Future Trends in Port Equipment: Driving Efficiency and Decarbonization

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CAVOTEC in a nutshell

50 YEARS OF HERITAGE IN INNOVATION

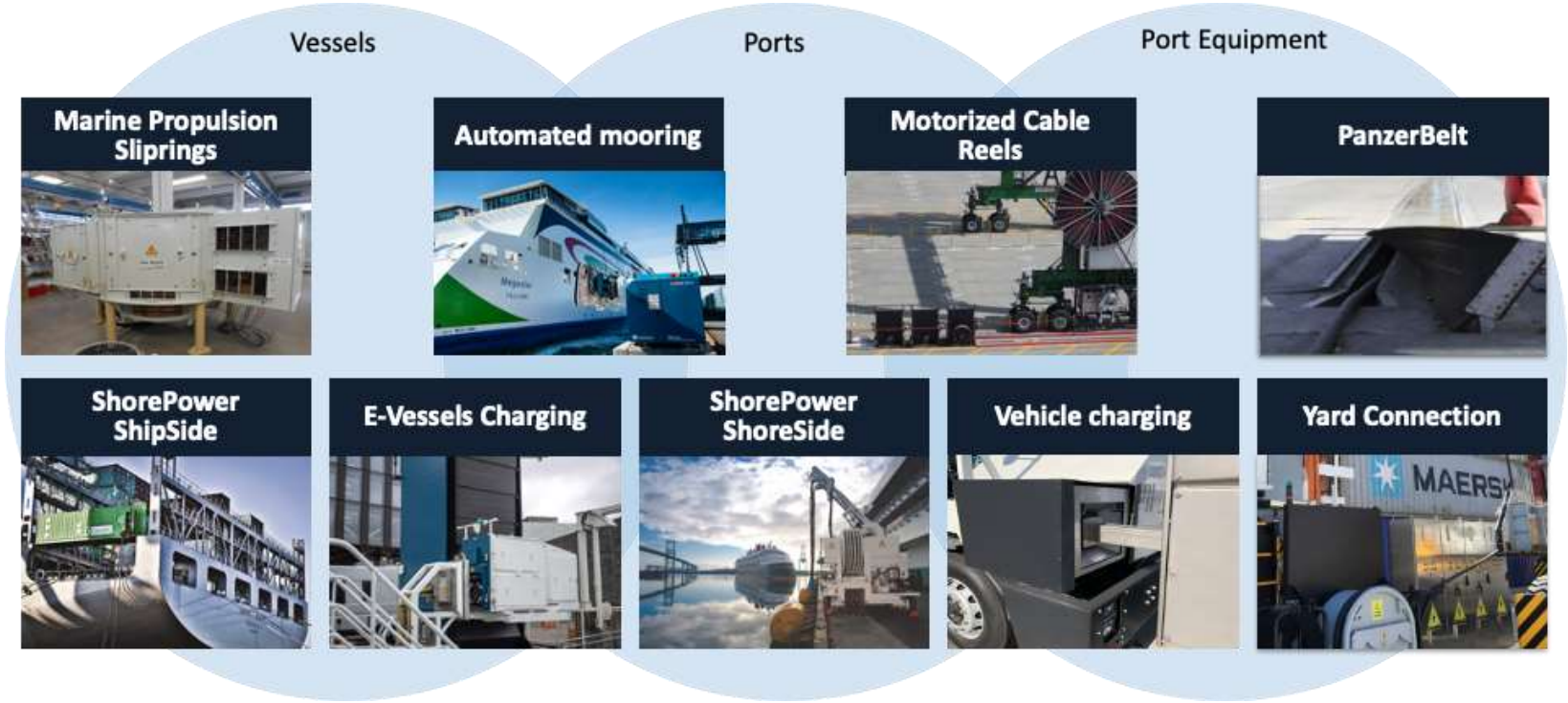
Cavotec is a leading cleantech company that designs and delivers connection and electrification solutions to enable the decarbonization of ports and industrial applications.

50
Years

708
Employees

80+
Countries where Cavotec's systems are installed

24,000+
Installations worldwide



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Shore Power

Shore Power

https://youtu.be/kDIlUOIS5bE

What does Shore Power stand for?

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- Shore Connection
- Alternative Maritime Power (AMP)
- Cold Ironing
- Shore to Ship Connection
- Onshore Power Supply (OPS)
- Shore Side Electricity

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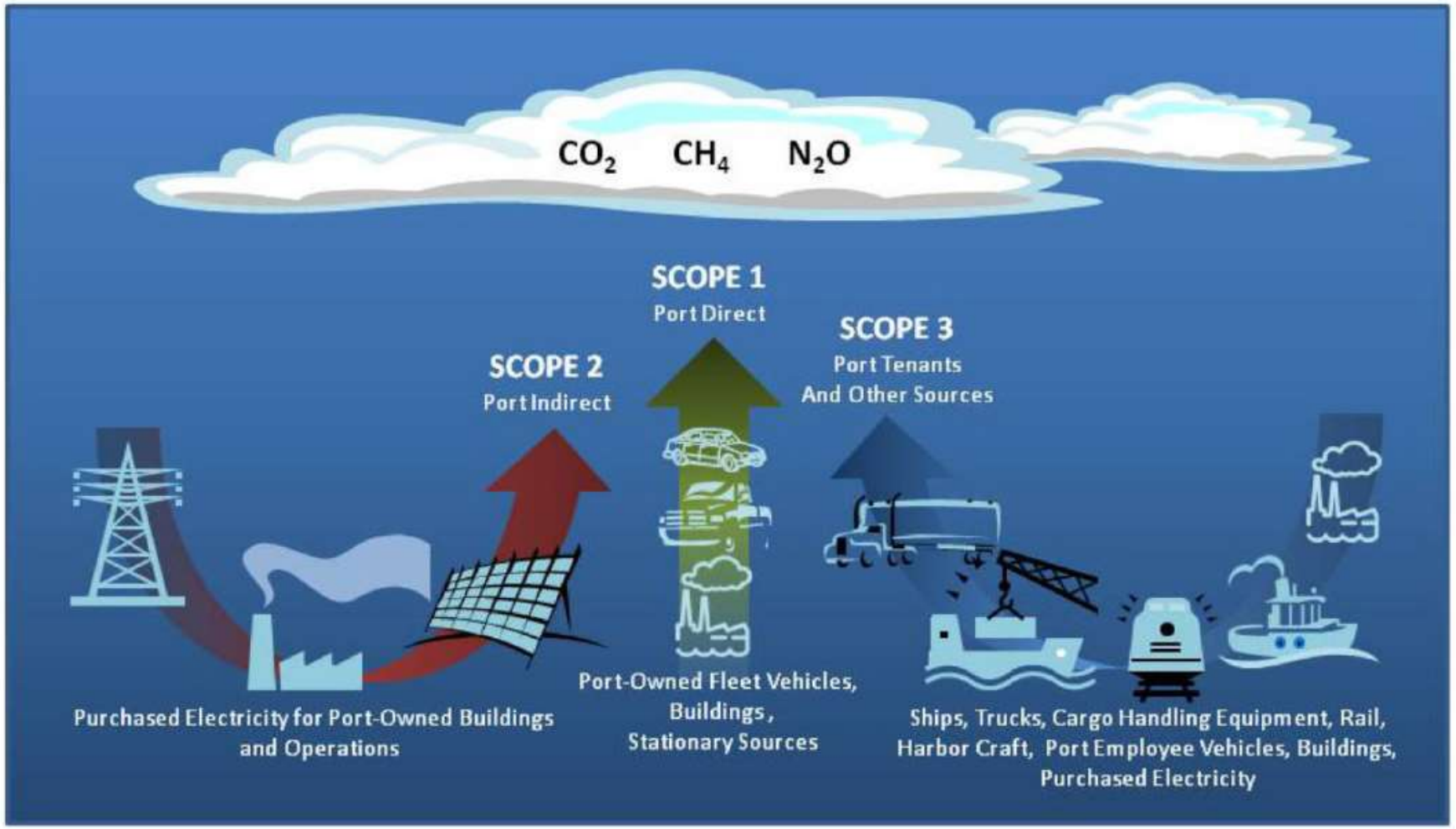
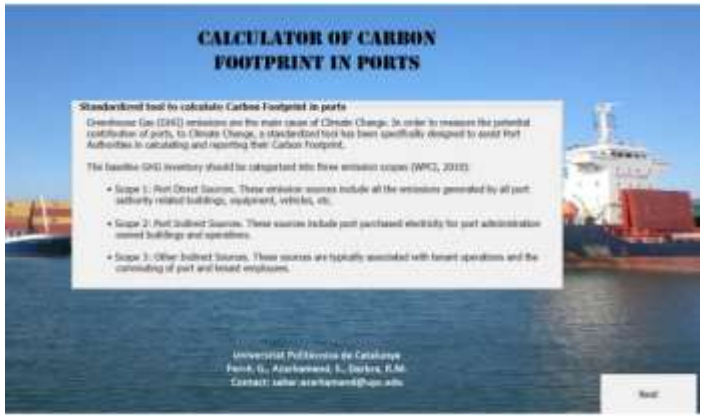
Everything starts with an assessment of how much GHG are emitted!

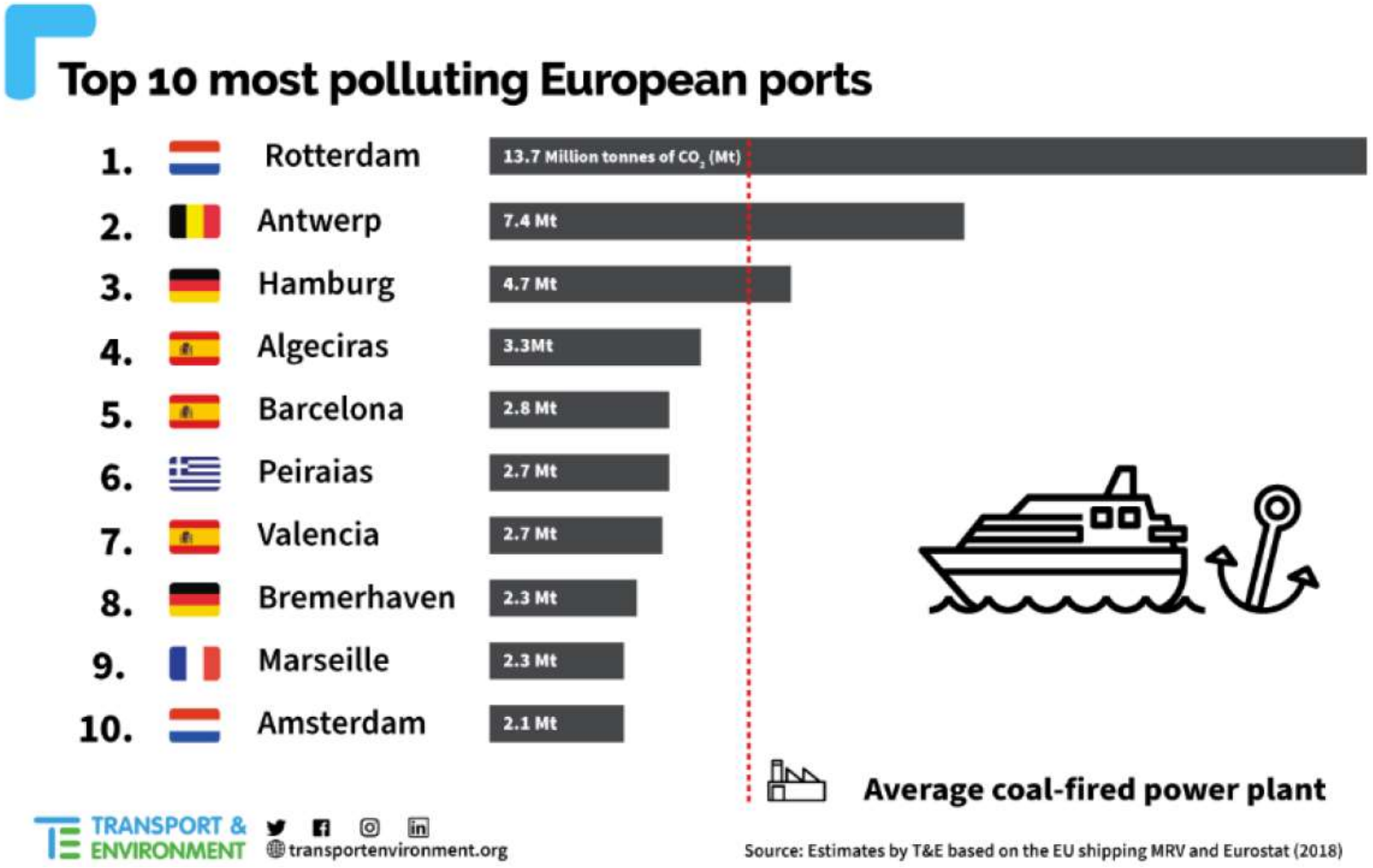
Using GHG Protocol to assess the Carbon Footprint of port on 3 different scopes





Eg: Software tool from University Polytechnic of Catalonia

European Ports CO2 Emissions



References

Global CO2eq Emissions (2022):
36.8 GtCO2eq

Maritime sector Emissions (2018):
1.07 GtCO2eq

European Maritime Sector (2021):
124 MtCO2eq

Source: IEA (International Energy Agency)

Detailed reports are key to identify key drivers of GHG!

Vessels (manoeuvring/at berth), Heavy Duty Trucks, Cargo Handling Equipment and Harbor Crafts are key contributors

Ports	Ship Traffic within ports & At berth			Harbor Vessels		Cargo Handling		Heavy Duty Transportation in Terminal
	Cruise	Container	Others	Tugs/dredger	Others vessels			
Valencia 2016	28%	25%	10%	4~5%		15%		
POLA 2022	28%			5%		17.5%		43%
POLB 2022	36%			3.6%		13.7%		42%
Port of NY & NJ 2021	23%			4.3%		20%		49%
Oakland	53%			10%	1%	22%		13%

Sum not equal to 100%. Focusing on main contributors
(*) Affectation of Ferry from Harbor vessels to Ocean Going Vessels

Many solutions exist to decarbonize your ports operations

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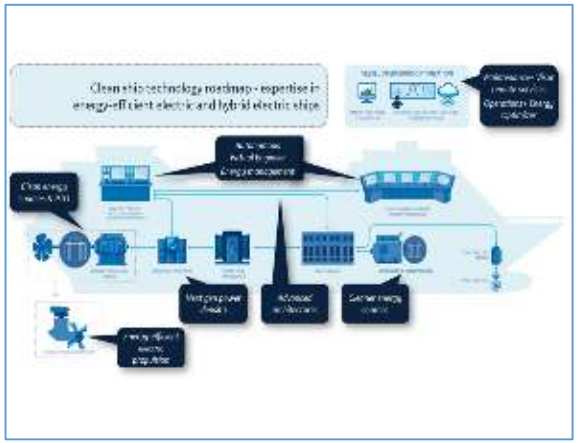
Electrification and Automation Solutions are available NOW and effective!

Energy Efficient Assets

Alternative Fuel

Process Automation



Carbon Capture

Automated mooring

ShorePower

Cargo Handling Electrification

Harbor Craft / Truck Electrification

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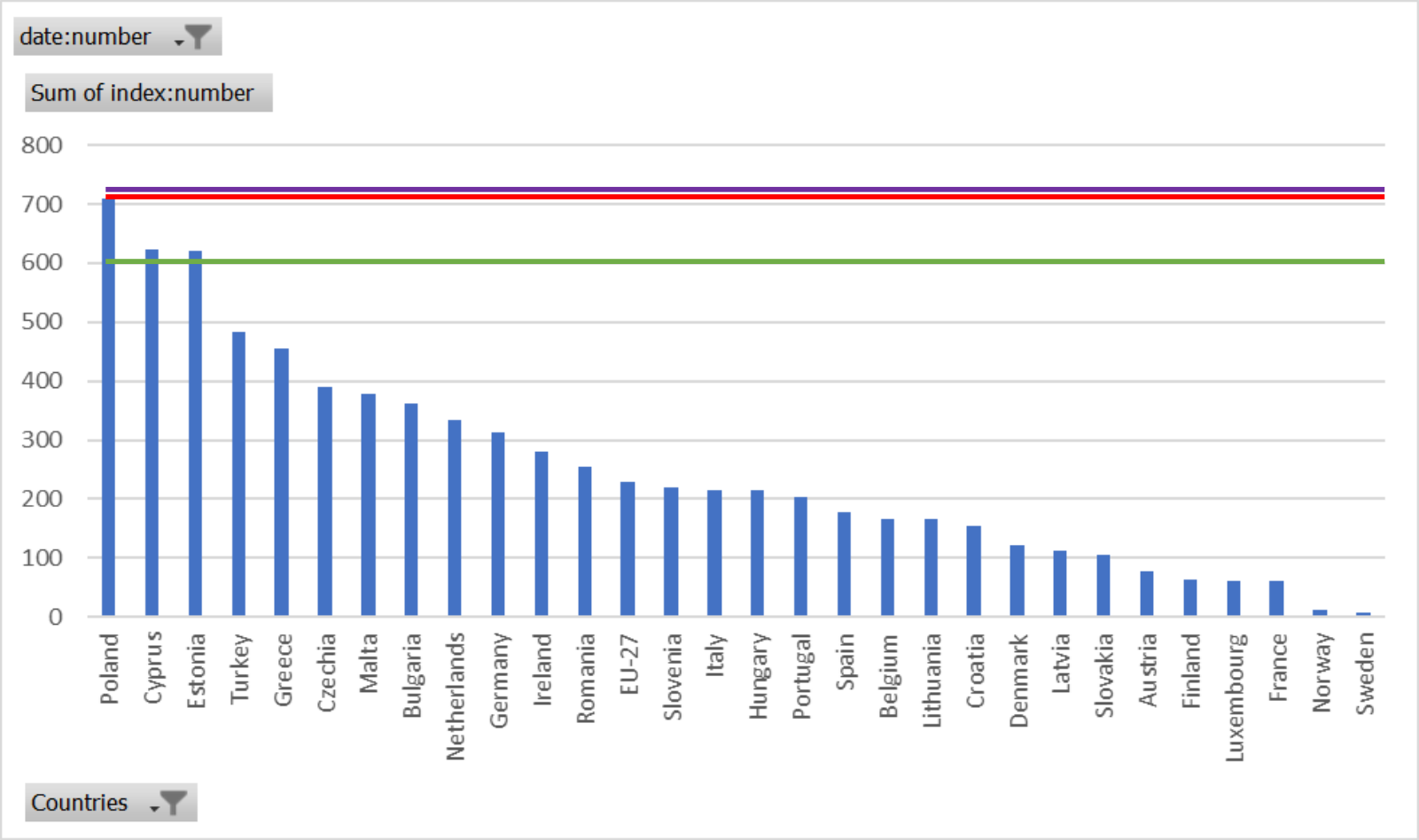
Electrification: A Quick Win to Drastically Reduce Emissions

Grid Mix might be “grey” but it is almost always greener than current alternatives (MDO/HFO) for ships or Diesel engine of crane.



Auxiliary engine emission factors in gCO2e/kWh (from EPA 2022)
Emission factors generally assume medium speed diesel engines.

HFO Tier 0 to III - 717
MGO/MDO – Tier 0 to III - 705
LNG - Otto – MS - 603

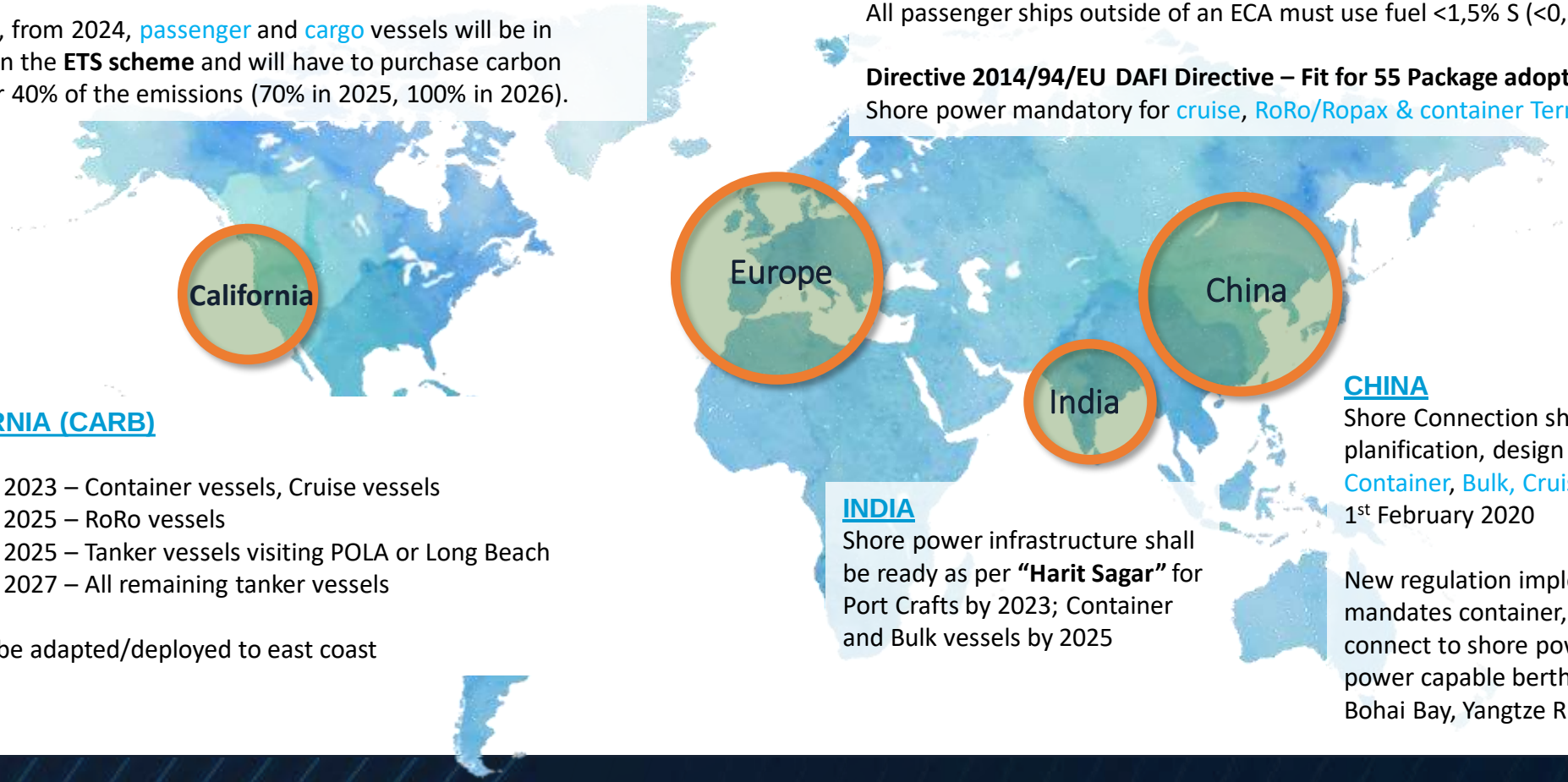
EU Average: 229 gCO2eq/kWh

Worldwide Regulations

ShipSide

IMO introducing & enforcing diverse schemes for CO2 reduction
CII, EEDI, EEXI.

In Europe, from 2024, passenger and cargo vessels will be in included in the **ETS scheme** and will have to purchase carbon credits for 40% of the emissions (70% in 2025, 100% in 2026).



EUROPE

Directive 2005/33/EC:
Since 2015, all ships in an Emissions Control Areas (ECAs) must use fuel <0,1%S as of 2015.
All passenger ships outside of an ECA must use fuel <1,5% S (<0,5% as of 2020)

Directive 2014/94/EU DAFI Directive – Fit for 55 Package adopted in 2023
Shore power mandatory for cruise, RoRo/Ropax & container Terminals by 2030

CALIFORNIA (CARB)

January 1, 2023 – Container vessels, Cruise vessels
January 1, 2025 – RoRo vessels
January 1, 2025 – Tanker vessels visiting POLA or Long Beach
January 1, 2027 – All remaining tanker vessels

CARB will be adapted/deployed to east coast

INDIA

Shore power infrastructure shall be ready as per **"Harit Sagar"** for Port Crafts by 2023; Container and Bulk vessels by 2025

CHINA

Shore Connection should be included in project planification, design and construction for new Container, Bulk, Cruise and Ropax terminals from 1st February 2020

New regulation implemented in 2021/2022 mandates container, cruise, RORO and bulk vessels to connect to shore power when docking at shore power capable berths in emission control areas : Bohai Bay, Yangtze River Delta, and Pearl River Delta.

ShorePower main principles are defined by IEC-80005 standards

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IEC/ISO/IEEE 80005-1: High Voltage Shore Connection
IEC PAS 80005-3: Low Voltage Shore Connection (Pre-Standard)

Vessel Type	Annex	Nominal SSE Voltage	Maximum Power Requirement	Frequency	Number of MV Cables to Feed Vessel	Power Connector	Cable Management System Location	Status	Since
Ro/Ro Ro/Pax	B	11kV, 6.6kV acceptable for waterborne transportation	6.5MVA @11kV 3.5MVA @ 6.6kV	50Hz or 60Hz	1	Cavotec PC6 7 pilots	Shore	Normative	2012 rev 2023
Cruise	C	11kV, 6.6kV acceptable	16MVA (20MVA Recommended)	50Hz or 60Hz	4 Power + 1 Neutral + Communication	P&C 15kV with 1 pilot each	Shore	Normative	2012
Container	D	6.6kV	7.5MVA	50Hz or 60Hz	2	Cavotec PC5 3 pilots	Ship	Normative	2012 rev 2022
LNGC	E	6.6kV	10.7MVA	60Hz	3	Cavotec PC6 7 pilots	Shore	Informative	2012
Tankers	F	6.6kV	10.8MVA 3.6MVA/Cable	60Hz	3	Cavotec PC5 3 pilots	Shore	Informative under revision	2012
Vehicle Carriers	G	11kV	6.5MVA	60Hz	1	Cavotec PC6 7 pilots	Shore	Normative	2023
Bulk Carrier	n.a	Some precedent established in Chinese Market inspired by Container. Cable reel, on the ship, 1 cable, PC5 , 6.6kV ....Max Power Varying 2~3MVA						Under discussion	

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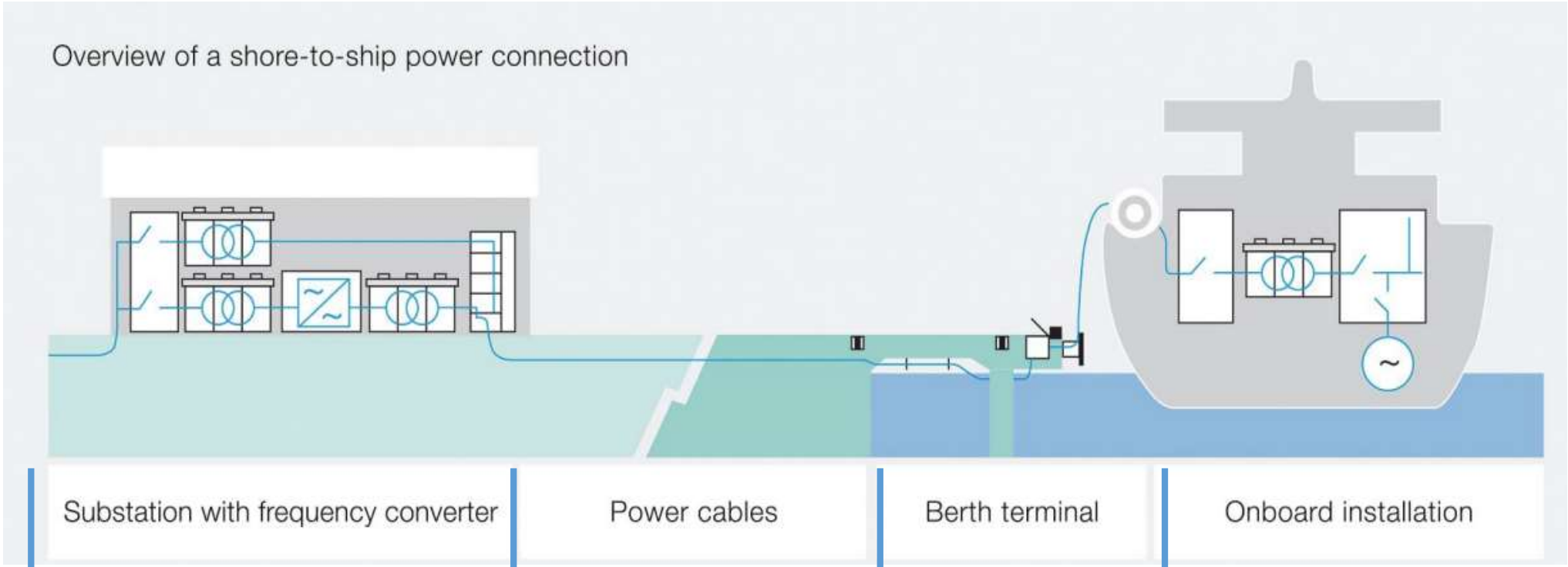
Shore Power Connection Overview : Container Terminal



Substation with frequency converter	Power cables	Berth terminal	Onboard installation
Availability of power from grid? Circuit breakers, transformers, frequency converters	Civil and electrical infrastructure	Space availability on quay side? Flexible CMS or fixed JB?	Power requirement of ships? Vessel shore power readiness?

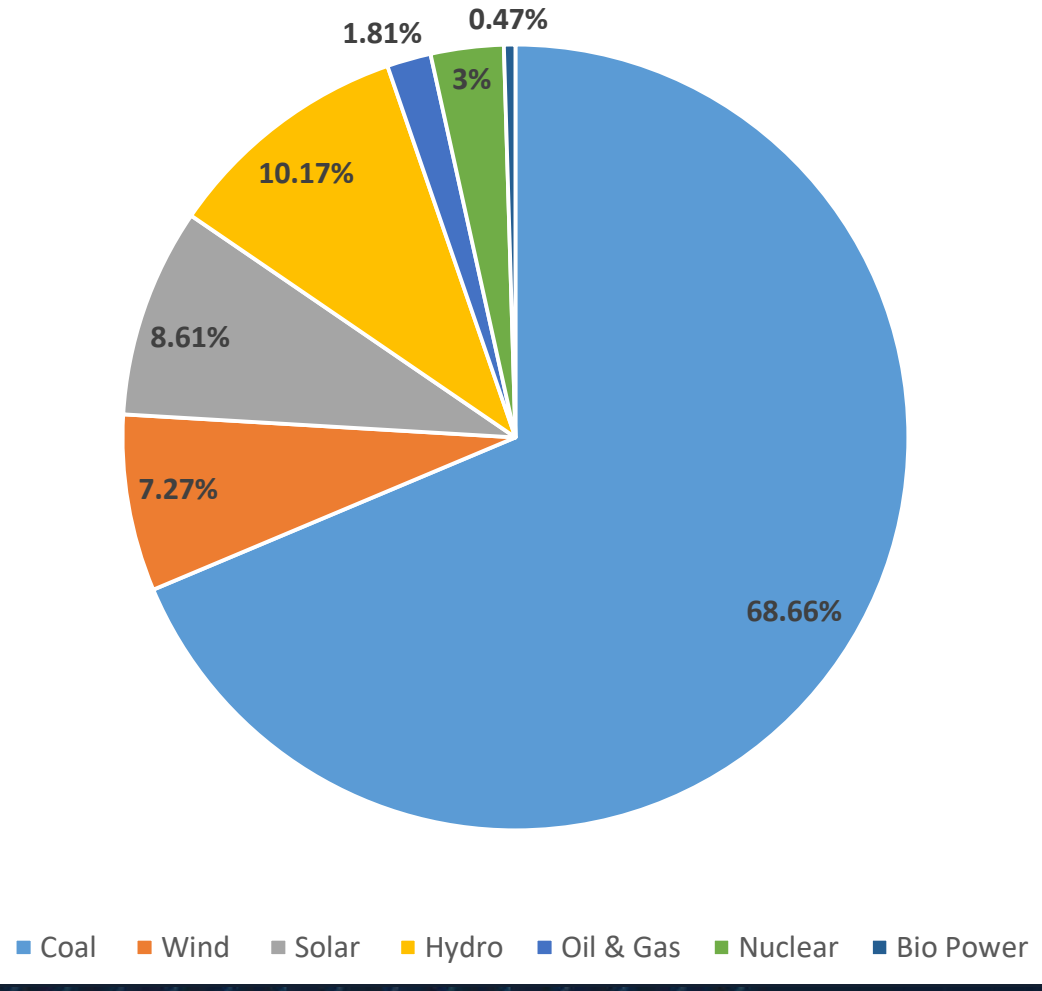
Shore Power Frequency Conversion and Power Demand

Frequency on board	50 Hz	60 Hz
Container (<140m)	63 %	37 %
Container (>140m)	6 %	94 %
Container tot	26 %	74 %
Ferry / RORO	30 %	70 %
Tanker	20 %	80 %
Cruise (<200m)	36 %	64 %
Cruise (>200m)	-	100 %
Crociera tot	17 %	83 %

Vessel type (length)	Average power demand (MW)	Peak power demand (MW)	Peak power demand for 95% of vessels (MW)
Container vessels (< 140 m)	0.17	1	0.8
Container vessels (> 140 m)	1.2	8	5
Container vessels (total)	0.8	8	4
RoRo and vehicle vessels	1.5	2	1.8
Oil and product tankers	1.4	2.7	2.5
Cruise ships (< 200 m)	4.1	7.3	6.7
Cruise ships (> 200 m)	7.5	11	9.5
Cruise ships (> 300 m)	10	20	12.5

India Power Generation Overview

India Electrical Grid Sources (July 2025)



- 74% derived from fossil/ other fuels
- 26% share of clean electricity

Source : CEA & NPP

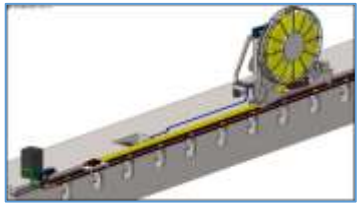
Cavotec ShorePower – ShoreSide Cable Management Systems

Cruise Terminals	Container Terminals	RoRo/RoPax PCC Terminals	Tanker/O&G Terminals	Special Vessels OSV/Yacht/Navy	Shortsea ferry Workboats















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Future of Mooring

MoorMaster NxG

https://youtu.be/sysyZ076aCs

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Thank you for your attention!