International Institute for Applied Systems Analysis
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science for global insight

Costs and benefits of reducing air pollution from shipping
A focus on the Mediterranean Sea

A study for the European Commission, DG ENV
Consortium: IIASA, MET.NO and EMRC

Main investigator:
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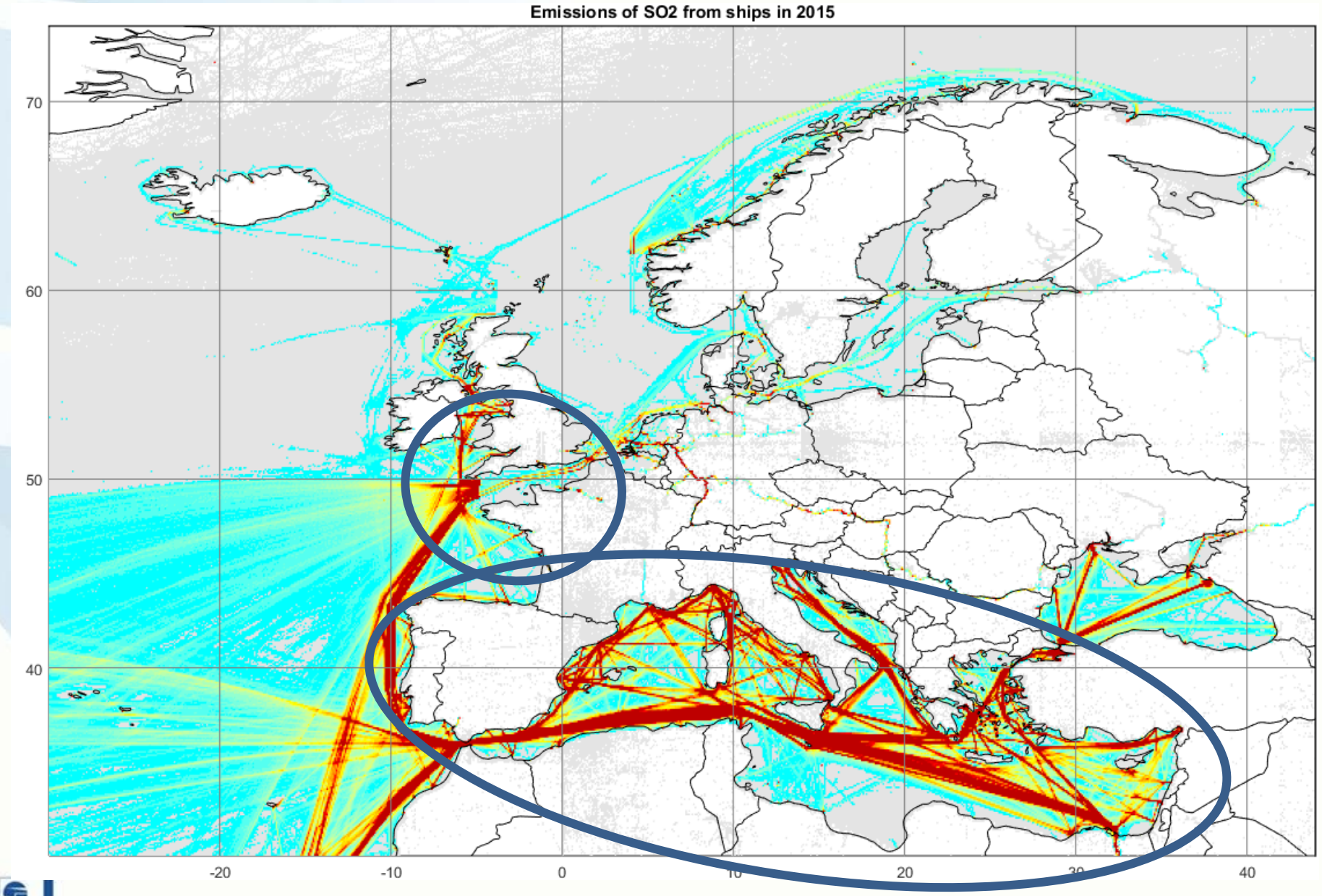
Task Force On Integrated Assessment Modelling (TFIAM)
48th session, 23 - 24 April 2019, Berlin, Germany

Shipping routes and SO_2 emissions around Europe (2015)



Source: FMI STEAMv3 2017

Health impacts from ship air pollution ⇔ Premature mortality due to fine particles ($PM_{2.5}$)

- Ships contribute ~4% to ambient $PM_{2.5}$ concentrations in EU-28
  - 6-8% in Greece, Italy, Turkey, a.o.
  - >10% Portugal, Spain, Cyprus and Malta

- ~12,000 premature deaths annually in EU-28 related to air pollutant emissions from international shipping in 2015

- ~50% of health damage occur in coastal areas, but long-range transport of PM and precursor gases => impacts also inland

- The global 0.5% sulphur limit in 2020 => ~30% reduction.
  But then increasing again as traffic volumes increase.

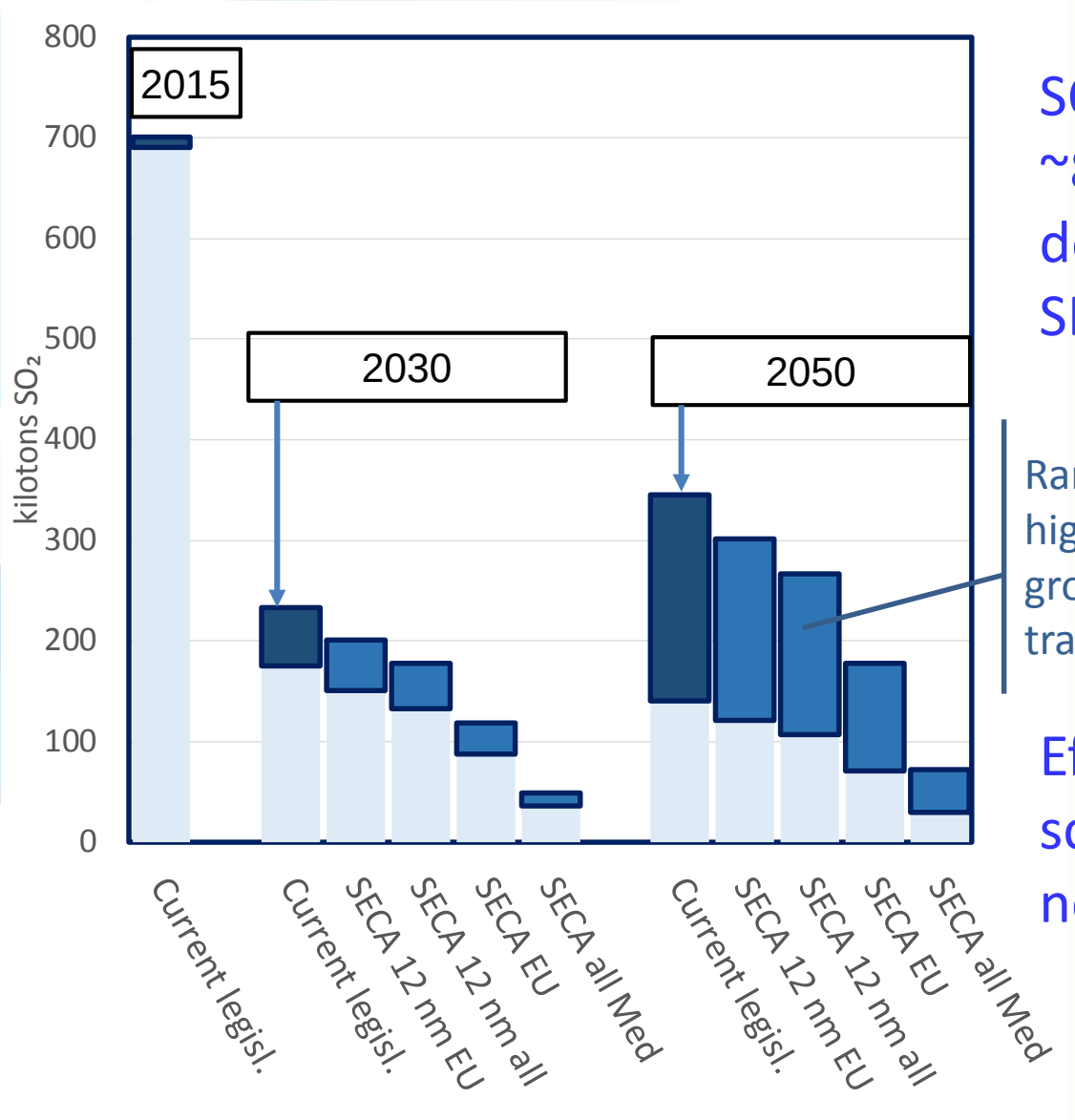
Investigate the following cases

Current legislation (CLE)	0.1%S at (EU) ports; 0.5%S global 2020	
Further emission control scenarios	**SO_x-ECA**	**NO_x-ECA**
SECA 12nm	EU waters/all waters	No
SECA	EU waters/all waters	No
SECA/NECA	EU waters/all waters	From 2025

Fuel demand projections

- "Baseline" (demand increases by 130% from 2015 to 2050)
- "With climate measures" (demand stabilizes from 2015 to 2050)

SO_2 emissions in the Mediterranean Sea

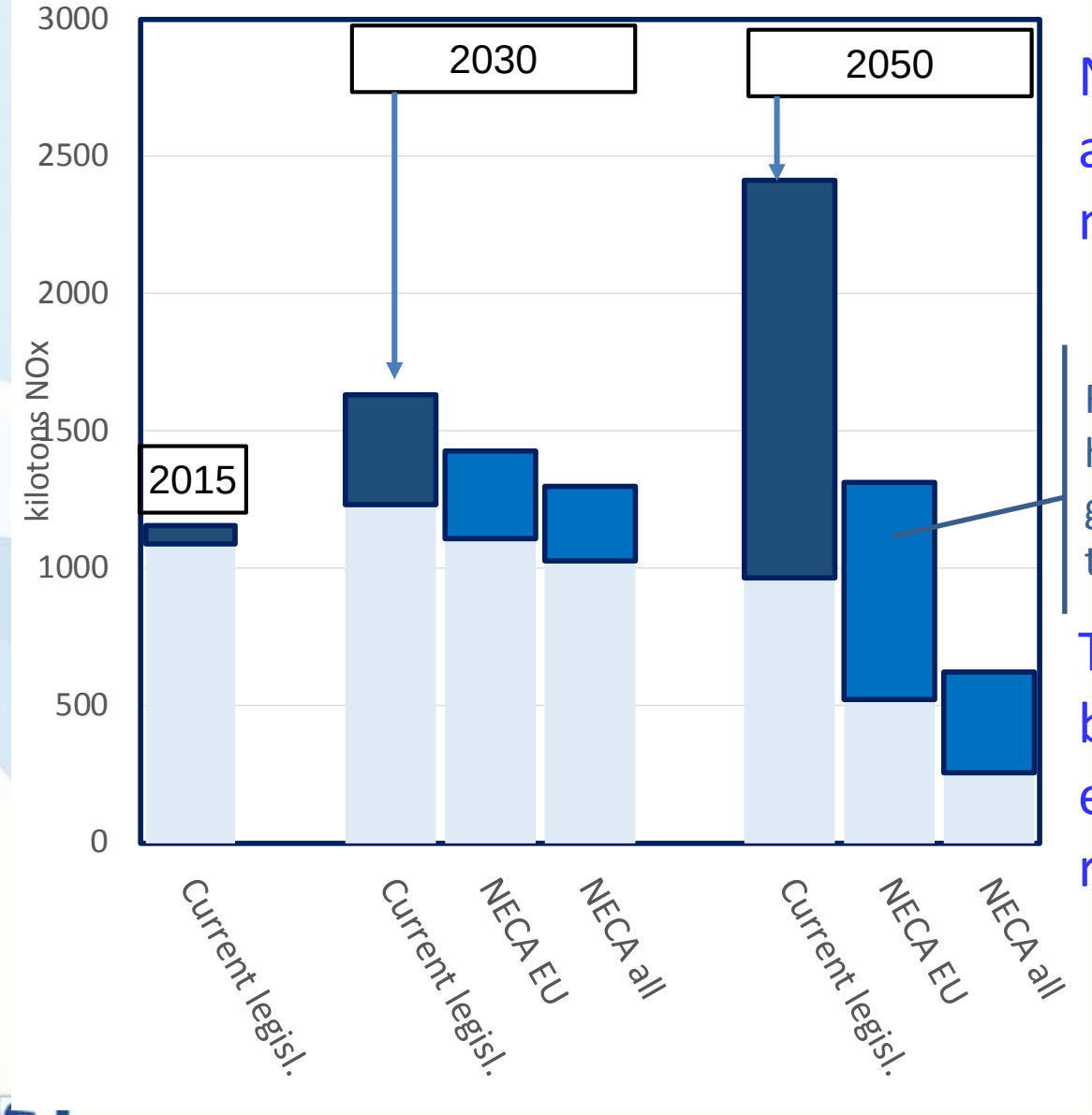


SO_2 emissions decrease ~80% already in 2020, could decrease another 80% when SECA imposed.

Range reflects high or low growth of ship traffic

Effectiveness depends on scope, doubles if EU and non-EU act together.

NO_x emissions in the Mediterranean Sea

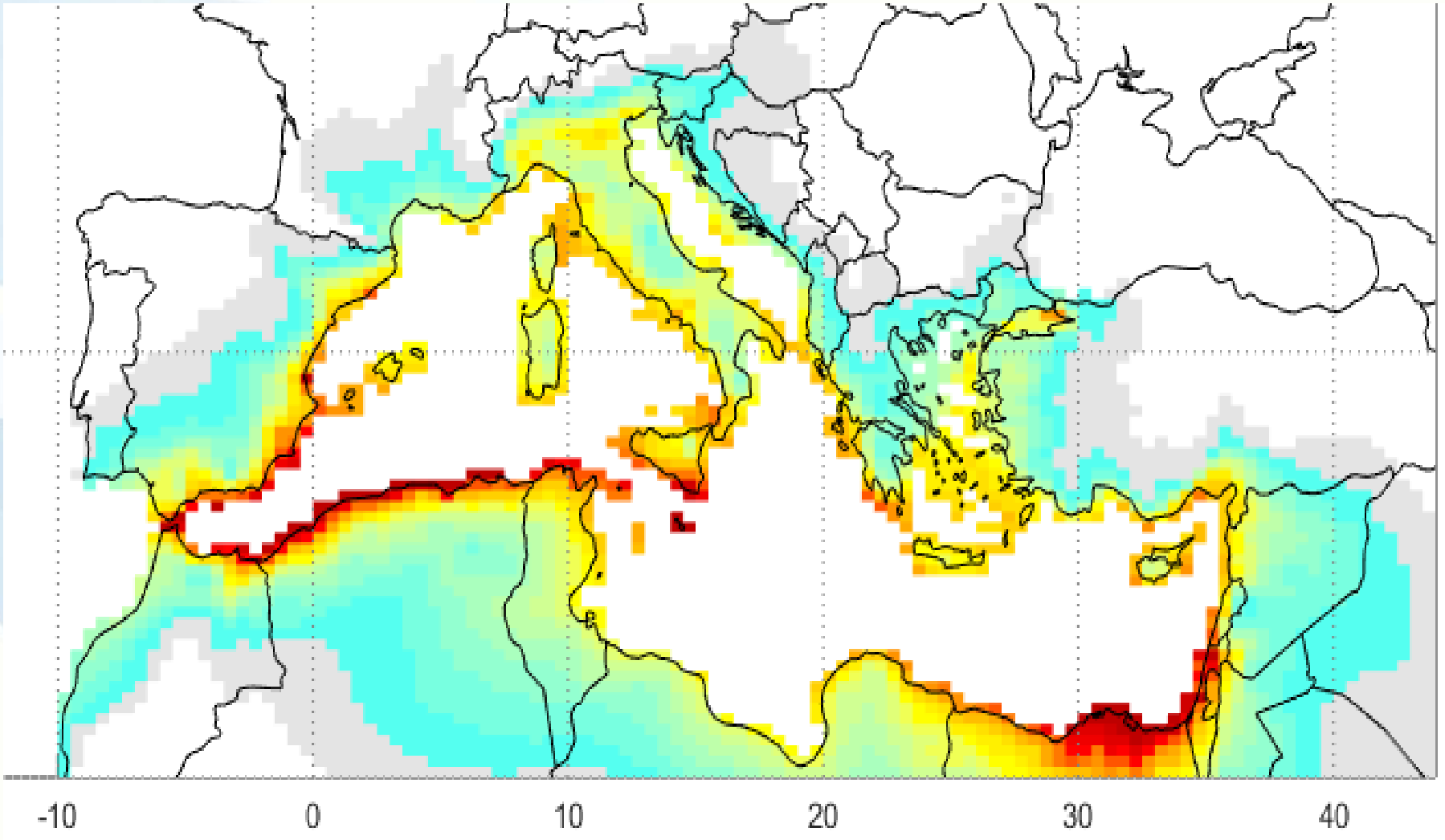


NO_x emissions increase in absence of control measures.

Range reflects high or low growth of ship traffic

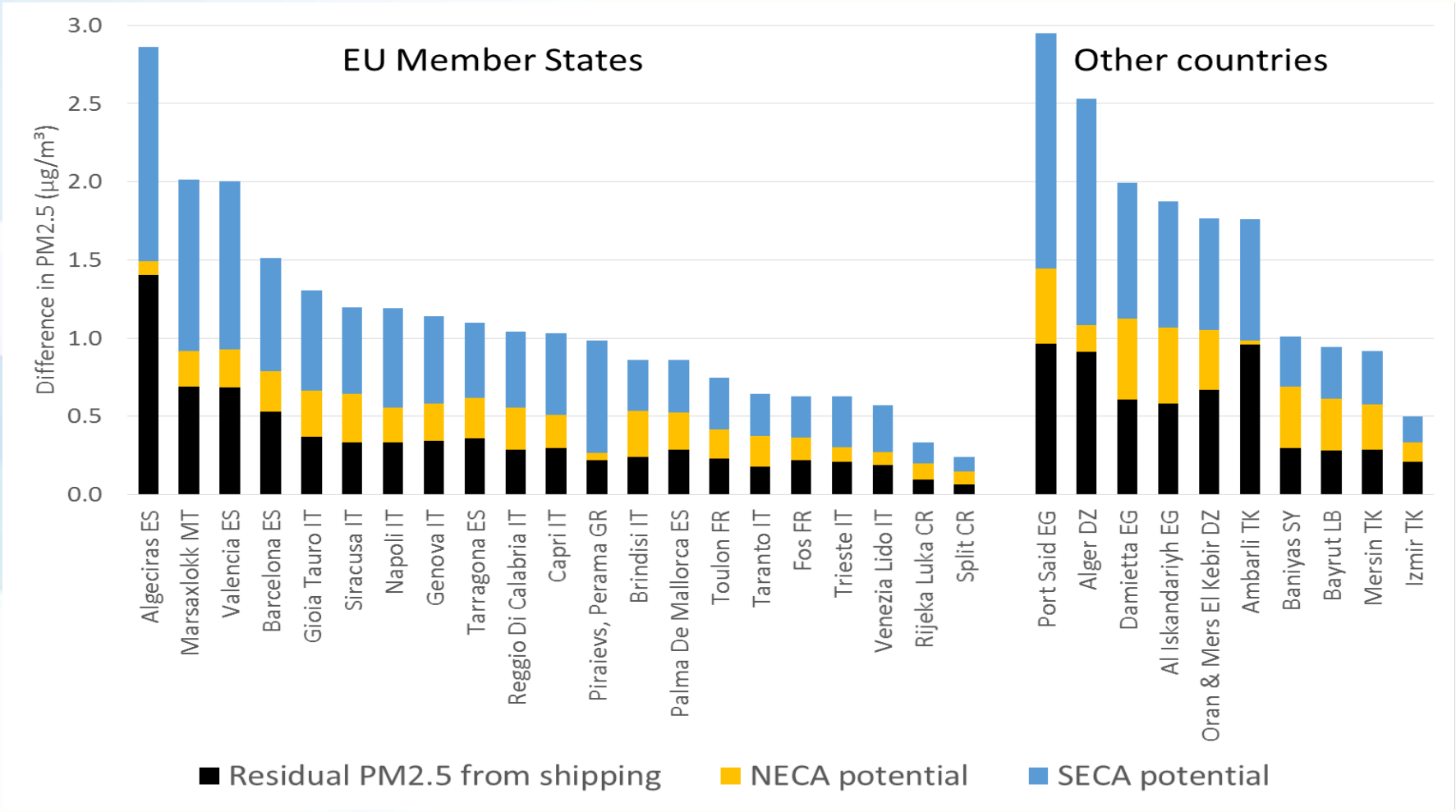
Tier III only for newly-built ships, hence full effect only after fleet renewal (beyond 2030).

Annual ambient $PM_{2.5}$ concentration reduced by SO_x- and NO_x ECA in the Mediterranean in 2050

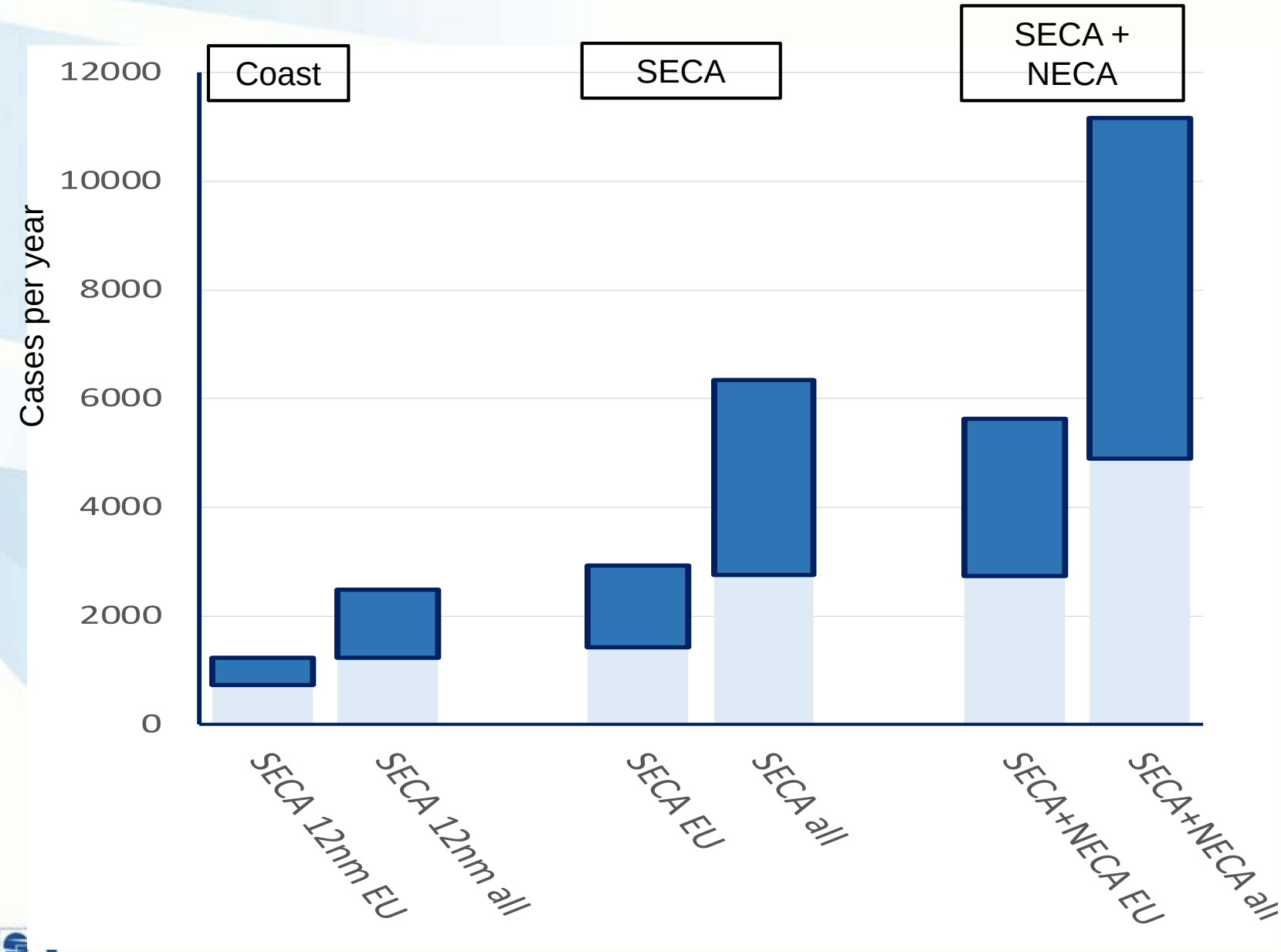


Biggest PM reductions close to the busiest shipping lanes in Northern Africa, Southern Italy, Southern Spain, Malta. Widespread reductions also further inland.

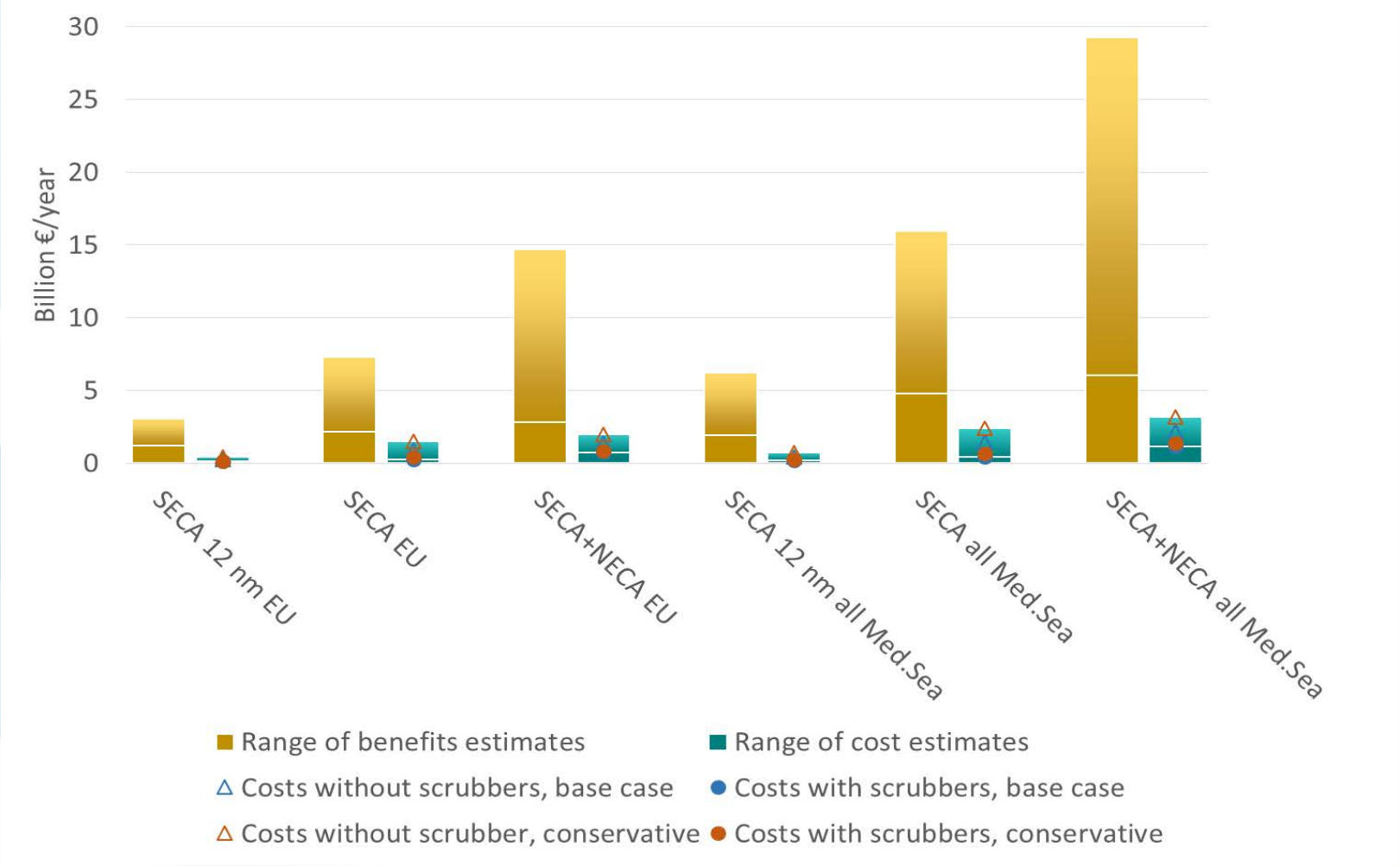
Reduction of $PM_{2.5}$ concentrations in port cities from SO_x- and NO_x ECA in Mediterranean Sea (2050 Baseline)



Avoided premature deaths due to ECA in MED (2050)



Monetized health benefits and costs of emission controls for the Mediterranean Sea 2050 (Baseline)



Range of benefits determined by assumed “value of life”.
Range of costs determined by assumed fuel price premium and scrubber utilization.

Findings

- SO_2- and NO_x ECAs in the Mediterranean Sea:
  - Will improve air quality by lowering ambient $PM_{2.5}$ by 1-2 µg/m^3.
  - Can prevent more than 4,000 cases of premature death annually by 2030 and up to 11,000 annual cases by 2050.
- Double benefits when action of EU + non-EU coastal states aligned.
- Benefits outweigh costs by on average a factor of 7 in 2030 and a factor of 12 in 2050.
- Climate policies have significant co-benefits for air quality.

Results published at:
http://www.iiasa.ac.at/web/home/research/researchPrograms/air/news/190131_SR13_shipping.html

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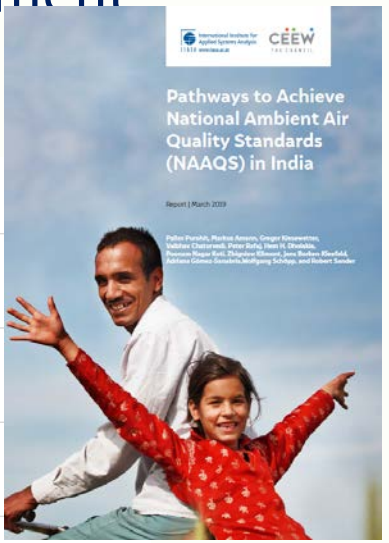
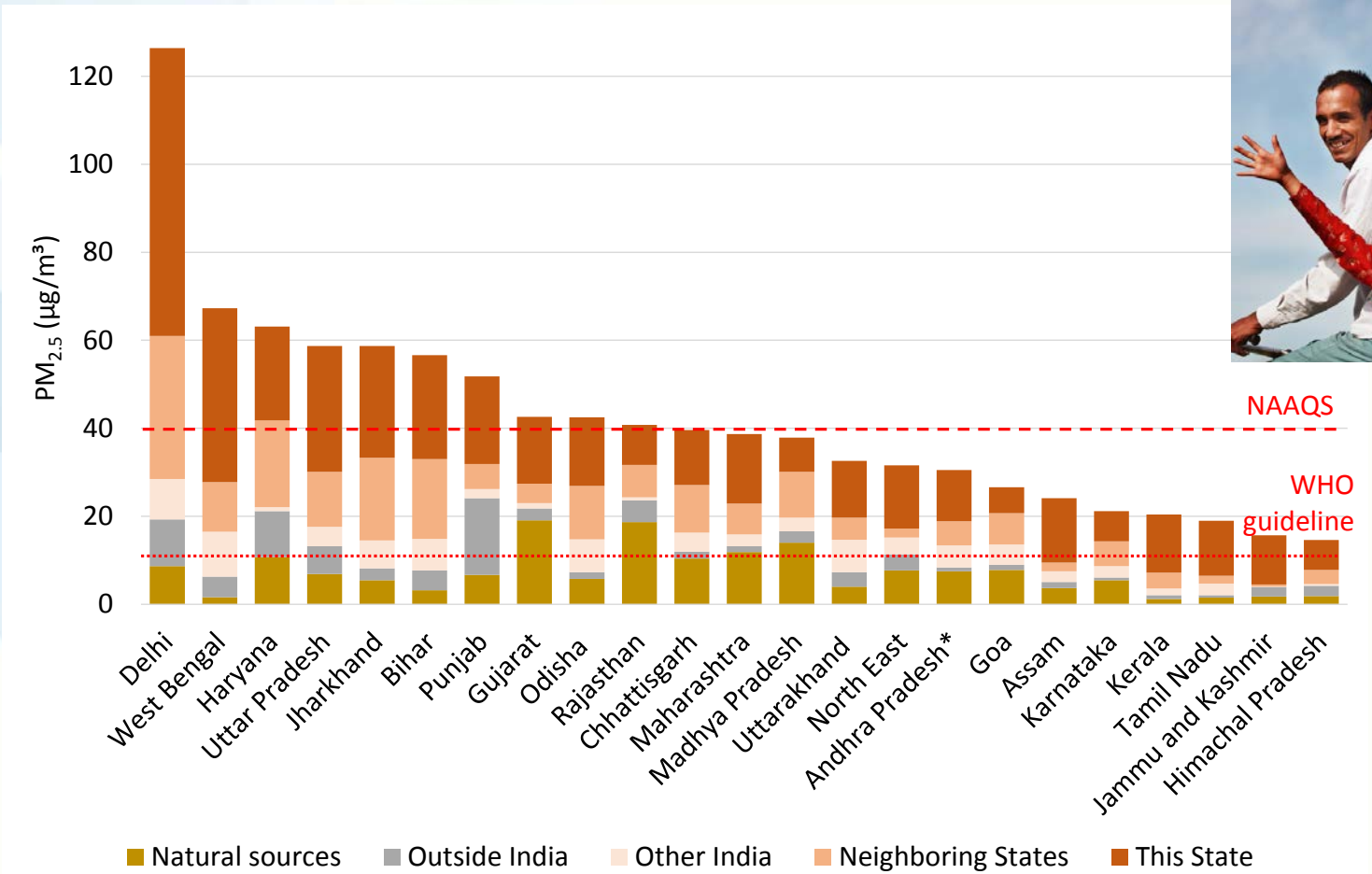
‘Meeting National Air Quality Standards in India’

A recent IIASA-CEEW study

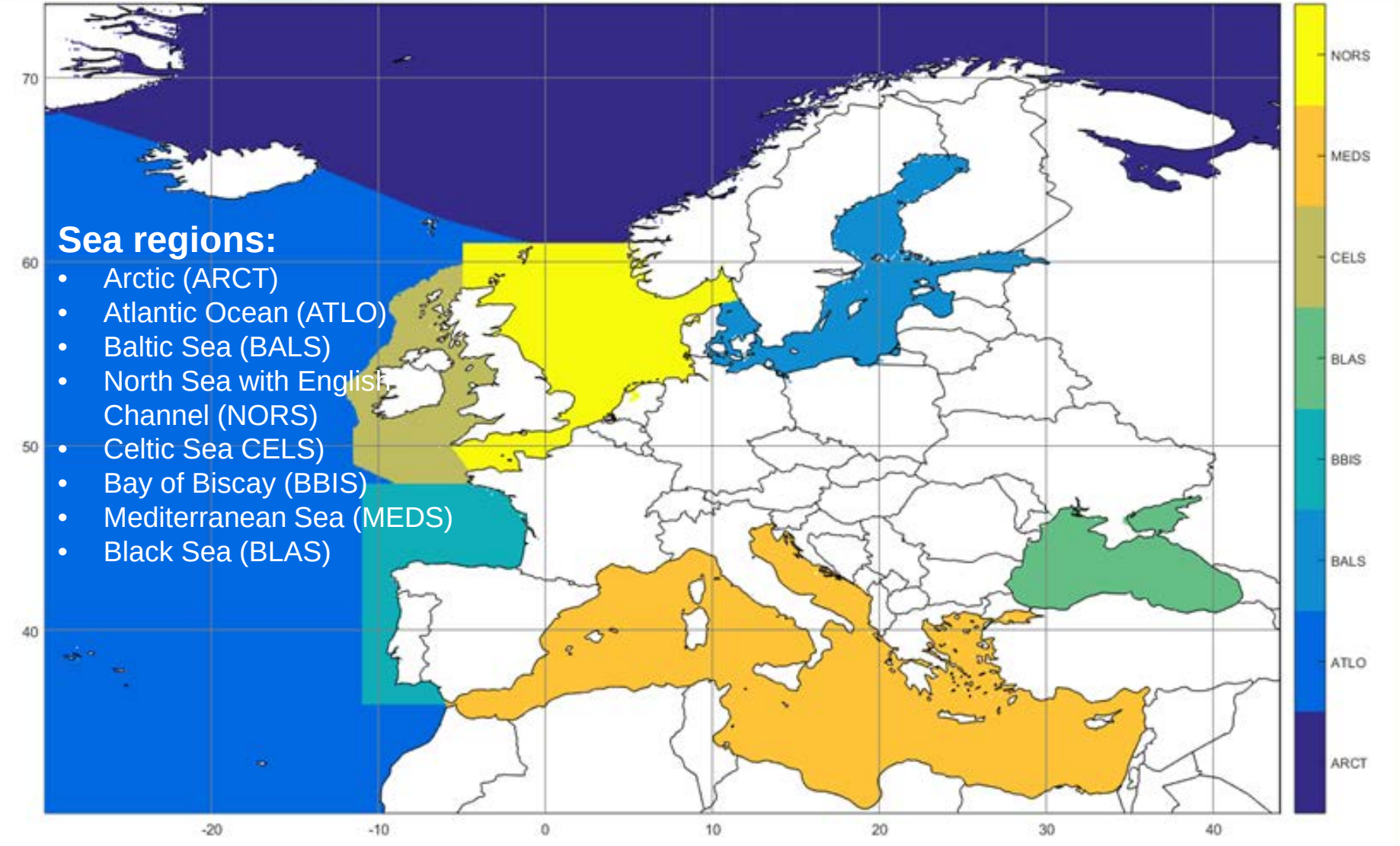
highlighting the importance of long-rang transport of air pollution and the need for multi-scale air quality management



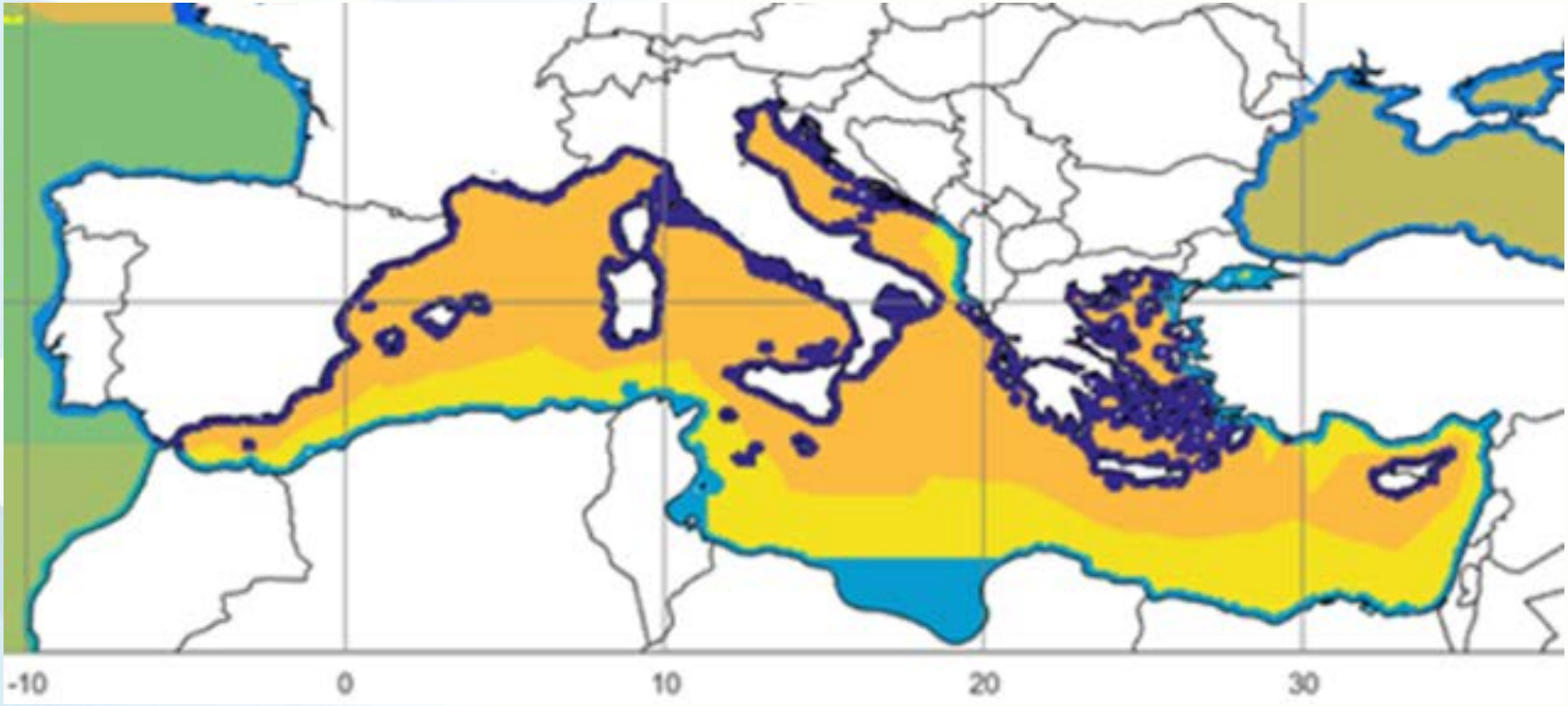


Backup slides

European sea regions



Mediterranean Sea & zones distinguished



Zones (EU and non-EU waters treated separately):

- Territorial waters (12 nm)
- Exclusive economic zones

Health impact & cost-benefit assessment

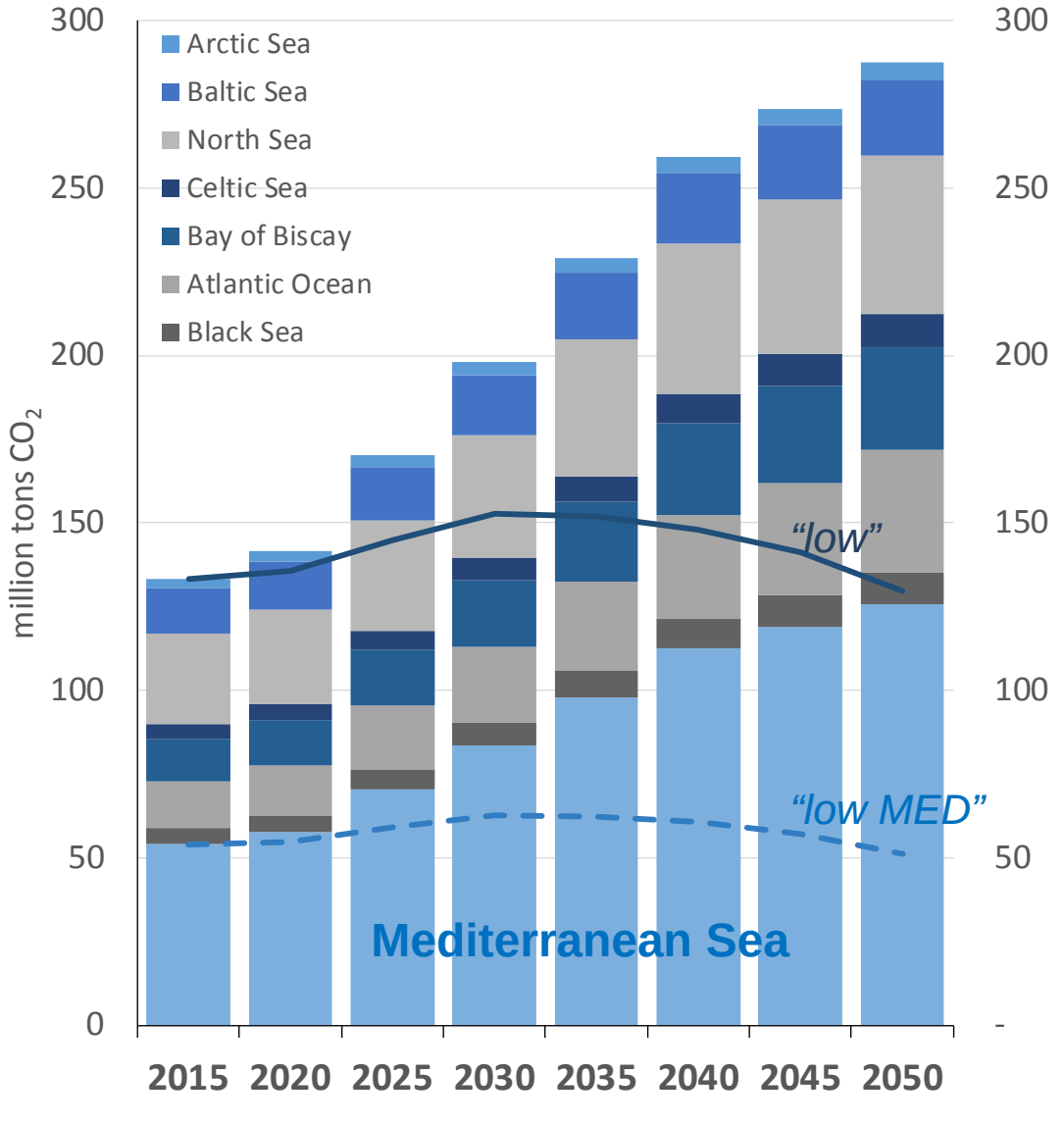
- Basis: Emission inventory for year 2015
  - Fine scale activity inventory by 7 vessel types (FMI 2017, STEAMv3)
  - Emission factors & cost parameters from recent literature

- Ships' fuel demand projections up to 2050
  (consistent with 3rd IMO GHG Study (2015)
  - "Base" (high)
  - "With climate policies" (low)

- Sulphur & nitrogen ECA scenarios for
  - MED only << MED as well as all other sea regions
  - Different zones: 12 nm << EEZ << all sea region for EU MS / non-MS

- All other sources: EU Air Pollution Strategy (IIASA 2014/17)

Fuel demand / CO_2 projections (high / low)

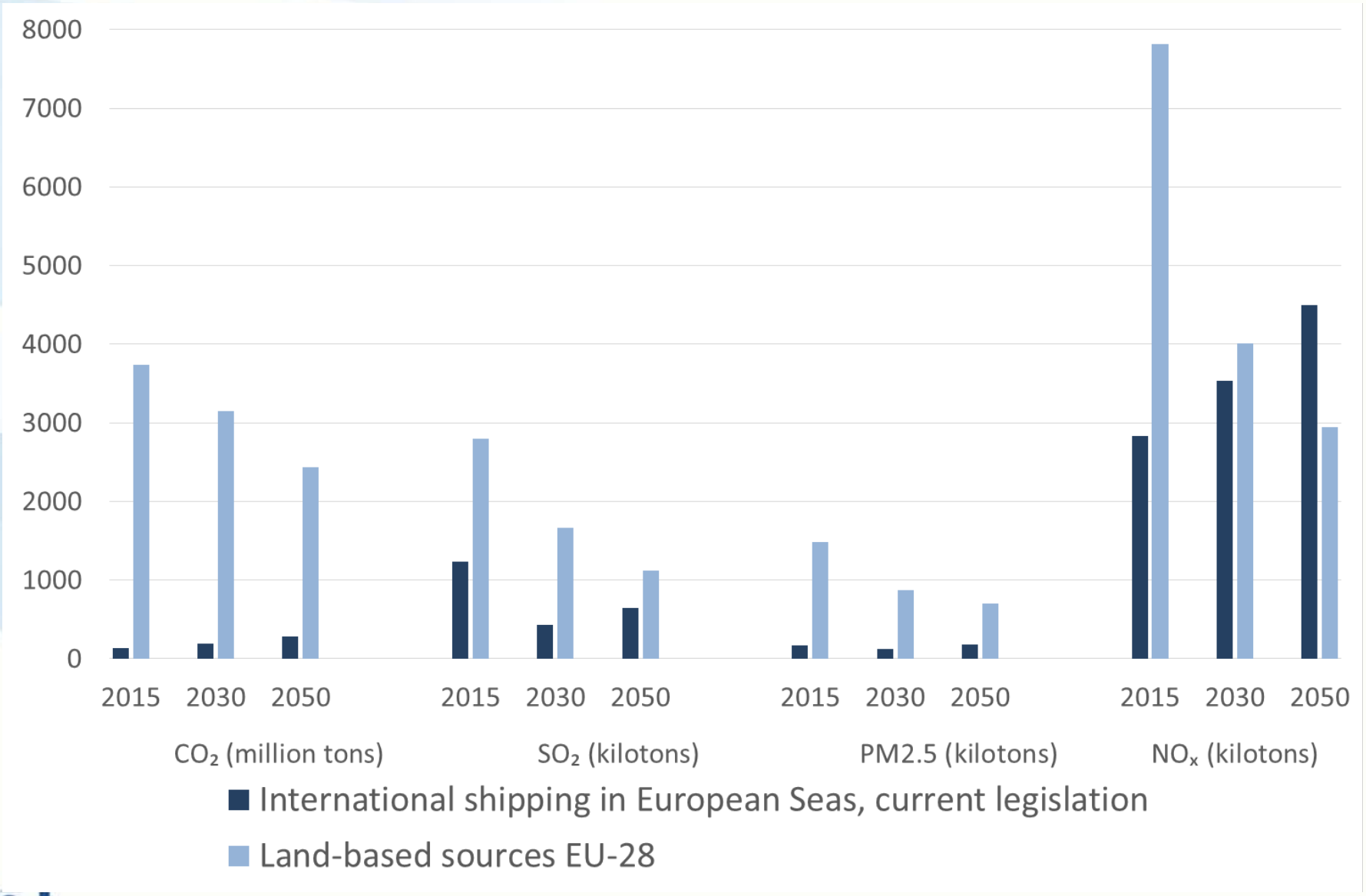


2050 vs. 2015 development:

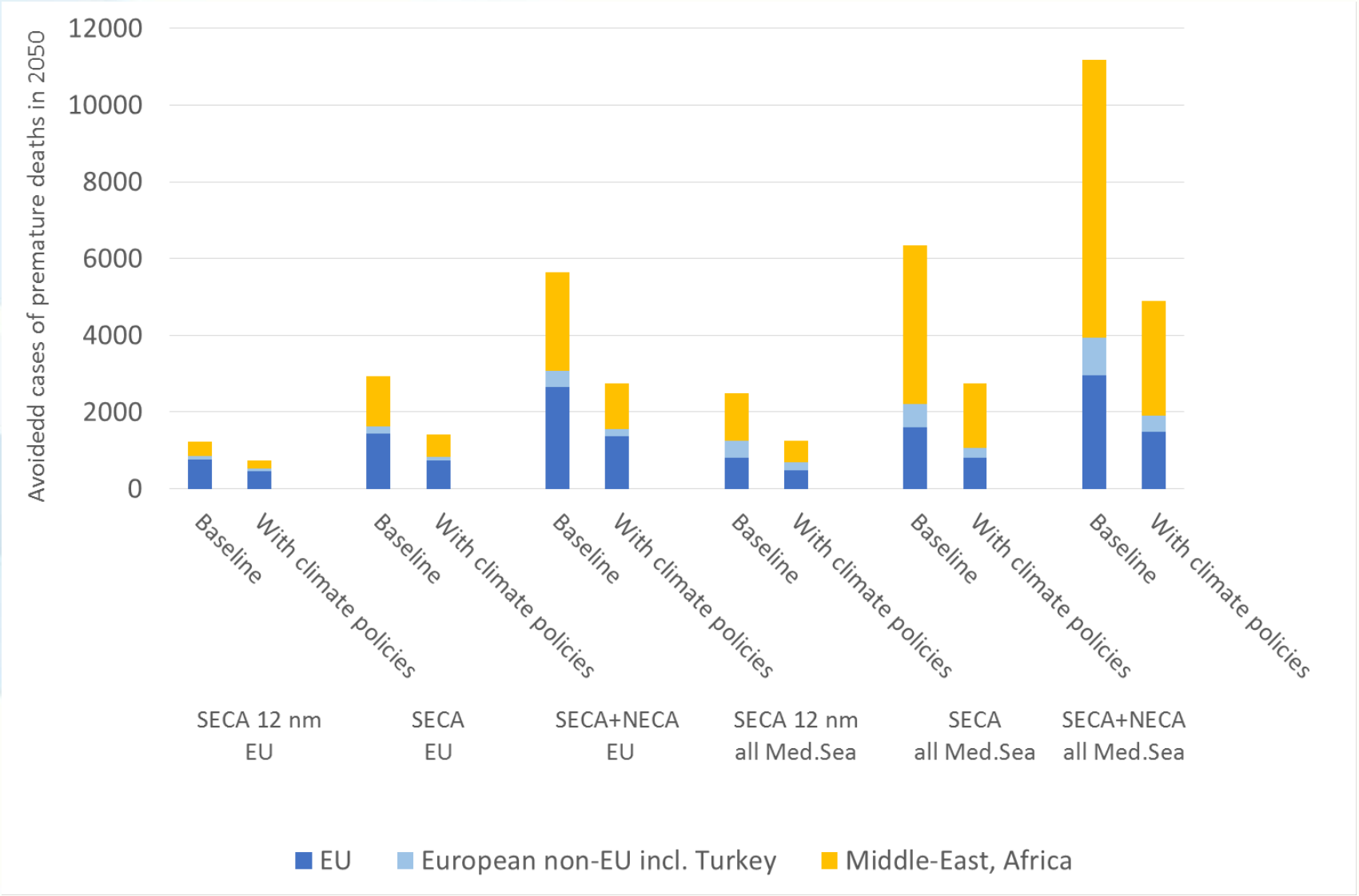
"Base": +130%

"with climate measures": ~0%

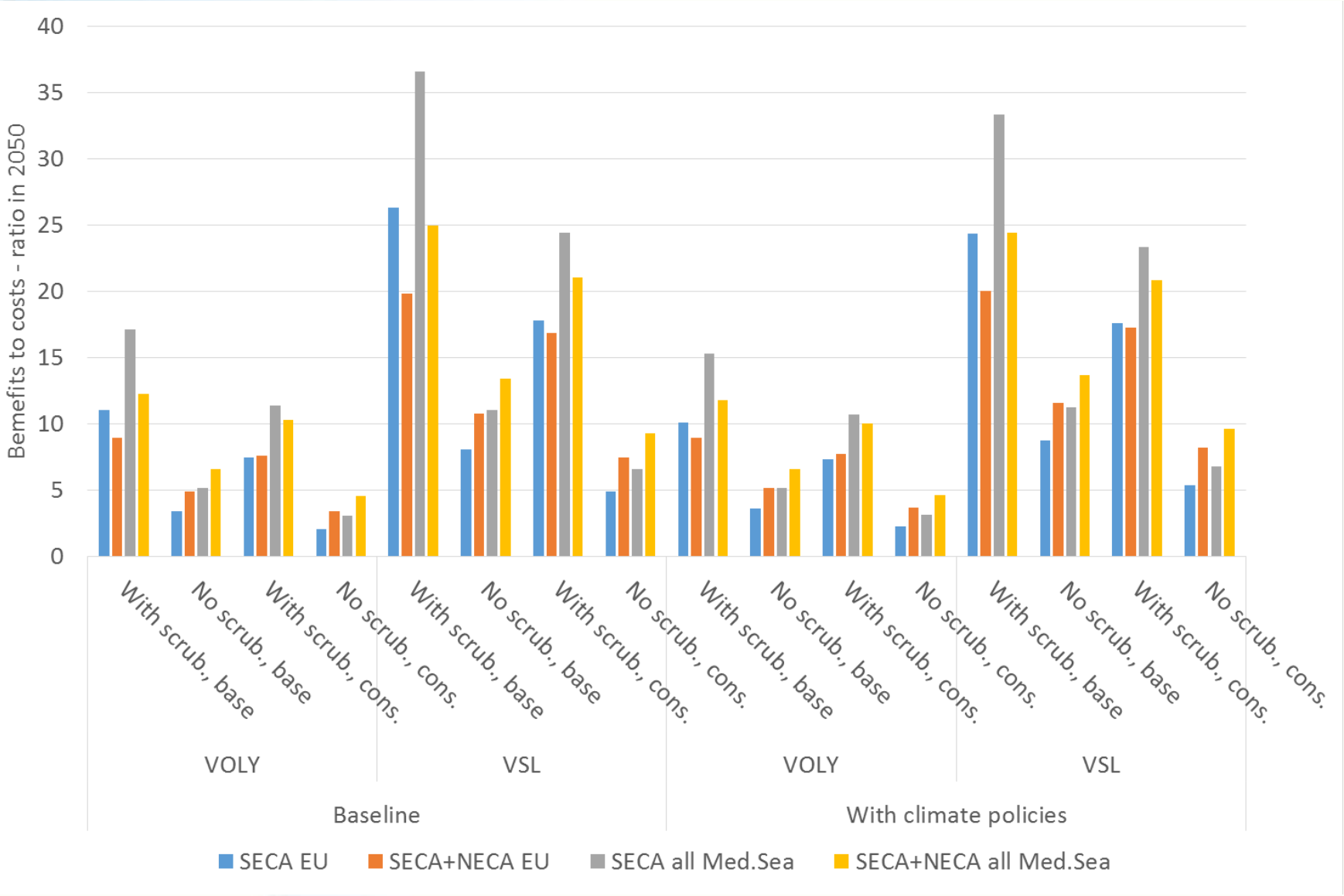
Emissions from shipping vs. all land-based sources (EU28)



Premature deaths avoided in 2050 through ship emission controls in the Mediterranean Sea



Benefits to costs ratios, MED 2050, VOLY and VSL values



base – low S fuel price premium as expected by MECL, 2017 in 2030.
cons. – high price premium as in EERA/FMI study (2018)