



GREEN TRANSITION
DENMARK



Particle pollution in Italian ports & experiences from Northern European ECA

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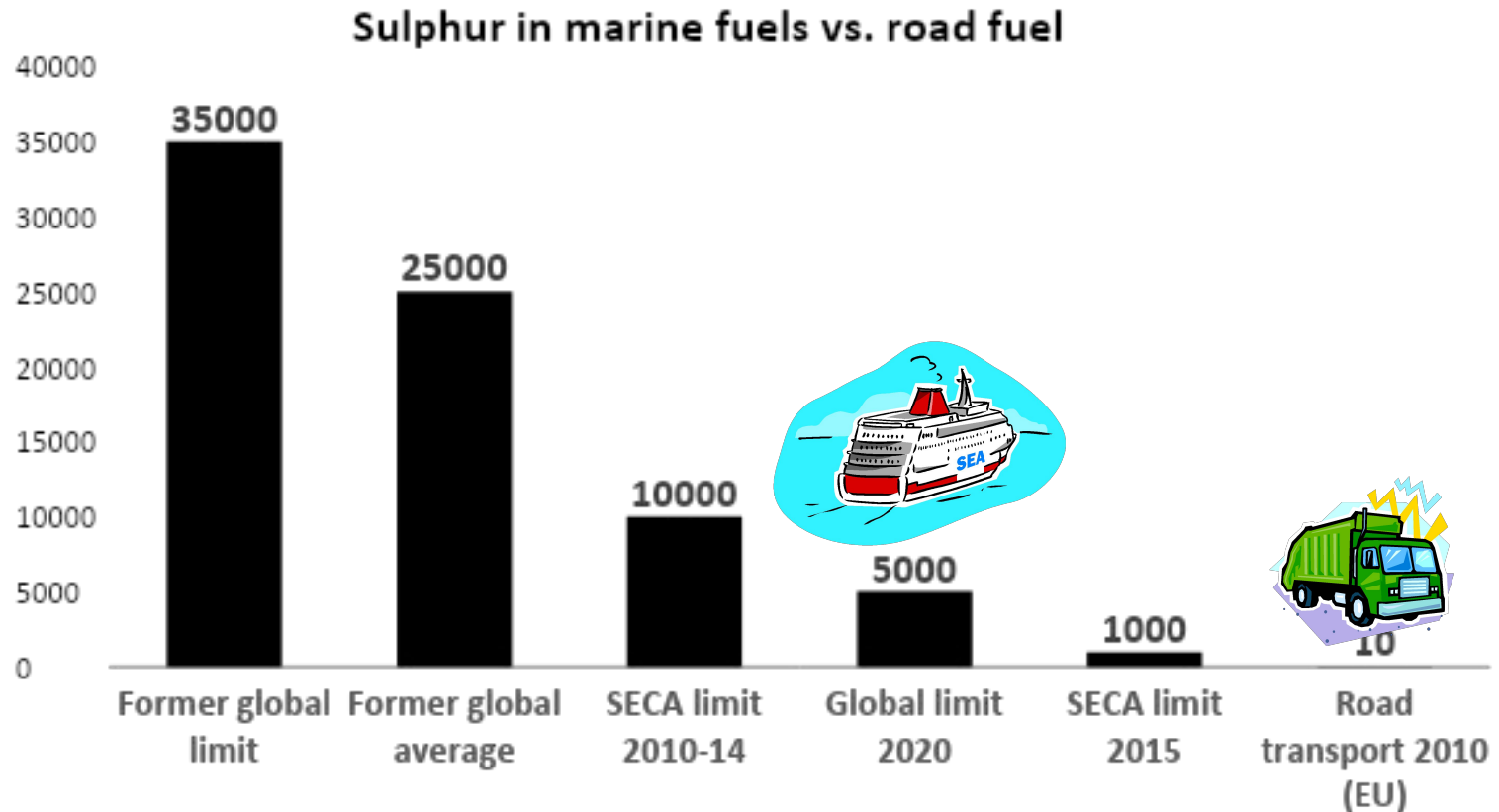
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Health effects of air pollution in Italy

- Around 65,000 people die from air pollution every year in Italy (EEA, 2020). That is 10.5% of all deaths (630,000).
- In 2020-22 air pollution (195,000) killed more people in Italy than COVID (180,000). No vaccine against pollution.
- If air pollution from shipping causes just 10% of deaths due to air pollution shipping kills 6,500 Italians per year.
- Cancer, cardiovascular diseases and airway diseases etc.
- It is very cost effective to reduce air pollution from ships.

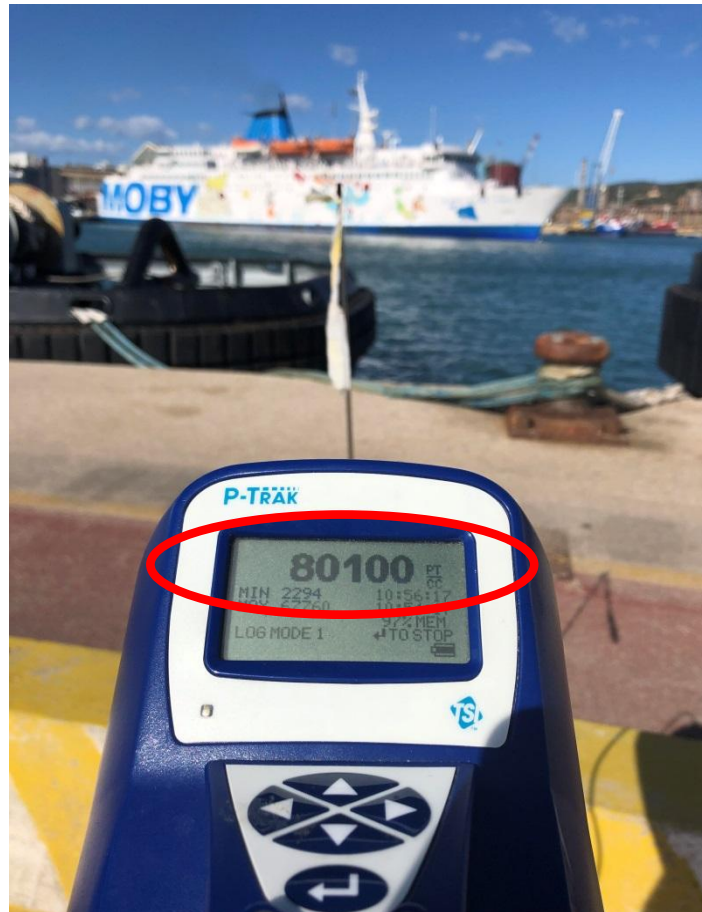


Shipping is poorly regulated



2014: All new trucks in EU have very effective exhaust gas cleaning systems – no ships have filters or catalytic converters !

Trucks have filters – Ships have no filters



Ships have no filters. A cruise ship (4,000 p.) at berth emits as many particles as 5,500 cars **per second**.

Piombino

Oct. 6th, 2021

Wind: 6-8 m/s.

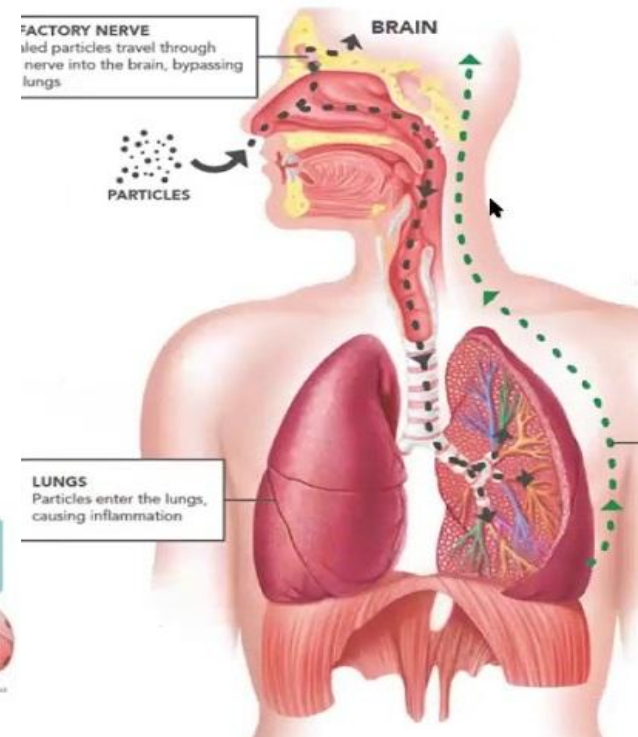
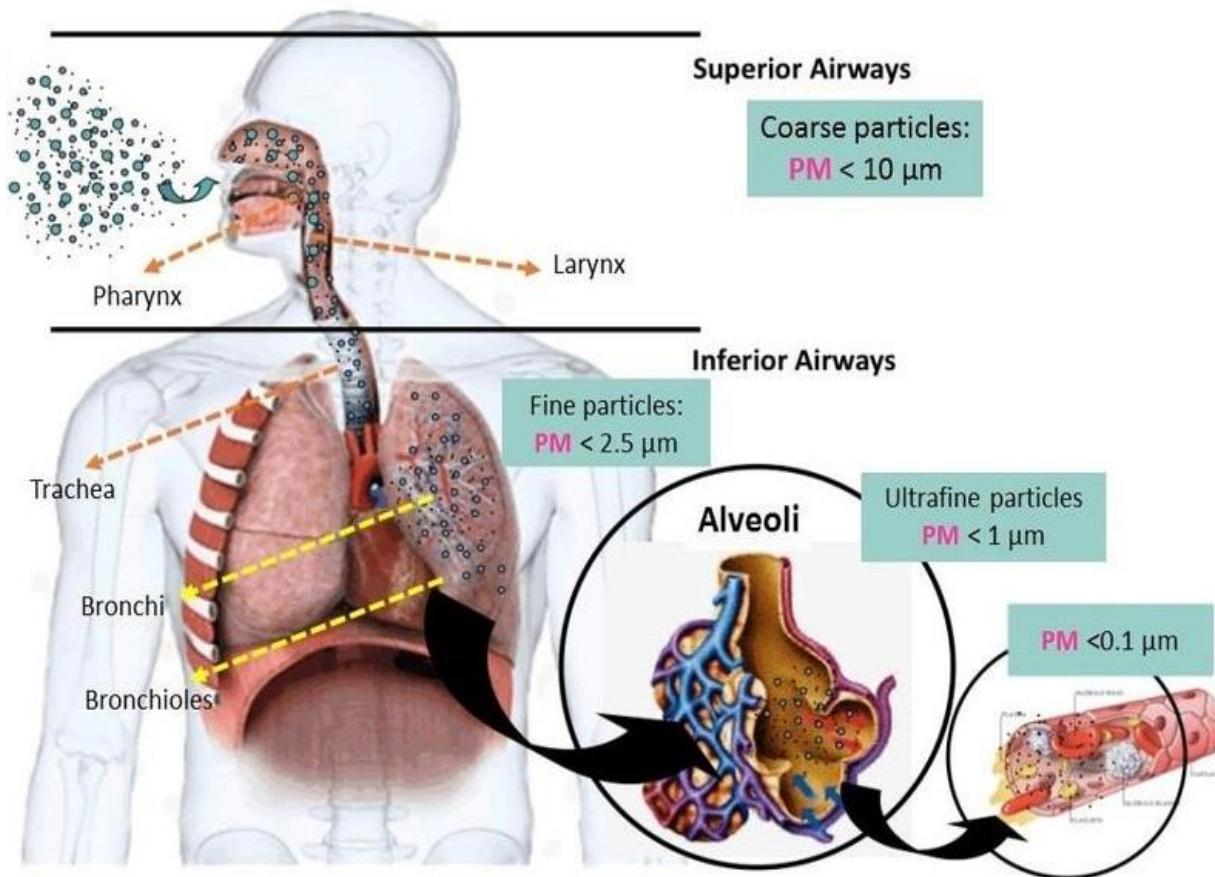
Soot from shipping (pictures from Genoa 2016)



Genoa: A cocktail of bad conditions

- A lot of polluting ferries and cruise ships inside the heart of the city for most of the year.
- The city almost covers a circle around the port so pollution plumes will hit residential areas most of the time.
- City is built uphill, so chimneys are in same height as windows.
- Have a warm climate so people spend much time outdoor, and windows are open when it is warm = when you have cruise ships.
- Still no shore power for cruise ships and ferries.

Measurements: Ultrafine exhaust particles



Measurements of air quality in Italy

- Measured ultrafine exhaust particles.
- Particles smaller than 100 nm consisting of soot (black carbon) coated with PAHs and heavy metals.
- Ultrafine particles are deposited in the finest parts of the lungs (alveoli) and transferred into the blood.
- Clean air in Europe contains 1,000-3,000 particles per cm^3 .

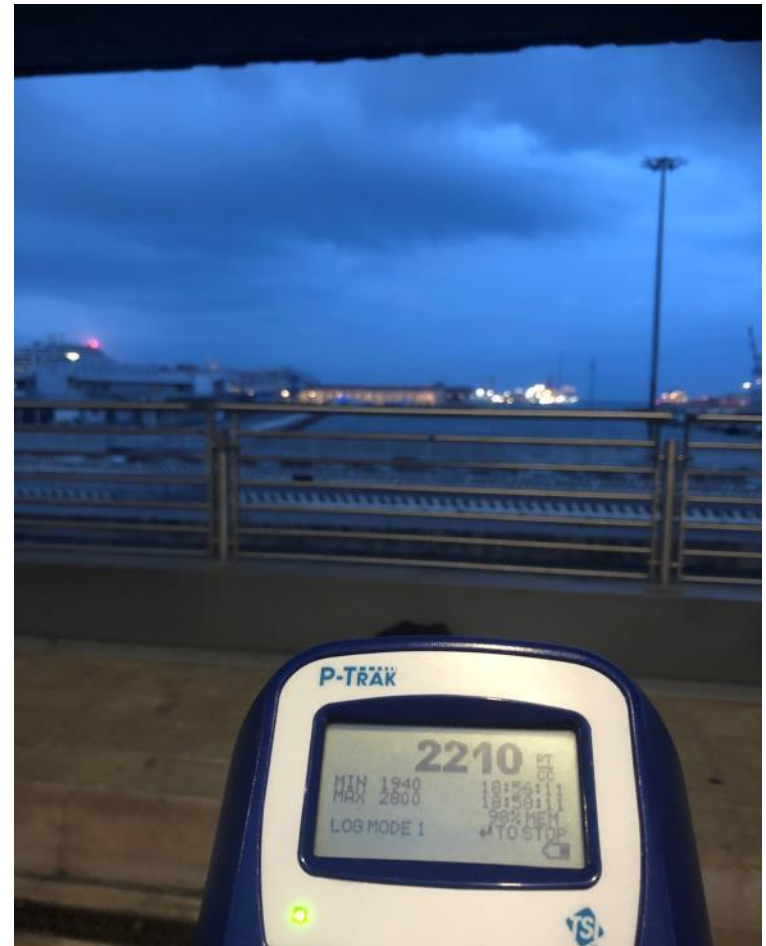




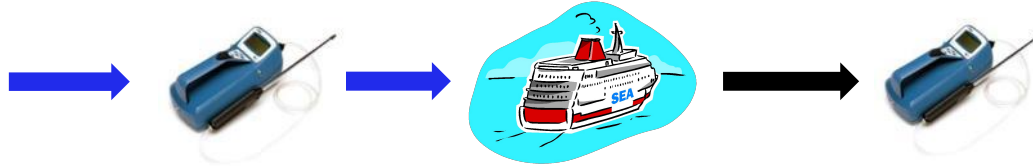
Genoa with/without cruise ship: 6-10 m/s



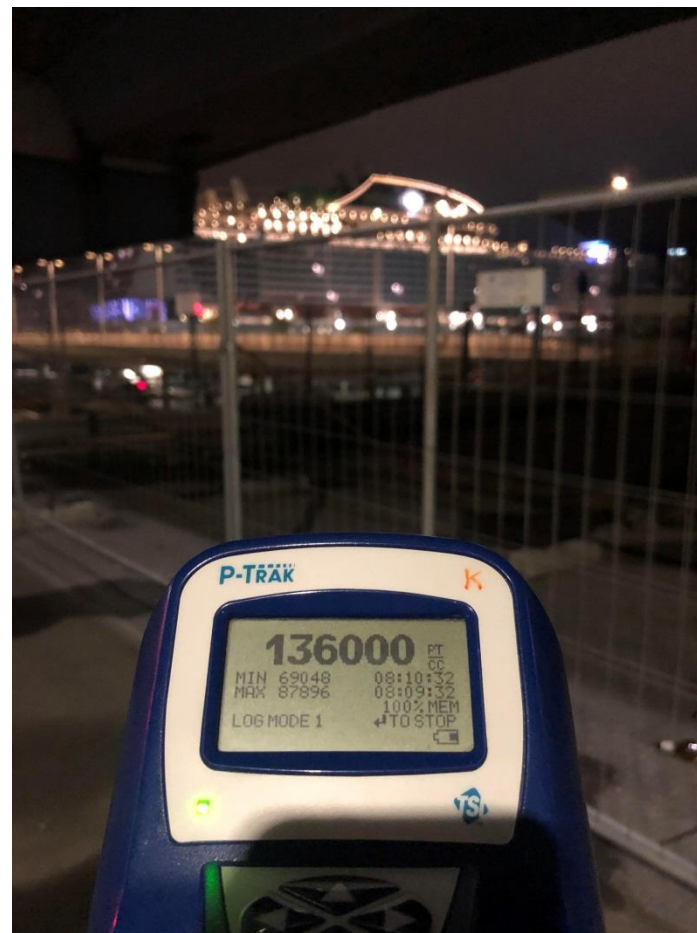
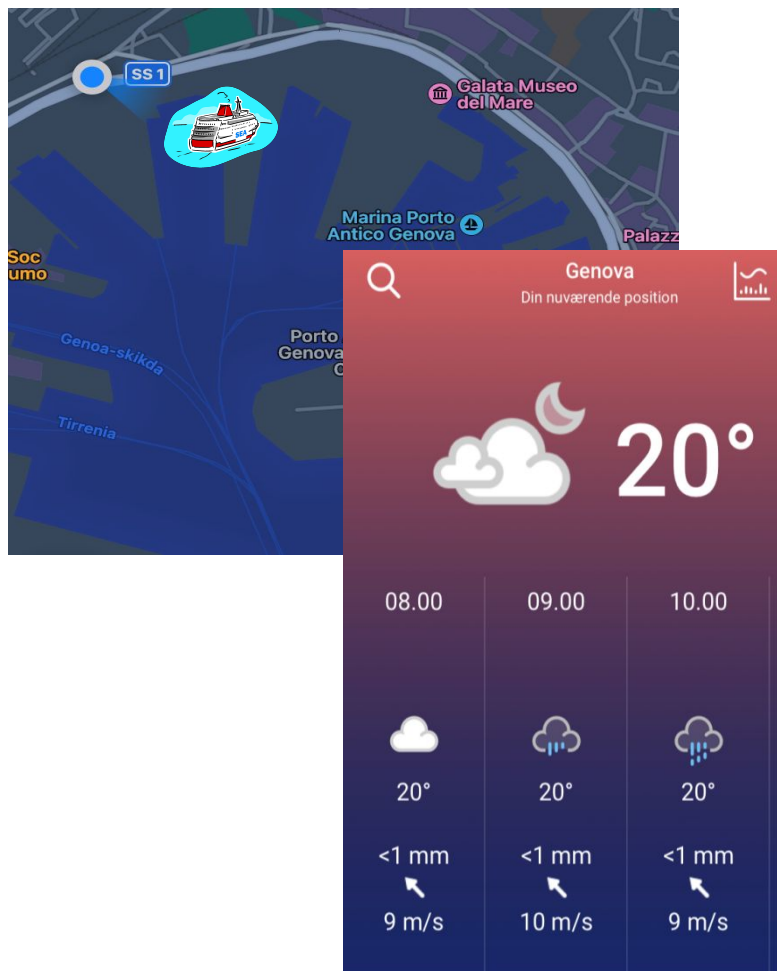
With cruise ship



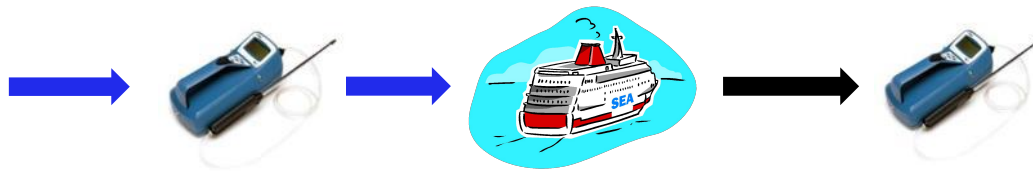
Without cruise ship



Genoa upwind cruise ship ferry: 9 m/s



Genoa, October 24, 2022



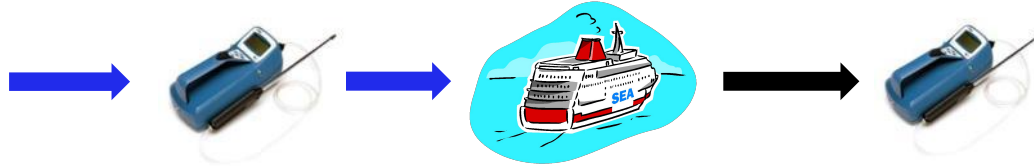
Livorno upwind and downwind ferry: 11 m/s



Up-wind: Before ship



Down-wind: After ship



Piombino upwind/downwind ferry: 6-8 m/s



Up-wind: Before ship



Down-wind: After ship



2021: Civitavecchia with/without wind from sea



No wind: Evening Oct. 1st



8 m/s from West: Oct. 6th



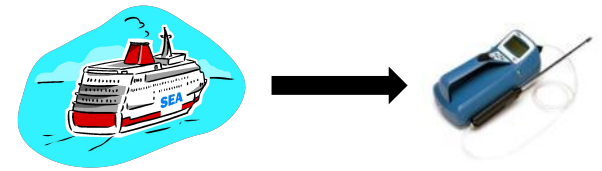
2021: Civitavecchia with/without wind from sea



No wind: Evening Oct. 1st



8 m/s from West: Oct. 6th



Civitavecchia: The pollution hits the city



8 m/s from West: Oct. 6th 2021



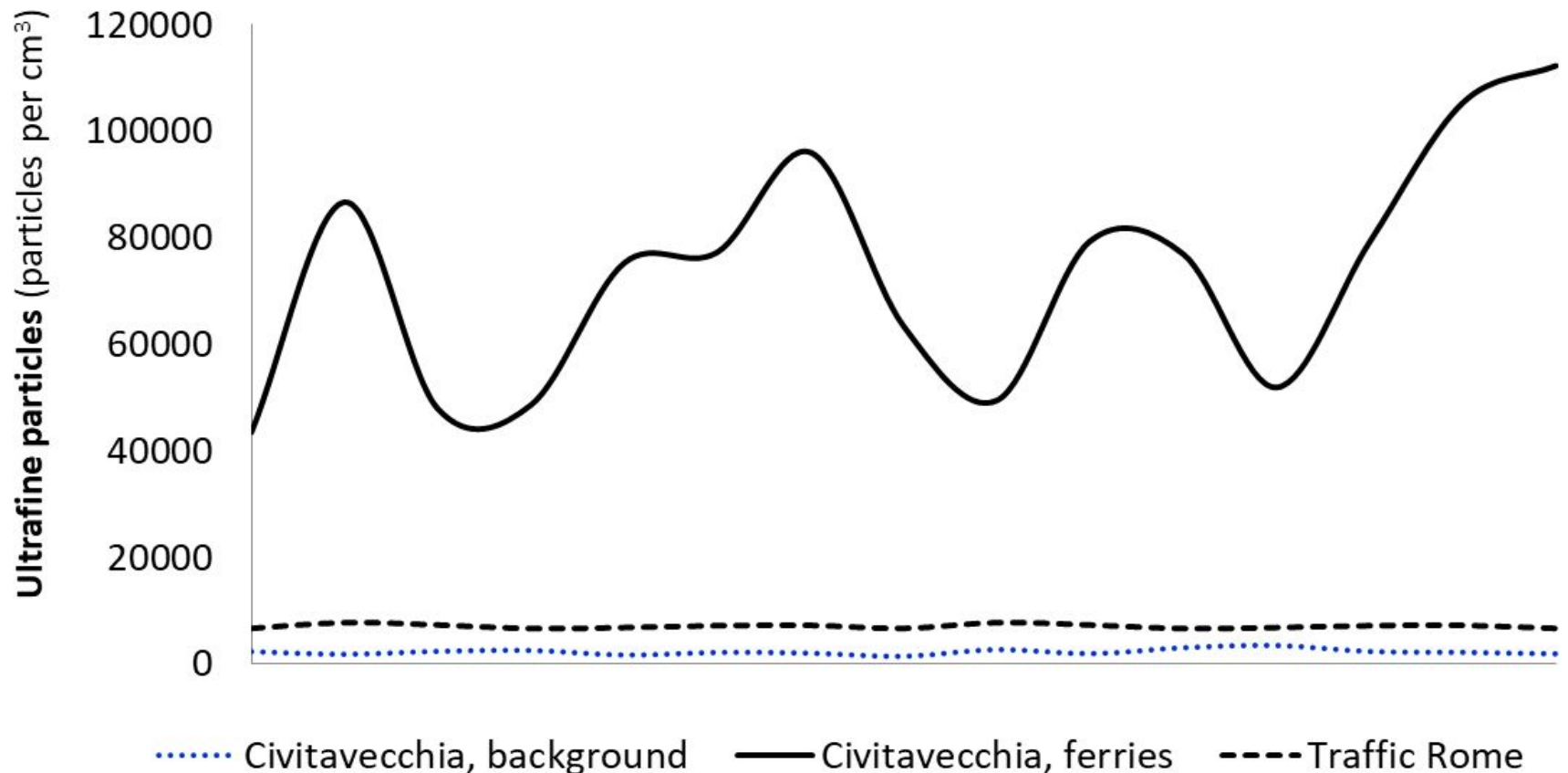
Results from measurements

		Date	Ship	Particle pollution (average particles per cm ³)	Wind (direction : speed)
Civitavecchia	City background	Oct. 1 st	---	1.600	W : 1-2 m/s
	With ship pollution	Oct. 6 th	Ferries	71.650	W : 8-9 m/s
Civitavecchia	City background	Oct. 1 st	---	2.250	W : 1-2 m/s
	With ship pollution	Oct. 6 th	Cruises	60.550	W : 8-9 m/s
Genoa	Sea background	Oct. 4 th	---	2.350	E : 6-10 m/s
	With ship pollution	Oct. 4 th	Cruise	82.400*	
Livorno	Sea background	Oct. 5 th	---	1.250	SW : 9-12 m/s
	With ship pollution	Oct. 5 th	Ferries	50.650	
Piombino	Sea background	Oct. 6 th	---	2.150	W : 6-8 m/s
	With ship pollution	Oct. 6 th	Ferries	45.550	
Rome city centre	Rush hour traffic	Oct. 7 th	Cars	7.100	4-5 m/s

Shipping cause significant pollution of Italian port cities.

Measurements from Civitavecchia

Air pollution from ferries in Civitavecchia



Measuring report



Air pollution with ultrafine particles from shipping in Italian port cities



Upwind ferries



Downwind ferries

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Report with screening
measurements from
Italian port cities:

<https://rgo.dk/wp-content/uploads/Air-pollution-from-shipping-in-Italian-ports.pdf>

Emission control area in Northern Europe

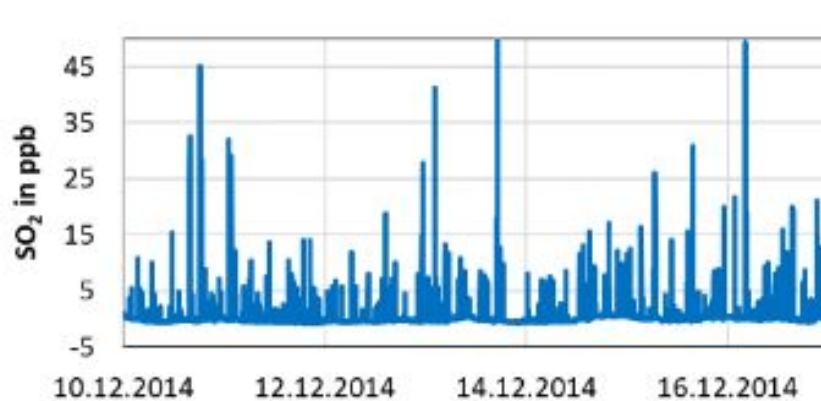
- SO_x Emission Control Area from 2007 with the strictest sulphur limit from 2015.
- NO_x Emission Control Area from 2021 for all new build ships.



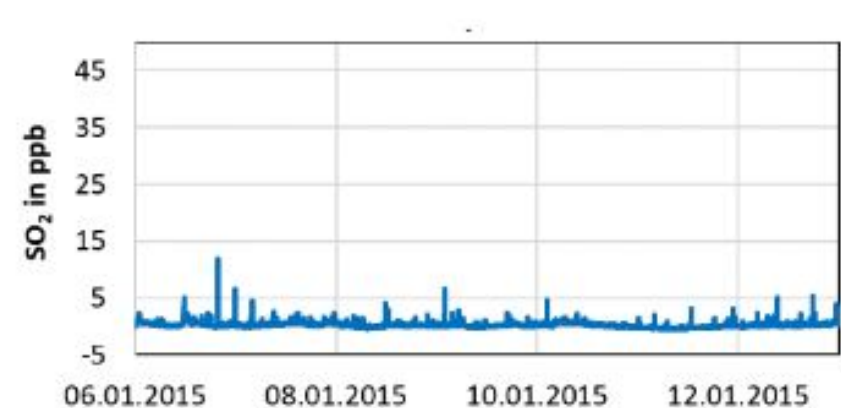
Source: International Maritime Organization

Measurements from Northern Europe

Before SECA



After SECA



Measurements from Neuwerk (German island)

Concentrations of toxic SO₂ immediately dropped, as expected, after introducing the SECA

Control and enforcement

- EU:**
- Min. 10% inspections and 4% sulphur analysis.
 - Fines must prevent systematic violations.
- DK:**
- Helicopters measuring sulphur, NO_x and CO₂ directly in the ship exhaust fan at sea (600/yr.).
 - Name and shame on ship/companies violating.



Conclusions from Northern European ECA

- Plenty of distillate fuel (0.1% sulphur) available.
- High reduction in sulphur on land (50% drop in 2015).
- Significant health and economic benefits for society.
- No enforcement challenges (0.0067% violations).
- No cargo transfer from ship to road.
- No notable price increases for consumers (< 0.005%).
- No notable extra costs for ship owners or authorities.

Solutions for ship pollution

In ports:

Shore power for cruise ships, ferries, cargo ships, etc.

At sea:

Electric ferries – Great potential.

Particulate filters for ships (removes > 95%).

Emission Control Areas (ECAs) limiting emissions:

- SO₂ emissions will drop 80% immediately.
- NO_x emissions will drop 80% over 20-25 years.
- Particle emissions will drop significantly and immediately.

Shore power in Northern Europe



Electric ferries in Denmark



With support from EU: LIFE4MEDECA

This presentation is part of the EU LIFE project:
LIFE4MEDECA with the purpose to designate a
Mediterranean Sea Emission Control Area to reduce
health hazardous and climate damaging emissions
of air pollution from ships.

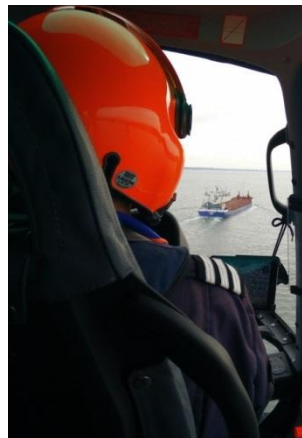


NOx from ships in Northern Europe

- **Adverse health effects:** 42 € per kg NOx emission.
- **Removal costs:** 2 € per kg NOx removed (using SCR).
- Society saves around 42 billion € in health damages every time society invests 2 billion € in NOx-removal
 - Rate of return: **2.000% !**
- + less damages on crops, constructions, ecosystems, etc.
- A NOx ECA is the best investment you can imagine ...

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Shore power in Northern Europe

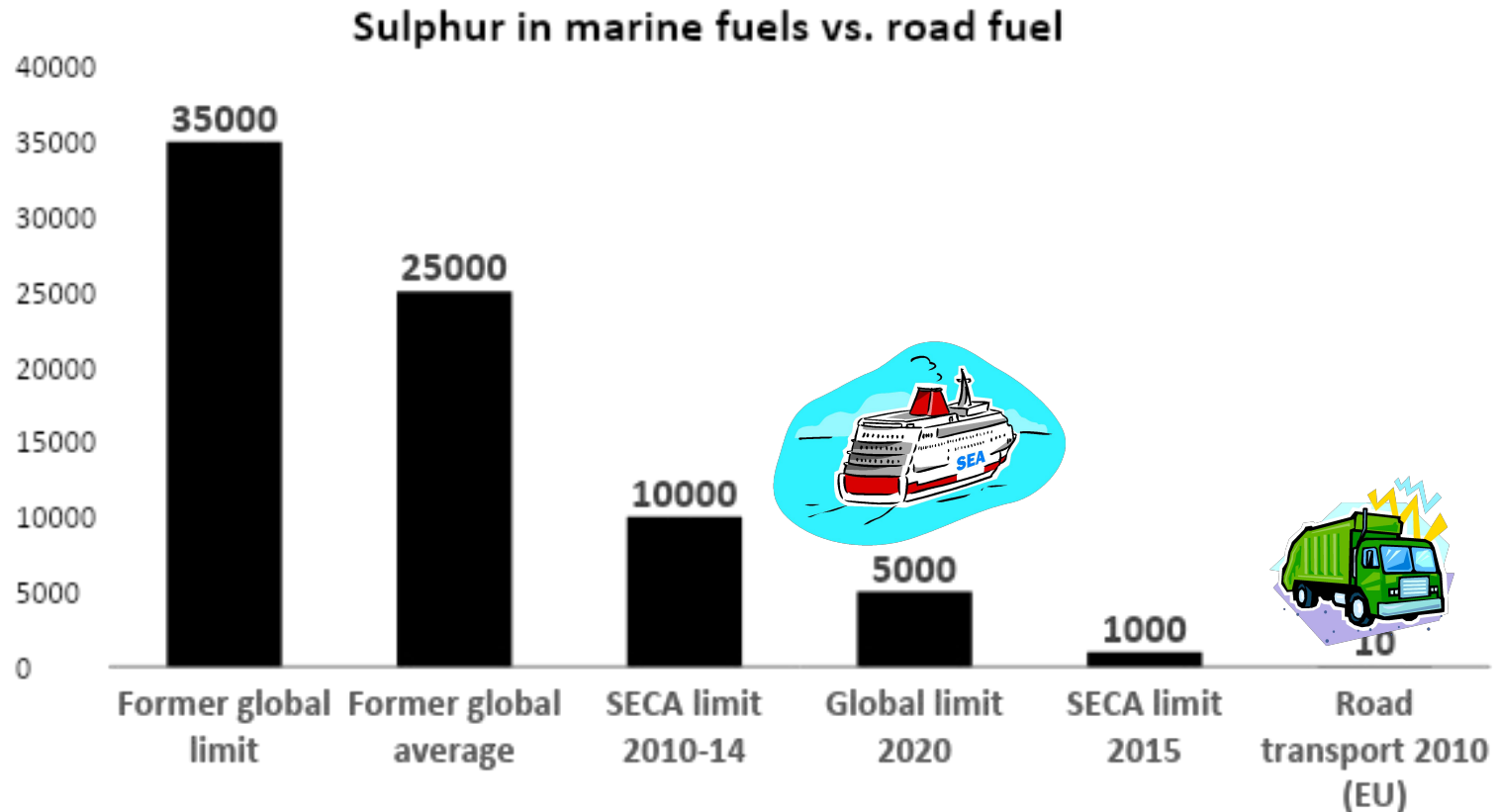


Electric ferries in Denmark





Shipping is poorly regulated



2014: All new trucks in EU have SCR & particulate filters!