



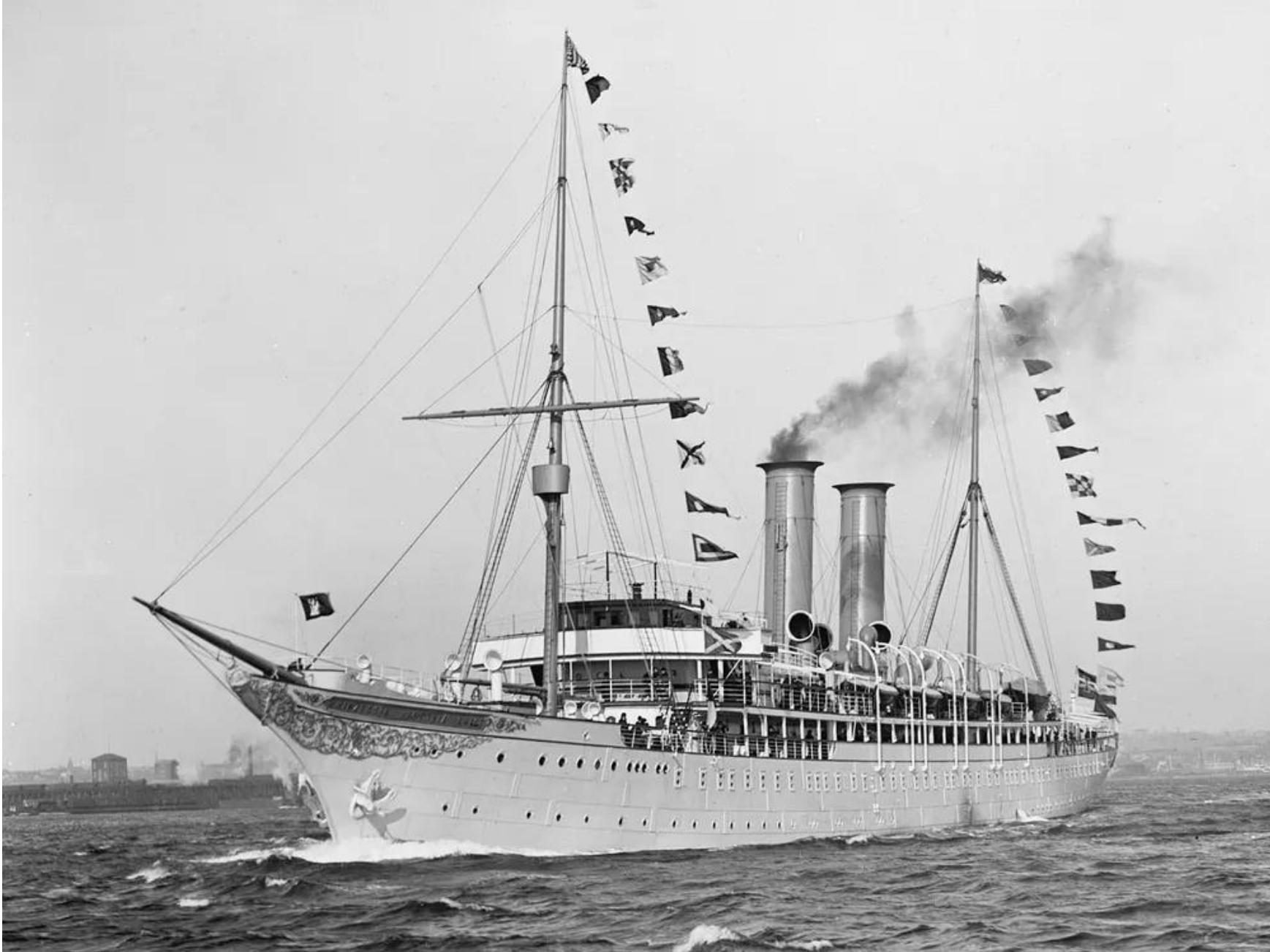
Project ShipsCHEM

Veronica van der Schyff

RECETOX



History of cruise ships

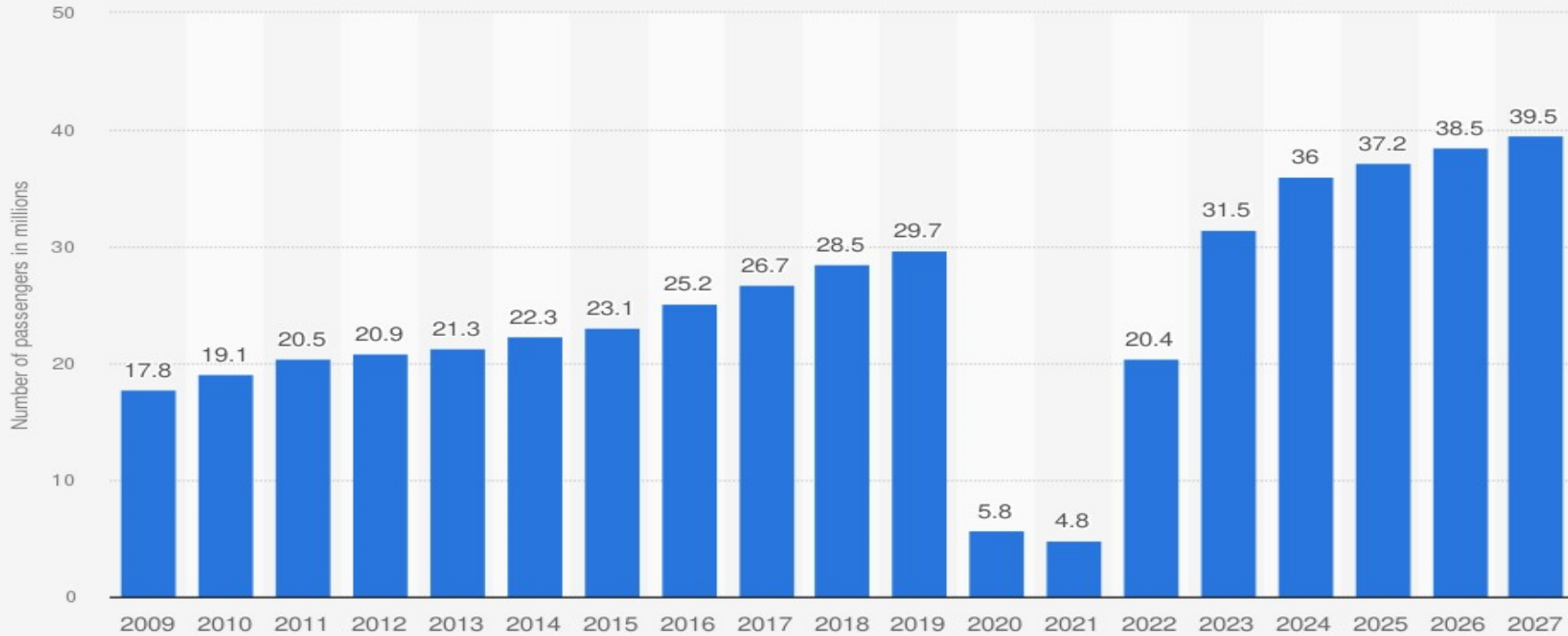


- Prinzessin Victoria Luise
- 1900
- First ship built for luxury cruising
- 120 passengers



Growth of the sector

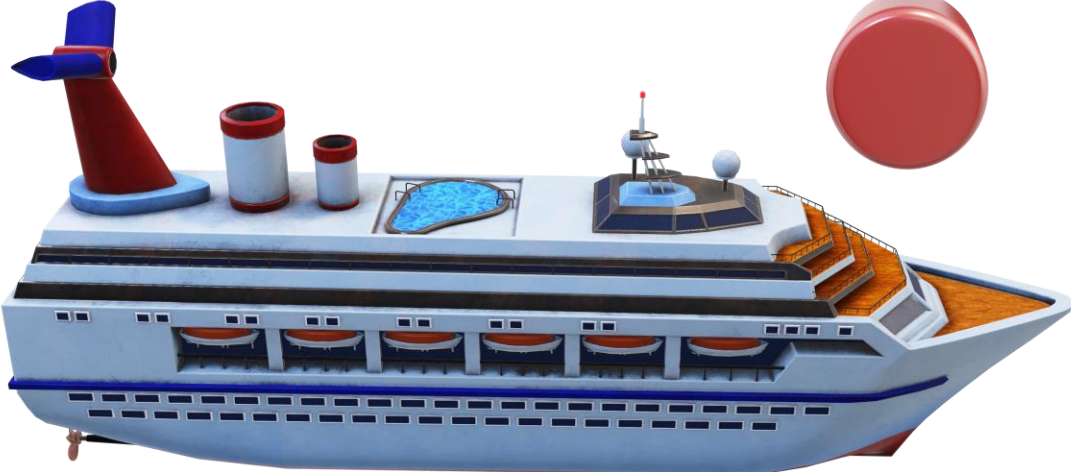
Number of ocean cruise passengers worldwide from 2009 to 2022, with a forecast until 2027 (in millions)



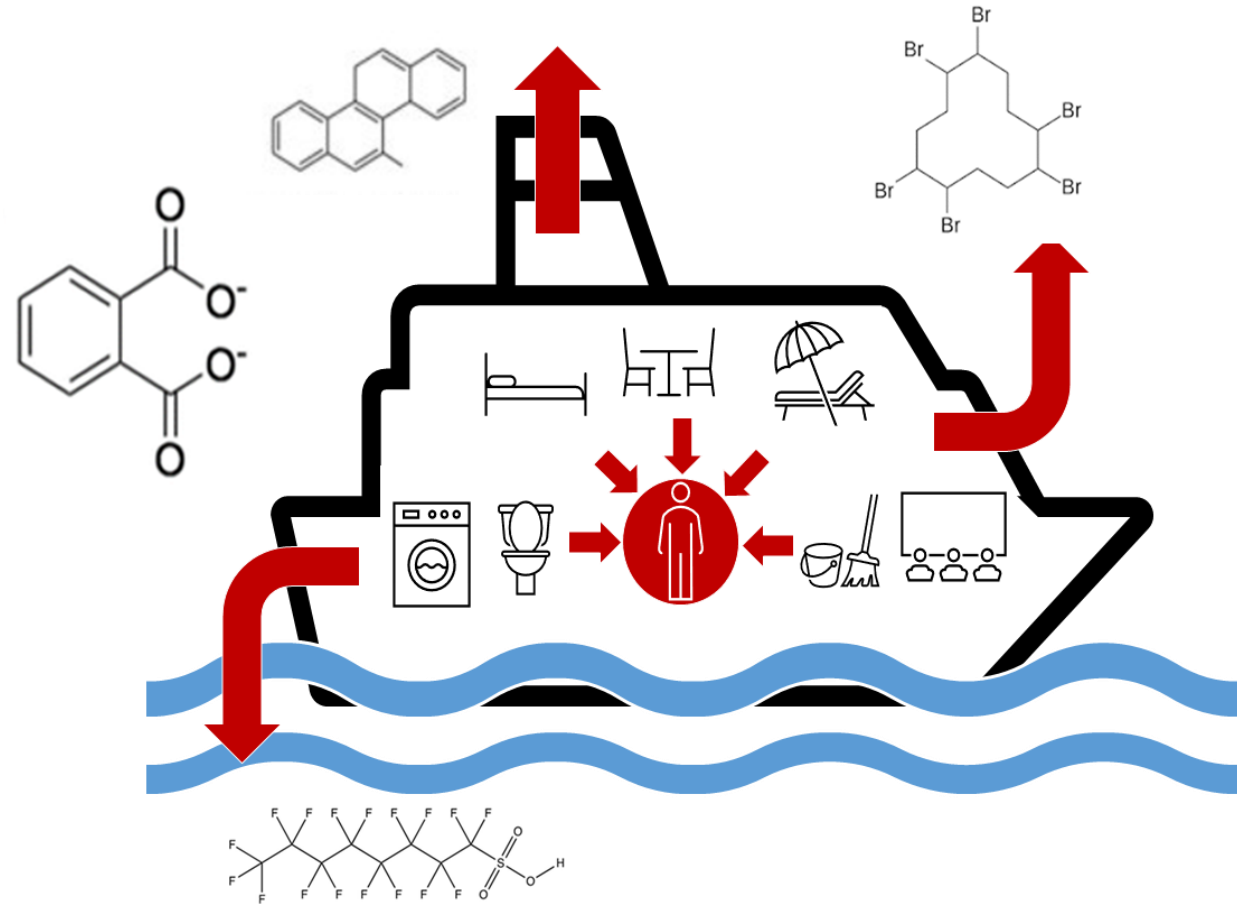
- 1.2 million job opportunities
- Over 1.5 billion UDS directly and indirectly
- Fastest growing sector in the tourism industry



Indoor chemical safety



ShipsCHEM: Investigating the indoor environment of cruise ships





MS Otto Sverdrup

Formerly known as MS FINMARKEN

Year built: 2002; Refurbished: 2020;

Capacity: 530; Gross tonnage: 15 960 T

3 – 15 March 2023



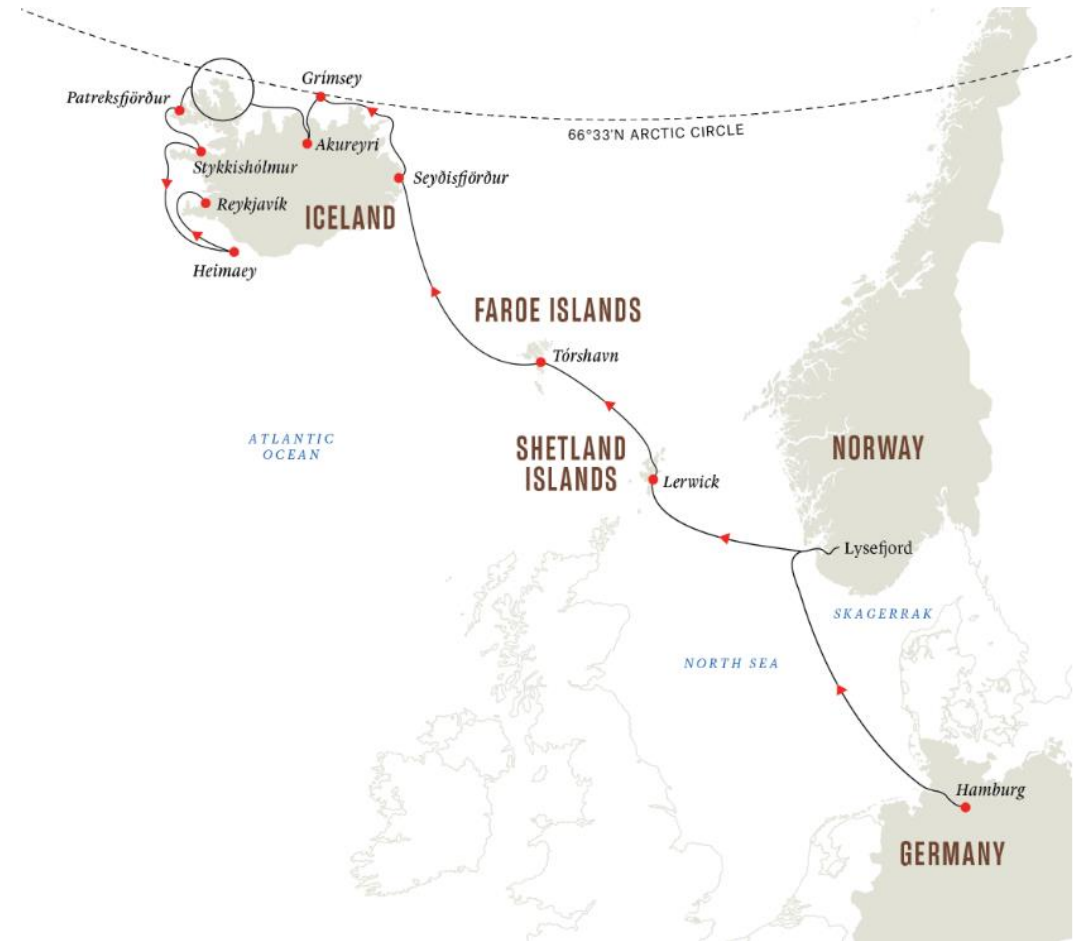


MS Fridtjof Nansen

Year built: 2020; Hybrid electric

Capacity: 530; Gross tonnage: 20 889 T

1 – 13 May 2023





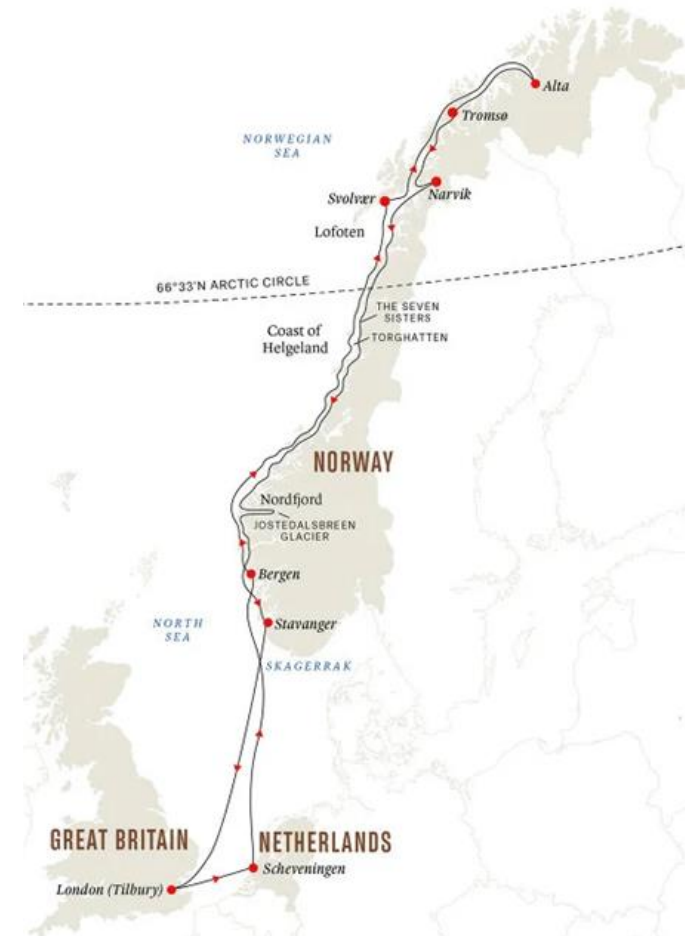
MS Maud

Formerly known as MS MIDNATSOL

Year built: 2003;

Capacity: 500; Gross tonnage: 16 151 T

30 September – 14 October 2023



Sampling



Air samples



Dust samples



Water samples

Target compounds

117 target compounds

Bisphenols (3) [#]	Polycyclic aromatic hydrocarbons (PAHs; 29) [*]
Musks (6) [*]	Oxy- and nitro PAHs (29) [*]
Novel flame retardants (NFRs; 24) [*]	Polychlorinated biphenyls (PCBs; 9) [*]
Organochlorine pesticides (OCPs; 13) [*]	Per- and polyfluoroalkyl substances (PFAs; 24) [#]
Organophosphate flame retardants (OPFRs; 14) [#]	Phthalates (16) [*]
Polybrominated diphenyl ethers (PBDEs; 10) [*]	[*] Supra extraction [#] Methanol extraction

Flame retardants

PBDEs

Stockholm Convention

Known human and environmental health impacts

NBFRs

Thought to be safer than PBDEs

New evidence to the contrary

OPFRs

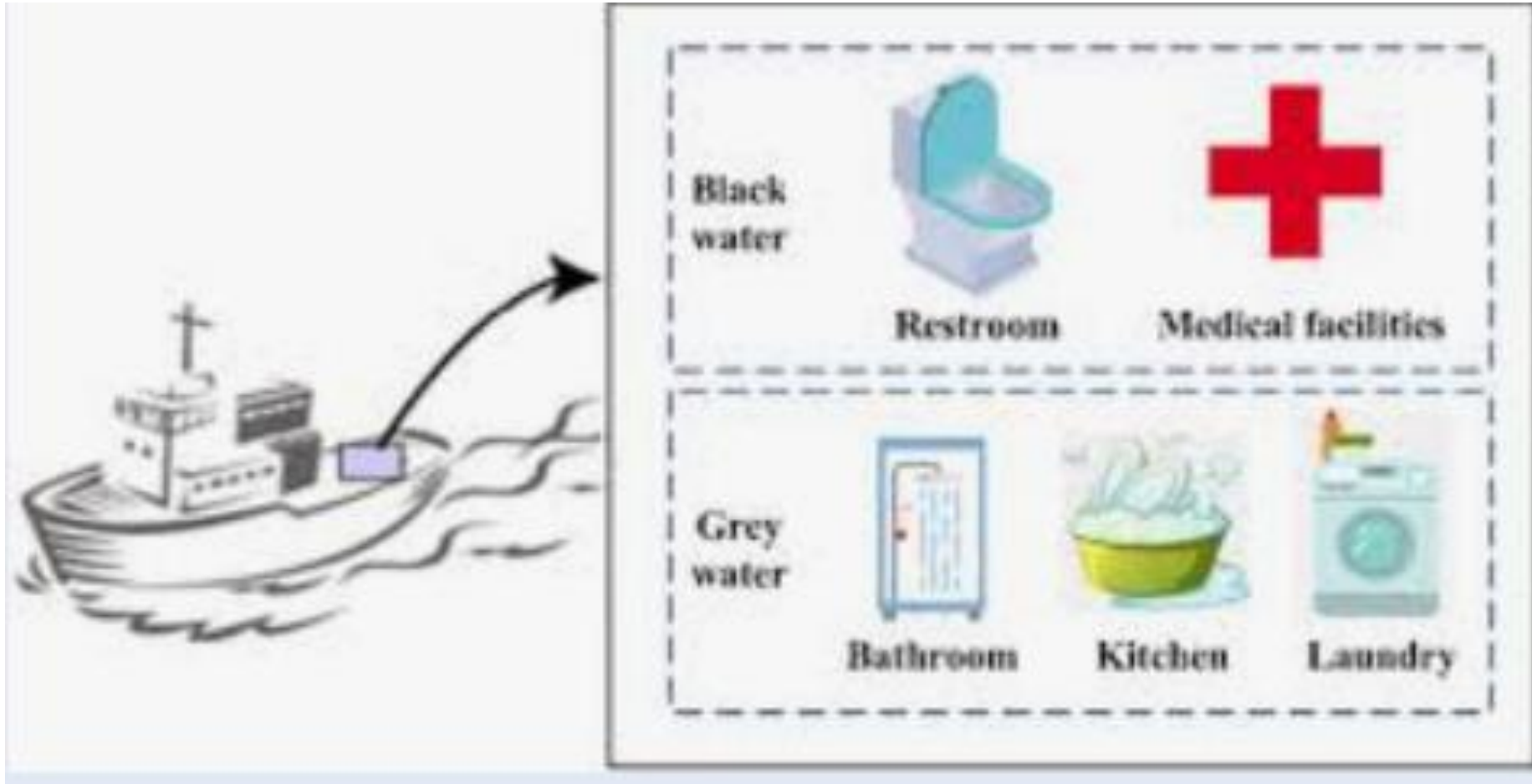


Estimated daily intake calculations

$$EDI_{ingestion} = (C_{dust} * IR_{dust} * AF_{gastro} * HEF) / BW$$

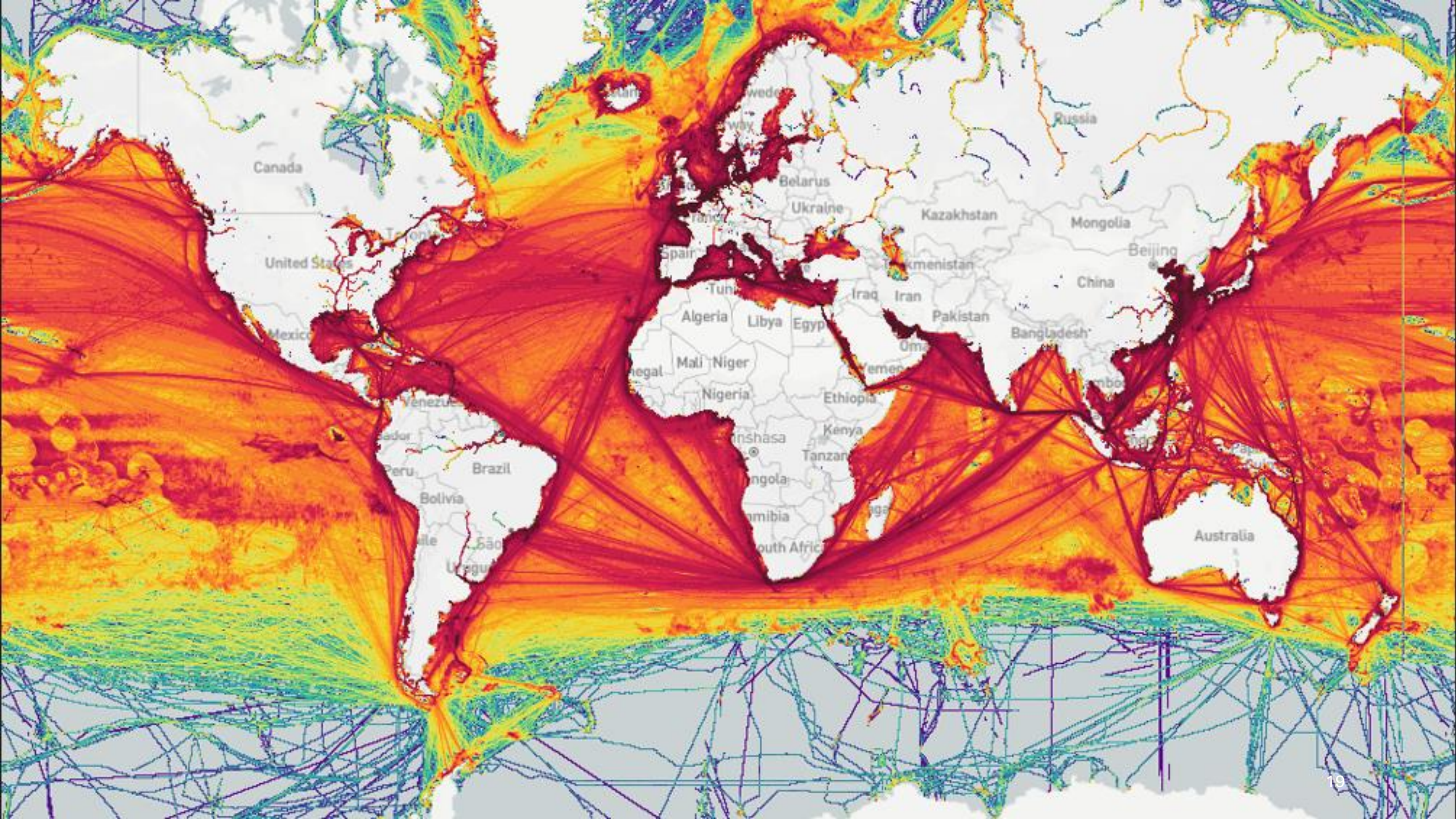
- EDI: Estimated daily intake (mg/kg bw/day)
- C_{dust} : Dust concentration (ug/g)
- IR: Ingestion rate (20 mg/kg for adults)
- AF_{gastro} : Absorption factor (100% for Flame retardants)
- HEF: Home exposure factor (100% for ship)
- BW: Bodyweight (70 kg)

Wastewater



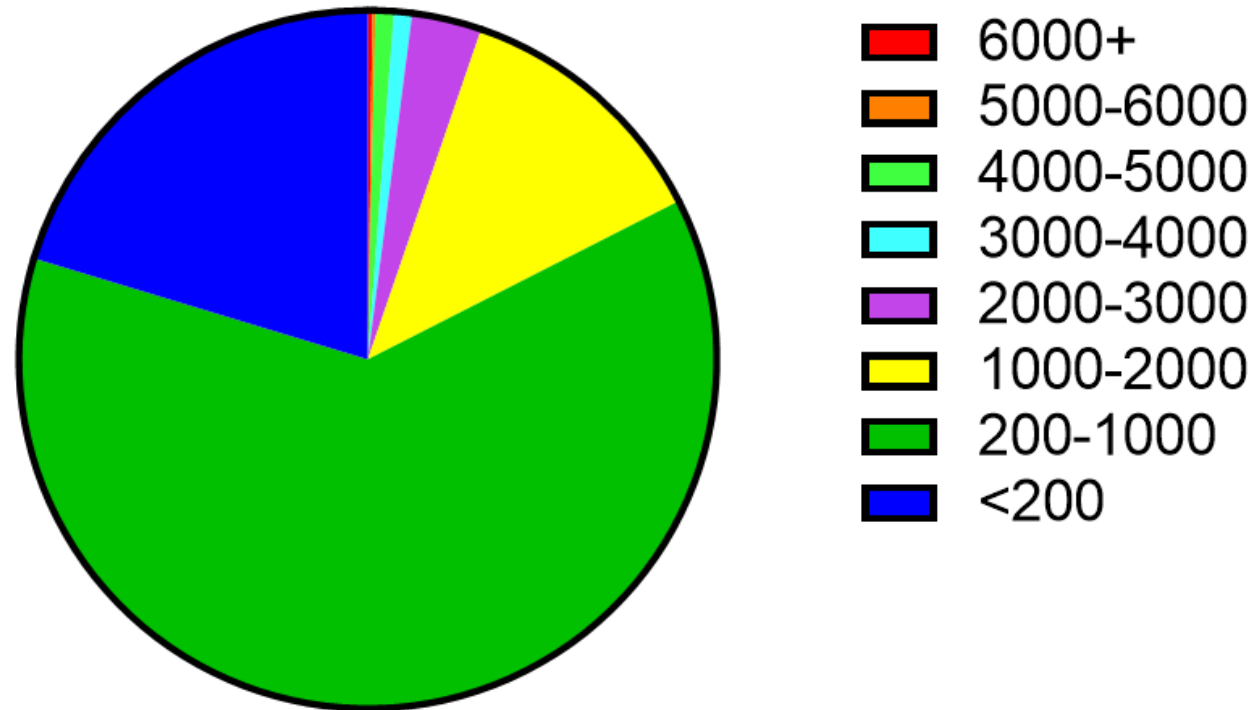
Next steps



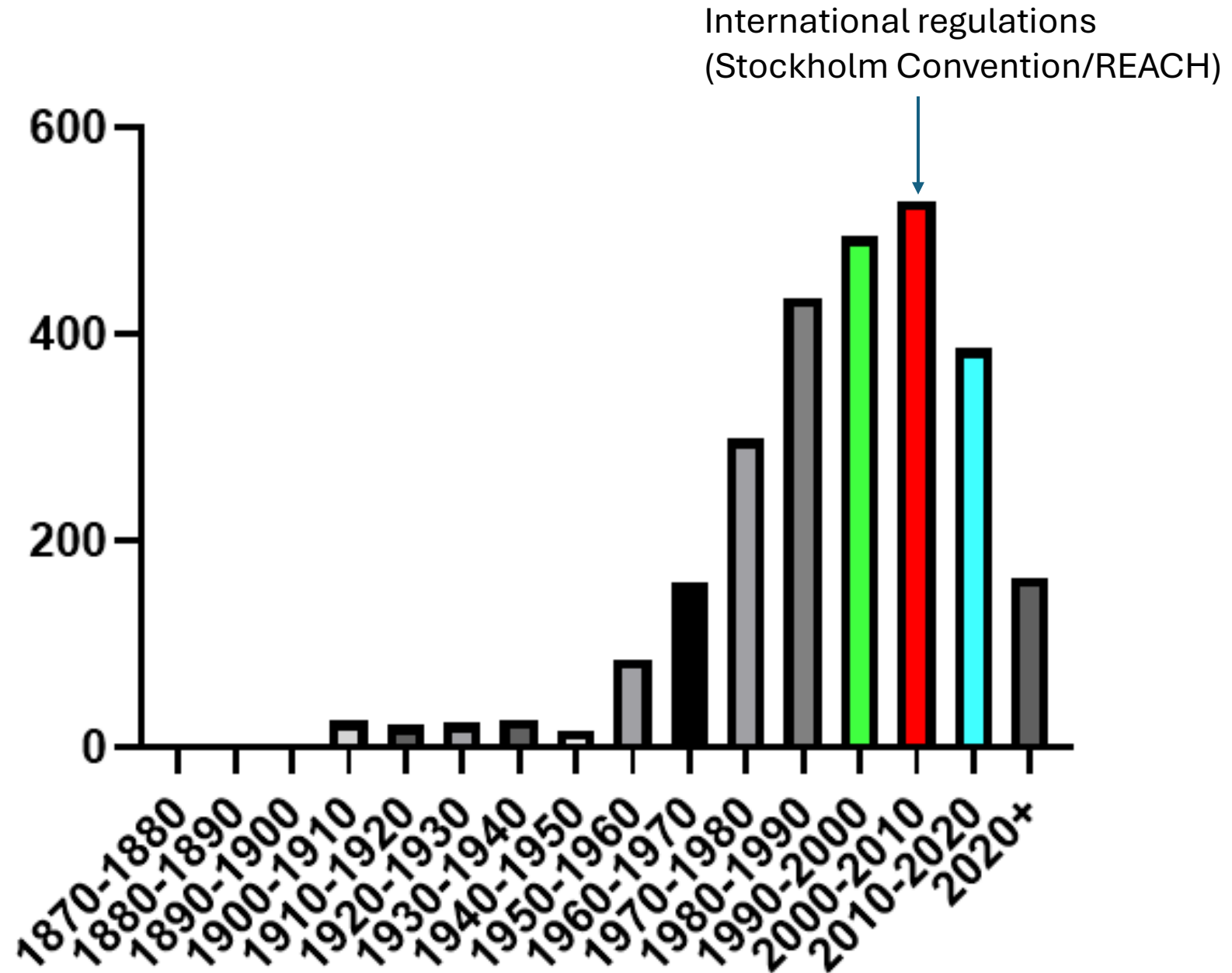




Passenger capacity of cruise ships in the North Atlantic



Ship Ages



Thank you 😊

