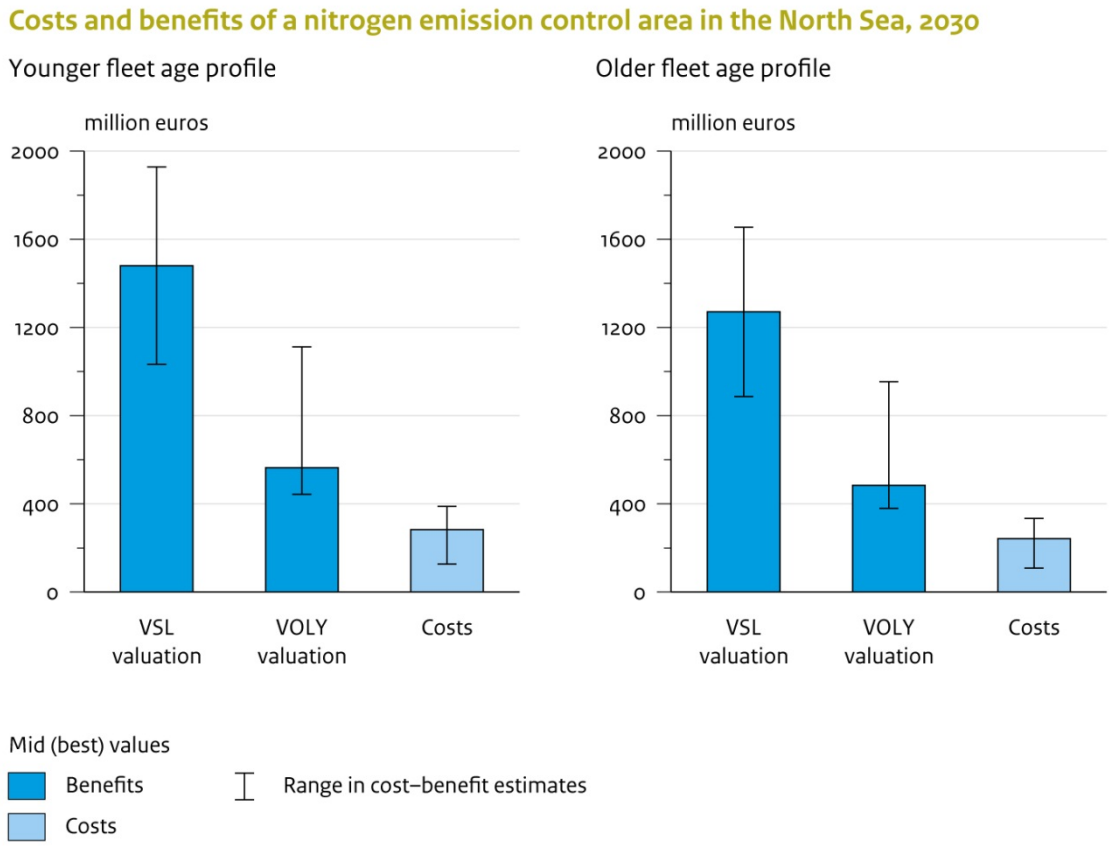
Years of life lost (total per grid cell)

- ≤ 250
- 250 – 500
- 500 – 1000
- 1000 – 2500
- > 2500

Contribution MFR (%)

- 0
- 0 – 1
- 1 – 2
- 2 – 4
- 4 – 7

Costs and benefits of a NECA compared, 2030

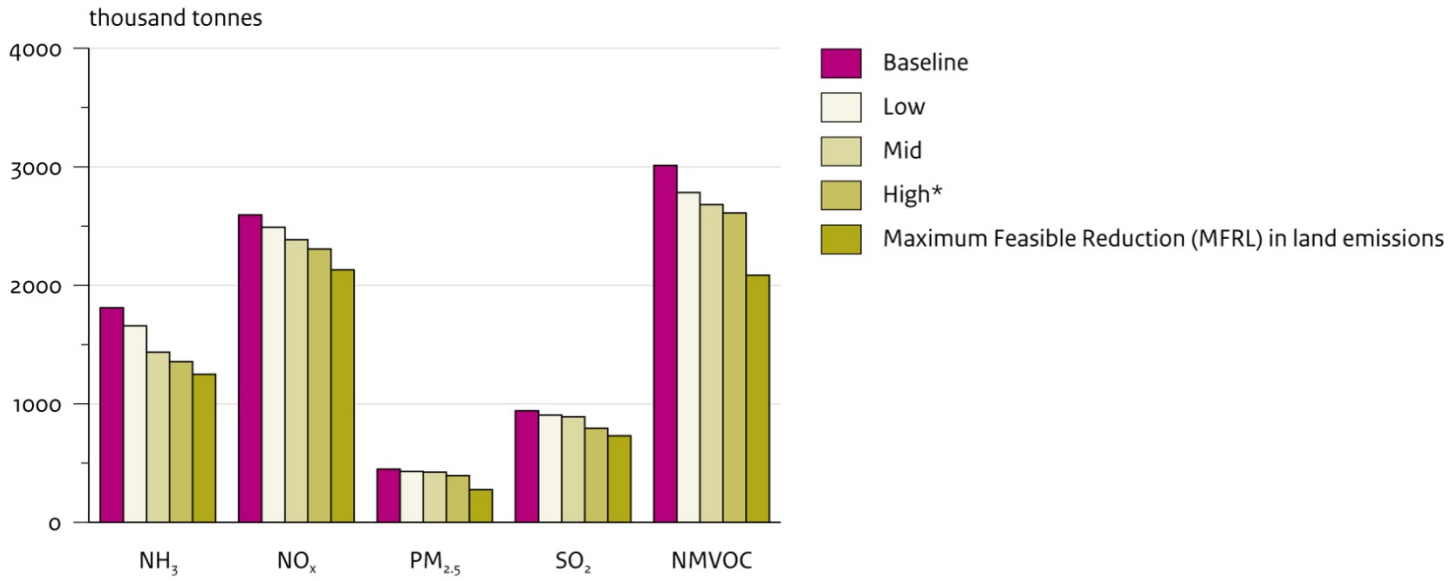


Sea-based versus land-based air policies: ambitions at land

Scenarios	Possible ambitions air policies at land, 2020			
	Health-PM	Acidification	Eutrophication	Ozone
Baseline	0%	0%	0%	0%
Low	25%	25%	25%	25%
Mid	50%	50%	60%	40%
High*	75%	75%	75%	50%
MFR	100%	100%	100%	100%

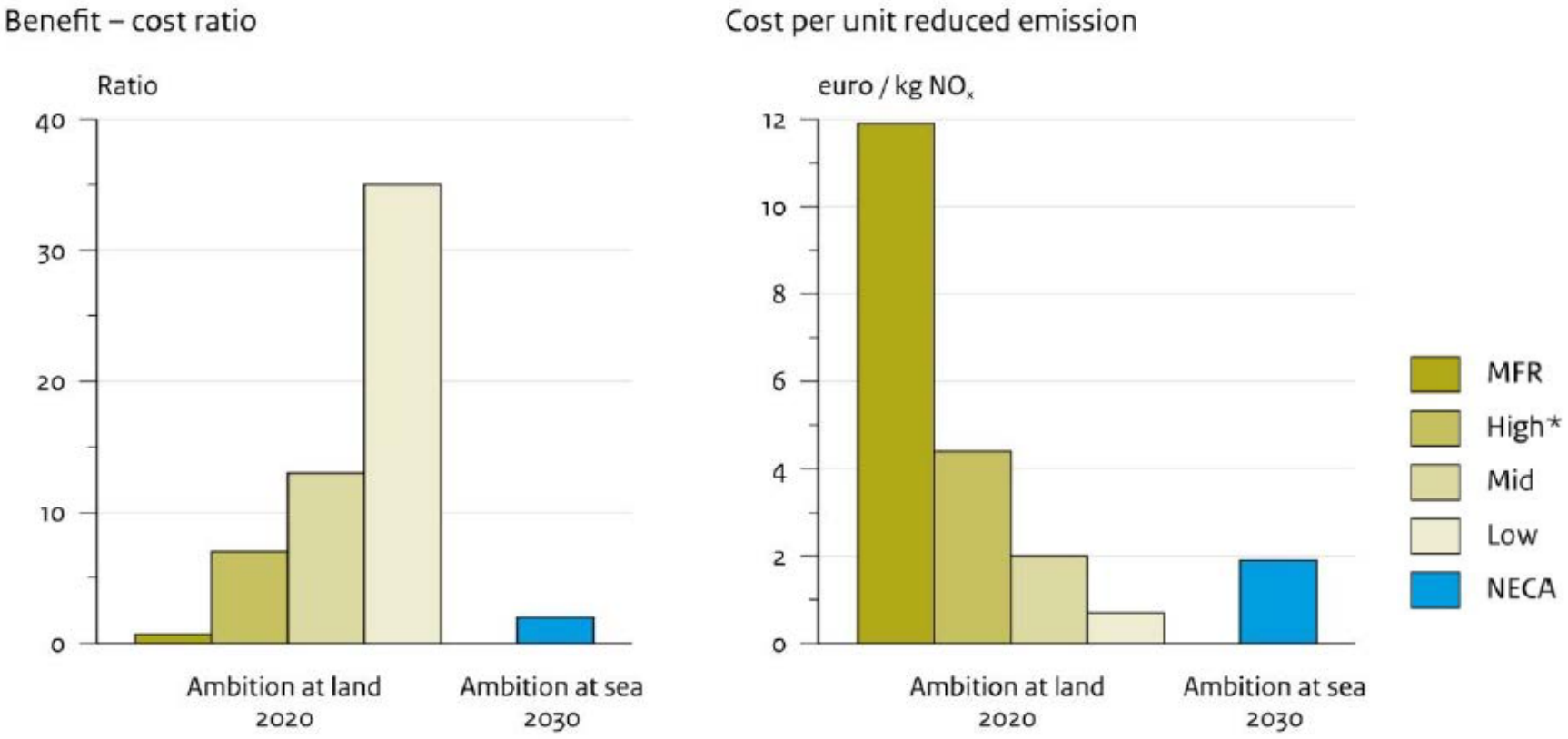
Sea-based versus land-based air policies: effects at land

Total emissions according to the air policy ambitions that were considered in the Gothenburg protocol revision for the North Sea countries, 2020



Sea-based versus land-based air policies:
cost and benefits and cost-effectiveness compared

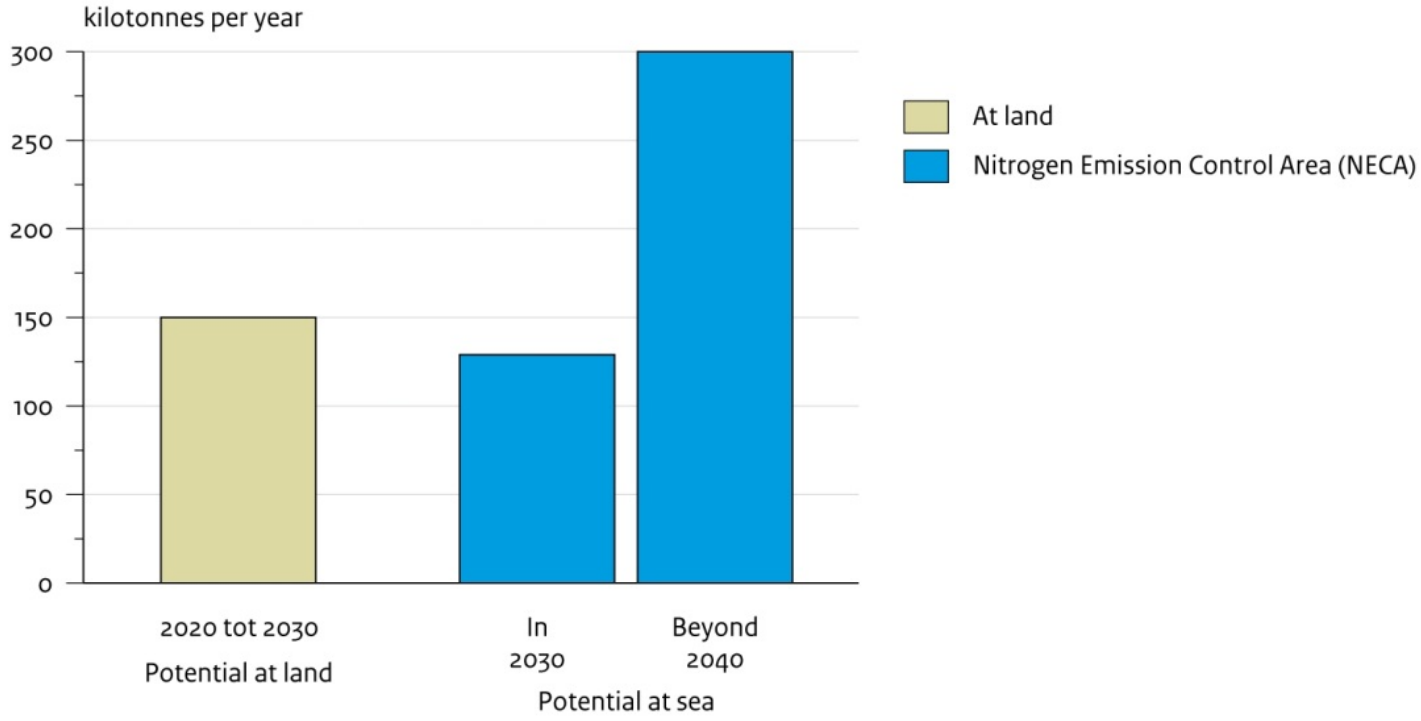
Air quality policy ambitions in the eight North Sea countries and the North Sea compared



Sea-based versus land-based air policies:
potential NO_x reductions compared

Air quality policy ambitions in the eight North Sea countries and the North Sea compared

Potential NO_x reduction at the cost effectiveness of a NECA (1.9 euro / kg)



Conclusions

- The benefit to cost ratio of a NECA is 2 (1.1-8.8), this excludes benefits to ecosystems and crops;
- A ‘medium ambition’ for a cost-optimal air quality improvement in Europe after 2020, could include a nitrogen emission control area at the North Sea;
- North Sea shipping contributes to health impacts (>3 %) and terrestrial ecosystem impacts (7 %) in the coastal countries in 2030; A NECA would reduce these contributions by about one-third in 2030 (and more afterwards).
- A NECA brings a modest improvement in YOLL in 2030 (1 %) compared to the ‘medium ambition’ in 2020 (11 %).

Thank you for your attention

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