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ONSHORE POWER SUPPLY

2023 EUROPEAN REGULATORY FRAMEWORK
STRATEGIC OPTIMISATION LEVERS
AT ENVIRONMENTAL, OPERATIONAL, INDUSTRIAL AND FINANCIAL LEVELS

Sophie ROUAN
Senior Consultant
Marseille - France
(+33) 6 08 67 79 14
Sophie.rouan@free.fr

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PREAMBLE & EXECUTIVE SUMMARY

PREAMBLE

This report is the result of many years of working experience in the port sector, particularly in the operation of maritime traffic and electricity distribution networks within port areas, notably at the Grand Port Maritime de Marseille.

It forms part of an ongoing effort to design and deploy shore power solutions that are environmentally sound, operationally efficient, industrially robust and financially viable.

The report also reflects extensive collaborative work and exchanges with other French ports, European ports, and several international ports — particularly in Argentina, Tunisia and Australia — as well as with engineering firms and equipment manufacturers. These cross-sector contributions have enriched the analysis, enabled benchmarking of practices, and helped identify concrete areas for improvement.

This report has been composed in full independence and reflects the author point of view.

It is intended for a broad audience:

- First and foremost, professionals in the maritime and port sectors who are in a position to influence the regulatory and commercial framework of their activities;
- But also stakeholders outside the maritime sector who are driven by environmental, industrial or financial objectives.

EXECUTIVE SUMMARY

The ambition of this report is to provide an operational, economically viable, and environmentally responsible vision of the conditions required for the development of shore-side electrical supply solutions, within a regulatory framework adapted to the constraints of port operations.

It identifies areas for improvement, highlighting desirable developments in two European regulatory texts (AFIR and FuelEU). This report aims to contribute to the preparation of the reviews of the AFIR and FuelEU regulations planned by the European Commission for the end of 2026 and the end of 2027, and also to identify areas for improvement in a broader port context.

In concrete terms, this report details the aspects that must be aligned today (targets, scopes, exemptions, definitions, allocation of responsibilities, levels of requirements, efficiency, performance, penalties, etc.) in order to achieve better overall efficiency.

It puts forward proposals along three main axes to evolve regulatory and standardization frameworks at national, European, and international levels, mainly to:

- **set more appropriate targets** within AFIR with thresholds per port terminal; define terminal operators—whether public or private—as project owners and operators of OPS (Onshore Power Supply) installations; ensure that new OPS installations are environmentally efficient and not oversized,

- **extend the connection obligation to Short Sea Shipping** and provide only 50 Hz power in European ports for all new Short Sea connections, with vessels required to adapt to this new situation,
- **technically harmonize, simplify, and refine current standards** so that connections are as standardized as possible, in order to limit costs and encourage widespread deployment of installations.

Without these regulatory and standardization developments, all port and maritime stakeholders would lose out—starting with shipping companies, which ultimately purchase electricity as fuel. The risk is that consequences would arise at all levels, particularly affecting:

- **vessels**, which would need to convert 50 Hz electricity to 60 Hz with suboptimal efficiency, and could face potential increases in port fees,
- **terminal operators** who, if they are neither project owners nor operators of OPS installations, would risk operational constraints at berth or having to deal with oversized and unsuitable installations,
- **port authorities**, which could overinvest and end up maintaining more fragile installations, particularly due to constraints related to frequency conversion,
- **funders** (Europe, Member States, local authorities), who could be required to support inconsistent overinvestment.

It is important to remain aligned with the very spirit of European legislation, whose primary objective is decarbonization, by adopting solutions that are themselves sustainable. It is therefore essential to fully leverage the revision of the AFIR and FuelEU regulations.

If you only wish to review the summary of this report, you may refer directly to the last two chapters: List of Recommendations (2 pages) and Conclusion (2 pages).

1 – The context of Shore Power for ships

1.1) European environmental regulation

Following the Paris Agreement adopted in **2015** at COP21, the European Union launched the European Green Deal in **2019**, its roadmap to achieving climate neutrality by 2050. A legislative package adopted in **2021**, known as 'Fit for 55', sets out how the EU intends to reduce greenhouse gas (GHG) emissions by at least 55% by 2030.

The package includes maritime transport. Although shipping is one of the least carbon-intensive modes of transport per tonne carried, it nonetheless represents approximately 3% of global greenhouse gas emissions.

Fit for 55 includes several measures targeting maritime emissions, notably:

- The MRV Regulation (Monitoring, Reporting and Verification), in force since **2018** and updated in **2025**;
- The extension of the EU Emissions Trading System (EU ETS) to maritime transport as of 1 January **2024**;
- The FuelEU Maritime Regulation and the Alternative Fuels Infrastructure Regulation (revised AFIR), both published in September **2023.**

This report focuses specifically on AFIR and FuelEU Maritime in relation to shore power deployment.

1.2) Shore Power (OPS / CENAQ)

In France, shore power for ships — known as CENAQ (Connexion Électrique des Navires à Quai) — has existed for many years in **low voltage** (400 V or 690 V) and at 50 Hz, primarily for small vessels or ships undergoing long stays such as repairs (**<1 MW**). However, this approach involves usually temporary onboard power interruption and lengthy connection times.

The development of **high-voltage** shore connection (6.6 kV or 11 kV), designed for commercial vessels in operation with power demands exceeding 1 MW and without onboard blackout during connection, is a more recent technological step forward, emerging in the late 2000s. It represents a major industrial innovation, **enabling electricity to function as a genuine marine fuel**.

These high-voltage installations were first deployed in France and the Mediterranean at the Grand Port Maritime de Marseille in 2017.

This report focuses exclusively on high-voltage shore connections for commercial vessels, which present the greatest technical and environmental challenges.

This technology known in France as CENAQ, is known internationally, as:

- **OPS** (Onshore Power Supply), currently the most widely used term;
- Shore Power or Shore Connection;
- SSE (Shore Side Electricity);
- AMP (Alternative Maritime Power);
- HVSC (High Voltage Shore Connection);
- Cold Ironing.

These various terms refer to the same type of installation: a high-voltage shore-based electrical supply, typically at 6.6 kV or 11 kV, delivering power levels above 1 MVA, regardless of the frequency used ashore or onboard (50 or 60 Hz).

1.3) Advantages of Shore Power

Shore power enables ships at berth to replace onboard fossil fuel generation (MGO, LNG, methanol, ammonia, etc.) with electricity supplied from the land-based grid.
It allows:

- Complete elimination of local air pollutant emissions (SOx, NOx, particulate matter);
- Elimination of greenhouse gas emissions while at berth (with the exception of excess pressure from LNG tanks);
- Removal of noise and vibration;
- Improved working conditions for crews;
- Reduced reliance on imported fossil fuels;
- Enhanced social acceptability of port activities;
- facilitate vessel maintenance and reduce operating costs;
- eliminate interruptions in cargo-handling operations caused by exhaust emissions drifting toward crane and gantry operator cabins.

These benefits are fully realised only if sufficient electricity is available and produced from low-carbon sources.

It should nevertheless be emphasised that the deployment of OPS entails significant investment, both for vessels and for ports. For ports in particular, the required capital expenditure can reach several tens of millions of euros — and, for the largest ports, potentially several hundred million euros.

1.4) Regulatory and standardisation challenges

Since 2012, the development of shore power has been framed by international technical standards and European legislation, in particular Directive 2014/94/EU. The 2023 adoption of AFIR and FuelEU Maritime marks a decisive shift from recommendation to obligation.

The objective is to ensure reliable industrial systems, maximise environmental performance, and reflect the operational realities of ports and maritime transport.

These European and international frameworks pursue several objectives, including:

- ensuring a reliable industrial system;
- delivering the highest possible environmental performance;
- accurately reflecting the operational realities of ports and maritime transport during port calls.

The purpose of this report is to identify desirable developments in these regulatory texts and in their broader framework, with a view to enhancing the overall effectiveness of shore power systems for commercial vessels across their various components.

2 – AFIR and FuelEU Maritime: A positive regulatory framework

The two regulations mandating shore power deployment in European ports were adopted by the European Parliament and Council and published in September 2023.

- Regulation (EU) **2023/1804**[1] (AFIR) requires Member States to ensure the deployment of shore power infrastructure in **ports.**
- Regulation (EU) **2023/1805**[2] (FuelEU Maritime) requires certain categories of **vessels** to use shore power when available from 1 January 2030.

This regulatory framework is a positive step forward, as it introduces binding obligations for the first time at European level.

However, the regulations do not specify technical characteristics such as power, voltage or frequency, referring instead to international standards, particularly IEC/IEEE 80005-1.

AFIR must be reviewed by the European Commission by 31 December 2026, and FuelEU Maritime by 31 December 2027. These review processes provide a strategic opportunity to refine and improve the framework.

[1] https://eur-lex.europa.eu/eli/reg/2023/1804/oj/eng
[2] https://eur-lex.europa.eu/eli/reg/2023/1805/oj/eng

This framework will become applicable as from 1 January 2030 for certain categories of vessels. Given the scale of the investments required, their magnitude and complexity — both in ports and terminals, and onboard vessels — this deadline may be regarded as very close, indeed almost "tomorrow".

These two Regulations do not define the technical characteristics of the electricity supplied by ports, whether in terms of:

- power [in megawatts (MW) or megavolt-amperes (MVA)];
- voltage [in volts (V)];
- frequency [in hertz (Hz)]; or
- connection interface.

For these technical characteristics, they rely on international standards, which are specified according to the categories of vessels concerned, and in particular on standard IEC/IEEE 80005-1, which currently constitutes the reference framework in this field.

Article 24 of the AFIR Regulation provides that, no later than 31 December 2026, and every five years thereafter, the Commission shall review the AFIR Regulation. In its review, the Commission will assess, in particular, the gross tonnage thresholds, the possible extension of the scope of application, and related aspects.

Similarly, Article 30 of the FuelEU Regulation provides that, no later than 31 December 2027, and every five years thereafter, the Commission shall review that Regulation. In particular, the Commission will assess the listed exemptions and the accounting of electricity supplied.

These review processes represent an crucial opportunity to adjust the regulatory framework and introduce the necessary modifications to address, in the most effective manner, the full range of port and maritime challenges — operational, environmental, technical, industrial and financial.

This report forms part of the preparatory work for the European Commission's review of the AFIR Regulation — which is expected to begin with stakeholder consultations from autumn 2026 — as well as of the FuelEU Regulation.

2.1) ARTICLE 9 OF THE AFIR REGULATION AND ARTICLE 6 OF FUELEU, OBJECTIVES AND OBLIGATIONS

In the AFIR regulation, article 9 sets the objectives to be achieved by 1 January 2030. These objectives form the basis of the requirements **imposed on ports** for the deployment of shore-side electrical connection infrastructure, namely:

Merchant Fleet Ship Categories > 5000 UMS	AFIR Article 9 Requirements per port	
	Average over the last 3 years	% minimum of the total number of port calls
Container Ships **Ferries / Ropax Ships** **Cruise Ships** **Miscellaneous:** liquid & dry bulk, roro, …	> 100 calls/year > 40 calls/year > 25 calls/year -	90% 90% 90% -

Similarly, and mirroring this, the FuelEU Maritime regulation **imposes on certain categories of ships** the obligation to connect to shore side electricity from 1 January 2030, in accordance with its Article 6, and in particular to:

- containerships;
- passenger ships.

However, this obligation is subject to several exemptions, and does not apply to ships that:

a) are moored at the quayside for less than two hours;
b) use zero-emission technologies;
c) due to unforeseen circumstances beyond the control of the ship, have to make an unscheduled port call, which is not made on a systematic basis;
d) are unable to connect to OPS due to the unavailability of OPS connection points in a port;
e) are unable to connect to OPS because exceptionally the electrical grid stability is at risk;
f) **are unable to connect to OPS because the shore installation at the port is not compatible with the onboard on-shore power equipment, provided that the installation for shore-connection on board the ship is certified in accordance with the technical specifications set out in Annex II to Regulation (EU) 2023/1804** for the shore-connection systems of seagoing ships; namely the technical specifications of the IEC/IEEE 80005-1:2019 standard for high-voltage shore connections;
g) for a limited period of time, require the use of onboard energy generation, under emergency or for other reasons of force majeure;
h) while remaining connected to OPS, for a period of time limited to what is strictly necessary, require the use of onboard energy generation for maintenance tests or for functional tests.

2.2) THE DIFFICULTIES IN IMPLEMENTING THE AFIR AND FUELEU REGULATIONS

Despite their environmental ambitions, these two regulations today present several implementation difficulties and in particular at the port level.

The main points of 'friction' in AFIR concern:

- the target of ships selected,
- the definition of a 'port',
- the non-definition of the electrical frequency to be used,
- the distribution of responsibilities among the various maritime and port stakeholders,
- the levels of requirement and objectives according to the categories of ships.

For FuelEU, the specific difficulties are related to:

- point f of the exemptions concerning technical compatibility,
- technical harmonization between the different categories of ships.

The difficulties encountered in these regulations lead to:

- extremely significant investment and operating costs,
- underutilization of the investments made and programmed,
- and even an environmental assessment in contradiction with the very spirit of the regulations.

The obstacles, the limiting factors identified are detailed in the following sections.

3- A MODEST GOAL BUT POSSIBLE DEVELOPMENTS INTO SHORT SEA SHIPPING

3.1) A VERY CAREFUL INITIAL TARGET

Currently, only three categories of ships are covered by the AFIR regulation.

By replacing these categories in the context of the global merchant fleet, it appears that the target of the AFIR regulation is relatively modest, since it represents only 25% of the trade fleet[3]

Merchant Fleet Ship Categories > 5000 UMS	AFIR Article 9 Requirements per port		World merchant fleet >1000 UMS			
	Average over the last 3 years	% minimum of the total number of port calls	Nb ships	%	Type of traffic	
Container Ships	> 100 calls/year	90%	7 100	12%	Deep & Short Sea	Mostly regular trade
Ferries / Ropax Ships	> 40 calls/year	90%	7 600	13%	Short Sea	**Very regular trade**
Cruise Ships	> 25 calls/year	90%	**400**	**<1%**	Deep & Short Sea	Mostly irregular
Miscellaneous: liquid & dry bulk, roro, …	-	-	**44 900**	**75%**	Deep & Short Sea	Mostly irregular
		Total	* **60 000**	**100%**		

** including 18,300 in Europe and 12,500 in the EU*

[3] Sources : Statista, Equasis, UNCTAD, Marine Traffic, Clia, Safecube, Atlas Magazine (Assurances), cruises - Facts and figures. Existing statistical data based on ships over 1000 UMS

This assessment of the target in terms of number of ships could be supplemented by data on estimated emissions linked to the number of port calls or the average power required for each category of ship. However, this data is difficult to model and, above all, to extrapolate over time. Within the same category, there may be large or small ships, such as "mothers/feeders." In addition, due to constantly changing regulations, ships are undergoing significant transformations that greatly influence their electrical needs (constant growth of reefers on container ships, efforts to reduce the fuel consumption of cruise ships, increasingly frequent use of batteries on ferries, etc.). For all these reasons, a simple approach based on the number of ships has been adopted, even though it would appear that these three kinds of ships currently emit relatively more CO_2 in EU ports than other ships.

The table above shows that **cruise ships are included in the three categories of ships, even though they represent less than 1% of the total global fleet**. Conversely, ships not included in the study, mainly RoRo ships and dry or liquid bulk carriers, represent three-quarters of the panel.

This discrepancy raises questions about the environmental ambition of the targeting, since the most voluminous segments of global maritime transport are outside the AFIR scope.

In addition, it should be noted that the fleet of cruise ships is a relatively recent fleet compared to other types of vessels which generally incorporates the latest technological advances compared to other categories of boats; notably most of the last constructed cruise ships run on LNG. They are also increasingly sober in terms of energy. Furthermore, these large cruise ships are much more difficult to connect than other vessels, as will be detailed below, due to the high levels of electrical power required to cover their stopover requirements and the frequency of the onboard electrical network.

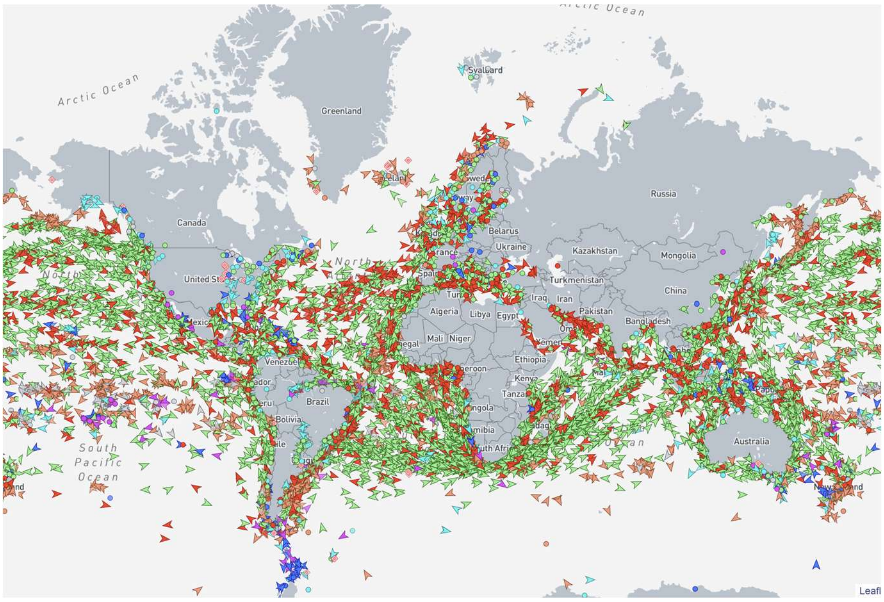
This modernity of cruise ships contrasts with the other segments (bulk carriers, oil tankers, roro, etc.) in which a significant part of the fleet is older and less energy efficient.

Ultimately, the AFIR regulation, although supporting the deployment of alternative fuels and shore connection, therefore covers only a limited fraction of the fleet that go around with European ports.

The current targeting, ultimately:

- **includes a marginal segment (cruise) but very visible politically,**
- **excludes very important segments (dry or liquid bulk, roll-on/roll-off) responsible of a significant share of global maritime transport emissions.**

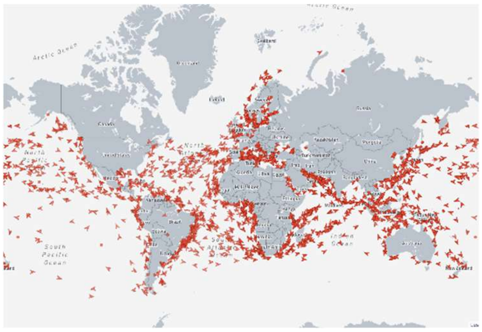
This asymmetry raises the question of the overall environmental effectiveness of the regulatory system and the need for a gradual expansion of the scope of AFIR.



Site MarineTraffic - Live Ships Map (February 5, 2026)

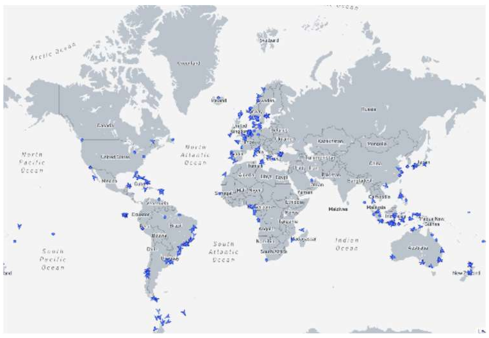
Cargo ships extract:

This category of cargo ships includes container ships **but also general cargo ships, bulk carriers, Ro-Ro / Con-Ro / PCTC carriers, reefers, aggregates / cement / ore carriers, livestock carriers, OBO / heavy load carriers, barges, inland cargos, special and others cargos.**



Tankers extract

Tankers (liquid bulk) represent a very large share of traffic, especially in Europe.



Passenger vessels extract

Passenger vessels are the least numerous. They only do Short Sea, with the occasional exception of cruise ships.

3.2) THE OPPORTUNITY OF SHORT SEA SHIPPING

In view of the current target of the AFIR regulation and the scheduled review of this regulation, it appears that there is an opportunity to expand its scope.

To take a further step towards reducing atmospheric emissions from the sector, one option would be not to target new categories of ships, but rather to **target a specific type of traffic, particularly Short Sea Shipping (SSS)**.

The European Commission has defined Short Sea Shipping as follows:

"*Short Sea Shipping means the transport of goods and passengers by sea between ports located in geographical Europe or between these ports and other ports located in non-European countries bordering a closed sea adjacent to Europe. Short sea shipping covers both domestic and international maritime transport activities along coastlines and to and from islands, rivers, and lakes. It also includes maritime transport services between EU Member States and Norway, Iceland, United Kingdom, and the countries bordering the Baltic Sea, the Black Sea, and the Mediterranean Sea.*"

Similarly, the regulations TEN-T ((EU) 2024/1679 specify:

"*Short-sea shipping' means the movement of cargo and passengers by sea between ports situated in geographical waters of one or several Member States or between a port situated in waters of Member States and a port situated in waters of an adjacent third country having a coastline on the seas bordering waters of one or several Member States*"

These regulations are supplemented by the Communication from the Commission to the Council, the European Parliament, the European Economic and Social committee and the Committee of the Regions on Short Sea Shipping[4]

These definitions encompass all intra-European maritime flows, making it a coherent scope for regulatory extension.

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[4] EUR-Lex - 52004DC0453 - EN
https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52004DC0453

Short Sea Shipping perimeter

This expansion would align the environmental ambition of the regulation with the operational reality of European maritime transport. Overall, about 50% of freight and passenger traffic in Europe is classified as short sea shipping. This traffic has the advantage of being very regular, frequent, and operated by stable fleets, which facilitates port investment planning and the adoption of alternative energy solutions. In other words, it is a massive, structuring segment that is technically accessible for ramping up OPS. The new ships concerned would mainly be Ro-Ro and Con-Ro vessels, as well as feeder tankers and feeder bulk carriers.

Although smaller than their deep-sea counterparts, these ships operate at higher frequencies, often in densely populated areas, which reinforces the importance of air quality.

The integration of all Short Sea Shipping vessels into the AFIR would make it possible to:

- significantly increase the share of the fleet concerned,
- target vessels with regular port call cycles that favor investment in OPS,
- maximize health and environmental benefits in European coastal and port areas.

The target vessels covered by this measure could be identified according to several criteria:

- for ro-ro and con-ro vessels, the entire fleet with the exception of PCTCs,
- for other vessels, based on their port of arrival or destination,

  or, based on their size, for example:

- for tankers and bulk carriers, by instance vessels with a tonnage of less than 30,000 GT,
- for container ships, vessels by instance of less than 4,000 TEU or less than 40,000 GT.

4 –The issue of the electrical frequency to be delivered by ports, a non-decision that costs everyone in Europe

4.1) The two global electrical frequencies

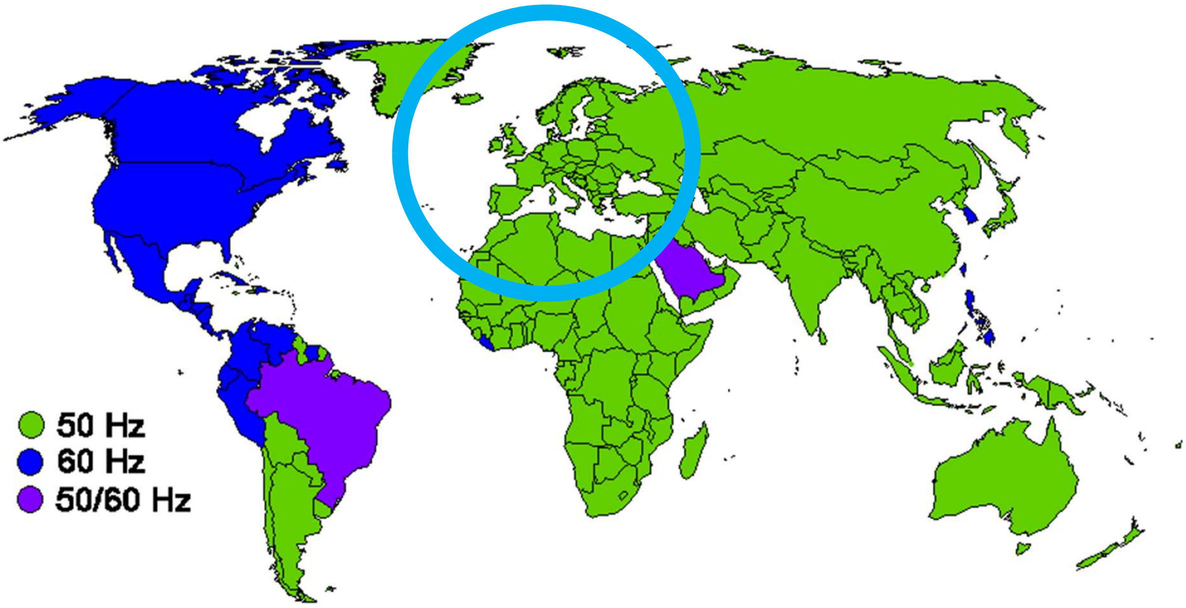
Alternating current electricity is produced in all countries around the world at two different frequencies: either 50 Hz or 60 Hz. Electricity is therefore transported and distributed using one of these two frequencies.

Globally,

- 50 Hz is found in most of the world, including all of Europe, all of Africa, most of Asia and South America, and Australia, i.e., almost the entire "eastern" hemisphere.
- 60 Hz is used in North and Central America, southern Japan, South Korea, and the Philippines, covering most of the "western" hemisphere.

Some countries, such as Brazil, Saudi Arabia, and Japan, use both frequencies depending on the region.

Globally, 175 countries currently use a frequency of 50 Hz, while the other countries use either 60 Hz or a combination of 50 Hz and 60 Hz.



Frequencies of national distribution networks

The entire area of European Short Sea Shipping is entirely in 50 Hz, which is a decisive and highly favorable factor for connecting ships.

4.2) Ships: a heterogeneous fleet between 50 Hz and 60 Hz

Similarly, merchant vessels operate with internal electrical networks at either 50 Hz or 60 Hz.

Historically, the majority of commercial fleets operated at 50 Hz, as shore connections were not available in ports and shipbuilding yards were primarily located in Europe and Asia — regions using 50 Hz systems.

Today, however, as California was the first jurisdiction to mandate shore power connections for commercial vessels in 2007 — well before Europe — most container ship and cruise vessel fleets built since that date operate at 60 Hz.

When California introduced mandatory shore power connections in its ports, notably at the ports of Los Angeles (POLA) and Long Beach (POLB), **these ports offered (and continue to offer) only connections at the frequency of their grid, namely 60 Hz**.

The global fleet of Ro-Ro vessels and ferries engaged exclusively in short sea shipping remains more or less split between the two frequencies, with a predominance of 50 Hz in Europe.

Certain shipping companies operating vessels in Europe continue to acquire ships configured for 60 Hz, without fully factoring in the additional costs involved — either because this frequency is considered more efficient for onboard equipment, or because the vessels are chartered and the owner imposes the 60 Hz configuration. In all cases, 60 Hz vessels connecting on shore to substations with frequency converters must, without exception, invest on board in specific equipment enabling the management of the electrical load increase during the connection process.

4.3) Frequency conversion: a financial, technical and ecological abyss

When a vessel operating with an internal 60 Hz electrical network needs to connect to a shore grid operating at 50 Hz, beyond the voltage adjustments — which require a transformer — it is necessary to convert the frequency, **either onshore or onboard the vessel**. For the high-power levels required by ships, this conversion is technically complex and requires significantly larger and more sophisticated equipment.

Onshore, frequency conversion requires the addition of:

- a frequency converter (generally static, i.e. based on power electronics);
- two additional transformers;
- and dedicated air-cooling systems (due to the extensive use of power electronics, which are sensitive to high temperatures).

While voltage transformation (in volts) using transformers is a proven, robust, durable and reliable technology, frequency conversion (in hertz), particularly at the high-power levels required by vessels, relies on converter technology that has significantly evolved with advances in electronics but remains less reliable and more sensitive. The equipment involved is costly and typically has a service life approximately half that of conventional transformer-based systems.

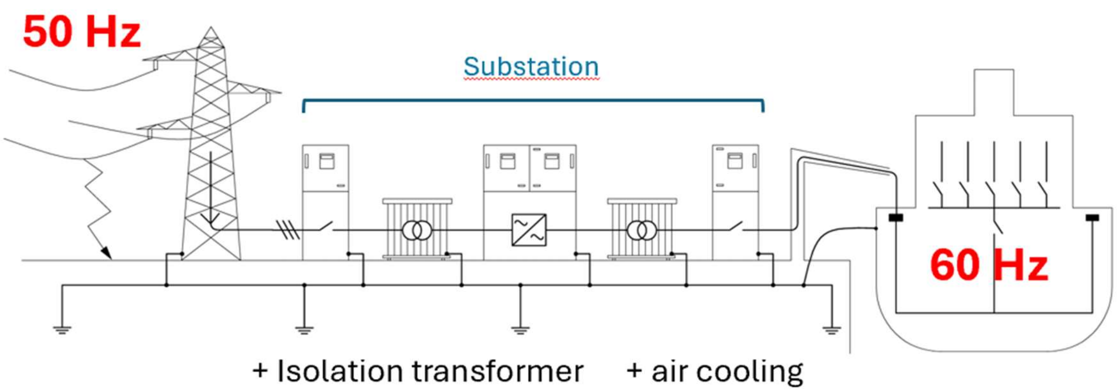


Diagram of a connection with frequency conversion

If no frequency conversion is required, i.e., if the land-based network operates at the same frequency as the shipboard network, then the equipment in the substation is limited and conventional.

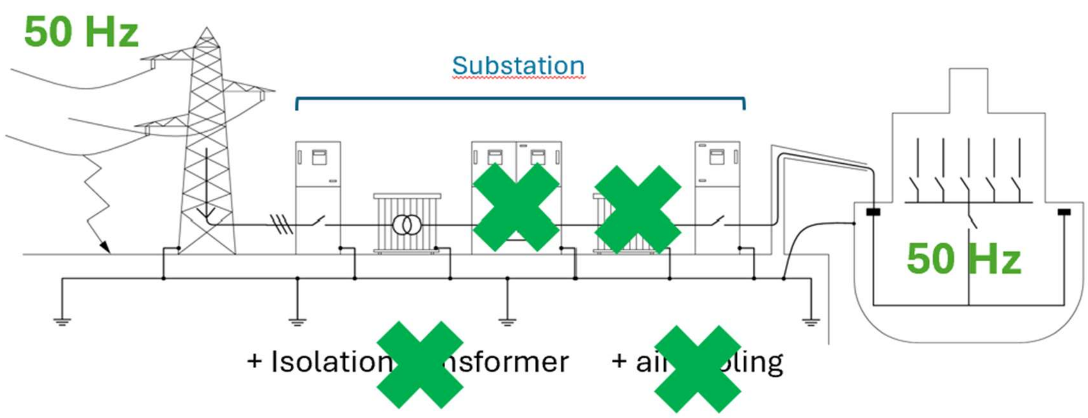


Diagram of a simplified connection without frequency conversion

Frequency conversion from 50 to 60 Hz is difficult to operate and less reliable than installations without conversion.

Beyond these difficulties, conversion has the following direct consequences:

- at the substation level, **investment costs are multiplied by 4 per MVA installed,**
- the conversion equipment (electronics) has a **shorter average lifespan** of approximately 10 to 12 years compared to 25 to 30 years for conventional electrical equipment (transformers, switchgear, networks, etc.),
- **additional specialized maintenance** (power electronics) that must be outsourced and is costly,
- **very high electrical line losses, on the order of 15%** (+/- 5%), due to the addition of conversion, transformation, and systematic cooling stages for the installations. The level of these line losses can vary significantly from one connection to another because they depend on the actual load on the converters and transformers during

port calls. These losses directly contradict environmental, energy efficiency, and conservation objectives.

Beyond the financial implications, considering electrical losses and the complete lifecycle of the equipment showss that these consequences are not aligned with the spirit of the AFIR and FuelEU regulations, whose primary objective is environmental protection.

Another solution exists for frequency conversion, known as "dynamic" conversion, using motor-generators or rotating machines. This technical solution offers the advantage of being robust, easier to operate and maintain, and has an estimated lifespan of around thirty years. However, the investment cost of this solution is significantly higher than the "static" solution, making it even more difficult to integrate into investment plans and associated business models.

If the goal is to protect the finances of the various stakeholders (shipowners, port terminal operators, port authorities, financiers) and promote sustainable development, it is essential to avoid any frequency conversion as much as possible, especially within the Short Sea Shipping sector where it is entirely unjustified since none of Europe's neighboring countries distribute electricity at 60 Hz; all use 50 Hz.

If Europe wants to be sovereign in this area, and given that its network is solely at 50 Hz, it is in its interest to mandate that Short Sea Shipping vessels connect to its existing 50 Hz network, as they only call at 50 Hz ports (Mediterranean, Baltic, North Sea, etc.), as California did in 2007, and as the entire USA now does. Within the European Short Sea Shipping area, no country uses 60 Hz. Therefore, there is no sufficient technical justification for ships operating exclusively in this area to be built to 60 Hz.

The choice of connection frequency must be made by the countries themselves and not imposed by an international standard (see Chapter 8 below). As reiterated by the French Minister for the Sea at the Euromaritime Summit in February 2026, Europe must also assert its sovereignty in the maritime domain.

Deep Sea shipping routes between North America and Europe that require frequency conversion are far fewer than the total number of intra-European Short Sea routes, including those between Asia and Europe, which likewise require no conversion.

4.4) A COMMON-SENSE PRINCIPLE: IT IS UP TO THE SHIP TO ADAPT TO THE LAND NETWORK

It is up to the ship (the mobile element) to adapt to the land-based network, not the other way around. To take an equivalent example, if a European stays in a hotel in North America, they will not ask the hotel to adapt the frequency of its electrical network to use their electric razor; they will buy an adapter.

It should be noted that large yachts, which are very accustomed to connecting to ports around the world, in order to avoid nuisances associated with running engines during their stopovers (noise, vibrations, smell) and which require electrical power equivalent to that of ro-ro and ro-pax vessels (around 2 MVA), are all equipped with on-board converters that allow them to connect in Florida and the Bahamas (60 Hz) as well as in Monaco (50 Hz).

The new cruise ship of the Orient Express company, the OE Corinthian, currently being finalised at Chantiers de l'Atlantique, and its sister ship, the OE Olympian, currently under construction, both 220 meters long and 25 meters wide, with a tonnage of 26,200 tons and a capacity of 120 passengers and 170 crew members, are equipped with onboard converters that allow these ships to connect to both 50 Hz and 60 Hz power supplies. These ships are equivalent in length and tonnage to ro-pax vessels or other luxury cruise ships.

The OE Corinthian at Chantiers de l'Atlantique

When ships need to integrate new fuels such as LNG, methanol, or ammonia into their architecture, they take the necessary measures to adapt their facilities (tank size, regasification equipment, safety equipment, etc.). Similarly, for electricity fuel, the process must be completed at the ship level and, if necessary, a converter must be integrated.

In Europe, it is up to ships—at least those in Short Sea Shipping—to adapt to a 50 Hz connection. It is neither useful nor efficient for ships—such as ferries serving Great Britain or RoRo ships serving North Africa—to be at 60 Hz, especially since there is an investment cost both on land and on board, an ecological cost and a human cost that undermine the benefits of the electrical connection and which are ultimately borne by the shipowner.

4.5) A CLEAR RECOMMENDATION: IMPOSE 50 HZ ON SHORT SEA SHIPPING

In order to preserve the financial viability of the various stakeholders and to safeguard European environmental objectives, it is essential that European port installations **supply only 50 Hz electricity to "domestic" vessels**, and more broadly to vessels operating on routes within the "Eastern Hemisphere" (Asia–Africa–Europe–Australia).

Vessels engaged in short sea shipping should be required to be compatible with 50 Hz; in other words, where their internal electrical network operates at 60 Hz, the frequency conversion should be carried out onboard.

It is both logical and consistent that European ports, for new OPS installations, supply electricity exclusively at 50 Hz and impose this standard, at a minimum, for short sea shipping operations.

The European Commission could also consider implementing the **equivalent of the US Jones Act** to protect its interests in cabotage or Short Sea Shipping. As a reminder, the Jones Act, adopted in 1920 in the United States, is a cabotage law that requires maritime transport between two US ports to be provided by ships built in the US, flying the US flag, and owned and operated by US interests. Similarly, the European Union could propose that maritime links between two EU ports be provided exclusively by ships built in Europe, which would be required to connect to ports via 50 Hz connections, flying the flag of an EU member state, and owned and operated by EU interests. This measure would strengthen the European Union's position and reduce the cost and reliability of port facilities. This measure could also be extended to the entire Short Sea Shipping zone at a later stage.

It should be noted that, in order to comply with increasingly stringent regulatory requirements on air quality and marine water quality, vessels operating in short sea shipping are making growing use of onboard electrical energy storage systems — particularly Ro-Ro and Ro-Pax vessels. These systems are used either for port approach manoeuvres and zero-emission port calls (for example, in the case of the future vessels of La Méridionale under the Corsica public service delegation contract), or for propulsion purposes (for example, the cross-Channel ferry projects in Calais, or the 100% electric feeder bulk carrier projects in Norway).

In the case of the Port of Calais project, where the simultaneous connection of three electrically propelled ferries is planned — requiring battery recharging within very short timeframes and representing an estimated total power demand of 100 MW — it would be entirely inappropriate, in view of costs and losses, to implement such connections with frequency conversion. It is for new vessels to be designed with the appropriate frequency corresponding to that supplied by the port.

Given that electricity-based uses are expected to expand significantly in the short sea shipping segment, it is all the more important that the technical solutions adopted are, from the outset, the most technically efficient and financially sound.

Mandating 50 Hz supply in AFIR as the sole standard for short sea shipping and **require ships to adapt in FuelEU** is a technically coherent measure, economically rational, environmentally necessary and politically consistent with European energy sovereignty. It represents a simple, structuring decision with immediate benefits for the entire port and maritime value chain.

One possible follow-up measure, aimed at objectively assessing the performance of electricity as a marine fuel, would be to **integrate it into the European MRV** (Monitoring, Reporting and Verification) system — from which it is currently excluded — and, beyond its origin, to differentiate for CO_2 calculation purposes between two categories of shore electricity: supply without frequency conversion and supply with frequency conversion.

5 –The "Maritime Port", a regulatory definition not suitable to port operations

5.1) A European definition of 'maritime port' too broad to reflect the operational reality

Within the meaning of European regulation (Regulation (EU) 2017/352[5] of the European Parliament and of the Council), a « maritime port » is *'an area of land and water made up of infrastructure and equipment mainly for the reception of ships, their loading and unloading, storage of goods, receipt and delivery of such goods and embarkation and disembarkation of passengers, crew members and other persons, as well as any infrastructure that carriers need in the port area'*

This very broad definition may be appropriate for an institutional view of ports, but it does not reflect the reality of the various activities of a "maritime port," because port operations are not organized in a comprehensive manner, but rather around port terminals specialized by type of traffic, with superstructures specific to commercial operations and with different governance for each terminal.

5.2) The "Port Terminal": the appropriate functional unit for the implementation of AFIR

In the operational reality of European ports, the port terminal — regardless of its specific activity — constitutes the fundamental building block of port operations, the basic functional unit.

A single port entity or "port authority" may comprise several terminals dedicated to the same type of traffic and vessels. These terminals may be spread across a very large geographical area, sometimes located several dozen kilometres apart.

For example, the Port of Antwerp-Bruges includes 13 container terminals — 2 in Bruges and 11 in Antwerp — located approximately 85 km from one another. In Antwerp, four of these terminals have mixed activities and are highly likely to handle fewer than 100 pure container ship calls per year (excluding ConRo vessels and inland barges). In the context of AFIR, this raises the question of whether such "small" terminals, which accommodate only a limited number of container ship calls, should be subject to AFIR obligations and therefore be required to install OPS facilities, on the grounds that the Antwerp-Bruges Port Authority, taken as a whole, records well over 100 container ship calls per year.

Should OPS installation be mandated for terminals handling very few container ship calls, even though the actual use of such connection facilities would be marginal?

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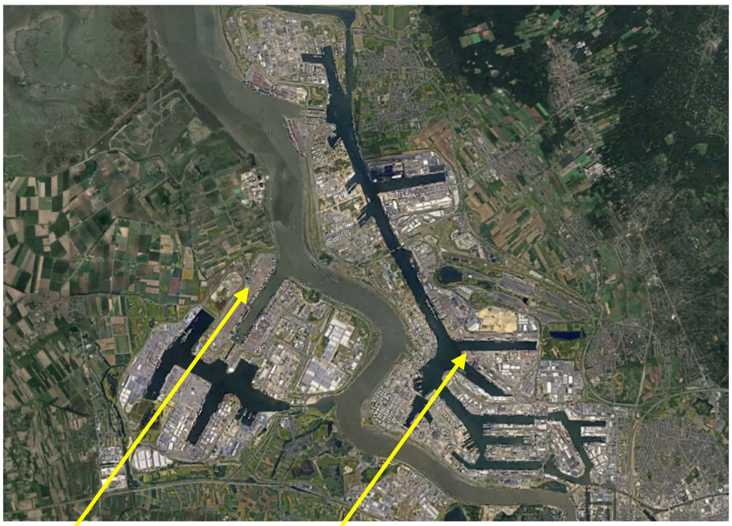
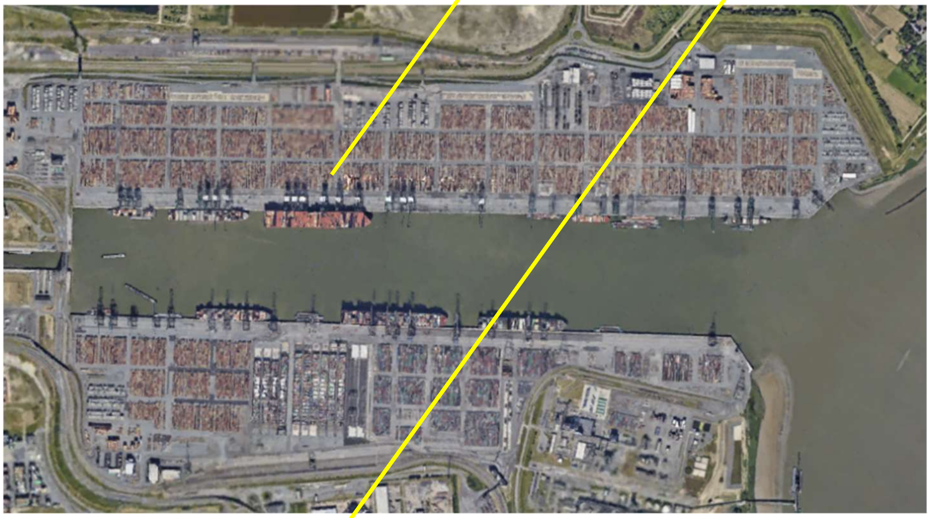
[5] Règlement - 2017/352 - EN - EUR-Lex ou
https://eur-lex.europa.eu/legal-content/FR/TXT/?uri=CELEX:32017R0352
Article 2, alinéa 16

The following illustrations of Port Autority of Antwerp-Bruges highlight the diversity of situations:



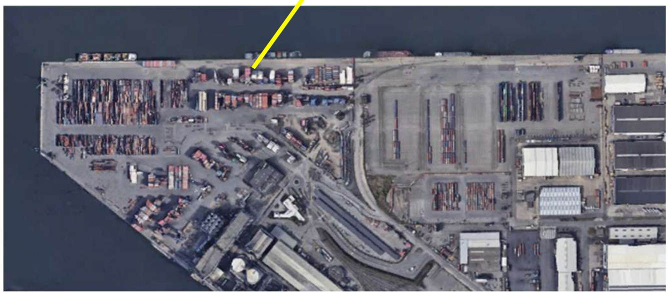
Port de Bruges

Port d'Anvers



Extract 1:

The large container terminals of Deurganckdok, equipped with numerous gantries in Antwerp



Extract 2:

Two small container terminals close to the city centre of Antwerp equipped simply with mobile cranes.

This same scenario is found in many European ports, including French ones, and notably at the Grand Port Maritime de Marseille.

In the port of Marseille-Fos, for example, there are:

- two container terminals in Fos-sur-Mer and one in Marseille, 65 kms away,
- two cruise terminals of very different sizes and spaced several kilometres between the North and South of the Marseille port,
- ferry terminals, national and international, distributed in different areas of the port area in Marseille.

These multisite configurations demonstrate that reasoning at the scale of the 'maritime port' does not reflect the operational reality of the ports. However, the 'recitals' of the AFIR clearly recognize this reality by mentioning the 'terminals' in their text, whereas Article 9 no longer makes it appear.

Recitals 45, 46, 47 and 49 of the AFIR regulation specify in particular:

> *(45) … Therefore, it is important to lay down **clear targets** for shore-side electricity infrastructure deployment in TEN-T ports. In view of the fact that Member States have different governance models for ports, in order to reach those targets, Member States should be able to decide on the best way for them in which to deploy infrastructure within their ports and **in the <u>different terminals</u> according to their needs**. It is important that within ports, and where relevant between terminals, infrastructure be deployed **where the maximum return on investment and occupancy rate result in the highest environmental benefits** in terms of greenhouse gas emissions reductions and air pollution reductions.*
>
> *(46) The planning, development and deployment of shore-side electricity supply for seagoing ships requires a **coordinated approach to match supply and demand**. Therefore, all public and private stakeholders on both the ship side and the port side, as well as any other relevant market actors, should coordinate to allow for smooth operation on an everyday basis.*
>
> *(47) **It is important to avoid stranded assets and to make sure that the public and private investments that are made today are future-proof and contribute to the transition to climate neutrality** as set out in the European Green Deal.*
>
> *(49) The mandatory deployment targets should take into account the types of vessels served and traffic volumes of maritime ports. **In order to avoid the installation of capacity that will be underused, maritime ports with low traffic volumes of certain ship categories based on the average annual number of port calls should not be subject to the mandatory deployment targets for the corresponding ship categories. Similarly, the mandatory targets should not aim to target maximum demand, but a sufficiently high volume, in order to avoid underused capacity and to take account of port operational characteristics[6].***

[6] The European Court of Auditors has produced two reports on this subject:
In 2016, a special report entitled 'EU maritime transport: a change of course is needed – investments that are largely inefficient and precarious'
https://www.eca.europa.eu/Lists/ECADocuments/SR16_23/SR_MARITIME_FR.pdf
In 2025, another special report titled "Combating marine pollution caused by ships. The EU is still navigating troubled waters"
https://www.eca.europa.eu/ECAPublications/SR-2025-06/SR-2025-06_FR.pdf

The articles of the regulation are by their very nature legally superior to their recitals. In fact, the current wording of Article 9, which does not distinguish between port terminals and port authorities, leads to obligations of overinvestment.

Indeed, if a port has several terminals receiving container ships which together handle more than 100 calls per year, but one of which may have less than 100 calls per year on average, then this "small" terminal, which may be very far from the others, should have an electrical connection facility that would ultimately be very little used and on which there would be no return on investment, either financial or ecological, taking into account the life cycle of the equipment! This terminal will also monopolise connection power on the public distribution network that will no longer be available to other users. The selling price of electricity will also be higher, as fixed costs will be spread over fewer consumers.

The thresholds for the number of port calls in Article 9 of the AFIR Regulation should, in order to best comply with its own recitals, apply to the "port terminal" and not to the "maritime port" as currently worded.

This amendment will clarify objectives, better align with real-world conditions, optimize investments, and provide a more effective environmental response, which is the primary ambition.

The distance between two terminals dedicated to the same category of vessels is a criterion that cannot be ignored, as the design of electrical networks also depends on the distance between the various delivery points to be served.

Currently, there is no definition of "port terminal" in European regulations; therefore, it would be advisable to add this definition to the text of the AFIR Regulation.

France, for its part, has clearly defined port concessions in its Maritime Ports Code; it has also defined port terminals in a decree. These definitions of terminals and concessions can serve as a basis for a proposed European definition of port terminals.

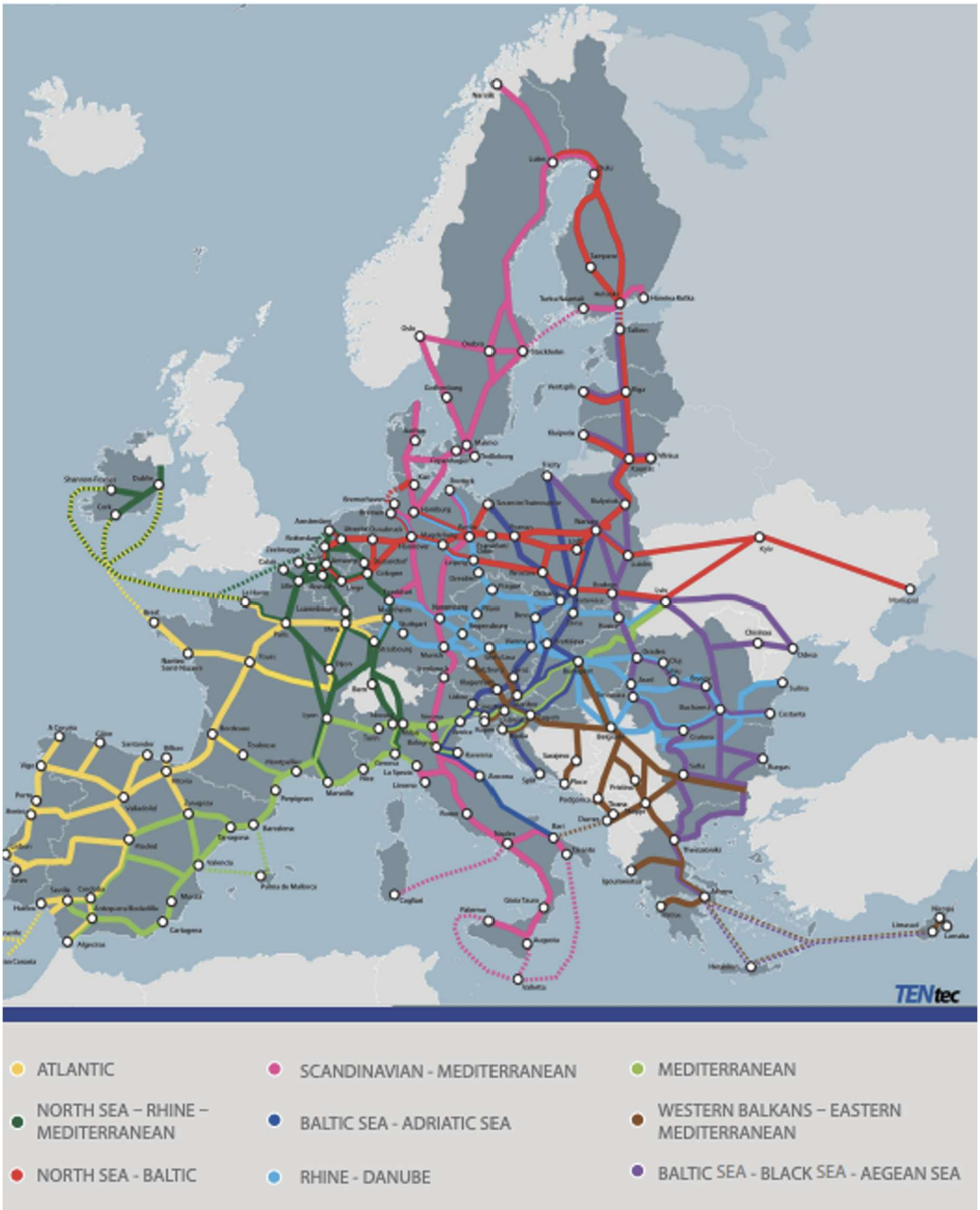
6 – Responsibilities to be clarified

The AFIR Regulation states that it is the **responsibility of Member States** to ensure that sufficient energy resources are available to develop OPS for container ships and passenger ships in TEN-T maritime ports. The regulation does not provide any further details on the division of responsibilities between the various maritime and port stakeholders, leaving room for a wide variety of legal and financial arrangements. Europe therefore gives Member States complete freedom to define the most appropriate organisation for each of them according to their specific characteristics, at national or local level.

This lack of a framework opens the way to a wide variety of legal and financial arrangements, but this latitude requires clarification and a European vision to avoid blockages and inconsistencies.

This situation also causes disparities between European ports, particularly in terms of funding.

A European vision, which could strengthen the position of ports and shipowners on the issue of port operations, is lacking. This absence of a clear direction leaves the door open to all sorts of choices and arrangements that ultimately benefit actors who can benchmark different ports in the EU or the Short Sea Shipping region and weaken them.



RTE-T Réseau central

6.1) THE TERMINAL OPERATOR, THE LEGITIMATE CONTRACTING AUTHORITY FOR SHORE POWER SUPERSTRUCTURE

As seen above, the difficulty lies in the fact that AFIR's objectives are currently defined by 'maritime port', which remains a very vague concept that does not correspond to any functional or operational reality and is therefore a source of tension. **The real functional unit is the 'port terminal', whether public or private.**

In view of the various pieces of legislation, it appears that the AFIR connection obligation should be imposed on 'terminal operators', whether public or private, who may, if necessary, create an ad hoc commercial entity to develop the OPS service and meet European obligations, and not on 'port authorities'.

This is particularly true given that most container port terminals are operated by subsidiaries of shipping companies, which mainly receive their own ships at their terminals, which are the final target of the OPS service.

In practice, **OPS facilities are superstructures** in the same way as the existing electrical networks in terminals that power gantry cranes or reefers, and are not infrastructure. They can be compared to fuel supply barges, as they have the same functionality.

If port authorities were to interfere in the creation of new electrical installations in these terminals under agreement, and in particular in container terminals, when there are already existing electrical networks and electrical substations belonging to the terminal operator and when the terminal also operates equipment at the quayside, then there will be conflicts of use, loss of efficiency and additional costs.

Moreover, it is hardly reasonable, even if it is technically possible, to superpose two electrical networks in the same space, in this case a shortened terminal, both intended for equipment on board at the dock (ships, gantries, barges, ...) for the same economic entity. This situation further prevents the proliferation of power and, of course, leads to overinvestment overall.

Lastly, to be energy efficient and financially sustainable, the sizing of electrical networks must be considered holistically at the terminal level; and a terminal's power requirements must be analysed as a single entity comprising the terminal AND the ships at berth. Indeed, a refrigerated container or reefer can only be on the ship OR in the terminal, and its electricity requirements must not be counted twice in order to avoid oversizing the installations. When a terminal has hundreds of refrigerated containers, the economic stakes are high. If there were two overlapping networks, one specifically for ships, then the electricity network would need to be oversized. As an indication, Ademe (French Ecological Transition Agency) considers ships moored at berth to be 'buildings' rather than means of transport, i.e. a 'fixed source' of pollution.

If, in the absence of decision, port authorities were pressured by various commercial players to create new networks to connect ships in order to meet AFIR obligations, this would be a step backwards, resulting in oversized electrical installations with associated additional costs (CAPEX and OPEX), conflicts of use and responsibilities.

Electricity must be considered as a marine fuel in its own right for commercial vessels, and it is in shipowners' interests to have the best 'electric refuelling' service at the most competitive price. For the supply of other fuels (MDO, LNG, methanol, etc.), delivered by marine suppliers or even by lorry, shipowners deal with private commercial companies. For electricity, the model must remain that of traditional marine refuelling.

It is necessary to have a common position on ports, terminals and ships, especially since many terminals in different ports have the same shareholders, starting with APM, CMA CGM and MSC. It is therefore important that there is a strong and consistent common vision at European level in order to avoid local differences or conflicting interpretations and to ensure that OPS facilities are developed within the AFIR deadline of 31 December 2029.

Only terminal operators truly know their own needs and those of their end customers, i.e. shipowners/shareholders; only they can truly define the electrical requirements related to the technical developments of their own activity, with:

- changes in the number of reefer plugs,
- the power requirements of new maritime or rail gantry cranes,
- the electrical recharging requirements for straddle carriers or other handling equipment,
- electric charging requirements for light vehicles and passing road tractors with batteries,
- requirements for river barges (not covered by AFIR regulations),
- the integration of photovoltaic energy,
- considerations regarding direct current for truck or ship batteries,
- etc.

In this context, **it is necessary for the terminal operator, who is familiar with its needs, to be the project owner of the OPS installations**, especially since, as it will have a good knowledge of the ships it receives, it will be able to size and organise its electrical network according to its own needs and constraints, and in anticipation of its projects.

It is in the interest of shipowners, the end users of the facility, that terminal operators be in charge of OPS installations, in terms of both CAPEX and OPEX.

6.2) THE FRENCH CONTEXT: DIVERSE PORT LEGAL STATUSES AND A LEGAL DEFINITION OF THE PORT TERMINAL

The French ports of the TEN-T have very diverse statuses: state Grands Ports Maritimes, ports owned by Regions, Departments or Metropolises, ports operated directly, or through a local public company, or port company, etc.

The French ports mentioned in the European texts concerning TEN-T and concerned by the obligations of the AFIR of 1 January 2030 are as follows:

TEN-T List of French Sea Ports in the Core and Comprehensive Networks

Core (Réseau Central) 2030		
Ports	**Propriétaire (Exploitant)**	**Corridors**
Bordeaux	GPM	Atlantic
Brest *	Région Bretagne (Sté portuaire BrestPort)	Atlantic
Calais	Région Hauts de France (Sté Expl. Ports du Détroit)	North Sea-Mediterranean
Dunkerque	GPM	North Sea-Mediterranean
Le Havre	GPM	Atlantic
Marseille	GPM	North Sea-Mediterranean
Fos sur Mer	GPM	North Sea-Mediterranean
Nantes Saint Nazaire	GPM	Atlantic
Rouen	GPM	Atlantic
Sète *	Région Occitanie (EPR Ports Sud de France)	North Sea-Mediterranean

10 ports continentaux dans la liste de la Commission Européenne
8 ports au niveau français en regroupant Marseille et Fos dans le GPMM et Le Havre et Rouen dans Haropa
Les ports de Brest et de Sète sont en cours de transfert du réseau Global vers le réseau Central

Comprehensive (Réseau Global)	
Ports	**Propriétaire (Exploitant)**
Bayonne	Région Nouvelle Aquitaine (Société Portuaire)
Boulogne	Région Hauts de France (Sté Expl. Ports du Détroit)
Caen	Syndicat mixte régional Ports de Normandie
Cherbourg	Syndicat mixte régional Ports de Normandie
Dieppe	Syndicat mixte régional Ports de Normandie
La Rochelle	GPM
Lorient	SAS Port de commerce de Lorient Bretagne Sud
Nice	Département des Alpes Maritimes (Société portuaire)
Roscoff	Région Bretagne (Sté portuaire BrestPort)
Saint Malo	Région Bretagne (Sté Publique Locale Bretagne Plaisance)
Toulon	Métropole Toulon Provence Méditerranée (Ports Toulon La Seyne, Métropole, CR, CCI, CD)
Ajaccio	Collectivité de Corse (Établissement Public du Commerce et de l'Industrie de Corse)
Bastia	Collectivité de Corse (Établissement Public du Commerce et de l'Industrie de Corse)
Cayenne	GPM d'Outre Mer
Fort de France	GPM d'Outre Mer
Guadeloupe	GPM d'Outre Mer
Port Réunion	GPM d'Outre Mer

17 ports dont 11 continentaux (avec Roscoff détaché de Brest)
2 ports corses et 4 ultra-marins (article 349 du Traité sur le fonctionnement de l'UE) qui peuvent bénéficier d'exemption au titre du paragraphe 3 de l'article 9 d'AFIR

Unlike European law, France has a definition of a port terminal, derived from Decree No. 2020-1559 of 9 December 2020 on the operation of terminals in major seaports. This 2020 decree specifies that:

"Art. R. 5312-83.-Subject to the cases of operation provided for in Article L. 5312-4, major maritime port terminals shall be operated under terminal agreements or, where the purpose of the contract is to meet the specific needs expressed by the port, under concession agreements concluded under the conditions provided for in this subsection.

"For the purposes of Article L. 5312-14-1, a terminal comprises all or part of the equipment and facilities necessary for all ship-related unloading, loading, handling and storage operations. "

This definition is in line with the 2008 french port reform, which transferred to terminal operators, and in particular to container terminal operators:

- equipment,
- **internal electrical networks within the terminal,**
- and all the resources necessary for operation.

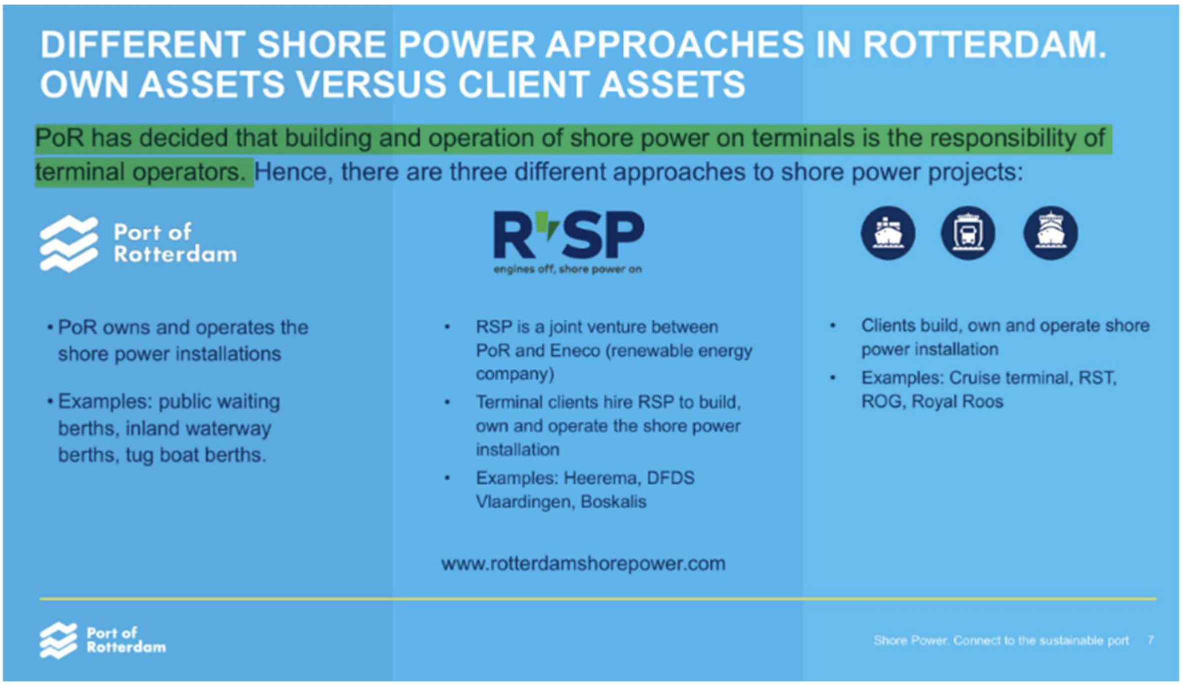
At the European level, it would be appropriate to distinguish the roles of each actor and as a priority:

- that of the 'port authorities' in charge of the 'maritime ports',
- that of the 'terminal operators', holders of terminal agreements or concessions in charge of 'port terminals'.

Some port authorities may cumulate different tasks and operate terminals themselves, which is frequently the case in passenger terminals or in small ports; but the functional distinction remains essential. They then operate public terminals.

6.3) THE CASES OF ROTTERDAM AND ANTWERP-BRUGES

At the European level, several major ports have ruled on the OPS organization and in particular "the Port of Rotterdam has decided that the construction and operation of OPS is the responsibility of terminal operators".



Excerpt from the presentation by the Port of Rotterdam at the OPS Summit on 12/11/2025 and the Transport and Environment Workshop on 26/11/2025

As stated by the Port of Rotterdam: "*Rotterdam's deployment model is distinguished by its balance between regulation, service provision and market autonomy. The port authority does not build or directly operate most OPS assets. It has also formed a 50/50 joint venture with energy supplier Eneco, Rotterdam Shore Power (RSP), which provides OPS "as a service" to contracted terminal operators.*"

Similarly, at the OPS Summit held in Rotterdam on 12 and 13 November 2025, the Port of Antwerp-Bruges stated that "*the port authority operates the cruise terminal (public terminal) and is responsible for the shore-side power system, while private terminal operators are responsible for implementing shore-side power in container, ro-ro and other facilities.*"

7 - AFIR, REQUIREMENT LEVELS NOT WELL SUITED TO THE TRAFFIC CONCERNED AND THE LEVEL OF INVESTMENT TO BE MADE

Article 9 of the AFIR defines European objectives based on a combination of two criteria:

- an average number of port calls over three years, which triggers OPS investment,
- a connection rate, excluding exemptions, to be achieved.

These criteria are differentiated for each category of vessel.

7.1) EQUIPMENT REQUIREMENTS BASED ON AN INSUFFICIENT NUMBER OF CALLS

Article 9 of the AFIR Regulation imposes targets by defining a minimum number of port calls and a minimum rate of connected port calls for three categories of ships, namely:

Merchant Fleet Ship Categories > 5000 UMS	**AFIR Article 9 Requirements per port**		***% OPS usage time per year (365 D x 24 H)***	***Traffic type***	***CAPEX Level***
	Average over the last 3 years	**% minimum of the total number of port calls**			
Container Ships	> 100 calls/year	90%	27%	Mostly regular	+++
Ferries / Ropax Ships	**> 40 calls/year**	90%	**5%**	**Very regular**	++
Cruise Ships	**> 25 calls/year**	90%	**2%**	**Irregular / Recent fleet**	+++++
Miscellaneous: liquid & dry bulk, roro, …	-	-		-	

In the case of **cruises**, a stopover generally lasts between 8 and 10 hours, with overnight stays in port being extremely rare, and the average connection time expected per stopover is a maximum of 8 hours, given the relatively long connection and disconnection times. If a terminal needs to be equipped for 25 stopovers, this means that the investment would have to be made for a minimum connection time of 25 stopovers x 8 hours, or 200 hours in a year of 8,760 hours, or 2% of the annual time, and even then, only if there are no simultaneous stopovers and if all stopovers are in the same terminal. **Which industrial would invest in equipment to use it only 2% of the time?**

The stopover times and operating profiles of these ships show that the thresholds used lead to derisory utilisation rates, incompatible with any rational industrial investment.

Similarly, for **ro-pax vessels and ferries**, the average duration of a stopover during the year is around 12 hours and the expected connection time is perhaps 10 to 11 hours. The investment would then be, according to the same calculation as above, around 5% of the annual time, which is better than for cruise ships but **still unsuitable for industrial equipment**. This rate remains extremely low to justify an investment of several million euros.

For **container ships**, port calls are generally longer and can last around 24 hours, depending on the shipping line. Using the same calculation, the investment would be triggered from 27% of the annual time, which is **more financially sustainable**.

7.2) THE SPECIAL CASE OF CRUISES

The case of cruise ship stopovers is all the more financially unsustainable given that, due to the characteristics of these vessels (with conversion to 60 Hz and power requirements defined by standards at a minimum of 16 MVA), investments for this category of vessels are by far the most expensive; even though these ships have a much lower average age than other categories of ships and generally benefit from the latest technological advances developed by shipyards, given the sensitivity to environmental issues of their cruise ship customers and the inhabitants of the port cities they visit.

Furthermore, OPS over-equipment in these terminals blocks significant electrical capacity and equally significant subsidies for other uses that would be more environmentally efficient.

With a threshold of 25 calls per year, **the equipment for cruise terminals is oversized in relation to the expected environmental benefits of the installation**. The connection facilities will be used very little. Decarbonised kWh will be extremely expensive if we analyse, as we should, the full life cycle cost of the equipment.

At Le Havre, the project to connect cruise ships at Pointe de Floride represents a total budget of €32 million for three equipped quays and, ultimately, three simultaneous connections, for approximately 150 stopovers per year and 400 kpax, with:

- connection to the public electricity distribution network via 3 km of underground high-voltage cables (20,000 volts);
- the construction of a 1,200 m² substation to house the electrical conversion and distribution equipment (18 transformers weighing 3 tonnes each, 59 high-voltage cells, converters, dozens of kilometres of cables, etc.);
- civil engineering and distribution on the three quays;
- the delivery of three cable trucks to connect ships to the quay.

At Marseille, OPS's investment is of a similar order, with around €35 million for the large cruise terminal at the Léon Gourret pier, for 4 equipped quays and 3 simultaneous connections, for around 650 stopovers and 2,600 kpax, with the same:

- connection to the public electricity distribution network and distribution within the port area,

- creation of a 1,000 m² substation on two levels to house the electrical transformation, conversion and distribution equipment,
- civil engineering and distribution on the four quays,
- delivery of three cable carrier trucks, CMS, to simultaneously connect ships to the quay.

These are two equivalent projects involving the ability to connect three large ships simultaneously, with more or less the same financial budgets, except that one is for 150 stopovers and the other for 650 stopovers.

Photos of ships with cables and plugs are often used to illustrate OPS's achievements, but **the most important infrastructure, both technically and financially, are the substations**, which are filled with electrical and electronic equipment. The substations are the heart of the system; they are where the system's intelligence lies.

The cruise terminal substation at the Léon Gourret Terminal in Marseille, handling three simultaneous connections. View from the southwest

The cruise terminal substation at the Léon Gourret Terminal in Marseille, handling three simultaneous connections. View from the north

For all these reasons, it is crucial that the thresholds for the number of stopovers defined by Article 9 of the AFIR be raised to avoid overinvestment and comply with the AFIR's considerations. A proposed threshold combined with the connection rate is provided below.

7.3) CONNECTION RATES THAT ARE TOO HIGH IN RELATION TO OPERATIONAL REALITIES

Article 9 of the AFIR mentions minimum connection rate targets of 90% for the three categories of vessels. To achieve this level of connection, all quays at all terminals must be equipped, even the least frequented ones; this is not in line with the recitals mentioned in points 45 to 49 and repeated in point 5.2) above, which call for the avoidance of unused equipment and under-utilised capacity.

Article 9 takes precedence in legal terms over the recitals, which have no independent regulatory value. These recitals therefore only serve to interpret the text of Article 9. However, **there is an inconsistency between the very ambitious thresholds set and the general objectives** of the European regulation. In order to comply with the spirit of the law, it is necessary to consider each type of traffic and its specific characteristics separately.

7.3.1) Ropax ships and ferries

OPS's facilities at the Grand Port Maritime de Marseille, which have been supplying high voltage power to ro-pax vessels and ferries since 2017, now offers nine years of operational experience. Currently, it is possible to connect eight ro-pax vessels simultaneously in Marseille: four for Corsica traffic and four for North Africa traffic. This experience shows that for this type of traffic – which is the easiest to connect given:

- the absence of conversion,
- the high regularity of rotations (with a public long-term contract),
- a limited and homogeneous fleet,
- Short Sea operations,

a 90% connection rate is very difficult to achieve. A rate of 80 to 85% for this type of traffic would be more realistic.

In fact, apart from the exemptions listed, there may be many events that compromise a ship's connection:

- strong winds with a captain who does not want to take risks,
- a social problem on board or ashore,
- a problem with balancing the electrical network,
- various technical problems on board or at the quayside,
- a captain who does not wish to be connected while being supplied by barge or lorry,
- etc.

In Marseille, the best score achieved with La Méridionale's Corsican ferries over this nine-year period was 90%, but more frequently, for the reasons outlined above, it was 85% or even 80%, even though the solution is relatively basic:

- the connection point is fixed and uses a single cable, making it inherently reliable,

- the connection is made by the ship, without the intervention of port crews,
- there is a single voltage (11,000 V) and a single frequency (50 Hz).

For the year 2025, despite its experience, the port of Marseille posted a connection rate of 86% for 'connectable stopovers' on ro-pax vessels and ferries.

7.3.2) Container ships

For container ships, the fleets involved comprise a larger number of vessels. On the other hand, traffic is regular, although less so than for the ro-ro ships mentioned above. Traffic is marketed on relatively stable routes. The connection is made with two cables instead of just one for ferries, and the connection points are mobile, spread out across the quays.

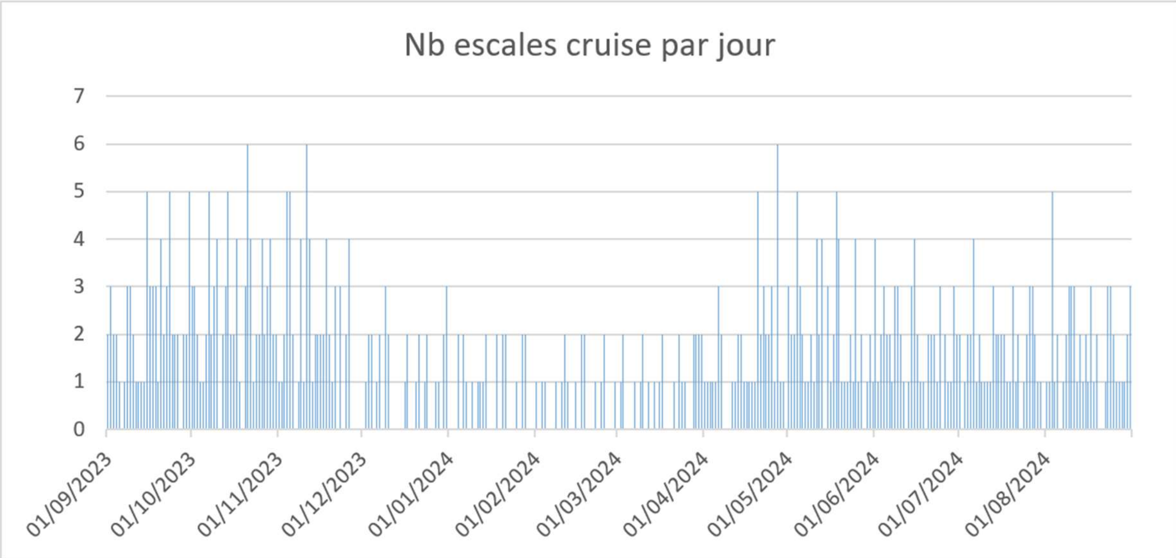
Given the greater complexity compared to ro-ro ferries, **the connection rate cannot be the same as that for ferries.**

7.3.3) Cruise ships

Lastly, for cruises, traffic is highly irregular and seasonal, and the fleet involved is even larger. Routes are highly sensitive to geopolitical, health, social, tariff and tax events, and ships can be repositioned quickly, if necessary, especially as this traffic is very rarely covered by contracts with terminals. In addition, the connection points on the quays are mobile, with nine cables on one side of the CMS connection device (seven for the ship and two for the CMS) and seven on the other side, which makes things even more complex.

Given the highly seasonal nature of the business, the occupancy rate of cruise ship docks is lower than for the other two categories of ships mentioned above, which operate on a more regular basis. There are many days during the winter when no ships are docked, whereas during the high season, all docks are occupied, but only on certain days of the week. If the objective is **to achieve 90% connectivity, this means that almost all cruise ship docks will need to be equipped** in order to reach this threshold and thus enable multiple simultaneous connections. However, given the high degree of irregularity in traffic depending on the season and day of the week, this means that while the OPS equipment for the first quay connection will be used extensively, the second will be used less, the third even less, and so on for each piece of equipment. **This raises the question of massive overinvestment for mediocre ecological results,** given the small number of days on which this additional equipment would actually be used, as well as the blockage of electrical power on the national or local distribution network.

For example, in Marseille, if we carefully analyse the seasonality of a year of cruise ship calls at the main terminal on the Léon Gourret terminal, we see significant disparities depending on the day of the week. For the 12-month period between 1 September 2023 and 31 August 2024, there were 570 calls, distributed over time as follows:



Number of cruise ships per day at Marseille Léon Gourret terminal
between 1/9/23 and 31/8/24 (12 months)

In summary, this corresponds to the following data:

Annual activity of the cruise terminal Synthesis 2023/24 (12 months)			Projected use of OPS facilities (in 8-hour days or stopovers, i.e., 1/3 of 24 hours)		
Number of ships present simultaneously in the terminal	**Nb days in the period (366 days)**	**%**	**Cruise terminal OPS installation**	**Number of days of use (8 hours per call)**	**Projected utilization rate of facilities (if 100% of ships are equipped on the port and starboard sides)**
0	86	24%			
1	109	30%	1st equipment	280	77%
2	100	27%	2nd equipment	171	47%
3	40	11%	3rd equipment	71	19%
4	17	5%	4th equipment	31	8%
5	11	3%	5th equipment	14	4%
6	3	1%	6th equipment	3	1%
Total of days	**366**	**100%**	**Total of calls**	**570**	

Analysis of the utilization rate of OPS equipment if all terminal pier were equipped

Over the entire 12-month period of 2023/24, there were 570 calls at this cruise terminal, which has six quays. Over the period, in order to meet the AFIR objective, it would be necessary to connect 570 port calls x 90%, i.e. a minimum of 513 port calls. To achieve this, the port of Marseille would need to invest in five OPS facilities capable of connecting five ships simultaneously.

Number of calls over the 12-month period:	**570 between 1/9/2023 & 31/8/2024**
Requirement AFIR:	**513 for 90% of calls connected**

Equipment level required to achieve the AFIR objective	**Total number of calls**	**Cumulative projected connection rate**
1 ship connected	109	19%
2 ships connected simultaneously	309	54%
3 ships connected simultaneously	429	75%
4 ships connected simultaneously	497	87%
5 ships connected simultaneously	**552**	**97%**
6 ships connected simultaneously	570	100%

This analysis, based on the seasonality of cruise ship calls and the occupancy of the six berths at the Léon Gourret terminal, shows that if the Grand Port Maritime de Marseille wishes to comply with the AFIR regulations, **it will have to invest, in addition to the investment already made for three simultaneous connections, in a fourth and fifth equipment, which will be used for 31 and 14 calls respectively, i.e. for the latter facility, even less than the lower threshold of 25 calls set out in Article 9**, which, as seen above, corresponds to a marginal use of 2% of the annual time!

The above analysis only concerns the main terminal and does not take into account the context of Article 9 of the AFIR, which theoretically requires that the two cruise terminals in Marseille (several kilometres apart) be equipped as a whole under the heading of 'maritime port'. **Taking into account the overall situation of the 'maritime port' of Marseille would further worsen the results of this analysis.**

In the case of Marseille, to achieve the AFIR target and therefore to have two additional connection points to allow for five simultaneous connections (instead of the current three), the investment can be estimated at 2 x €11 million, or €22 million, to be amortized over approximately 15 years (20 years for the conventional electrical equipment and 10 years for the converters). In this scenario, this equipment could potentially decarbonize 31 + 14 eight-hour port calls per year, or approximately 45 port calls x 8 hours x 7 MVA average power, representing 2,520,000 kWh per year. Over a 15-year period, this equates to a consumption of approximately 37,800,000 kWh. This means that, ultimately, to achieve the AFIR objective and thus equip the cruise terminal with two additional connection points, the decarbonization cost per kWh will be 22,000,000 / 37,800,000, or **€0.58 per kWh just to cover the investment. This calculation does not take into account operating costs (including line losses) or the carbon cost of the two additional connection points! This investment cost is completely out of proportion to the expected benefits.**

Using the same calculation and the same assumptions, for the Marseille cruise project with 3 connection points serving 522 calls per year, the investment cost is **€0.08/kWh**. For the Le Havre cruise terminal, with 3 connection points for 150 calls per year, the investment cost is **€0.25/kWh**.

The question is therefore: **between €0.08 and €0.58 of CAPEX per kWh, what is the sustainable investment amount to decarbonize 1 kWh produced with fossil fuel? Shouldn't the carbon cost of the equipment used for decarbonization also be taken into account? To what extent can shipping companies absorb an increase in their fuel costs? To what extent can funders support these investments?**

The current wording of Article 9 therefore leads to technical and financial overinvestment, especially since cruise ships require facilities to be sized for a minimum of 16 MVA according to the standard, and there is also conversion, which has negative impacts on equipment lifespan, maintenance, online electrical losses and electricity contract subscription levels.

In order to achieve environmental results consistent with the AFIR objectives, it is therefore necessary for cruise traffic to **adjust, or even significantly reduce, the target connection rate** of 90% of ports of call mentioned in Article 9.

For cruise ships, as for the other two categories of vessels, the publication of the AFIR regulation in 2023 has prompted many European ports to start investing, especially as these cruise terminals have often been a political priority for ports and associated local authorities (throughout the world, in fact) due to their proximity to urban centres and the sensitivity of port city residents.

However, it is important not to exacerbate this situation of overinvestment, which is completely at odds with the initial ecological ambition of the AFIR regulation and which severely penalises port operators and, ultimately, maritime operators financially.

For each new CENAQ installation, it is necessary to **establish a direct link between the planned investment (CAPEX) and the total projected consumption in kWh that will be decarbonised by that installation**; and to set a limit on investment per kWh to ensure that there is indeed an environmental benefit.

7.4) A PROPOSAL TO AMEND ARTICLE 9 IN RELATION TO EXPLOITABILITY

In the light of all the elements developed above and the accumulated experience, a proposal for drafting Article 9 in line with port operations, the levels of traffic and the specificities of each of them could be as follows, without integrating at this stage an expansion of the target's perimeter:

Merchant Fleet > 5000 UMS Ship Categories	**AFIR Article 9 Requirements per terminal**	
	Average over the last 3 years	**Minimum of the total number of calls**
Container Ships	> 100 calls/year	**80% of calls**
Ferries / Ropax Ships	**> 100 calls/year**	**80 à 85% of calls**
Cruise Ships	**> 100 calls/year**	**65% of calls**
Miscellaneous: liquid & dry bulk, roro, …	-	-

Taking into account the operational realities of ports, technical constraints and traffic variability, the following connection rates, assessed **per port terminal**, represent acceptable performance levels:

- **For Ro-Ro vessels and ferries**, the target connection rate should be set at a **maximum of 85%,** reflecting the best performance levels observed on regular, homogeneous services able to rely on fixed connection points.

- **For container ships**, the target connection rate cannot exceed that of Ro-Ro vessels, due to the greater diversity of fleets, less regular port calls, the requirement for two cables connected at the quay, and the use of mobile connection points. The expected connection rate should therefore **be less than or equal to 80%.**

- **For cruise vessels**, given the strong seasonality, irregular traffic patterns, fleet diversity, the high number of cables required, and highly variable berth occupancy, the target connection rate must be adjusted to a level compatible with the effective use of the equipment, taking into account periods without calls and occasional peaks in activity. **This rate should not exceed 65%.**

Furthermore, with regard to the minimum number of port calls required to justify installation, it is reasonable — in order to avoid overinvestment — to **set a threshold of 100 calls per year per port terminal, regardless of the type of vessel concerned**.

Infrastructure sizing must be proportionate:

- to the actual frequency of equipment use;
- to the seasonal variability of traffic;
- and to the full cost of decarbonised electricity per kWh, including fixed and variable costs, as well as the lifecycle carbon impact of the equipment.

The environmental objective remains the **optimisation of the ratio between the number of decarbonised kWh delivered to vessels and the port investments required to supply them**, in order to avoid costly and underutilised capacity, whose lifecycle assessment may itself be significantly carbon-intensive. The aim is to ensure that the environmental response is genuinely proportionate to the financial and technical effort required from the various port stakeholders.

7.5) EUROPEAN SANCTIONS IN CASE OF FAILURE TO ACHIEVE THE OBJECTIVES

AFIR does not provide automatic penalties in the event that the targets set out in Article 9 are not met. The Regulation establishes an obligation of result for Member States, but it is the general enforcement mechanisms of EU law — in particular infringement procedures — that apply in cases of failure to deploy the required infrastructure. In such circumstances, the European Commission may initiate infringement proceedings pursuant to the Article 258 TFEU. Ultimately, this may lead to a judgment by the Court of Justice of the European Union (CJEU), potentially accompanied by financial penalties in the form of lump sums or periodic penalty payments.

At the level of FuelEU, Article 23 (5) and (6) provides that: *"The administering State in respect of a company shall ensure that for any of its ships which made at least one non-compliant port call, after a possible validation by its competent authority, the company shall pay by 30 June of the verification period an amount equal to the FuelEU penalty resulting from the multiplication of EUR 1,5 by the established total electrical power demand of the ship at berth and by the total number of hours rounded up to the nearest whole hour, spent at berth by the ship in non-compliance with the requirements set out in Article 6.*
Member States shall have the necessary legal and administrative framework in place at national level to ensure the fulfilment of the obligations concerning the imposition, payment and collection of the FuelEU penalties."

In practical terms, this penalty means that a vessel failing to connect must pay EUR 1.5 per kWh, calculated on the basis of its estimated electricity consumption during the port call — which would amount approximately to:

- **€3,000** at a minimum for smaller vessels requiring 1 MW and remaining at berth for only 2 hours;
- **€22,500** for an average Ro-Pax call (10 hours at 1.5 MW);
- **€45,000** for an average ferry call (10 hours at 3 MW);
- **€84,000** for an average cruise call (8 hours at 7 MW);
- **€108,000** for an average container ship call (24 hours at 3 MW).

These penalty levels are extremely deterrent and may be of a nature to destabilise the financial position of the most fragile shipping companies.

The amount of EUR 1.5 per kWh is consistent with Recital 61 of the FuelEU Regulation.

This penalty does not specify the point at which it is triggered. In California, vessels are generally granted a two-hour window for connection and disconnection, measured between the moment the first mooring line is secured and the release of the last line ("first line, last line").

7.6) A MEASURE OF OPS EFFICIENCY TO BE COMPARED WITH THE COSTS OF PRODUCING THE ELECTRICITY SUPPLIED TO SHIPS

It is difficult to base the assessment of the environmental performance of shore power on volumes of CO_2 "avoided", as this would require detailed knowledge of the performance of the onboard engines generating electricity (generally auxiliary generator sets, whose efficiency may vary depending on their tuning and load), as well as the quality of the fuel consumed at berth (typically MDO or MGO, but also LNG).

Similarly, the number of connected port calls cannot constitute a reliable performance indicator, since the duration of calls must be taken into account and the electrical power demand can vary significantly from one vessel to another.

The most reliable and robust indicator for measuring environmental performance is therefore the quantity of kWh delivered to the vessel over a given period.

By way of illustration, a vessel at berth operating an auxiliary generator set (typically four-stroke engines) at loads that are not always optimal will often have an actual specific fuel consumption of around 200 g of MGO per mechanical kWh (median value). Applying the generator and distribution efficiency factor of approximately 0.9, this results in:

1 tonne of MGO consumed by auxiliary engines at berth ≈ 4.5 MWh of electricity;

1 kg of MGO ≈ 4.5 kWh of electricity.

For reference, the emission factors established by the EU under the MRV system are approximately:

- MGO ≈ 3.206 tCO_2 per tonne;
- HFO ≈ 3.114 tCO_2 per tonne;
- LNG ≈ 2.750 tCO_2 per tonne.

7.6.1) Financial charges on the port side

From the port's perspective, the number of decarbonised kWh effectively sold to vessels must be assessed against the full cost of producing those same decarbonised kWh.

The total cost comprises two categories of expenditure: fixed costs and variable costs, to which must be added the carbon impact over the entire lifecycle of the equipment.

Fixed costs correspond to the unavoidable expenses required to provide the service, regardless of the number of connections, namely:

- depreciation of equipment, taking into account the different service lives of the various components (cables, transformers, converters, etc.);
- industrial maintenance;
- the proportionate share of subscriptions to the national or local electricity distribution network, sized to guarantee the maximum power demand during peak load periods.

Variable costs depend directly on the energy actually delivered to vessels and therefore include:

- electricity purchases, including line losses related to transmission, conversion and cooling of the installations.

Even under an approach centred on decarbonised kWh delivered, it is necessary to integrate the **carbon impact of the equipment lifecycle** — that is, the tonnes of CO_2 associated with the full lifecycle of the installations, particularly those specific to frequency conversion (additional transformers, converters, air-cooling systems, additional cables and switchgear, civil engineering works). This carbon impact must be allocated to the total quantity of kWh actually delivered over the lifetime of the installation, in order to determine a comprehensive carbon cost per decarbonised kWh.

7.6.2) Financial charges on the ship side

At vessel level, when comparing the cost of electricity purchased from the port with that produced onboard, several factors must be taken into account:

- savings in preventive maintenance for the engines generating electricity onboard, which operate for fewer hours when shore power is used;
- the EU ETS costs that are not incurred when vessels are connected to shore power;
- the price differential between currently used MGO and alternative fuels such as LNG, methanol or ammonia.

From the vessel's perspective, comparing the cost of a kWh purchased from the port with that of a kWh generated onboard is complex. The price of shore-based electricity is generally fixed (or contractually determined), whereas the cost of onboard generation is highly variable, as it depends directly on fluctuations in oil prices. Oil prices are extremely volatile and this is timely influenced by geopolitical and public health events.

Over the past 20 years — roughly corresponding to the service life of a vessel and of OPS installations — the price of a barrel of oil has ranged from a low of USD 20 to a high of USD 147, representing a factor greater than seven. It is therefore difficult to determine a stable average price per tonne of MGO or LNG on which to base a long-term economic model.

Variation in the price per barrel of oil (Brent) over the last 20 years – Source: Boursorama

However, in order to overcome this difficulty, an "open book" mechanism was incorporated in Marseille for the first OPS connections with La Méridionale. Under the 2014 contract between the port and the shipping company, this mechanism allowed for an annual comparison between the electricity invoiced by the port and the costs the company would have incurred had it consumed MGO instead.

The system provided for yearly monitoring of gains or losses for the company, with cumulative tracking since the start of the contract. After several years, the cumulative balance showed that the company had consistently remained financially better off.

8 – An international technical framework that does not encourage the OPS installation proliferation or the limitation of their cost

The AFIR Regulation specifies, in paragraph 5 of Annex II, entitled "Technical specifications for electricity supply for maritime transport and inland navigation", that:

5.1. Shore-side electricity supply *to seagoing vessels, including the design, installation and testing of systems,* ***shall comply, at a minimum, with the technical specifications of standard IEC/IEEE 80005-1:2019/AMD1:2022 for high-voltage shore connection systems.***
5.2. *Plugs, socket-outlets and ship couplers for high-voltage shore connection systems shall comply, at a minimum, with the technical specifications of standard IEC 62613-1:2019.*

The **European** Regulation therefore refers to an **international** standard which, while offering the advantage of global applicability, is not directly under the control of the European legislator.

8.1) A SIGNIFICANT NEED FOR HARMONISATION WITH REGARD TO STANDARD 80005-1

The IEC/IEEE 80005-1 standard is entitled: **"Utility connections in port – Part 1: High Voltage Shore Connection (HVSC) Systems – General requirements."**

It describes high-voltage shore connection (HVSC) systems, both onboard and onshore, designed to supply electrical power to a vessel from the shore. It applies to the design, installation and testing of HVSC systems.

The annexes to the standard set out the technical characteristics to be complied with for each type of vessel. These annexes provide the following specifications for the main criteria:

Merchant Fleet Ship categories	Utility connections in port High Voltage Shore Connection (HVSC) Specifications ISO, IEC, EEEI 80005.1 Norm					
	Power	**Voltage**	**Frequency**	**Nb Power cables (onshore)**	**Connector location (IEC 62613)**	**Reference annexes**
Container Ships	< 7,5 MVA	6 600	Not specified	2	Shore	Annex D
Ferries / Ropax Ships	< 6,5 MVA	11 000	Not specified	1	Board (most of the time)	Annex B (Ropax et roro)
Cruise Ships	16 MVA mini to 20 MVA	6 600 & 11 000	Not specified	4 (+ 1 neutre + 2 controle + 2 cms)	Board & Shore	Annex C
Misc.: LNG carrier	< 10,7 MVA	6 600	60 Hz	3	Board (2 positions)	Annex E (LNGC)
Misc.: Tankers	3 x 3,6 MVA, = 10,8 MVA	6 600	Not specified	3	Board	Annex F (Tankers)
Misc.: PCTC / car carrier	< 6,5 MVA	11 000	60 Hz	1	Board	Annex G (Pctc)

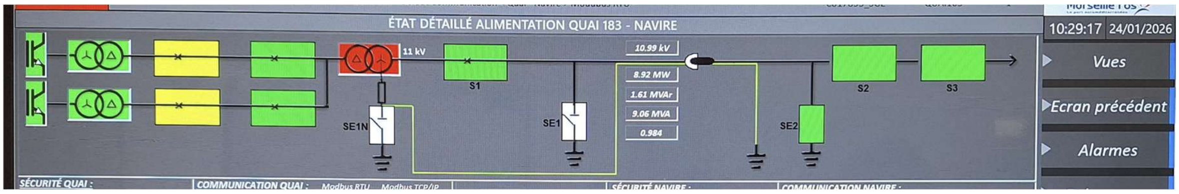
As can be observed, there are **significant differences between the various categories of vessels**. These differences mean that installations cannot be easily standardised or shared from one berth to another or from one terminal to another. As a result, **it is not possible to optimise the procurement of OPS installations, nor their operation and maintenance, including spare parts management.**

Several avenues for simplification can be identified in order to promote standardisation and better control capital expenditure.

8.1.1) Power level, an adaptation necessary with the last generations of ships

Currently, the highest power demands observed are those of cruise ships. With the latest technologies and efforts made by shipyards and shipowners for the latest ship constructions, **maximum power requirements are increasingly reduced**.

For example, the MSC World Europa, one of the largest existing cruise ships calls during the winter stopover around 9 MVA.



Power demand of the MSC World Europa at 9.06 MVA on 24/1/2026 in Marseille

Ranking of the 10 largest cruise ships by gross tonnage					
Rank	**Ship**	**Company**	**Year of construction**	**Maximum passenger capacity**	**Gross tonnage (GT)**
1	Icon of the seas	Royal Caribbean	2024	7 600	250 800
2	Utopia of the seas	Royal Caribbean	2024	6 988	236 860
3	Wonder of the seas	Royal Caribbean	2022	6 988	236 857
4	Symphony of the seas	Royal Caribbean	2018	6 680	228 081
5	Harmony of the seas	Royal Caribbean	2016	6 687	226 963
6	Oasis of the seas	Royal Caribbean	2009	6 771	226 838
7	Allure of the seas	Royal Caribbean	2010	6 780	225 282
8	MSC World Europa	MSC Cruises	2022	6 762	215 863
9	MSC World America	MSC Cruises	2025	6 700	215 863
10	Costa Smeralda	Costa Cruises	2019	6 554	185 010

The thresholds specified in the standard for cruise ships (Appendix C) indicate a minimum of 16 MVA and an optimum of 20 MVA. **To avoid overinvestment, the standard should adjust these thresholds** to show, for example, a minimum of 12 MVA and an optimum of 16 MVA.

Similarly, for container ships, experience shows that the prescribed 7.5 MVA is above the power levels observed. A requirement of 6 MVA would be sufficient.

These **normative power levels should be updated** based on feedback from the various ports that currently connect these categories of ships.

These thresholds are all the more important given that if ships require, for example, 6 MVA of power at the connection points, i.e. downstream of the substation, then the upstream requirement of this OPS substation, i.e. at the delivery point of the national electricity distribution network, is around 20% higher due to losses.

Furthermore, for lower power ratings, it is important to specify that ships in operation during commercial **calls requiring a power rating greater than or equal to 1 MVA must comply with standard 80005-1 for high-voltage connections**. Ships of any kind may not request a low-voltage connection on the grounds that their internal network is itself low-voltage if the peak power is greater than or equal to 1 MVA.

8.1.2) Voltage, a single voltage is sufficient

In terms of voltage, the annexes to the standard specify two voltage levels: 6,600 volts and 11,000 volts. **For the purposes of standardisation and economy, it would be simpler to have a single voltage, i.e. 11,000 volts.**

Being able to connect ships with two different voltages to the same quay requires dual-voltage transformers, which are more complex than single-voltage transformers. They have either a double coil or two outputs. In addition, the presence of these two voltages requires different safety and protection chains, which must be adapted at each port of call. This dual-voltage situation therefore generates additional investment and more complex equipment operation.

Above all, one might wonder why LNG carriers and tankers, which can call for up to 10.8 MVA, are to be supplied with 6,600 volts (Annex E), while ro-pax vessels, which can call for only up to 6.5 MVA, i.e. much less power, are to be supplied with 11,000 volts (Annex B). There is no logic to this.

Furthermore, in terms of cruise ships, the latest new builds are 11,000 volts.

It would be appropriate to have a single voltage of 11,000 volts in all Annexes B to G of the standard:

- **which would reduce the number of cables, as we shall see below,**
- **and which would facilitate the standardisation of cables and plugs.**

8.1.3) Frequency, a criterion that should not be relevant to the standard

The frequency criterion is a **very sensitive issue** because it has very significant technical and financial consequences compared to the first two criteria. Indirectly, it is also a geopolitical criterion because, broadly speaking, it pits North and Central America (more or less the Western Hemisphere) against the rest of the world (broadly speaking, the Eastern Hemisphere).

Of the six annexes to the standard, only two of the most recent annexes specify a mandatory frequency:

- for the three categories of ships currently covered by AFIR - container ships, ro-pax ships and cruise ships - no frequency is specified, as is also the case for tankers,
- LNG carriers, on the other hand, appear with a frequency of 60 Hz, without any explanation to justify this position; this has been the case since the 2019 version of the standard.
- Finally, Amendment 2 of the 2019 version specifies a frequency of 60 Hz for PCTCs, even though these are ro-ro vessels that can be fully assimilated into Annex B, which describes the connections for ro-ro, ro-pax and ferries without mentioning any frequency! **One might wonder why a new annex was created for PCTCs when standardisation and simplification should be the goal.**

It is not within the remit of standardisation bodies to specify a frequency for connections. <u>Only countries, or groups of countries such as Europe, should be able to choose the frequency</u> at which ships will connect in their own ports. They must retain this freedom.

As seen above in point 2.1), Article 6 of the FuelEU Regulation provides for several exemptions, including the one in paragraph f), which specifies that ships are not required to connect:

f) If the shore-side facility is not compatible with the on-board equipment, provided that the on-board equipment is certified in accordance with the technical specifications set out in Annex II to the AFIR Regulation, namely the technical specifications of IEC/IEEE 80005-1:2019 for high-voltage shore-side connections

This implies inconsistencies such as, for example:

- a ro-pax or ferry operating at 60 Hz, whether old or new, compliant with standard 80005-1 from Corsica Ferries, Corsica Linea or GNV, which only sails in the Mediterranean, will not be required to connect to a 50 Hz port network and will not be penalised on the grounds that its frequency is 60 Hz, even though it is clear that connections without frequency conversion are much more environmentally efficient and much less expensive!

- Similarly, a 60 Hz container ship belonging to Africa Express Line, which complies with standard 80005-1 and sails only in the Mediterranean and along the coast of West Africa at 50 Hz, will require conversion equipment in the French port of Port-Vendres, which will consequently be overfunded by the various local authorities.

This exemption Art 6, 5.f) must be removed.

It is essential that the international standard remove all references to electrical frequency in its annexes so that Europe regains the flexibility to standardise on this point in order to increase efficiency and savings, thereby gaining sovereignty.

If Europe is unable to achieve this change to the standard quickly, it will have to derogate from this criterion directly in its regulations AFIR and FuelEU.

8.1.4) Cables and plugs, standardisation as a goal

With the threefold objective of:

- sharing and multiplying facilities,
- ensuring consistency in costs,
- and standardising connections (types of cables and plugs),

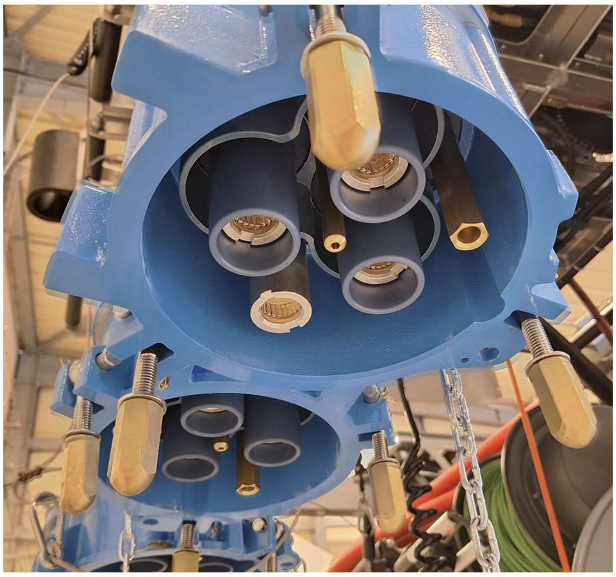
it is important to **limit the number of cables** and **standardise cables and plugs** as much as possible.

Regarding the number of cables, if the power levels for each category of ship are adjusted to what is actually required and if there is a single voltage of 11,000 volts, then **tankers and LNG carriers would only need two cables, instead of three**, for a power of 10.8 MVA. Similarly, container ships could potentially have a single cable depending on the power actually required.

Currently, the cables that carry power are not standardised for the different categories of ships and are specially manufactured in minimum quantities; the same applies to plugs. Their costs are therefore particularly high. If all cables and plugs were standardised (which is possible), costs would automatically decrease and spare parts management would be facilitated, resulting in shorter corrective maintenance times.

Furthermore, it is essential that work be done to **limit and standardise power cables and plugs, as was done when USB-C plugs were imposed in Europe** for all smartphones, tablets, cameras, etc.

Ropax Cable



Cruise Plug

8.1.5) Connection locations, a subject not covered

Currently, the standard does not provide specifications regarding the location of sockets or cable reels on ships, with the exception of LNG carriers (Appendix E), for which it specifies two connection positions depending on the ship's tonnage.

This means that each ship can have a connection point located anywhere on its hull, both in terms of length and height. However, this information is very important for land-based installations.

If a 400-metre container ship has its connection point at the front or rear, or a 365-metre cruise ship has its connection room door at the stern or bow, this has a significant impact on the land-based network along the quay and its quay connection points (PITs), in terms of investment costs, of course, but also in terms of operating costs.

Container ships are generally equipped with a movable ‘connection container’, known as an ‘AMP container’. This container is usually located at the stern, but there is no defined rule regarding its positioning. On the latest ships, the connection point is more likely to be located at the forecastle.

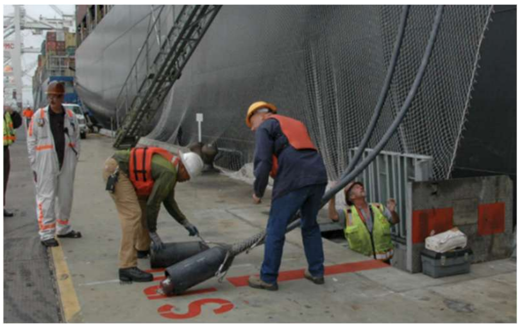
AMP connection container on starboard side with direct connection to the quayside PIT
(without CMS Cable Management System)
If the ship had had to moor on the port side, it would have had to move its AMP container

Similarly, there are no rules for cruise ships, but in addition, there is no established practice, so it is possible to have connection areas along almost the entire length of the ship.

Furthermore, container ships and cruise ships may be moored at the quay differently from one port of call to another if there are operational or weather constraints.

Finally, for ro-pax vessels, the issue of positioning is less critical because these ships always use the same terminals, or even the same quays, and, in addition, they position their rear door on a fixed quay step or inclined plane, which allows them to always have the same mooring configuration; therefore, the side door of the technical room is always positioned in the same place.

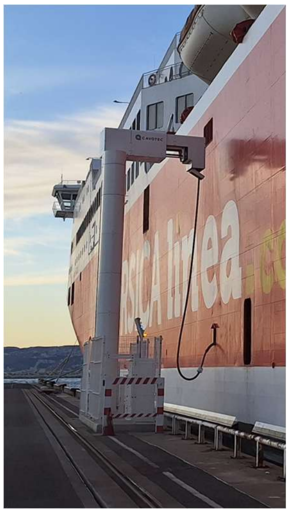
If the ship's connection point is always in the same place, then the port connection device or CMS (Cable Management System) can be fixed. On the other hand, if this connection point is never in the same place, then the connection device or CMS must be mobile on the quay. Mobile CMSs are like huge extension cords that connect the various connection points (PITs) positioned at regular intervals along the quay to the ship's connection room. They require additional operating teams to position them in the right place.




Sockets connected directly to the PIT   Mobile CMS for container ship in Barcelona

Container ship with two cables connected on the quay



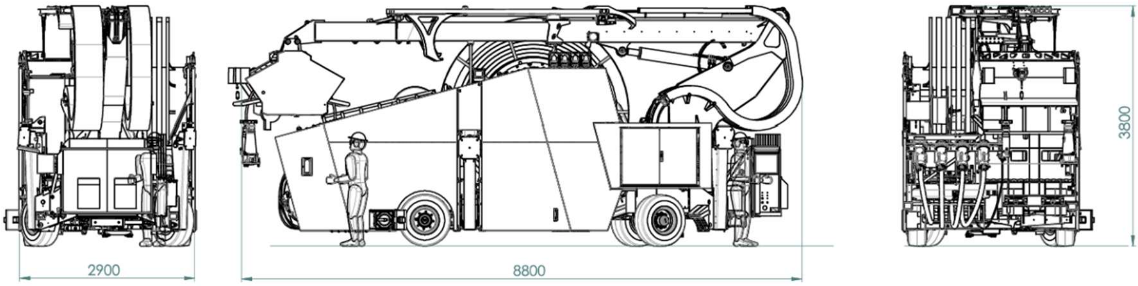


Ferries and ro-pax vessels – Various **fixed CMS** systems with 1 power cable – Marseille


Ferries and ro-pax vessels – Example of a **mobile CMS** with 1 power cable – Gdynia, Poland

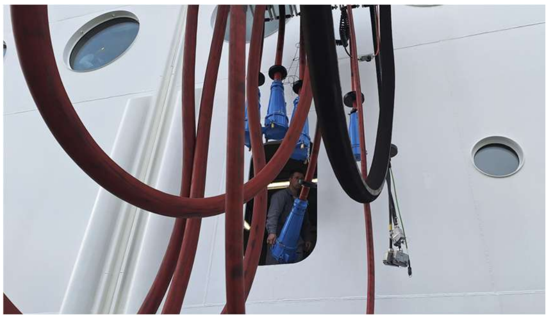
Mobile CMSs are much more expensive to purchase and operate.

Cruises – Examples of **mobile CMS** with 7 cables, including 4 power cables – Southampton and Norway



Cruises – Mobile CMS for cruise ships weigh 20 tonnes

Cruises – Examples of **PITs** on the quays in Kiel and Marseille



Cruises – Between the PIT and the ship's door, a few cables

As long as the positioning of connection points is not ‘standardised’ for each category of ship, there will need to be high-capacity mobile CMSs in port terminals, which are expensive to purchase and operate as they require large teams of shore-based operators, especially for cruise ships with large CMSs and numerous cables. These teams will need to be present when the ship arrives and departs, which means, particularly for container ships, that operators will need to be present almost continuously (three 8-hour shifts).

The aim is therefore to encourage, for each category of ship, connections to a fixed point on the hull with limited height. These connections should preferably be made by a ship's electrician, rather than by additional teams on shore, which would further increase operating costs.

It is important to quickly define a standardised connection point position for each category of ship in order to limit:

- the number of shore power connections (PIT),
- the size of the CMS,
- the operating teams,
- and ultimately the costs.

As **it is essential that future or current ship constructions incorporate these geometric criteria**, a proposal for recommendations to be included in the standard could be, for example:

- For container ships, the connection will always be made at the rear on the last row of containers.
- For ferries and RoRo ships, the connection will always be made 90 metres from the corner of the quay where the rear door is located, at a height above sea level of between 3 metres minimum and 9 metres maximum (like in all the French mediterranean ports),
- For cruise ships, the connection will always be made at the front of the ship, for example 100 m from the bow and at a height between 3 and 9 m above sea level.
- For other ships, the connection must be made to one of the two existing annexes, preferably Annex B (ro-ro/ro-pax) or Annex D (container ships).

In addition, **all ships must be equipped for connection on both the port and starboard sides**. As it is technically impossible to connect a vessel from land to the side opposite the quay, vessels must have connection points on both sides.

Container ships must position their container containing the connection device, known as AMP (Alternative Maritime Power), in the correct location depending on the port of call.

Cruise ships and ro-pax vessels must have sockets, power outlets on both port and starboard sides. However, there may be an exception for PCTCs, as these ships are always moored starboard side to the quay because the car loading doors are only on that side.

While the latest cruise ships are equipped on both sides, most of those built three or four years ago are equipped on only one side, either port or starboard.

If a ship equipped only on one side is moored, for various reasons, on the opposite side to its connections, then it must be considered 'unequipped' within the meaning of the regulations. The same applies to container ships if the AMP container is on the wrong side; in the same way, the ship will be considered as equipped on one side only.

Finally, recitals 71 et seq. of the AFIR Regulation deal with the standardisation of facilities. In particular, they specify:

> *(71) … It is important that those standards be based on current international standards or ongoing international standardisation work, where applicable. To that end,* ***it is important that European standardisation processes for recharging and refuelling infrastructure proceed quickly****, supporting prompt adherence to the timeline necessary for planning, tendering and building the infrastructure required under this Regulation.* ***It is also important to initiate or accelerate the standardisation processes*** *for a Union-wide harmonised recharging infrastructure for stationary and dynamic recharging*
>
> *(72) Maritime transport and inland navigation need new standards to facilitate and consolidate the entry into the market of alternative fuels, in relation to electricity supply and hydrogen, methanol and ammonia bunkering, as well as standards for communication exchange between vessels and infrastructure.*
>
> *(73) The International Maritime Organization ('IMO') develops uniform and internationally recognised safety and environmental standards for maritime transport. Conflicts with international standards should be avoided in view of the global nature of maritime transport. Therefore,* ***the Union should ensure that technical specifications for maritime transport adopted pursuant to this Regulation are consistent with international rules adopted by the IMO****.*

8.2) The IEC/IEEE 80005-1 standard and the OPS institutional context

The **IEC/IEEE 80005-1:2019 standard** was first published in 2012. The currently available version was published in 2019. This version was subject to a first amendment published in 2022 concerning phase rotation in Annex C (**AMD1:2022**). A second amendment for the creation of a new Annex G concerning PCTCs or car carriers was published in 2023 (**AMD2:2023**). These two amendments will be incorporated into the next official publication of the standard, the first version of which, dated November 2025, has already been released.

This standard is being developed by three international standardisation bodies, **independent of the European institutions**:

- **IEC** TC 18 (Electrical installations of ships and mobile units)
- **IEEE** (Power and Energy Society)
- **ISO** TC 8 (Ships and marine technology)

IEC International Electrotechnical Commission — IEEE Advancing Technology for Humanity — ISO International Organization for Standardization

The composition of the Joint Working Group IEC/IEEE for this 80005-1 standard is not public. Freely accessible documents do not disclose any list of WG members by name. IEC and IEEE working groups do not generally publish detailed lists of their members for reasons of confidentiality and internal governance.

France can submit comments, feedback and requests only through AFNOR, collected within a group that mirrors the WG, composed of public authorities, ports, manufacturers, shipowners, etc.

This is the only place where France can directly influence the standard itself, before the EMSA and the European Commission use it in the AFIR. The relevant AFNOR group is UF 18: 'Electrical installations and cables for ships and mobile and fixed offshore units'.

EMSA is the European Maritime Safety Agency, which was created in 2002 by the European Union.

Its mission is to serve the EU's maritime interests "for a safe, secure, green and competitive maritime sector, and to act as a point of reference in the maritime sector in Europe and worldwide. EMSA works on maritime safety, security, climate, environment and single market issues, primarily as a service provider for Member States and the Commission, but also as a knowledge centre for the European maritime cluster and potentially beyond as an international reference point.

EMSA supports the European Commission and EU Member States in the maritime dimension of the European Green Deal. In particular, **EMSA supports the implementation of the "Fit for 55" package, which includes the Zero Emission Action Plan, the FuelEU Maritime Regulation,** the Alternative Fuels Infrastructure Regulation and the extension of the Emissions Trading System (ETS) to maritime transport. "

EMSA's role is to make recommendations to the European Commission and advise DG MOVE on:

- the technical requirements to be included in regulations,
- harmonisation needs,
- gaps in existing standards.

EMSA does not write laws or standards but provides technical interpretations of them. **EMSA does not participate in IEC, ISO or IEEE committees** and does not sit on national standardisation committees (including AFNOR). It has no voting rights in standardisation processes. The standard remains an international technical product, shaped by industry, governments through their national committees, and standardisation bodies.

EMSA has produced guidelines[7] to detail and supplement the standard, making it a 'mandatory reference' in the EU. This is how standard 80005-1 became the mandatory reference for OPS in AFIR, and ports must comply with it to be considered 'AFIR-compliant'.

The standard does not deal with port governance. However, the EMSA, via AFIR, can potentially integrate the concept of 'port terminal = operational unit' as it relies heavily on national feedback from Member States; and can influence the need for clarification, revision of objectives, or even broadening of the scope and, finally, harmonisation of technical standards between different types of ships.

Finally, there is another player in the OPS ecosystem, namely the International Association for Waterway Transport, known as PAINC in English and AIPCN in French.

This international organisation, founded in 1885, aims to contribute to the promotion of operating conditions for both inland and maritime navigation. It is a non-political, non-profit association.

Its main areas of focus are port infrastructure (design, construction, development) and sustainable development. Its missions include:

- organising exchanges and producing feedback and technical recommendations from around the world,
- bringing together public and private experts on maritime and river transport issues,
- leading international commissions and organising thematic working groups,
- organising an international congress and conference on port and coastal engineering (PIANC COPEDEX) every four years.

PIANC has set up a Working Group, WG248, which deals with OPS. Third countries, such as Australia, which do not have the equivalent of EMSA, are actively working with PIANC to develop its shore power projects.

The French branch of PIANC has around 85 members and one government representative, mainly institutions, project owners, design offices, transport companies and experts in the maritime and port sectors.

Cerema, which is the public authority responsible for development and which supports the State and local authorities in adapting territories to climate challenges, is heavily involved in PIANC France, which is based at its premises.

Cerema reports to the Ministry for Ecological Transition, Biodiversity and International Negotiations on Climate and Nature. Cerema provides the secretariat for PIANC France and represents France in international committees.

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[7] Normes de sécurité navale - Électricité à terre (SSE) - EMSA - Agence européenne de la sécurité maritime
https://emsa.europa.eu/electrification/sse.html

OPS Institutional Context	Nature	Role	Restrictive	Objectives Added Value
AFIR	**European** Regulation	OPS Equipment Obligations, Timetable, Scope	Yes	Member State Obligations
EMSA	**European Union** Technical Agency	Analyses, studies, support to the Commission, monitoring. FuelEU/AFIR	No (but strong influence)	Strategic vision and AFIR adaptation for TEN-T ports
IEC/IEEE 80005-1	**International** Standardization	Detailed technical standard HVSC	Yes	Compatibility, safety, technical requirements
AFNOR	**National** Standardization	Technical standard	No (but possible influence)	Raise France's position at the IEC/IEEE level
PIANC WG248	**International** Operational Guide	Port integration, organization, safety, lessons learned	No	Practical approach for project owners and managers
PIANC France (IAPCN) / CEREMA	**National** Agency	Port Infrastructure	No (but possible influence)	Raise France's position at the PIANC WG248 level

Furthermore, IAHP and ESPO can relay Europe's position to the standardisation groups.

In conclusion, it would be highly desirable for EMSA to be a member of the Joint Working Group IEC/IEEE working on changes. Europe needs a strong institutional representative in this working group. EMSA is currently mainly supporting the application of the standard.

9 – A DELICATE TRANSITION BETWEEN THE CURRENT SITUATION AND CHANGES TO AFIR AND FUELEU REGULATIONS – SUPPORTING THE TRANSITION AND PLANNING FOR THE LONG TERM

The two European regulations AFIR and FuelEU of 2023 established the **first OPS framework** for the obligation of 1 January 2030. European TEN-T ports (port authorities and terminals) have mobilised to achieve this objective. During implementation, the first difficulties arose, initially in interpreting the texts, then technical, commercial and financial difficulties, and finally in achieving the objectives. More than two years after the regulations were published, changes appear to be necessary.

This is not a question of calling into question the primary target for the three categories of ships mentioned in Article 9 of the AFIR and Article 6 of FuelEU, but rather of adapting the levels of requirements to be met by the ports and ships concerned, in order to:

- comply with the initial objectives and the spirit of the regulations, namely to decarbonise efficiently without overinvesting or mobilising too much electrical capacity unnecessarily,
- and not be further penalised by competition from non-EU ports located in the Short Sea Shipping zone (UK, Norway, southern Mediterranean).

The downward adjustment of the current target criteria may be accompanied by the extension of this target to Short Sea vessels.

Today, the planned reviews of the two regulations represent a real opportunity to propose improvements and optimizations to the Commission.

9.1) A PRECISE TIMETABLE WITH OPS IMPLEMENTATION STEPS TO BE MANAGED

The two regulations AFIR and FuelEU were published on **September 13, 2023** for an obligation as of **January 1, 2030**.

The **AFIR** regulation provides in its article 24, ***"no later than 31 December 2026, and every five years thereafter****, the Commission shall review this regulation.*" *'In its review, the Commission shall assess in particular the possibility of lowering the gross tonnage threshold set out in Article 9 and of extending the scope of this Regulation to other types of vessels .... In the context of this review, the Commission shall also assess to what extent the implementation of this Regulation has achieved its objectives and to what extent this Regulation has had an impact on the competitiveness of the sectors falling within its scope. This review also covers ... measures that have been taken or could be taken to alleviate the total cost of implementation for relevant sectors. As part of the Commission's analysis of the efficiency of this Regulation, the review shall also include an assessment of the burden placed on undertakings by this Regulation. Where appropriate, the Commission shall consider, depending on the outcome of the evaluation ... to accompany this review with a proposal to amend this Regulation.'*

Article 30 of **the FuelEU** Regulation provides that: ***'by 31 December 2027, and every five years thereafter****, the Commission shall report to the European Parliament and to the Council on the results of an evaluation of the functioning of this Regulation, including possible impacts of market distortions or port avoidance; on the evolution of zero-emission technologies in maritime transport and their market, as well as on the evolution of technologies and the market for renewable and low-carbon fuels and shore-side electricity supply, including at anchor* (!!)*; on the use of revenues generated by FuelEU sanctions, and the impact of this Regulation on the competitiveness of the Union's maritime sector.*
In this report, the Commission shall examine inter alia: ...

> *(c) The types and sizes of vessels to which Article 6(1) applies, and an extension of the obligations referred to in Article 6(1) to ships at anchor* (!!),
> *(d) The exceptions listed in Article 6(5), ...*

The Commission shall consider ... whether a proposal to amend this Regulation should accompany this report. When preparing the report referred to in paragraph 2, the Commission shall examine the extent to which the implementation of this Regulation has achieved its objectives and the extent to which it has had an impact on the competitiveness of the maritime sector. In this report, the Commission also examines ... actions and measures that have been or could be taken to reduce the pressure on total costs weighing on the maritime sector. As part of the Commission's analysis of the effectiveness of this Regulation, the report shall also include an assessment of the burden that this Regulation imposes on undertakings. The Commission shall consider ... whether a proposal to amend this Regulation... should accompany this report;'

These two regulations therefore provide for a self-assessment mechanism opening the way to adjustments, allowing hope that the requests submitted will be taken into account.

The AFIR is considering an expansion to ships with a tonnage of less than 5,000 UMS. This hypothesis is not of much interest because it concerns small vessels (more or less than 100 m long) that do not connect at High Voltage but at Low Voltage, with high rotations without stopping the motors, or long-term parking stops without necessarily maintaining electrical production on board. An expansion to Short Sea Shipping seems more appropriate to obtain greater benefit in the decarbonization of maritime transport.

Moreover, **the complex issue of converter replacement will be inserted into the schedule of periodic negotiations. Indeed, the lifespan of a frequency converter is around 10 to 12 years** and it is a significant investment especially for cruise ships, but also for container ships and ferries. If the conversion could not be avoided, then it will be necessary to regularly rethink the question of the technical solution and therefore the renewal of the converters every 10-12 years.

All these dates are beneficial milestones that allow us to re-examine the efficiency of OPS systems and their regulatory framework, and this will probably last until the arrival of nuclear propulsion in ships.

In any case, it is necessary to be ready as early as possible to participate in the process of optimizing equipment and OPS regulations and to provide the necessary impetus to avoid succumbing to pressure from the various stakeholders.

Only a roadmap for the short, medium and long terms will allow:

- to organize the OPS ecosystem in a shared direction, and to present a clear and strong position to the Commission,
- to assert a clear European position at the international level with standards committees and the IMO,
- to anticipate the renewal of equipment,
- to provide shipowners with a clear position for the construction of their new vessels or the refitting of their existing ones.

9.2) Some avenues for progress

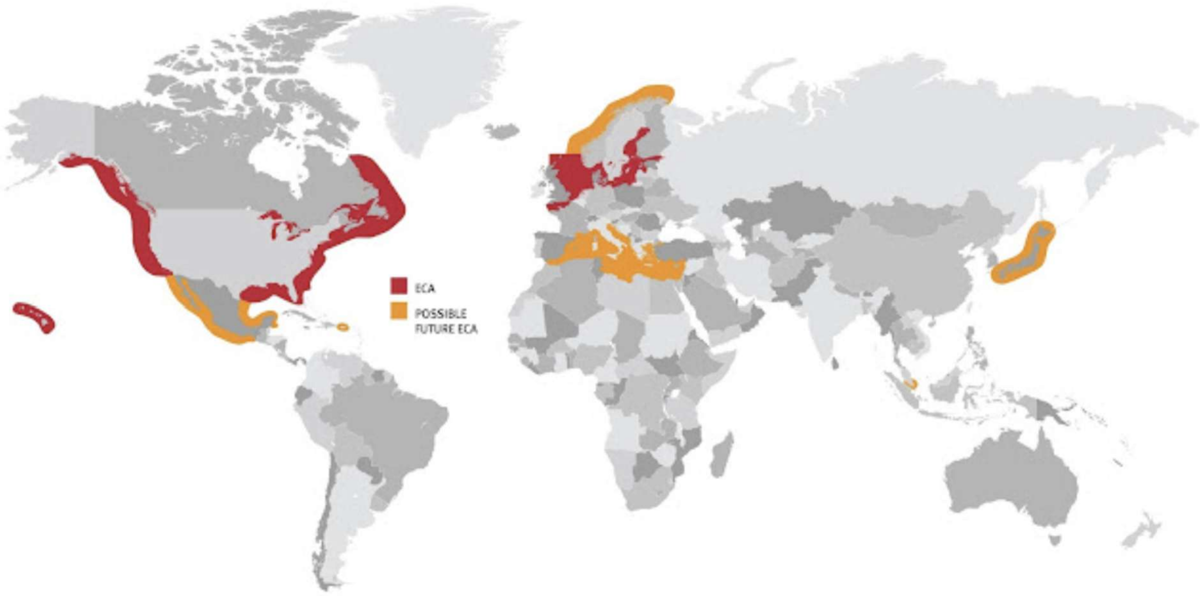
9.2.1) The creation of EECA zones

The IMO's experience in creating ECA[8] zones is an interesting example that should be replicated. Following the same model as existing zones, it is conceivable to create new zones for controlling the electrical connections of merchant ships in ports, or EECA for Electrical Connections Control Area.

[8] ECA : Emission Control Area, Regulated marine zones for the reduction of pollutant emissions

It would then be necessary to **propose to the IMO the creation of a new type of ECA zone, in addition to the existing NECA[9] (NOx) and SECA[10] (SOx) zones, namely EECA[11] (Electricity) zones** for the electrical connection of ships, at a minimum in the four existing ECA zones in Europe, which are:

. Baltic Sea (SECA/NECA),
. North Sea/English Channel (SECA/NECA),
. Mediterranean Sea (SECA since 1/5/2025),
. Norwegian Sea (SECA since 1/3/2027, NECA since 1/3/2026).



ECA zones worldwide

The Mediterranean Sea has been confirmed as of May 1, 2025

The creation of these EECA zones would allow EU ports to be less affected by competition from European ports in third countries, particularly those in Great Britain, as well as from ports in the Southern Mediterranean, especially those in Morocco.

Furthermore, this measure would allow shipowners to better amortize, charge off their OPS facilities, as these facilities would be used more frequently.

[9] NECA : ECA for the reduction of nitrogen oxide (NOx) emissions from ships,
[10] SECA : ECA for the reduction of sulfur oxide (NOx) emissions from ships,
[11] EECA : ECA Regarding the requirement for ships to connect to shore power *(proposal)*

9.2.2) The example of the implementation of NECA zones in MARPOL

The IMO's experience with the implementation of NECA zones is a good example of how ship fleets can adapt to new regulations. Indeed, it was agreed when these zones were established that ships, depending on their construction date, would have to comply with certain levels of constraints. For example, the transition was as follows:

Période de construction	Norme applicable hors NECA	Norme applicable en NECA
Avant 2000	Aucune norme spécifique	Tier I
2000–2010	Tier I	Tier I
2011–2015	Tier II	Tier II
À partir de 2016/2021	Tier II	Tier III

Similarly, it would be possible to request that the European Commission establish a timetable for 50 Hz compliance for ships, including:

- all Ro-Pax vessels, ferries, and Ro-Ro vessels,
- other Short Sea vessels.

Implementing such a timetable would have the advantage of not hindering ongoing projects and providing a future perspective, allowing for the preparation of specifications for new constructions and limiting investment costs. Naturally, this assumes that the technical standards are simplified beforehand.

This implementation would also allow ports to anticipate the replacement of converters.

10 – SUMMARY OF RECOMMENDATIONS

10.1) AT THE EUROPEAN LEVEL

1. Add a definition of "port terminal" to the AFIR regulation *(§5.2)*,
2. In Article 9 of the AFIR, take into account the recommendation in point *§7.4*, namely:
    a. Define the requirements by "port terminal" and not by "seaport *(§5.2)*,
    b. Harmonize the minimum number of port calls for each vessel category and specify a minimum of 100 calls per year per port terminal for all categories.
    c. Reduce target connection rates to a maximum of 85% for roll-on/roll-off (RoRo) vessels and ferries, 80% for container ships, and 65% for cruise ships.
3. Define and incorporate into the AFIR, for each new OPS installation, an investment limit per kWh to be decarbonised, *(§7.4)*,
4. Define AFIR obligations as the primary responsibility of terminal operators, whether public or private, who may, if necessary, create ad-hoc commercial entities to develop the OPS service and meet European obligations. Member States should be only secondarily responsible *(§6.1)*,
5. Consider a vessel equipped on only one side, port or starboard, and unable to connect because it is moored on the opposite side from its power outlets, as 'Not equipped' as defined by regulations, with the exception of PCTCs *(§8.1.5)*,
6. Regarding shore power frequency, mandate that new European OPS port facilities provide only 50 Hz to "domestic" vessels operating in Short Sea Shipping, or even to vessels operating routes within the "Eastern Hemisphere" (Asia-Africa-Europe-Australia) *(§4.5)*,
7. Program in the AFIR the requirement for Short Sea Shipping to only operate on 50 Hz power in ports and require in FuelEU that ships adapt to this standard *(§4.5)*,
8. Remove or restrict the exemption in paragraph (f) of Article 6-5 of FuelEU, which states that vessels are not required to connect "if the shore power installation is not compatible with the onboard equipment, provided that this onboard installation is certified in accordance with the technical specifications set out in Annex II of the AFIR Regulation, namely the technical specifications of IEC/IEEE 80005-1:2019 for high-voltage shore power connections *(§8.1.3)*,
9. Implement the equivalent of the US Jones Act and stipulate that ships operating between two European Union ports be built in the European Union and connect at 50 Hz, fly one of the European Union flags and be owned and operated by European interests *(§4.5)*,
10. Extend the current scope of AFIR to all European Short Sea vessels *(§3.2)*,

11. Integrate electricity, as a marine fuel, into the European MRV (Monitoring, Reporting and Verification) system and differentiate between two types of land-based electricity for CO_2 calculations: electricity without conversion and electricity with conversion *(§4.5)*,

12. Integrate EMSA into the IEC/IEEE Joint Working Group, which is working on updates to standard 80005-1. Alternatively, request that EMSA form a group with a representative from each Member State to finalize a European position on the standard; these members should then be integrated into the standard's Joint Working Group *(§8.2)*.

10.2) At the international level

At the level of the ISO, IEC, and IEEE standards bodies

1. Lower the power thresholds indicated in the text of the standard 80005-1, particularly for cruise ships (Annex C) and container ships (Annex D), based on port experience *(§8.1.1)*,

2. Specify that for power demands greater than or equal to 1 MVA, vessels must comply with standard EN 80005-1 for high-voltage connections and cannot require a low-voltage connection *(§8.1.1)*,

3. Use a single 11,000-volt voltage throughout all annexes in the standard *(§8.1.2)*,

4. Remove all references to electrical frequency from the annexes *(§8.1.3)*,

5. Limit the number of cables in each annex, ideally using only one, and standardize cables and connectors (plugs and sockets) regardless of vessel category *(§8.1.4)*,

6. Promote connections to a fixed point on the quay and limit the height of the connection point on the vessel's hull. Encourage connections by crew members rather than shore-based teams *(§8.1.5)*,

7. Define a standardized position for the vessel's connection point for each category of vessel. ships, as has been done for LNGCs *(see proposed recommendation in §8.1.5)*,

8. Require all ships, regardless of type, to be equipped for connection on both the port and starboard sides, with the exception of PCTCs *(§8.1.5)*.

At the IMO level

9. Demand to the IMO the creation of EECA zones for electrical connection within the four existing ECA zones in Europe (Baltic Sea, North Sea/English Channel, Mediterranean Sea, Norwegian Sea) *(§9.2.1)*.

11 - CONCLUSION

Electricity is a marine fuel like any other.

The OPS electrical connection presents the best ecological solution. It can also prove financially advantageous thanks to a number of cost savings (reduced engine maintenance, fixed electricity prices, price differences compared to new fuels, reliability, lower operating costs, etc.). OPS is a cost-effective solution, provided there is no frequency conversion, no over-investment and no dedicated operating teams; provided that the technical and organisational solutions are effective.

European regulations, with their two 2023 regulations, represent a major step forward in the field of connectivity for merchant ships in operation. The requirement, although currently modest and somewhat late compared to the USA (California in 2007) and China (2021), lays the groundwork and structures the development of European installations across all environmental, industrial, technical, operational, and financial aspects.

However, the levels of requirements defined at this stage in the regulations are difficult to achieve, financially disproportionate to the expected results and block electrical capacities that will be little used.

The reviews of the two European regulations AFIR and Fuel EU are a real opportunity for the preparation of a updated roadmap. The date of September 2026 is crucial for integrating the consultations of the European Commission. This provides an opportunity to negotiate changes to the regulatory or normative provisions.

It is clearly stated in the recitals of the AFIR regulation that the ambition is to minimize the environmental footprint of maritime transport in Europe. To achieve this objective, it is therefore necessary that all the AFIR and FuelEU criteria, as well as those of the 80005-1 standard, be refined in parallel, to allow real ecological gains with the most robust and economical technical solutions in a clarified and efficient organization of fully empowered actors.

With this in mind, it is necessary to **evolve the regulatory and normative frameworks at the national, European, and international levels along three main lines**:

1. **Set realistic objectives** in Article 9 of the AFIR, in line with port organization and the different types of traffic and vessels. This implies setting thresholds and objectives for each port terminal, and defining terminal operators—whether public or private—as the project owner and operator of the OPS facilities.

2. **Extend the connection obligation** to Short Sea Shipping—regardless of the type of vessel involved: RoRo, bulk, etc.— and offer only 50 Hz power in European ports for all Short Sea traffic connections.

3. **Harmonize, simplify**, and refine current standards (voltage, number of cables, connection location, port and starboard gates, gate positions, etc.) to ensure that connections are as standardized as possible, thereby limiting costs and encouraging the proliferation of installations.

If these changes were not made, everyone would lose out, starting with the shipping companies that ultimately buy the fuel. In fact, if investment and operating costs are not controlled, whatever the cause, the consequences will include:

- **Ships** needing to convert 50 Hz to 60 Hz electricity will incur an additional cost of approximately 20%, due to line losses, specialized maintenance, the limited lifespan of converters, and the size of electrical subscription contracts, as well as potential increases in port fees;

- **Terminal operators**, if they are neither project owners nor operators of the OPS, will risk being penalized in their berth operations or having to deal with oversized and unsuitable facilities;

- **Port authorities** could overinvest and end up maintaining more fragile facilities, particularly due to the constraints related to the conversion;

- **Funders** (Europe, Member States, local authorities) would be led to support overinvestments that are not entirely coherent.

All these potentially negative consequences contradict the spirit of the law. It is therefore essential to take full advantage of the AFIR regulation revision scheduled for the end of 2026 in order to coordinate nationally and, on the one hand, submit requests for changes to this regulation to the European Union and, on the other hand, present converging proposals at the international level to standards bodies and the IMO.

The two major, and most politically sensitive, points regarding the changes to be achieved, but which will be crucial for the future, both economically and environmentally, are:

- to confirm that terminal operators must invest in and operate OPS facilities like other terminal infrastructure;
- to assert Europe's sovereignty by imposing a connection frequency of 50 Hz, at a minimum for Short Sea Shipping, and if possible, for all traffic within the Eastern Hemisphere (Asia, Africa, Australia), or even for all new installations.

OPS facilities, which provide a proven environmental — and potentially financial — benefit, can only be fully effective and widely used if they meet strict criteria for economic efficiency and coherent integration into the maritime and port ecosystem.

To achieve these objectives, two priority projects must be launched without delay and carried out in parallel:

- the organization of the group responsible for advocating for changes to the international standard,
- the collaborative development of a roadmap to prepare for subsequent steps.

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