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Electrification of European Ports (EU)

Status for onshore power supply in selected EU ports

European Federation for Transport and Environment A.I.S.B.L.

Report no.: 2024-1792, Rev. 1
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Objective: To better understand the current level of EU port electrification and the plans for the nearest future, in order to see how ports are faring towards the expected electrification demand in 2030.

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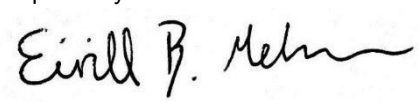	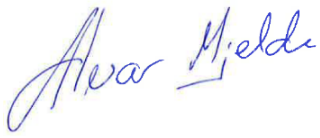	
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Table of contents

1 EXECUTIVE SUMMARY

This report summarises the findings from the study on electrification of European ports (EU) performed by DNV for Transport & Environment. The findings regarding UK ports are summarised in a separate report. The study includes installed and contracted commercial-scale maritime onshore power supply (OPS) facilities in selected major ports and assesses the infrastructural readiness to meet the upcoming EU regulations in 2030.

The findings of this report are intended to inform policy makers and other relevant stakeholders about the progress ports in the European Union (EU) are making towards the 2030 shore power requirements, thereby facilitating informed decision-making for infrastructure investments and regulatory compliance.

31 core ports in the Trans-European Transport Network (TEN-T) are selected based on activity (port visits per year), geographical distribution, and the ports' willingness to provide information. For each port, the following results are presented:

1. An overview of the current ship activity and energy requirements, based on an AIS analysis of the ship traffic in the selected ports in 2023.
2. The current status and plans for OPS in each port, based on data collection through interviews with relevant representatives for the selected ports.
3. A comparison of the installed and contracted OPS connection points, versus the estimated required number of connection points, split on high voltage and low voltage systems.

The first two points above are covered for all ship segments, with a special focus on the three ship segments relevant for the upcoming EU maritime regulations (container, cruise, and passenger ships above 5000 gross tonnage (GT) in point 1. The assessment of OPS coverage in point 3 addresses the three regulated ship segments (container, passenger, and cruise ships). The ports' readiness to meet OPS demand from vessels that must comply with upcoming EU regulations is indicated using a "traffic light rating", where a red light indicates that less than 50% of the required connection points are either contracted or already installed, a yellow light indicates that more than 50% of the required connection points are contracted/installed, but less than 100%, and a 100% or higher coverage is denoted by a green light.

Some EU ports are well on their way to comply with the upcoming EU regulations for maritime onshore power supply. Other ports have to make significant investments in shore power infrastructure for container, cruise, and passenger ships in the coming years to fulfil the requirements.

3 of the 31 selected ports do not fulfill the criteria and are thus not concerned with the maritime mandate. 7 of the 31 selected ports (Genoa, Ghent, Hamburg, Klaipeda, Le Havre, Rotterdam, Valletta, and Venice) have enough connection points installed or contracted for at least one of the three main ship segments, but not all. The remaining 21 ports do not have enough connection points installed or contracted for any of the three main ship segments. This demonstrates the need for further development of shore power infrastructure across Europe.

It should be noted that several ports have plans for installation of OPS connection points where contracts have not been signed, and these are not included in the assessment of OPS coverage. Furthermore, the assessment of OPS coverage only includes maritime OPS for the three regulated ship segments (container, passenger and cruise ships), and some ports have installed or contracted connection points for other ship types and in inland waterways.

2 INTRODUCTION

This report summarises the findings from the study on electrification of European ports (EU) performed by DNV for Transport & Environment. The findings regarding UK ports are summarised in a separate report. The study includes installed and contracted maritime onshore power supply (OPS) facilities in selected major ports and assesses the infrastructural readiness to meet the upcoming regulations in 2030. OPS facilities can also be used for battery charging, provided that the ships have an onboard converter and there is sufficient capacity in the electricity grid. It should be noted that charging of onboard batteries requires higher grid capacity than supplying the power needs of ships at berth.

2.1 Background

In the EU, there are upcoming regulatory requirements for the supply and use of onshore power supply. Due to Brexit, the UK ports are not subject to these upcoming regulations. However, it is likely that the same ships will be sailing between the UK and EU and therefore it is also important to harmonize OPS infrastructure in the geographical area.

The Fuel EU Maritime Regulation (FEUM) introduces a zero-emission mandate while at berth.[1] This means that seagoing passenger ships (i.e., ferries and cruise ships) and container ships above 5000 gross tonnage (GT) must use OPS or alternative zero-emission technologies[2] from 2030 onwards to meet their electrical power needs when berthed for more than two hours in a TEN-T port. From 2035, this requirement applies to all ports where shore power is available. This requirement does not apply to ships that are moored at the quayside for less than two hours or ships that have to make an unscheduled port call. There are also exceptions for ships that are unable to connect to OPS due to the unavailability of OPS connection points in a port or because electrical grid stability is at risk.

The Alternative Fuels Infrastructure Regulation (AFIR) complements this requirement by mandating core and comprehensive maritime TEN-T ports to install enough OPS facilities to provide shore-side electricity for at least 90% of the port calls by seagoing passenger, cruise, and container ships above 5000 GT every year from 2030.[3] This requirement does not apply if the annual number of port calls, averaged over the last three years, is low (under 100 for container ships, under 40 for passenger ships, and under 25 for cruise ships).

AFIR also mandates TEN-T core inland waterway ports to install at least 1 OPS connection by January 2025, and all inland waterway ports to do it by January 2030.

In light of the upcoming regulatory requirements for maritime ports, Transport & Environment has approached DNV to better understand the progress European ports (EU and UK) are making towards the expected maritime shore power requirements in 2030. The findings of this report are intended to facilitate informed decision-making for infrastructure investments and regulatory compliance.

2.2 Scope

31 TEN-T core ports in the EU were selected for this study based on size (port visits per year), geographical distribution, and the ports' willingness to provide information (Table 2-1).

Table 2-1 Ports in scope.

Country	Port(s)
Belgium	Antwerp, Ghent, Zeebrugge
France	Le Havre, Rouen
Germany	Bremerhaven, Hamburg
Greece	Thessaloniki
Ireland	Dublin
Italy	Genoa, Livorno, Taranto, Venice

[1] https://data.consilium.europa.eu/doc/document/PE-26-2023-INIT/en/pdf (Article 6)
[2] Defined as onboard fuel cells with zero-emission fuel, onboard electrical energy storage, or onboard power generation from wind and solar energy.
[3] https://data.consilium.europa.eu/doc/document/PE-25-2023-INIT/en/pdf (Article 9)

Latvia	Ventspils
Lithuania	Klaipeda
Malta	Valletta
Netherlands	Amsterdam, Rotterdam, Terneuzen, Vlissingen
Poland	Gdansk, Świnoujście, Szczecin
Portugal	Lisbon
Romania	Constanta
Slovenia	Koper
Spain	Algeciras, Barcelona, Palma de Mallorca, Valencia
Sweden	Gothenburg

Other major TEN-T core ports that could not be included in the study because DNV did not receive any reply include Calais, Civitavecchia, Dunkerque, Gdynia, Napoli, Piraeus, Riga, and Sines.

Chapter 3 in this report describes the methodology applied in the study. The high-level results, including the gap between supply of and demand for shore power in the selected ports, are presented in chapter 4. Detailed results and discussions for each port can be found in the Appendix, including an overview of current ship activity and energy requirements, and current status and plans for onshore power supply. The questionnaire used in the interviews with ports is also presented in the Appendix.

Results are shown for all ship segments above 400 GT, with a special focus on container, cruise, and passenger ships above 5000 GT. This is because these ships are within scope of the upcoming EU regulations regarding maritime OPS and the interviewed ports were clearly focusing on meeting these new rules. Hence, our assessment of OPS coverage in ports addresses these three ship segments. Small-scale OPS systems (industrial plugs, e.g., for harbour craft) are outside the scope of this study. Because the data provided refers to maritime OPS only, installations for inland waterway vessels are not in the scope of this study.

The ports have been asked to provide information about the available capacity in the local power grid, but a detailed analysis of the grid infrastructure in ports is relevant for the UK ferry case study only. This is a case study performed for two UK ports (each side of a ferry route), to investigate the need for local grid infrastructure upgrades and the associated costs. The results of the ferry case study are presented in the UK report.

3 METHODOLOGY

This chapter describes the methodology applied to evaluate ports' current installed OPS capacity and readiness to meet OPS demand from vessels that must comply with upcoming EU regulations for maritime OPS in 2030. The overall methodology is illustrated in Figure 3-1, listing the main steps, which are further described in the following subchapters.

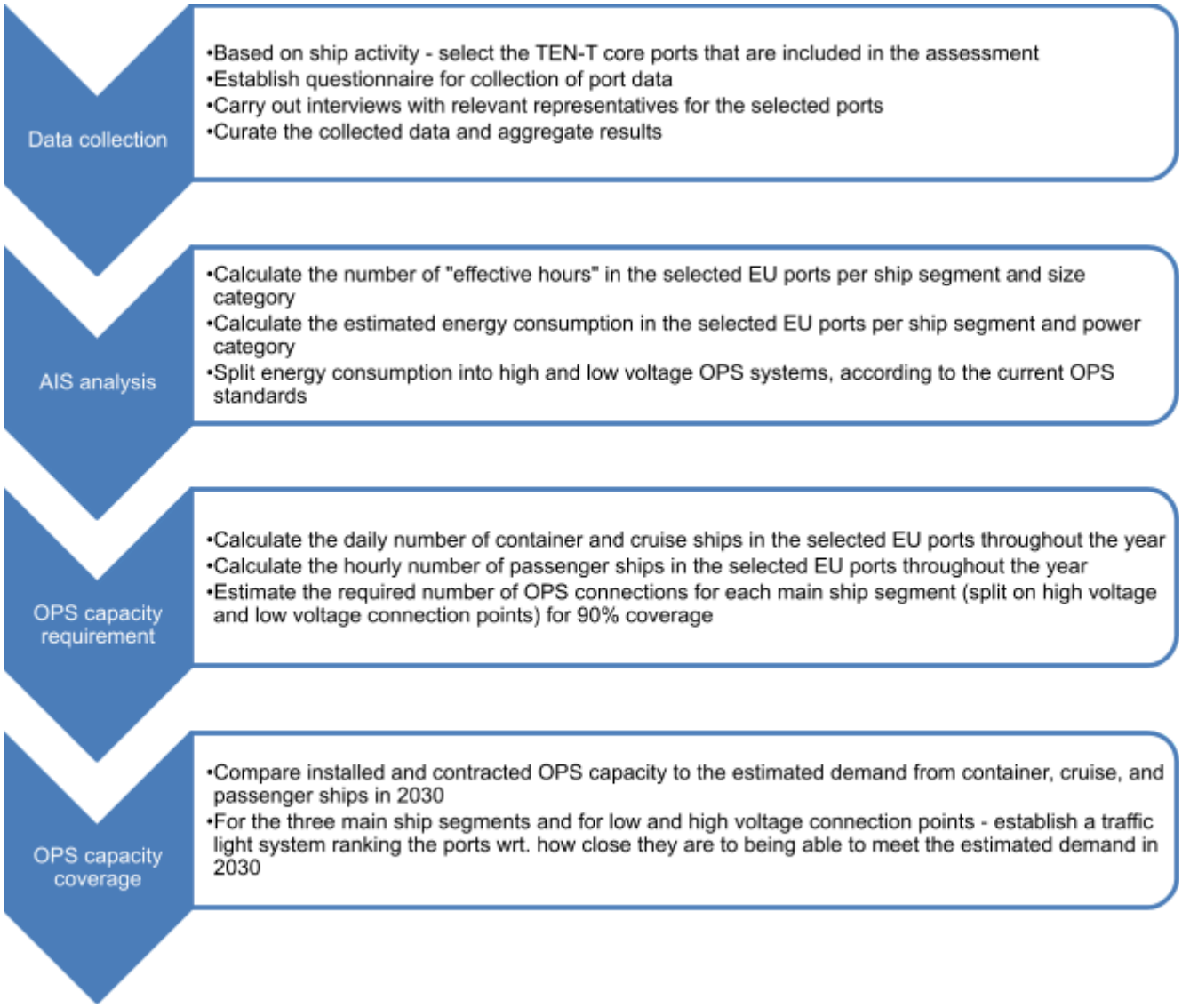


Figure 3-1 Overall methodology applied in the study.

3.1 Ship categories

In this study it has been decided to use a DNV standard ship breakdown structure derived from the IHS Markit breakdown structure.[4] The 15 different categories are listed in Table 3-1 below. There are also 7 ship size categories as shown in Table 3-2.

[4] https://imonumbers.lrfairplay.com/Home/About

Table 3-1 Standard ship type breakdown structure.

Bulk carriers	Ship for carrying dry cargo in bulk
Chemical tankers	Tanker ship with segregated tanks with the ability to carry several types of liquid cargo
Container ships	Ship dedicated for carrying standardized containers stacked in dedicated holds
Crude oil tankers	Crude oil tankers
Cruise ships	Passenger ships dedicated for the cruise industry
Fishing ships	All types of ships dedicated for commercial fisheries
Gas tankers	Tankers dedicated for carrying liquified gas
General cargo ships	Ships with holds for carrying dry cargo of different types
Offshore supply ships	Ships dedicated for supplying goods to offshore installation
Oil product tankers	Tanker ship with segregated tanks with the ability to carry several types of oil cargo at the same time
Other activities	Ships outside the standard categories such as crane ships, tugs, dredgers and non-commercial service ships
Other service offshore ships	Ships serving the offshore industry such as cable laying ships and anchor handlers
Passenger ships	Ferries, Ro-Pax and general passenger ships
Refrigerated cargo ships	Ships dedicated to transporting refrigerated goods
Ro-Ro cargo ships	Ships with open space deck areas with for goods carried on vehicles

Table 3-2 Standard ship size categories.

Ship size categories	400 - 999 GT	1000 - 4999 GT	5000 - 9999 GT	10000 - 24999 GT	25000 - 49999 GT	50000 - 99999 GT	100000 GT <

3.2 Port definition

DNV has modelled several thousands of ports in our AIS data system (Figure 3-2). Hence, an overview of ship activity and energy consumption for the selected ports may be generated and tabulated. The selected ports in this study are defined based on UN/LOCODEs[5]. Each UN/LOCODE corresponds to a port shape with geographical boundaries defined in the DNV analysis system. These port shapes are illustrated in the Appendix. Port visits are counted when ships are within the port shape for a given duration (depending on ship type) and with zero speed.

Modern ports may consist of a conglomerate of quays spread over a large geographical area and there is also a constant change in ownership and management introducing uncertainty with respect to what constitutes the port definition at any given time. In the analysis, the port shapes are verified and checked to our best knowledge. However, changes may have been made to the port constellation that are not reflected in the DNV analysis system, thus causing deviations between port data and our estimates.

[5] https://unece.org/trade/cefact/unlocode-code-list-country-and-territory

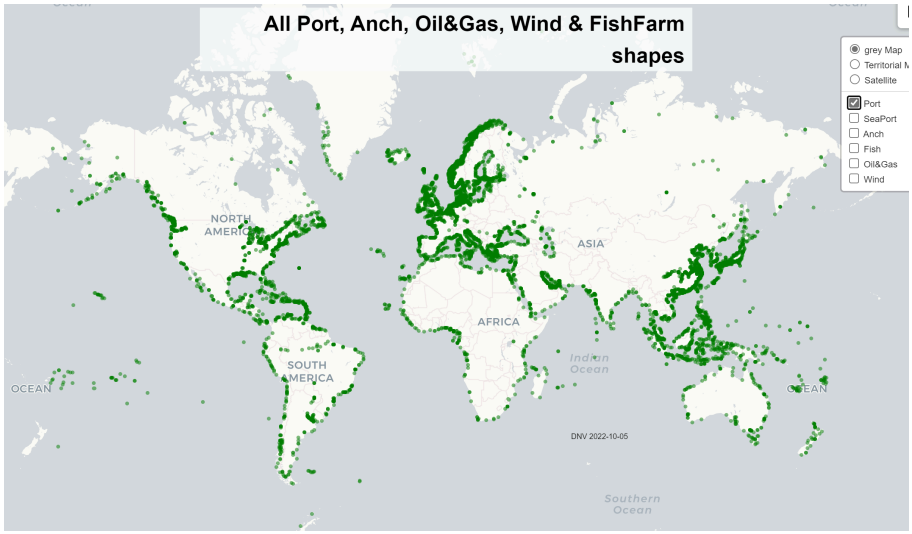


Figure 3-2 Illustration of ports modelled in DNVs AIS data system.

3.3 Current ship activity and estimated requirement for OPS connection points

DNV has utilized the MASTER (Mapping of Ship Tracks, Emissions and Reduction potentials) model which draws on Automatic Identification Systems (AIS) data for ships, to deduce the number of ships visiting each port in 2023. The MASTER model[6,7] utilizes data from the AIS system, which provide a detailed and high-resolution overview of all ship movements, where sailing speeds, operating patterns, sailed distances (nautical miles) and time spent in various areas are identifiable for each ship for those ships having the AIS system installed (carriage requirements for shipborne navigational systems and equipment, IMO). Coupling the ship positions and movements with geographical delimitation of the ports allows for counting the ships entering the ports, and thus also the need for OPS connection points for every day throughout the year. This way seasonal differences will be accounted for – particularly predominant for cruise ships.

It is assumed that a ship may potentially use OPS for their time in port minus one hour. This is based on the experience that some time must be allowed for connection and disconnection to the shore power facilities every time the ship visits the port. Hence, what is referred to as “Effective hours” equals the total hours in port minus one hour per port stay. The exception is for passenger ships, which may use negligible time for connection and disconnection due to port facilities dedicated to the specific ships, often with automatic connection and disconnection mechanisms. For passenger ships, one hour is therefore not deducted to establish the number of effective hours.

The estimated energy consumption is based on regression analysis of installed auxiliary power and a relevant usage factor for each ship. To translate installed power to realistic power consumption when in port (particularly important for ship types where diesel-electric is dominating), regression analysis is performed applying energy consumption data reported on DNVs Emissions Connect[8] platform. Additionally, more than 600 applications (including documented power consumption for several thousand vessels) for funding of OPS installations[9] in Norway since 2016 have been used for further calibration of the energy consumption data and to ensure correlation with the most current fleet.

The estimated requirements for OPS systems are split into high (6.6-11 kV) and low (400-690 V) voltage according to the current OPS standards.The split is merely indicative as the regulation does not mention power specificities. It is assumed that the power needs in the categories <100 kilowatts (kW), 100-500 kW, and 500-1000 kW can be covered by low voltage OPS systems (as described in the standard IEC 80005-3[10]), while power needs in the categories 1-5 MW, 5-10 MW, and > 10 MW are best covered by high voltage OPS systems (as described in the standard IEC 80005-1[11]). Power requirements in

[6] Mjelde (2008). *Environmental Accounting System for Ships Based on AIS Ship Movement Tracking, report no. 2008-1853.*
[7] DNV (2022). *Maritime Forecast to 2050 - Energy Transition outlook.*
[8] https://www.dnv.com/services/emissions-connect-237579/
[9] https://www.enova.no/bedrift/sjotransport/maritimt-tema/landstrom/
[10] https://webstore.iec.ch/en/publication/7578
[11] https://webstore.iec.ch/en/publication/29485

the range 10-15 MW are not uncommon for cruise ships in port, and it should be noted that such power requirements constitute a very demanding load for the local power grid.

Based on the daily number of ships in port throughout the year, the required number of low voltage and high voltage connection points for the three main ship segments can be estimated. Container and cruise ships above 5000 GT are assumed to stay in port for at least one full day, hence the estimated number of required connection points corresponds to the number of ship visits in each category per day. Passenger ships may typically have shorter port stays and several port visits per day, hence there is a chance that we over-estimate the requirements for connection points by aggregating on ships per day. It was therefore decided to use a finer granularity for this ship type estimating the number of required connection points on an hourly basis, but following the same methodology. When testing hourly granularity for container and cruise ships, this revealed little or no changes to the results.

To fulfil the AFIR maritime OPS requirements, the ports must provide onshore power supply for at least 90% of the total number of port calls of seagoing container ships above 5 000 GT, if the annual number of port calls of such ships is above 100. Similarly, the ports must provide OPS for at least 90% of the total number of port calls of seagoing passenger ships above 5 000 GT, if the annual number of port calls of such ships is above 40. Furthermore, the ports must provide OPS for at least 90% of the total number of port calls of seagoing cruise ships above 5 000 GT, if the annual number of port calls of such ships is above 25. We estimate that the ports can provide OPS for 90% of the total number of port calls for the three main ship segments if they install a sufficient number of low and high voltage connection points to cover 90% of the days (for container and cruise ships) or hours (for passenger ships) in a year.

Figure 3-3 illustrates the method for how we translate from the number of port calls to the likely number of connection points required to serve 90% of the port calls. The port visits are extracted from the voyage database for 2023 and the amount of unique IMO numbers in port during each day or hour is counted. The data is sorted and flipped, so that the number of port visits in each main ship segment per day/hour in 2023 is plotted in increasing order. Then the data is normalised to obtain the cumulative distribution of port visits for each main ship segment (blue stepped line). The orange dotted line shows the 90th percentile (the number of connection points needed for covering 90% of the days/hours in a year), in this example resulting in an estimated need for 5 high voltage connection points. The rightmost value on the bottom axis, i.e. 7 in Figure 3-3, is the required amount of connection points that would yield a 100% coverage in 2023. For ports with only one simultaneous port stay for a ship category throughout the year, 90% coverage will always require 1 connection point, no matter the number of effective hours spent in port. In such cases, plots like the one in Figure 3-3 are not shown. It should be noted that this is a conservative estimate if only a few effective hours are spent in port.

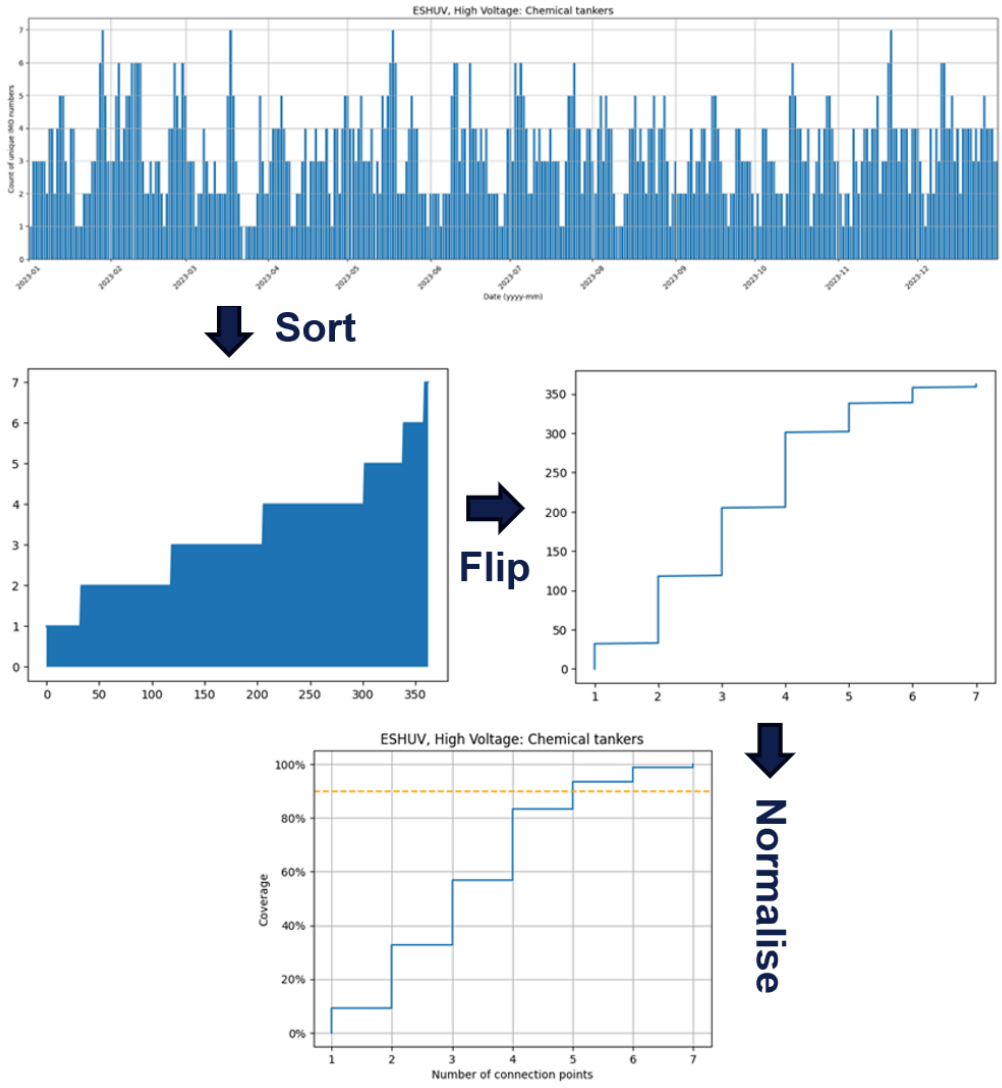


Figure 3-3 Methodology for estimating the number of required connection points for a 90% coverage.

3.4 Current status and plans for onshore power supply

Collecting data on the current OPS status and plans for OPS development in the selected ports has been a major part of the work involved with this project. As part of establishing a strategy for data collection, a questionnaire was developed in consultation with T&E (Table 6-1). This includes questions regarding the technical details of the current and planned OPS systems (power, voltage, frequency, standards, etc.), as well as the power grid in the port.

A list of contacts for all ports to be interviewed was established by DNV, and T&E contributed with their contacts. Based on previous similar undertakings, it was decided not to just send the questionnaire by email, but rather to initiate direct Teams meetings with the relevant personnel in the ports. The ports were approached via email and phone with information about the project and a request for an interview. The interviews were conducted in March and April 2024.

The interviews were conducted via Teams and the questionnaire was used as an interview guide, with a degree of flexibility to accommodate variations in the availability of data and other information. This was particularly true for questions related to the local grid infrastructure and its available capacity relative to the required capacity, where there was in most cases limited knowledge about the status and the implications of an upgrade.

Only firm plans for OPS development with contracts signed (contracted OPS) are included in the quantitative analysis, but information about plans for OPS without contracts signed is also provided in this report for the ports that provided such information.

When using the results of this study, it should be considered that the information provided regarding current status and plans for onshore power supply is based on interviews with the ports. Not all ports were able to provide information regarding all the questions in the questionnaire and some of the information provided by the ports might be incorrect. Furthermore, the information regarding some of the Italian ports was provided by the Italian Ports Association, Assoporti, since we did not succeed in contacting the ports directly.

3.5 Comparison of installed/contracted and estimated requirement for OPS connection points

The estimated number of simultaneous connection points needed for container, cruise, and passenger ships above 5000 GT (Chapter 3.3) is then compared to the number of installed and contracted connection points for these ship types (Chapter 3.4). The ports' readiness to meet OPS demand from vessels that must comply with the upcoming EU requirements for OPS in 2030 is indicated with a "traffic light rating", where:

- a green light indicates that all required connection points or more are either contracted or already installed;
- a yellow light indicates that more than 50% of the required connection points are contracted or installed; and
- a red light indicates that less than 50% of the required connection points are either contracted or already installed.

It should be noted that the upcoming EU regulations apply from 2030, while the estimated requirements for connection points are based on the ship traffic in the ports in 2023. Various studies[12,13] forecast a growth in shipping in the coming years. Our assessment is that UNCTAD's Review of Maritime Transport 2023 is the most relevant for this study, since it is recent and looks at the period 2024-2028. UNCTAD forecasts maritime trade to expand at an average growth rate of 2.1% during this period. The global growth rate cannot easily be translated to growth in individual ports, but such an increase is not likely to significantly increase the requirements for OPS in terms of the number of connection points needed in the port. Some of the expected growth will likely be seen as an increase in ship size, and therefore not affect the number of port calls or effective hours. The increase in ship size applies in particular to container and cruise ships, where economy of scale is particularly important. Furthermore, most of the expected growth globally will likely be seen in areas outside of Europe. Hence, we do not have sufficient basis to estimate an increased number of required connection points in 2030 as compared to 2023.

[12] https://www.imo.org/en/OurWork/Environment/Pages/Fourth-IMO-Greenhouse-Gas-Study-2020.aspx
[13] https://unctad.org/publication/review-maritime-transport-2023

4 RESULTS

Table 4-1 shows the compiled results of the AIS-based ship activity analysis and the results from the interviews with the selected ports regarding the installed and contracted maritime shore power connection points for container, cruise, and passenger ships. More detailed results from both assessments can be found in the Appendix. Only firm plans with contracts signed are included in this summary table, while the Appendix also provides information about plans for OPS without contracts signed.

For each port, the currently installed and contracted connection points for container, cruise, and passenger ships above 5000 GT are added, and split on low voltage and high voltage connection points. This is then compared to the estimated number of simultaneous low voltage and high voltage connection points required for each of the main ship types, according to the observed port traffic throughout 2023.

The ports' readiness to comply with the upcoming EU maritime regulations is indicated using "traffic lights", as defined in section 3.5. If there are no contracted or installed connection points and no estimated need for any connection points, this is indicated by a hyphen (-).

Table 4-1 Summary of collected data and data analysis – including "traffic light rating".

Port Name	Ship type	Connection points (installed+contracted / required)			
		Low Voltage	High Voltage	Total	
Port of Algeciras, Spain	Container	0/9	9[14]/13	9[14]/22	
	Cruise	-	-	-	-
	Passenger	5/6	6/7	11/13	
Port of Amsterdam, Netherlands	Container	-	-	-	-
	Cruise	0/1	1/2	1/3	
	Passenger	-	-	-	-
Port of Antwerp, Belgium	Container	0/10	0/23	0/33	
	Cruise	-	-	-	-
	Passenger	-	-	-	-
Port of Barcelona, Spain	Container	0/7	2/9	2/16	
	Cruise	0/1	0/5	0/6	
	Passenger	0/2	1/8	1/10	
Port of Bremerhaven, Germany	Container	0/8	3/11	3/19	
	Cruise	0/1	1/2	1/3	
	Passenger	-	-	-	-
Port of Constanta, Romania	Container	0/3	0/3	0/6	

[14] Including 5 multi-purpose connection points, assumed usable for all ship types.

Port Name	Ship type	Connection points (installed+contracted / required)			
		Low Voltage	High Voltage	Total	
	Cruise	-	-	-	-
	Passenger	-	-	-	-
Port of Dublin, Ireland	Container	0/8	-	0/8	
	Cruise	0/1	0/1	0/2	
	Passenger	0/1	0/5	0/6	
Port of Gdansk, Poland	Container	0/3	0/4	0/7	
	Cruise	0/1	0/1	0/2	
	Passenger	-	0/3	0/3	
Port of Genoa, Italy	Container	0/4	4/8	4/12	
	Cruise	0/1	3/3	3/4	
	Passenger	0/1	4/8	4/9	
Port of Ghent, Belgium	Container	-	-	-	-
	Cruise	-	-	-	
	Passenger	-	-	-	-
Port of Gothenburg, Sweden	Container	0/4	0/1	0/5	
	Cruise	0/1	0/1	0/2	
	Passenger	-	3/3	3/3	
Port of Hamburg, Germany	Container	0/13	10/15	10/28	
	Cruise	0/1	4/2	4/3	
	Passenger	-	-	-	-
Port of Klaipėda, Lithuania	Container	0/5	0/3	0/8	
	Cruise	0/1	0/1	0/2	
	Passenger	-	4/4	4/4	
Port of Koper, Slovenia	Container	0/3	0/3	0/6	
	Cruise	-	0/1	0/1	
	Passenger	-	0/1	0/1	
Port of Le Havre	Container	0/3	0/11	0/14	

Port Name	Ship type	Connection points (installed+contracted / required)			
		Low Voltage	High Voltage	Total	
	Cruise	-	3/2	3/2	
	Passenger	-	0/1	0/1	
Port of Lisbon, Portugal	Container	0/6	0/2	0/8	
	Cruise	0/2	0/3	0/5	
	Passenger	-	-	-	-
Port of Livorno, Italy	Container	0/2	3/4	3/6	
	Cruise	0/1	3/3	3/4	
	Passenger	-	3/5	3/5	
Port of Palma de Mallorca, Spain	Container	-	-	-	-
	Cruise	0/1	0/3	0/4	
	Passenger	0/1	1/8	1/9	
Port of Rotterdam, Netherlands	Container	1/31	0/20	1/51	
	Cruise	0/1	1/2	1/3	
	Passenger	-	2/2	2/2	
Port of Rouen, France	Container	-	-	-	-
	Cruise	-	-	-	-
	Passenger	-	-	-	-
Port of Świnoujście, Poland	Container	-	-	-	-
	Cruise	-	-	-	-
	Passenger	-	5/8	5/8	
Port of Szczecin, Poland	Container	0/2	-	0/2	
	Cruise	-	-	-	-
	Passenger	-	-	-	-
Port of Taranto, Italy	Container	-	-	-	-
	Cruise	-	0/1	0/1	
	Passenger	-	-	-	-

Port Name	Ship type	Connection points (installed+contracted / required)			
		Low Voltage	High Voltage	Total	
Port of Terneuzen, Netherlands	Container	-	-	-	-
	Cruise	-	-	-	-
	Passenger	-	-	-	-
Port of Thessaloniki, Greece	Container	0/4	0/2	0/6	
	Cruise	0/1	0/2	0/3	
	Passenger	0/1	0/2	0/3	
Port of Valencia, Spain	Container	0/8	2/14	2/22	
	Cruise	0/1	1/2	1/3	
	Passenger	0/1	1/6	1/7	
Port of Valletta, Malta	Container	-	-	-	-
	Cruise	0/2	5/2	5/4	
	Passenger	0/2	0/1	0/3	
Port of Venice, Italy	Container	0/4	0/3	0/7	
	Cruise	0/1	6/2	6/3	
	Passenger	14/1[15]	4/1[16]	18/2[16]	
Port of Ventspils, Latvia	Container	-	-	-	-
	Cruise	-	-	-	-
	Passenger	-	0/2	0/2	
Port of Vlissingen, Netherlands	Container	0/2	0/2	0/4	
	Cruise	-	-	-	-
	Passenger	-	-	-	-
Port of Zeebrugge, Belgium	Container	0/2	0/2	0/4	
	Cruise	0/1	0/2	0/3	
	Passenger	-	-	-	-

[15] According to our AIS analysis, there was limited passenger traffic in the port of Venice in 2023 and therefore an estimated need for just two connection points. Either the port is planning for a significant increase in the passenger traffic, or the port shape used for Venice in our analysis is not accurate. It could also be that the information provided about the planned OPS systems is not accurate, since it was provided by the Italian Ports Association, Assoporti, and not by the port directly.

5 CONCLUSION

Some EU ports are well on their way to comply with the upcoming EU regulations for onshore power supply. Other ports have to make significant investments in shore power infrastructure for container, cruise, and passenger ships in the coming years to fulfill the requirements.

3 of the 31 selected ports (Ghent, Rouen and Terneuzen) are not concerned by the maritime OPS mandate of the AFIR. 7 of the 31 selected ports (Gothenburg, Hamburg, Klaipeda, Le Havre, Rotterdam, Valletta, and Venice) have enough connection points installed or contracted for at least one of the three main ship segments, but not all. The remaining 21 ports do not have enough connection points installed or contracted for any of the three main ship segments. This demonstrates the need for further development of shore power infrastructure across Europe.

The cruise ship segment has the best OPS coverage in the selected ports. The ports with enough connection points installed or contracted for cruise ships above 5000 GT are Hamburg, Le Havre, Rouen, Valletta, and Venice. There are also a few ports with enough connection points installed or contracted for passenger ships above 5000 GT (Gothenburg, Klaipeda, Rotterdam, and Venice). None of the selected ports have enough connection points installed or contracted for container ships above 5000 GT.

For most of the ports and main ship segments with sufficient OPS coverage, the installed or contracted connection points are high-voltage systems. Overall, 82 of 270 required high-voltage connections have been installed (30,4%), compared to only 7 of the 175 required low-voltage ones (4%). The ports should consider the balance between installation of low and high voltage connection points, since ships with low power demands cannot necessarily make use of high voltage connection points.

It should be noted that several ports have plans for further connection points where contracts have not been signed, and these are not included in the assessment of OPS coverage. Furthermore, the assessment of OPS coverage only includes the three regulated ship segments (container, passenger, and cruise ships), and some ports have installed or contracted connection points for other ship segments. Finally, the data has been collected between March and April 2024, hence additional connection points may have been installed or contracted since.

6 Appendix

In this chapter, we present the port shapes and detailed results and discussions for each of the selected ports.

The full picture of current ship activity in ports is illustrated by the number of effective hours in port per ship segment and size category. All ships above 400 GT are included, and the ship segments and size categories relevant for the upcoming regulations are highlighted in green.

The estimated energy consumption in the ports (in MWh) is presented per ship segment and power category. Energy consumption in the higher power categories (> 1 MW) is best covered by high voltage OPS systems, while energy consumption in the lower power categories (< 1 MW) can be covered by low voltage OPS systems. All ships above 400 GT are included, and the ship segments relevant for the upcoming regulations are highlighted in bold.

More details regarding current ship activity and energy requirements are presented for the ship segments relevant for the upcoming 2030 mandate (container ships, cruise ships, and passenger ships above 5000 GT). This includes plots showing the number of container and cruise ships in the ports per day in 2023, and the number of passenger ships in the ports per hour in 2023. The ship traffic is split on the ships requiring high voltage connection points and ships with power needs which can be covered by low voltage connection points. The number of ship visits in each category per day/hour in 2023 is also plotted in increasing order, with a yellow dotted line showing the estimated number of required low voltage and high voltage connection points for 90% coverage. Plots are not shown for categories with no traffic in the ports in 2023.

Furthermore, the information collected through the interviews with the ports regarding installed and planned onshore power supply systems is listed and discussed. Installed OPS systems and firm plans with contracts signed are included in tables, while plans for OPS without contracts signed are described in the text for the ports who provided such information. Each row in the tables represents one berth, except for the cases when different types of OPS systems are found on the same berth (then they are split on several rows). Table 6-1 shows the questionnaire used in the interviews with the ports, with explanations of each data field. For each port, only the data fields where the port could provide information are included.

Table 6-1 Questionnaire used in interviews with ports.

Port general questions	**Maximum power from grid**	How much power can the local electricity grid deliver to the port area (MW)
	Current surplus capacity in grid	How much power is still available in the local electricity grid after delivering shore power to the port (MW)
	Energy delivered through OPS	How much energy was delivered through onshore power supply in 2023 (MWh)
Quay general questions	**Berth name**	Berth/quay where OPS system is installed or planned
	Longitude	Geographic coordinate of berth/quay
	Latitude	Geographic coordinate of berth/quay
System specific questions	**Maximum system power capacity**	How much power can be delivered from the OPS system (kW). It is assumed that the power factor is 1, hence the active power (measured in kW or MW) is equal to the apparent power (measured in kVA or MVA).
	Maximum number of simultaneous ships	How many ships can be connected at the same time
	System voltage	Which voltage level can be delivered from the system (400-690 V / 6.6-11 kV / other)

	System frequency	Which frequency can be delivered from the system (50 Hz / 60 Hz / both). Since the electricity grid frequency in Europe is 50 Hz, a 50/60 Hz transformer is required for delivering 60 Hz.
	Types of ships	Which types of ships are using the system (see definitions in Table 3-1)
	Standard	Standard of OPS system (IEC 80005-1 / IEC 80005-3 / other). IEC 80005-1 is the high voltage OPS standard while IEC 80005-3 is the low voltage OPS standard.
	Availability	Availability of OPS system (private / public). Note that some OPS systems are private and not publicly available.
	Operational from	Year from which the system has been or will be operational
Comments		Any other information provided

6.1 Port of Algeciras, Spain

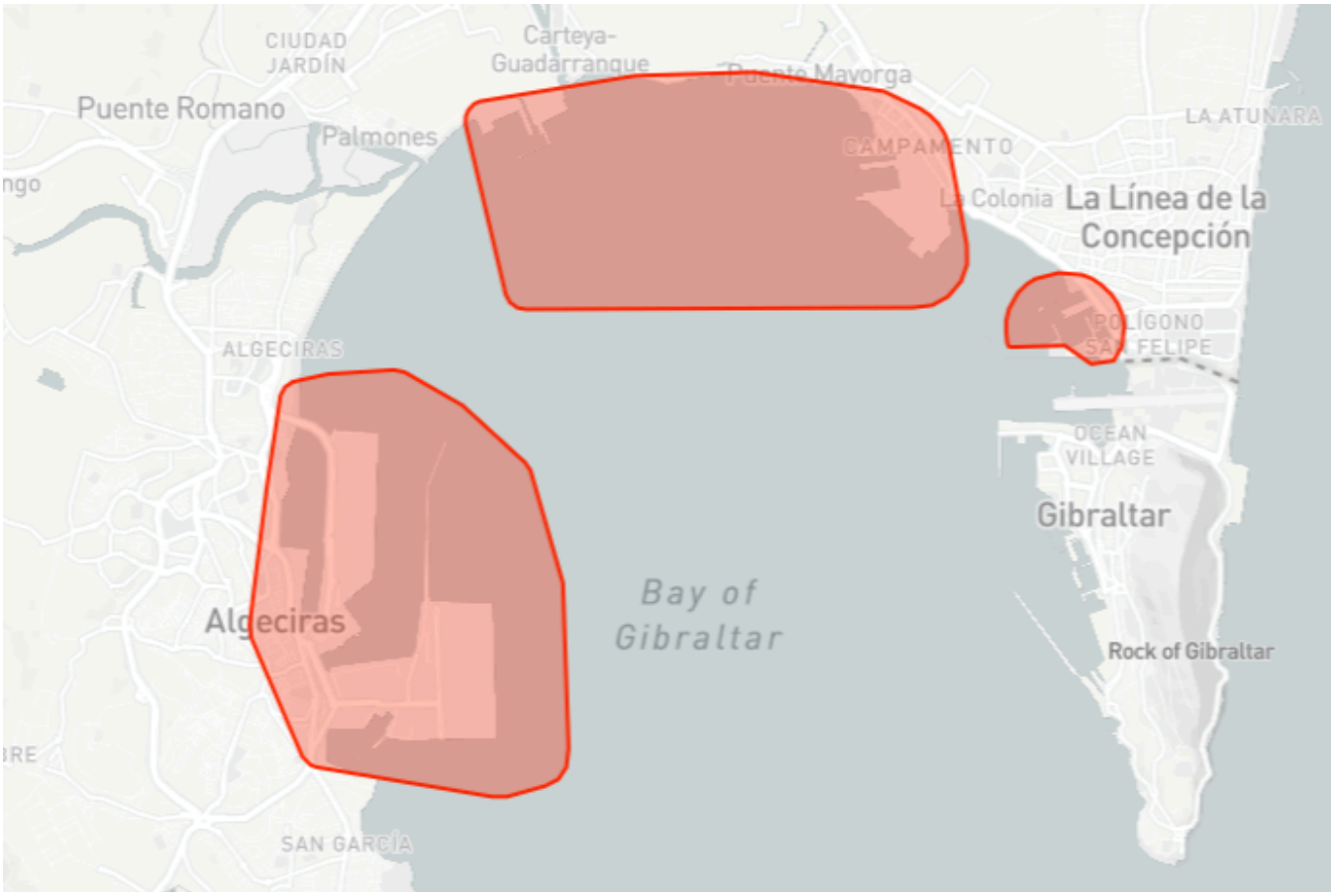


Figure 6-1 Port shape for Algeciras (ESALG).

6.1.1 Current ship activity and energy requirements

Table 6-2 shows the effective hours in port per ship segment and size category for the port of Algeciras in 2023. There are nearly 62 000 effective hours in port for container ships larger than 5000 GT. For cruise ships larger than 5000 GT there are only 25 effective hours in port, and for passenger ships larger than 5000 GT there are around 45 000 effective hours in port. Other segments with a high number of effective hours in the port are oil tankers, chemical tankers and other activities.

Table 6-2 Effective hours in port per ship segment and size category.

Algeciras	400 - 999 GT	1000 - 4999 GT	5000 - 9999 GT	10000 - 24999 GT	25000 - 49999 GT	50000 - 99999 GT	100000 GT <	Total
Bulk carriers		35		2 534	6 592	1 241	9	10 411
Chemical tankers		5 104	10 808	10 780	11 873			38 565
Container ships		581	14 787	8 229	15 444	15 982	7 355	62 378
Crude oil tankers			128		800	7 831	378	9 137
Cruise ships							25	25
Fishing ships	17							17
Gas tankers		7 697	2 262	661	337	689	856	12 502
General cargo ships		8 936	7 423	1 387	178			17 924
Offshore supply ships		145	30					175
Oil product tankers		38 430	12 028	914	5 203	20		56 595
Other activities	22 877	7 690	1 017	940				32 524
Other service offshore ships		660	108	31		147		946
Passenger ships	6	5 901	22 136	19 353	3 642			51 038
Refrigerated cargo ships		45	41	373				459
Ro-Ro cargo ships			3 578	4 014	726	16		8 334
Total	22 900	75 224	74 346	49 216	44 795	25 926	8 623	301 030

Table 6-3 shows the estimated energy consumption per ship segment and power category for the port of Algeciras in 2023. For container and passenger ships, most of the estimated energy consumption is in the power category 1-5 MW. Additionally, for passenger ships, there is a notable portion of energy consumption in the power category 500-1000kW. For cruise ships, the estimated energy consumption is in the highest power category (> 10 MW). Other segments with substantial energy consumption in the port are chemical tankers, gas tankers, and oil product tankers.

Table 6-3 Estimated energy consumption in port (MWh) per ship segment and power category.

Algeciras	<100 kW	100-500 kW	500-1000 kW	1-5 MW	5-10 MW	>10 MW	Total
Bulk carriers	0	3 332	657	0	0	0	3 989
Chemical tankers	0	252	8 603	27 084	0	0	35 938
Container ships	0	7 454	5 834	82 130	0	0	95 418
Crude oil tankers	0	0	843	10 374	0	0	11 217
Cruise ships	0	0	0	0	0	250	250
Fishing vessels	1	0	0	0	0	0	1
Gas tankers	0	2 933	0	6 547	4 565	0	14 045

General cargo ships	885	2 201	111	0	0	0	3 197
Offshore supply ships	0	31	16	0	0	0	47
Oil product tankers	0	9 262	12 045	25	0	0	21 332
Other activities	961	1 999	1 328	0	0	0	4 288
Other service offshore vessels	0	188	161	0	0	0	349
Passenger ships	0	2 107	18 041	46 136	0	0	66 283
Refrigerated cargo ships	0	30	303	0	0	0	333
Ro-Ro cargo ships	0	1 141	3 073	16	0	0	4 231
Total	1 847	30 929	51 015	172 311	4 565	250	260 918

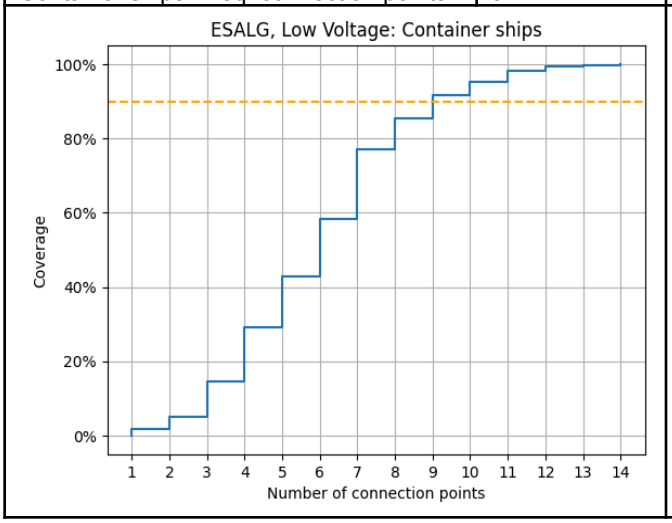
Table 6-4 presents simultaneous port calls for quantification of the need for low and high voltage connection points for container, cruise, and passenger ships above 5000 GT. There were some days in 2023 with more than 10 **container ships** requiring low voltage connection points in the port, but 9 such connection points would be sufficient for 90% coverage. Similarly, there were some days in 2023 with more than 15 container ships requiring high voltage connection points in the port, but 13 such connection points would be sufficient for 90% coverage.

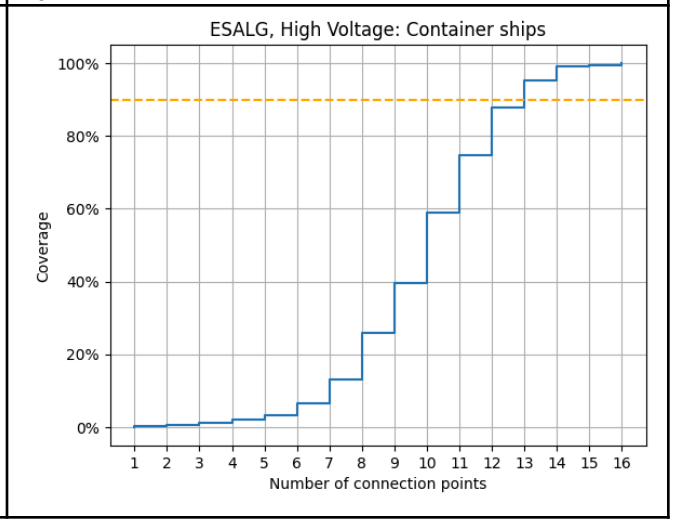
Since there were less than 25 port calls from **cruise ships** in 2023, it is assumed that there is no need for connection points for this segment in the port of Algeciras.

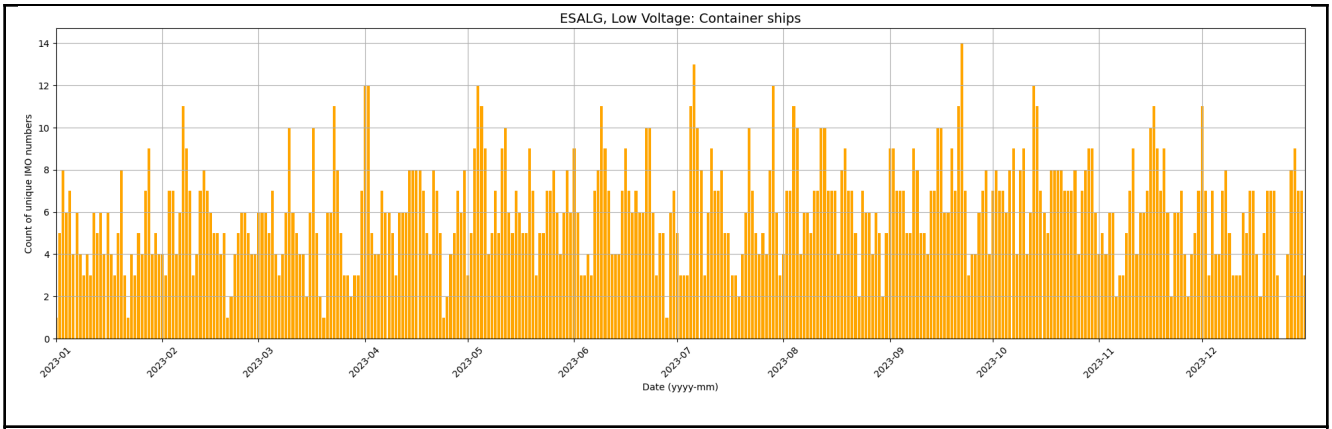
For **passenger ships**, there were a few hours with a need for 8 low voltage connection points and a few hours with a need for 10 high voltage connection points. However, 6 low voltage and 7 high voltage connection points would be sufficient for 90% coverage. In total, there is an estimated need for 22 connection points for container ships and 13 connection points for passenger ships.

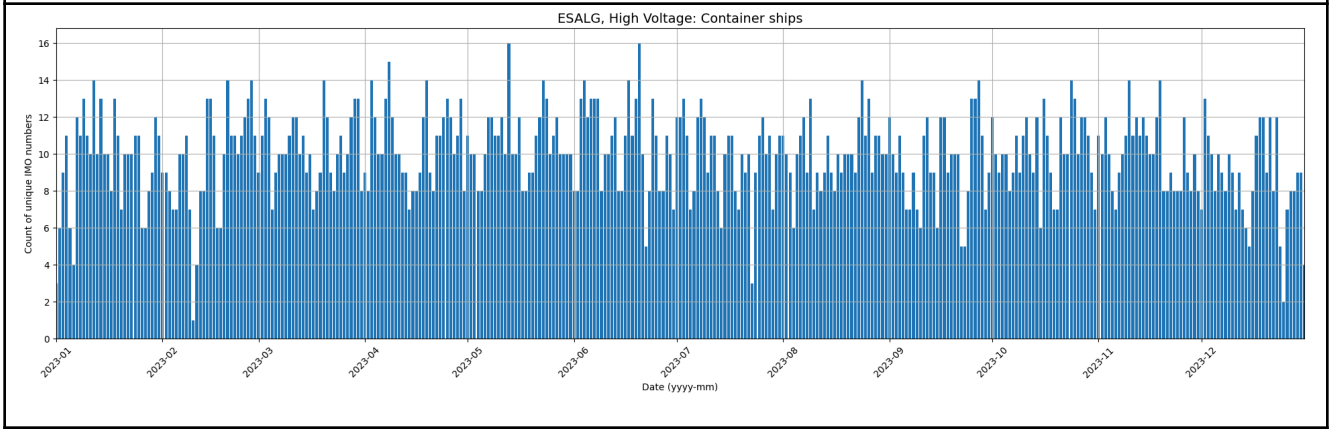
Table 6-4 Number of container and cruise ships at any day and passenger ships at any hour in 2023, and the estimated number of required connection points – split on low and high voltage.

Algeciras	**Low Voltage**	**High Voltage**
Container ships – req. connection points	9	13

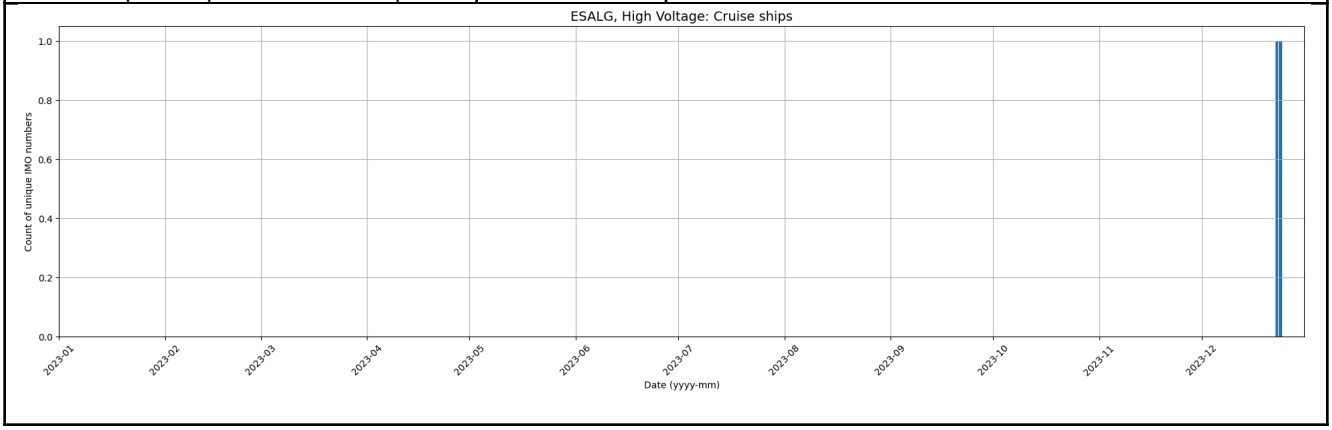




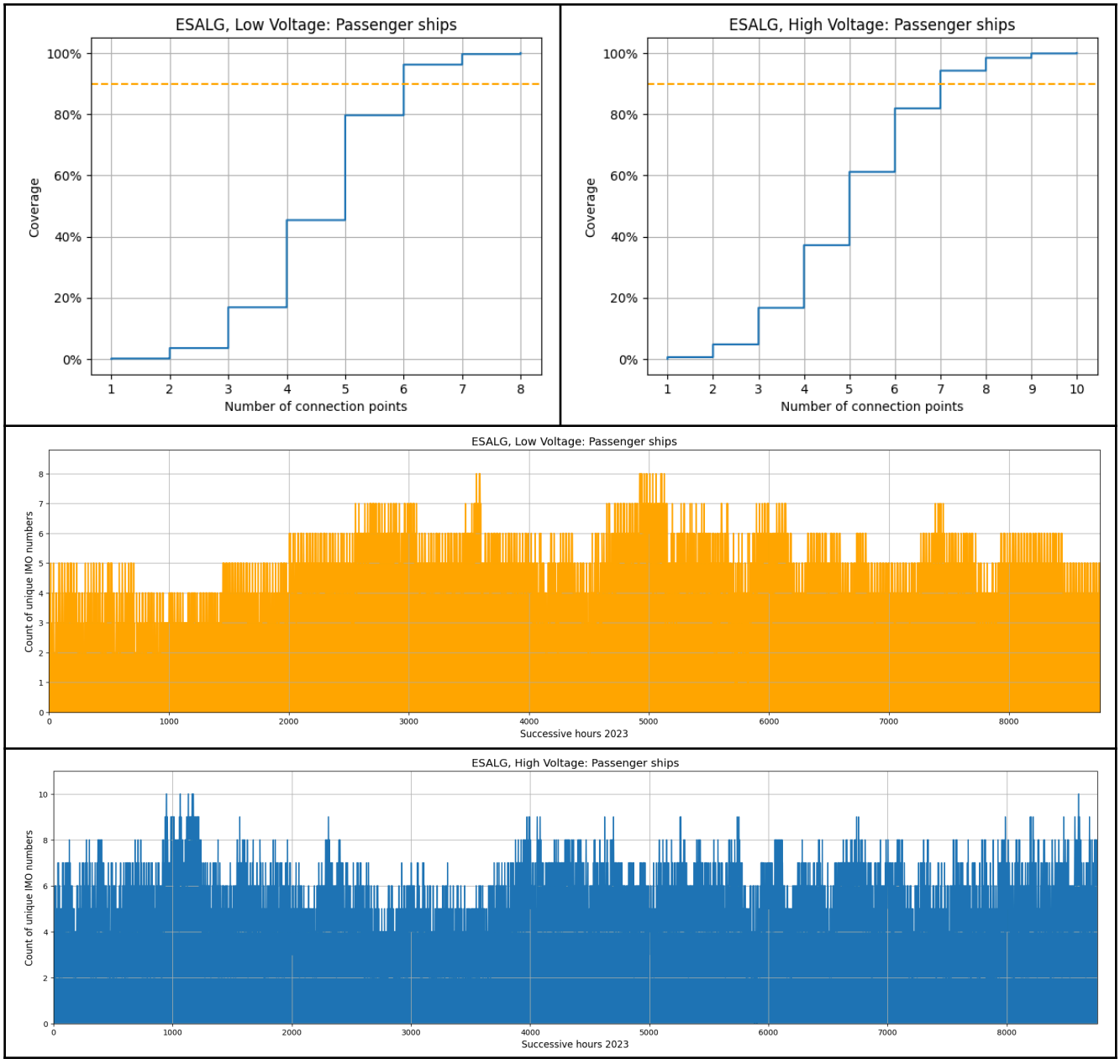




Algeciras	Low Voltage	High Voltage
Cruise ships – required connection points	0	0



Algeciras	Low Voltage	High Voltage
Passenger ships – req. connection points	6	7



6.1.2 Current status and plans for onshore power supply

In the port of Algeciras, there are no OPS systems installed yet, but there are concrete plans for installing OPS systems for different types of ships (see Table 6-5). All plans have contracts signed and part-funding from the EU. The port authorities stated that they are acting ahead of regulatory deadlines for alternative fuels infrastructure.

Capacity in the local electricity grid

According to the port, there is currently sufficient surplus capacity in the grid for the contracted OPS systems. However, scaling up to meet the 2030 demand will require upgrades to the grid system.

Table 6-5 Contracted OPS in the port of Algeciras.

Berth name	Max. no. of simultaneous ships	Types of ships	Max. system power capacity [kW]	System voltage	System frequency (Hz)	Standard	Operational from
Muelle de Galera	4	Passenger ships (Ro-Pax)	4 600	6.6-11 kV	50 and 60	IEC 80005-1	2025
Muelle de Galera	2	Passenger ships (fast ferries)	4 600	400-690 V	50 and 60	IEC 80005-3	2025
Tarifa	2	Passenger ships (fast ferries)	790	400-690 V	50 and 60	IEC 80005-3	2025
Principe Felipe	2	Passenger ships (Ro-Pax)	2 300	6.6-11 kV	50 and 60	IEC 80005-1	2025
Principe Felipe	1	Passenger ships (fast ferries)	2 300	400-690 V	50 and 60	IEC 80005-3	2025
Juan Carlos I (APMT)	2	Container ships	12 000	6.6-11 kV	50 and 60	IEC 80005-1	2026
Isla Verde Exterior (TTIA)	2	Container ships	12 000	6.6-11 kV	50 and 60	IEC 80005-1	2026
Dique Norte	5	All types[16]	5 000	6.6-11 kV	50 and 60	IEC 80005-1	2026

[16] Assume usable for all ship types

6.2 Port of Amsterdam, Netherlands

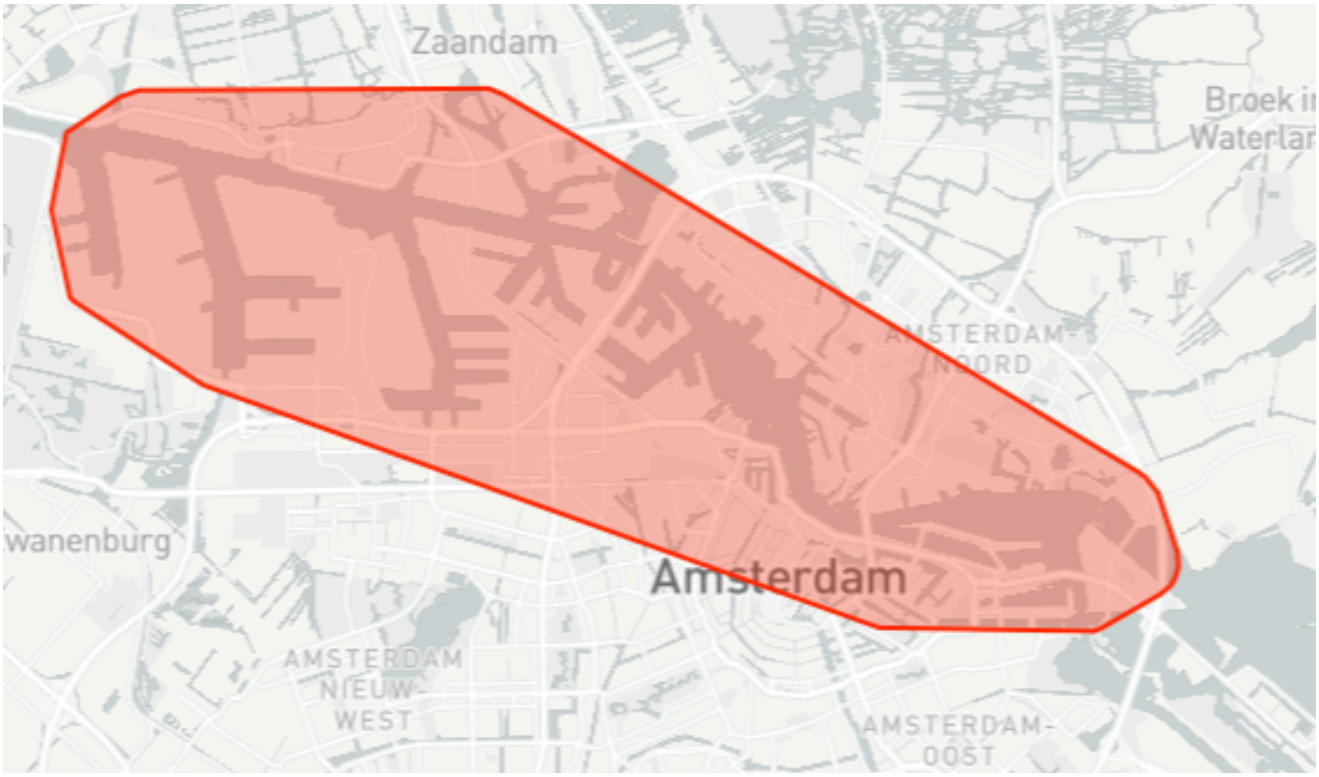


Figure 6-2 Port shape for Amsterdam (NLAMS).

6.2.1 Current ship activity and energy requirements

Table 6-6 shows the effective hours in port per ship segment and size category for the port of Amsterdam in 2023. There are around 400 effective hours in port for container ships larger than 5000 GT. For cruise ships larger than 5000 GT there are more than 2000 effective hours in port, and for passenger ships larger than 5000 GT there are around 600 effective hours in port. Other segments with a high number of effective hours in the port are chemical tankers, general cargo ships, and bulk carriers.

Table 6-6 Effective hours in port per ship segment and size category.

Amsterdam	400 - 999 GT	1000 - 4999 GT	5000 - 9999 GT	10000 - 24999 GT	25000 - 49999 GT	50000 - 99999 GT	100000 GT <	Total
Bulk carriers		577	298	7 957	30 560	5 003	126	44 521
Chemical tankers	19 062	135 343	19 307	38 273	41 979			253 964
Container ships		3 730	394					4 124
Crude oil tankers				215	3 907	4 757		8 879
Cruise ships		22 321	157	457	291	800	513	24 538
Fishing ships		649	1 494					2 143
Gas tankers	167	5 173	4 343	588	48			10 319
General cargo ships	3 375	49 887	11 447	6 672	241	380		72 002

Offshore supply ships		7 122	76					7 198
Oil product tankers	983	6 300	816	388	5 657	342		14 485
Other activities	14 507	15 347	4 424	2 517	266			37 060
Other service offshore ships	66	785	3 386	3 681				7 918
Passenger ships	296	24		139	427			886
Refrigerated cargo ships			1 026					1 026
Ro-Ro cargo ships			545	2 088	947	2 507		6 088
Total	38 453	247 256	47 714	62 971	84 320	13 789	639	495 142

Table 6-7 shows the estimated energy consumption per ship segment and power category for the port of Amsterdam in 2023. For container ships, the estimated energy consumption is in the power category 100-500 kW. For cruise ships, most of the estimated energy consumption is in the power category 100-500 kW, but there is also significant energy consumption in the highest power categories (1-5 MW, 5-10 MW, and > 10 MW). For passenger ships, most of the estimated energy consumption for ships above 5000 GT is in the power category 1-5 MW. Other segments with substantial energy consumption in the port are chemical tankers, bulk carriers, and general cargo ships.

Table 6-7 Estimated energy consumption in port (MWh) per ship segment and power category.

Amsterdam	**<100 kW**	**100-500 kW**	**500-1000 kW**	**1-5 MW**	**5-10 MW**	**>10 MW**	**Total**
Bulk carriers	0	14 432	2 709	0	0	0	17 142
Chemical tankers	0	1 615	15 368	95 931	0	0	112 914
Container ships	0	871	0	0	0	0	871
Crude oil tankers	0	0	3 939	5 946	0	0	9 886
Cruise ships	0	9 129	146	2 090	5 774	5 135	22 275
Fishing vessels	0	783	0	0	0	0	783
Gas tankers	0	1 999	0	5 159	0	0	7 157
General cargo ships	5 003	5 153	480	0	0	0	10 636
Offshore supply ships	0	1 538	39	0	0	0	1 578
Oil product tankers	55	1 518	6 190	428	0	0	8 190
Other activities	609	3 990	4 432	394	0	0	9 426
Other service offshore vessels	4	1 452	2 304	0	0	0	3 760
Passenger ships	18	9	0	1 767	0	0	1 793
Refrigerated cargo ships	0	490	0	0	0	0	490
Ro-Ro cargo ships	0	174	2 051	2 512	0	0	4 737
Total	5 689	43 154	37 660	114 226	5 774	5 135	211 639

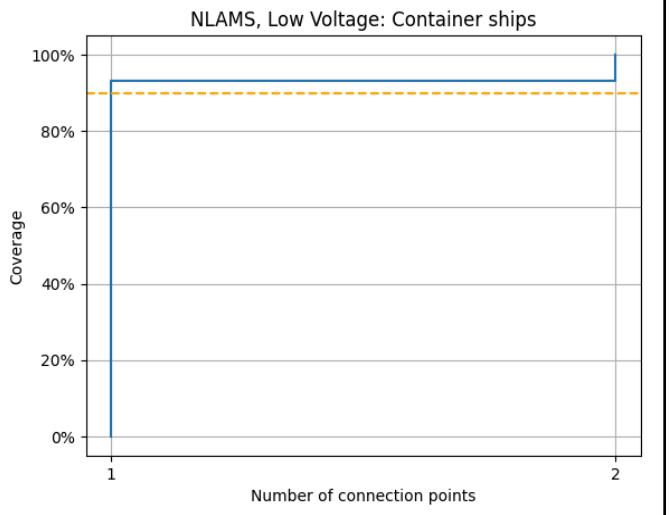
Table 6-8 presents simultaneous port calls for quantification of the need for low and high voltage connection points for container, cruise, and passenger ships above 5000 GT. Since there were less than 100 port calls from **container ships** and less than 40 port calls from **passenger ships** in 2023, it is assumed that there is no need for connection points for these segments in the port of Amsterdam.

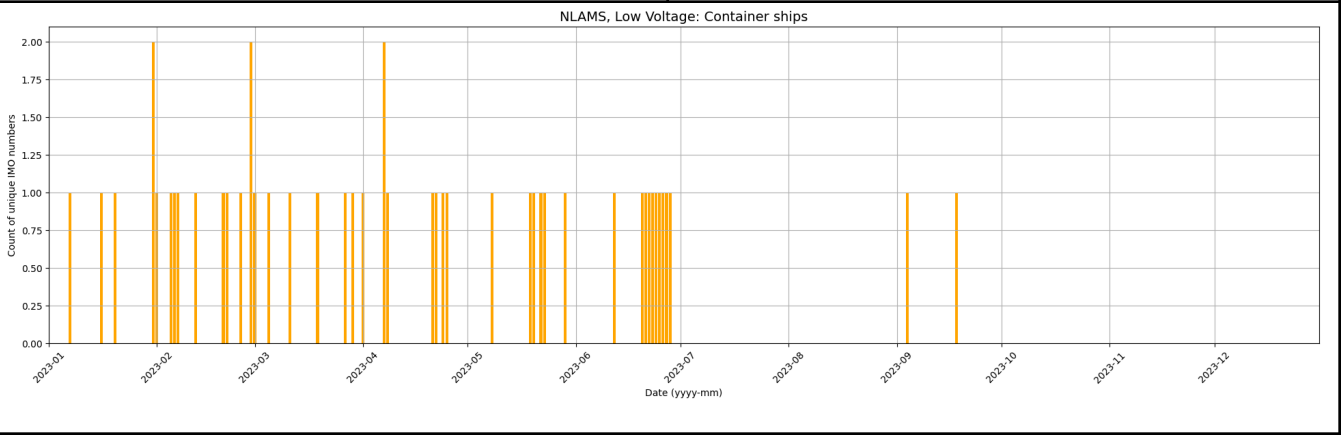
For 90% coverage, there is an estimated need for one low voltage connection point for **cruise ships**, although there was only such traffic in the port on a few days in 2023. Unless a significant increase in the cruise traffic to the port is expected

towards 2030, the port should not invest in such a connection point. There were a few days with a need for 3 high voltage connection points for cruise ships, but 2 such connection points would be sufficient for 90% coverage.

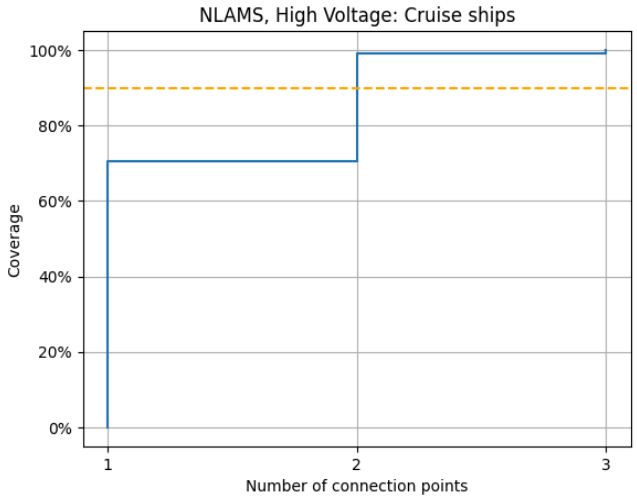
Table 6-8 Number of container and cruise ships at any day and passenger ships at any hour in 2023, and the estimated number of required connection points – split on low and high voltage.

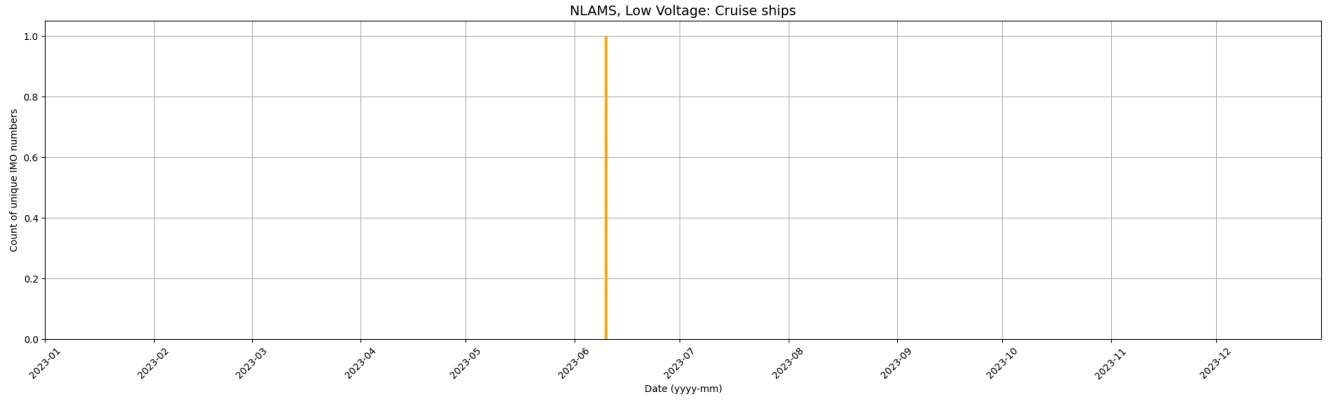
Amsterdam	Low Voltage	High Voltage
Container ships – req. connection points	0	0

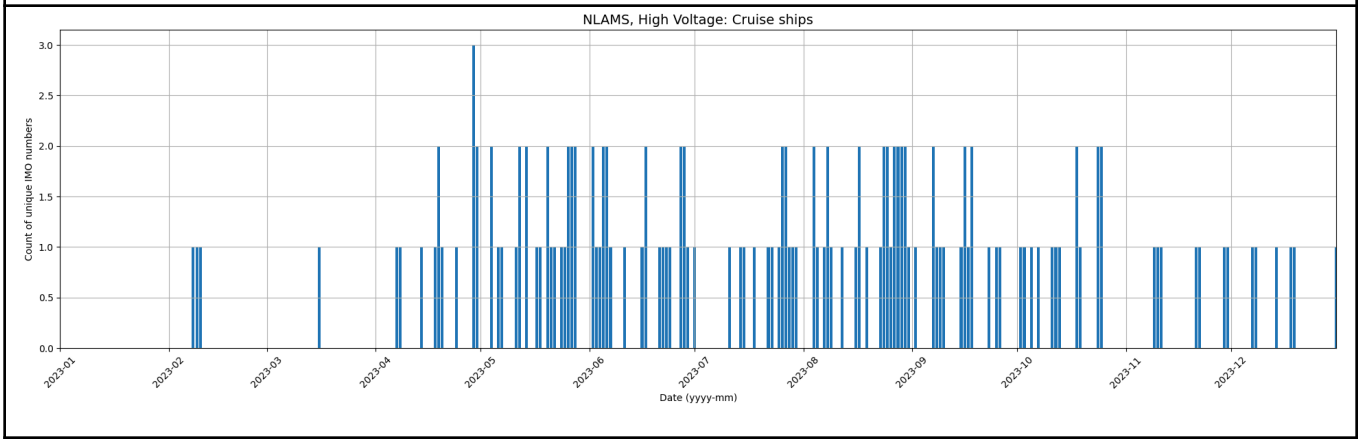




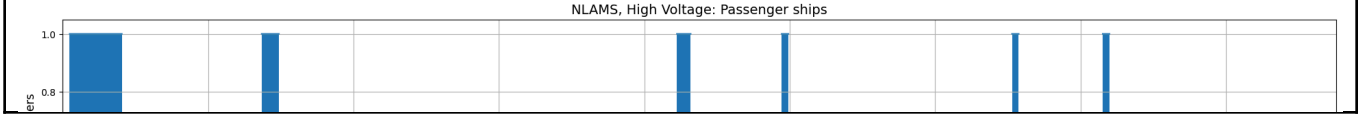
Amsterdam	Low Voltage	High Voltage
Cruise ships – required connection points	1	2







Amsterdam	Low Voltage	High Voltage
Passenger ships – req. connection points	0	0



6.2.2 Current status and plans for onshore power supply

In the port of Amsterdam, there are no OPS systems installed yet, except 16 connection points for river cruise ships (400 V/400A), which are outside the scope of this study.The port has contracted an OPS system for cruise ships to be operational from 2025 (see Table 6-9). There is ongoing research on future plans, but nothing concrete as of yet.

Capacity in the local electricity grid

According to the port, there is currently sufficient surplus capacity in the local electricity grid for the installed and contracted OPS systems (depending on the specific location in the port).

Table 6-9 Contracted OPS in the port of Amsterdam.

Max. no. of simultaneous ships	Types of ships	Max. system power capacity [kW]	System voltage	System frequency [Hz]	Standard	Operational from
1	Cruise ships	20 000	6.6-11 kV	50 and 60	IEC 80005-1	2025

6.3 Port of Antwerp, Belgium

Antwerp is organized together with Zeebrugge as Port of Antwerp-Bruges, but the results presented here relate to the port with UN/LOCODE BEANR (Figure 6-3).

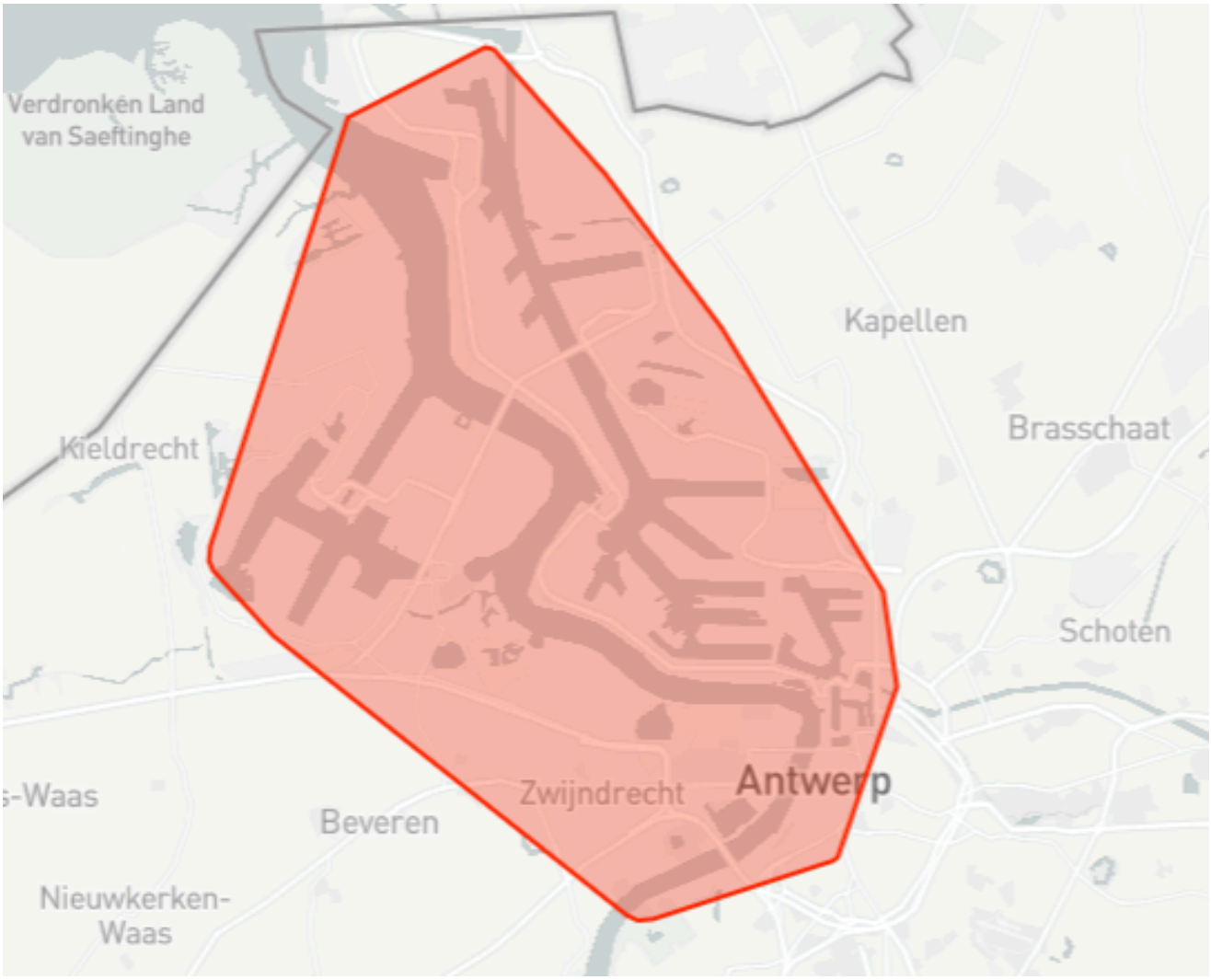


Figure 6-3 Port shape for Antwerp (BEANR).

6.3.1 Current ship activity and energy requirements

Table 6-10 shows the effective hours in port per ship segment and size category for the port of Antwerp in 2023. There are more than 121 000 effective hours in port for container ships larger than 5000 GT. For cruise ships larger than 5000 GT there are around 400 effective hours in port, and for passenger ships larger than 5000 GT there are only 31 effective hours in port. Other segments with a high number of effective hours in the port are chemical tankers, cargo ships and gas tankers.

Table 6-10 Effective hours in port per ship segment and size category.

Antwerp	400 - 999 GT	1000 - 4999 GT	5000 - 9999 GT	10000 - 24999 GT	25000 - 49999 GT	50000 - 99999 GT	100000 GT <	Total
Bulk carriers		80	429	29 807	32 844	283		63 443
Chemical tankers	22 610	321 914	47 415	95 502	57 978			545 419
Container ships		4 960	12 255	15 579	29 529	37 998	26 184	126 505
Crude oil tankers				626	6 288	15 690		22 604

Cruise ships		3 667	38	58	228	53		4 044
Fishing ships								0
Gas tankers	1 189	45 193	13 874	5 666	5 567	114		71 603
General cargo ships	7 488	76 367	27 454	19 269	6 322			136 900
Offshore supply ships	246	132	5					383
Oil product tankers	14 338	29 626	1 446	821	12 514	1 256		60 001
Other activities	65 914	2 332	1 131					69 377
Other service offshore ships	855	4	57					916
Passenger ships	6 095	9			15	16		6 135
Refrigerated cargo ships			18	7 747				7 765
Ro-Ro cargo ships		3 838	399	274	13 308	28 167	2 487	48 473
Total	118 735	488 122	104 521	175 349	164 593	83 577	28 671	1 163 568

Table 6-11 shows the estimated energy consumption per ship segment and power category for the port of Antwerp in 2023. For container ships, most of the estimated energy consumption is in the power category 1-5 MW. For cruise ships, most of the estimated energy consumption is in the power categories 100-500 kW and 1-5 MW. For passenger ships, the estimated energy consumption for ships above 5000 GT is in the power categories 1-5 MW and > 10 MW, but these requirements are very small. Other segments with substantial energy consumption in the port are chemical tankers, gas tankers, and Ro-Ro cargo ships.

Table 6-11 Estimated energy consumption in port (MWh) per ship segment and power category.

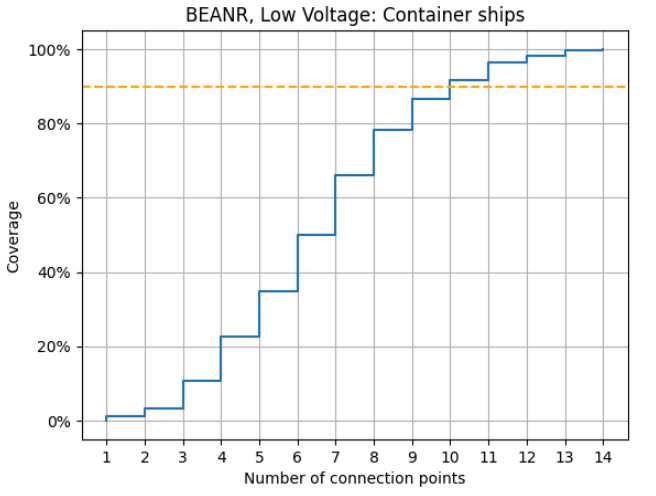
Antwerp	<100 kW	100-500 kW	500-1000 kW	1-5 MW	5-10 MW	>10 MW	Total
Bulk carriers	0	21 760	149	0	0	0	21 908
Chemical tankers	0	2 148	37 742	178 759	0	0	218 649
Container ships	0	6 988	11 046	215 901	0	0	233 935
Crude oil tankers	0	0	6 540	19 613	0	0	26 153
Cruise ships	0	1 500	35	1 049	383	0	2 967
Fishing vessels	0	0	0	0	0	0	0
Gas tankers	0	17 417	0	30 474	0	0	47 891
General cargo ships	7 703	13 626	3 945	0	0	0	25 274
Offshore supply ships	17	29	3	0	0	0	48
Oil product tankers	803	7 140	13 476	1 570	0	0	22 989
Other activities	2 768	606	584	0	0	0	3 958
Other service offshore vessels	54	22	0	0	0	0	76
Passenger ships	366	3	0	54	101	0	523
Refrigerated cargo ships	0	9	6 298	0	0	0	6 307
Ro-Ro cargo ships	0	668	10 737	30 969	0	0	42 374
Total	11 710	71 916	90 554	478 388	483	0	653 052

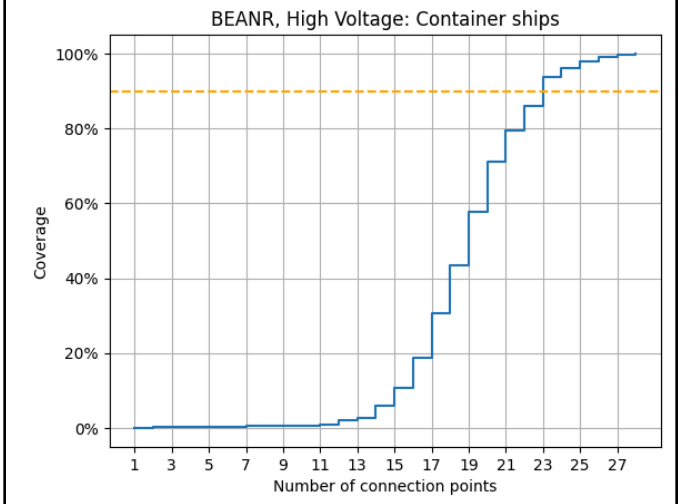
Table 6-12 presents simultaneous port calls for quantification of the need for low and high voltage connection points for container, cruise, and passenger ships above 5000 GT. There were some days in 2023 with close to 15 **container ships** requiring low voltage connection points in the port, but 10 such connection points would be sufficient for 90% coverage. Similarly, there were some days in 2023 with close to 30 container ships requiring high voltage connection points in the port, but 23 such connection points would be sufficient for 90% coverage.

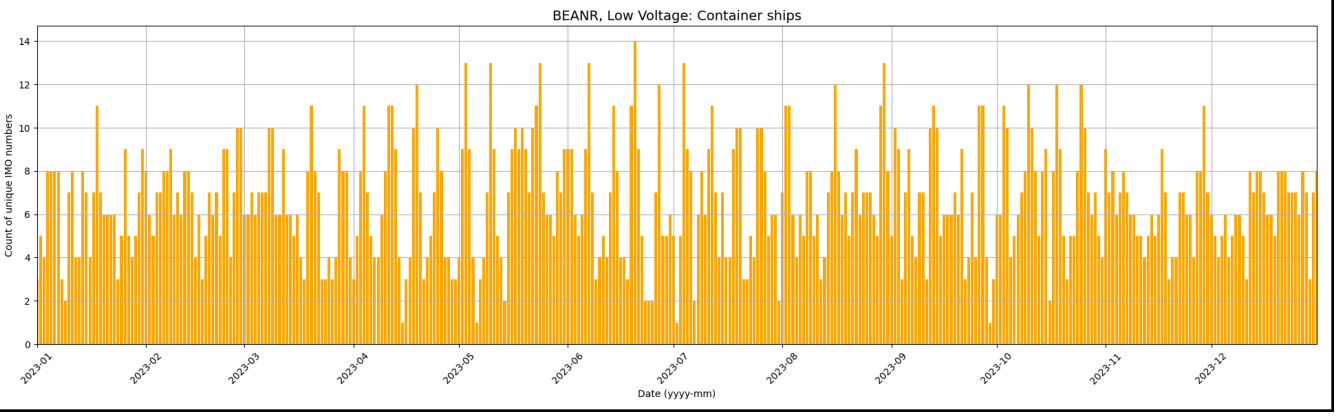
Since there were less than 25 port calls from **cruise ships** and less than 40 port calls from **passenger ships** in 2023, it is assumed that there is no need for connection points for these segments in the port of Antwerp.

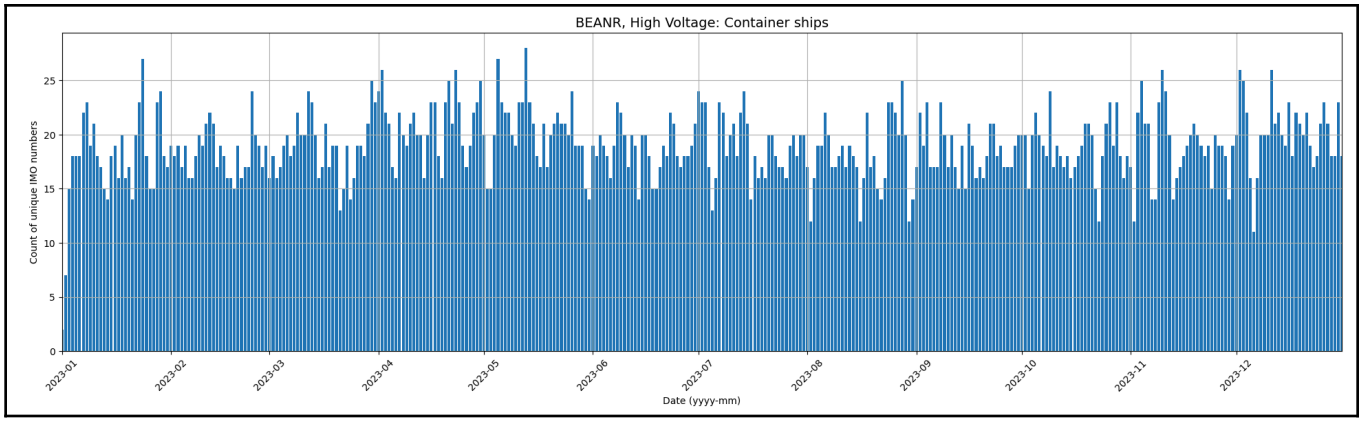
Table 6-12 Number of container and cruise ships at any day and passenger ships at any hour in 2023, and the estimated number of required connection points – split on low and high voltage.

Antwerp	Low Voltage	High Voltage
Container ships – req. connection points	10	23

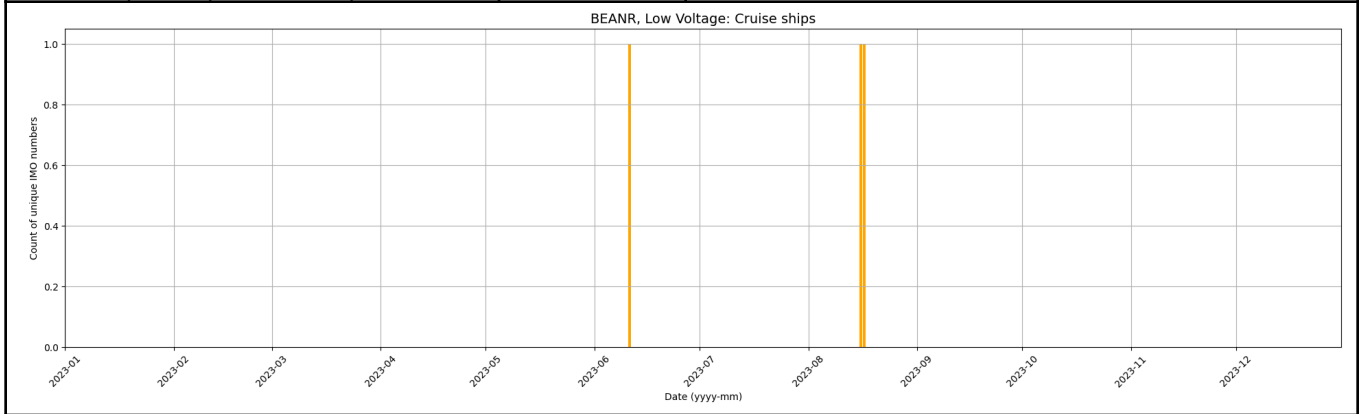


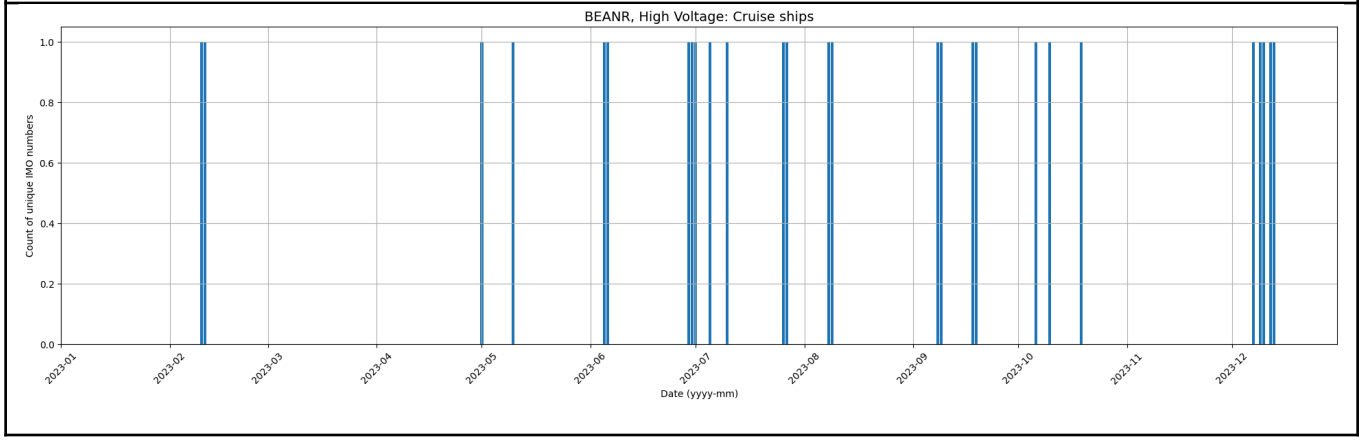




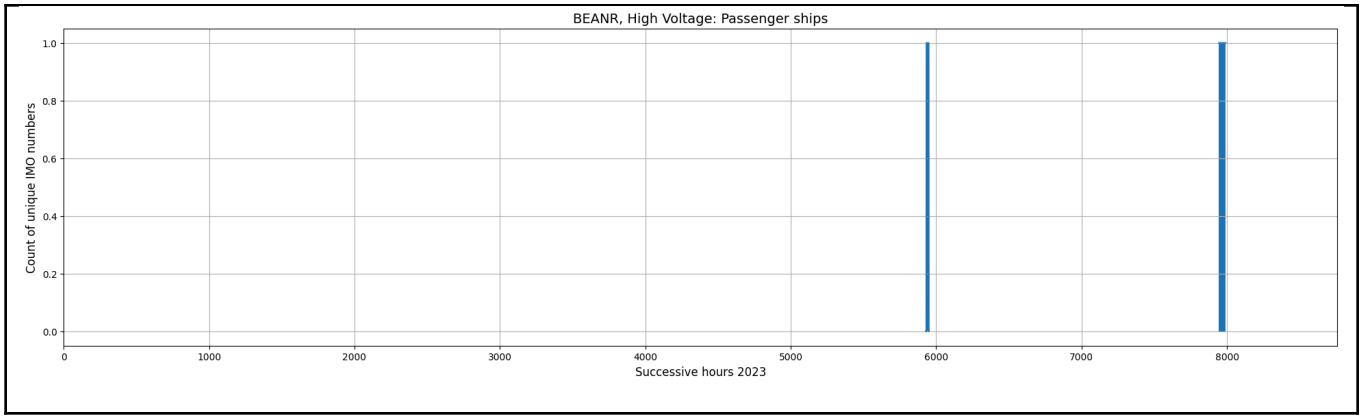


Antwerp	Low Voltage	High Voltage
Cruise ships – req. connection points	0	0





Antwerp	Low Voltage	High Voltage
Passenger ships – req. connection points	0	0



6.3.2 Current status and plans for onshore power supply

In the port of Antwerp, there are no OPS systems installed yet. The port is planning to install OPS systems, but is currently in the tendering phase only, so there are no contracts signed yet. The plans include:

- One high-voltage system for cruise ships of 10 MW capacity to be in operation from 2026;
- Extension to 16 MW capacity and possibility to connect two cruise ships simultaneously in 2028;
- 20 connection points at 5 terminals for container ships by 2028;
- 4 connection points at 2 terminals for container ships by 2030.

Capacity in the local electricity grid

According to the port, the power available from the grid is sufficient for all OPS and battery charging plans towards 2030.

6.4 Port of Barcelona, Spain

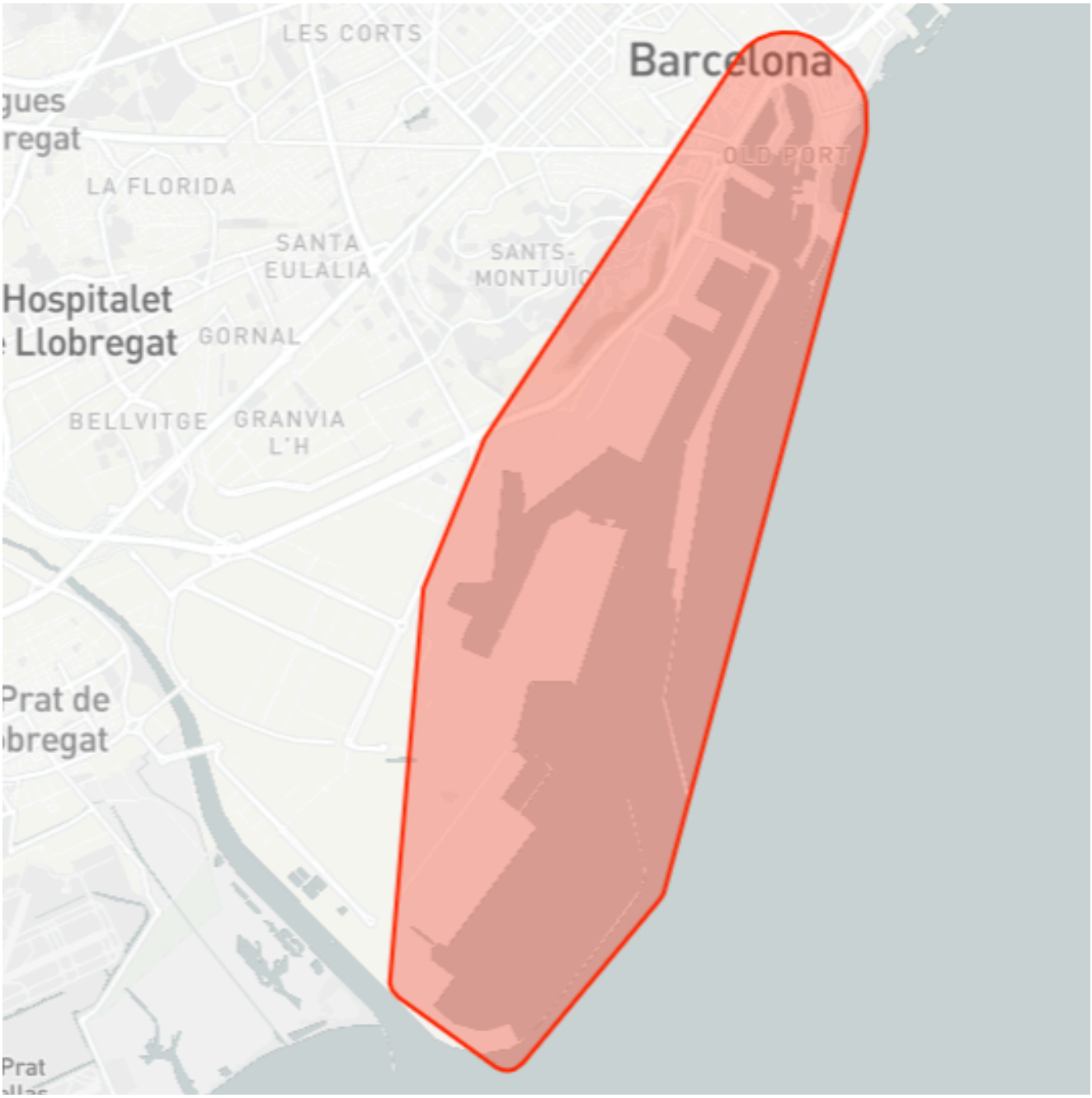


Figure 6-4 Port shape for Barcelona (ESBCN).

6.4.1 Current ship activity and energy requirements

Table 6-13 shows the effective hours in port per ship segment and size category for the port of Barcelona Metropolitan Area in 2023. There are around 40 000 effective hours in port for container ships larger than 5000 GT. For cruise ships larger than 5000 GT there are more than 10 000 effective hours in port, and for passenger ships larger than 5000 GT there are around 27 000 effective hours in port. Other segments with a high number of effective hours in the port are chemical tankers, oil product tankers and other activities.

Table 6-13 Effective hours in port per ship segment and size category.

Barcelona	400 - 999 GT	1000 - 4999 GT	5000 - 9999 GT	10000 - 24999 GT	25000 - 49999 GT	50000 - 99999 GT	100000 GT <	Total
Bulk carriers		125		4 938	9 595			14 658
Chemical tankers		4 596	7 526	10 445	5 408			27 975
Container ships		65	11 287	3 383	8 121	8 064	9 279	40 199
Crude oil tankers					430	1 746		2 176
Cruise ships		395	438	411	2 058	1 925	5 707	10 934
Fishing ships								0
Gas tankers		8 524	276	71	325	408	968	10 572
General cargo ships	20	6 951	3 594	1 514	327			12 406
Offshore supply ships	1 045	3 609						4 654
Oil product tankers		38 019	25	262	751	60		39 117
Other activities	54 347	43 436	2 171	698				100 652
Other service offshore ships								0
Passenger ships			2 652	5 879	16 162	2 381		27 074
Refrigerated cargo ships								0
Ro-Ro cargo ships			33	1 895	2 843	5 779		10 550
Total	55 412	105 720	28 002	29 496	46 020	20 363	15 954	300 967

Table 6-14 shows the estimated energy consumption per ship segment and power category for the port of Barcelona Metropolitan Area in 2023. For container ships and passenger ships most of the estimated energy consumption is in the power category 1-5 MW. For cruise ships, most of the estimated energy consumption is in the highest power category (> 10 MW). Other segments with substantial energy consumption in the port are chemical tankers, other activities, and gas tankers.

Table 6-14 Estimated energy consumption in port (MWh) per ship segment and power category.

Barcelona	<100 kW	100-500 kW	500-1000 kW	1-5 MW	5-10 MW	>10 MW	Total
Bulk carriers	0	5 228	0	0	0	0	5 228
Chemical tankers	0	28	5 991	18 342	0	0	24 360
Container ships	0	5 621	2 399	61 036	0	0	69 056
Crude oil tankers	0	0	417	2 183	0	0	2 599
Cruise ships	0	162	409	9 250	13 895	57 127	80 841
Fishing vessels	0	0	0	0	0	0	0
Gas tankers	0	3 248	0	2 614	5 162	0	11 024
General cargo ships	689	1 392	204	0	0	0	2 285
Offshore supply ships	71	780	0	0	0	0	851
Oil product tankers	0	9 163	928	75	0	0	10 166
Other activities	2 283	11 293	1 716	0	0	0	15 292

Other service offshore vessels	0	0	0	0	0	0	0
Passenger ships	0	0	2 161	67 929	14 998	0	85 089
Refrigerated cargo ships	0	0	0	0	0	0	0
Ro-Ro cargo ships	0	11	3 436	5 791	0	0	9 237
Total	3 042	36 925	17 660	167 218	34 055	57 127	316 028

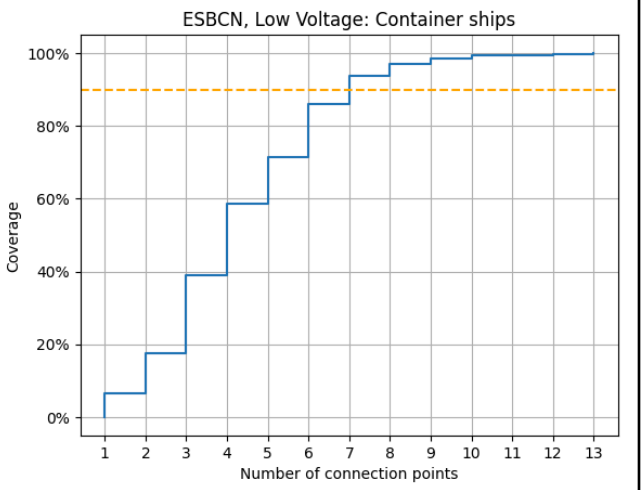
Table 6-15 presents simultaneous port calls for quantification of the need for low and high voltage connection points for container, cruise, and passenger ships above 5000 GT. There were some days in 2023 with more than 10 **container ships** requiring low voltage connection points in the port, but 7 such connection points would be sufficient for 90% coverage. Similarly, there were some days in 2023 with more than 10 container ships requiring high voltage connection points in the port, but 9 such connection points would be sufficient for 90% coverage.

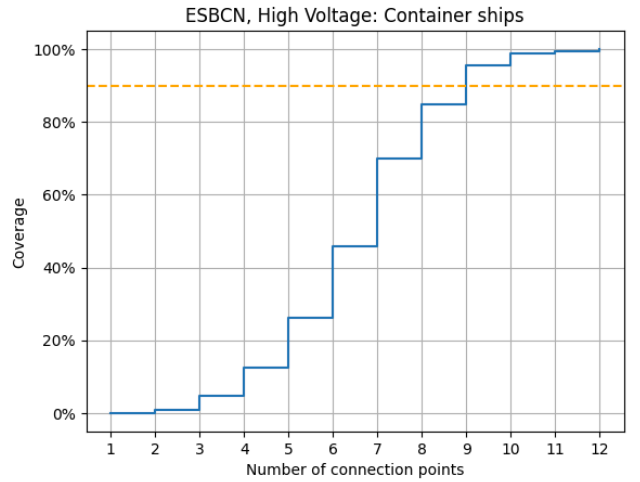
For **cruise ships**, there was one day with a need for 2 low voltage connection points and some days with a need for 7 high voltage connection points. However, 1 low voltage and 5 high voltage connection points would be sufficient for 90% coverage.

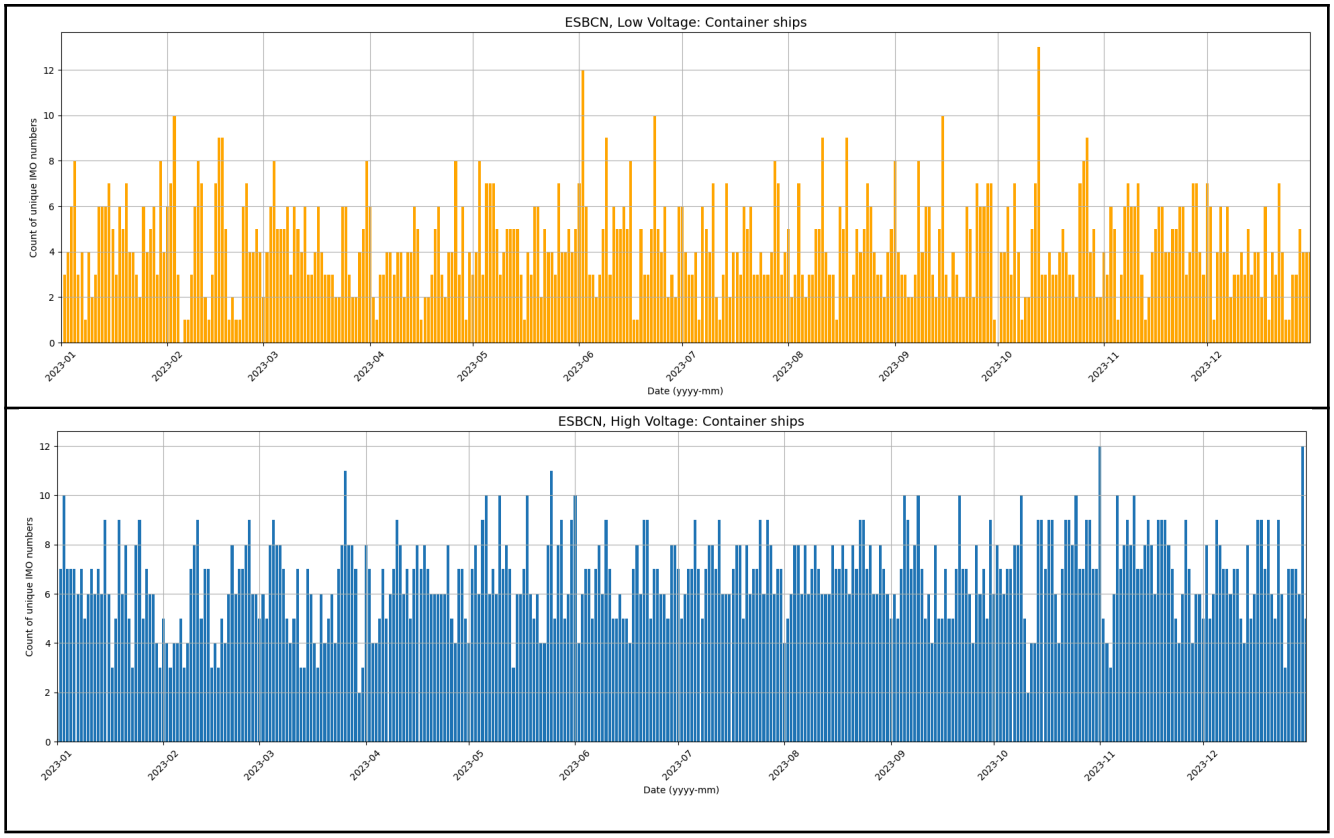
For **passenger ships**, 2 low voltage and 8 high voltage connection points are needed for 90% coverage. In total, there is an estimated need for 16 connection points for container ships, 6 connection points for cruise ships, and 10 connection points for passenger ships.

Table 6-15 Number of container and cruise ships at any day and passenger ships at any hour in 2023, and the estimated number of required connection points – split on low and high voltage.

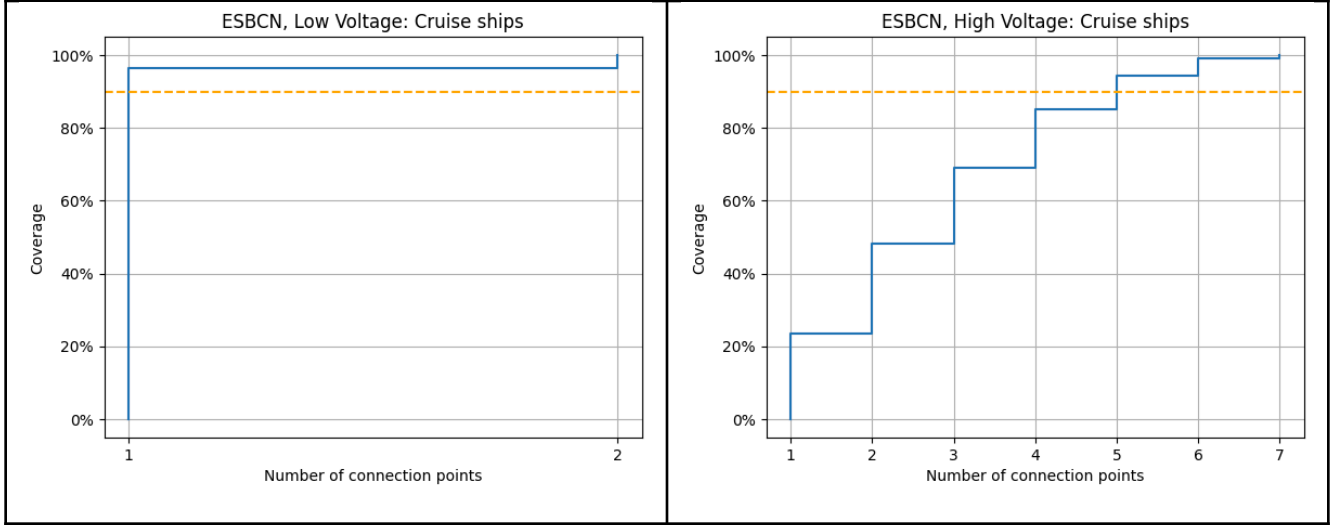
Barcelona	Low Voltage	High Voltage
Container ships – req. connection points	7	9

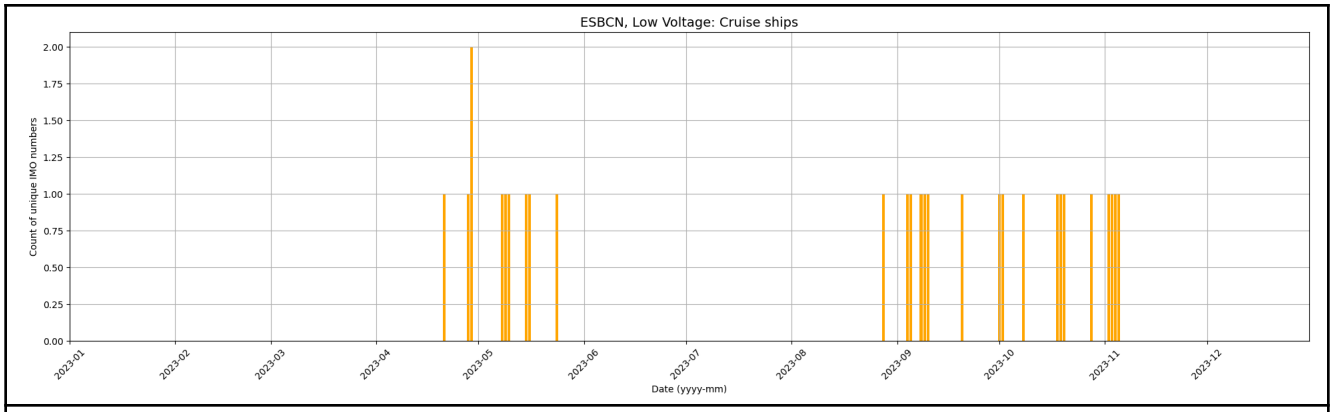


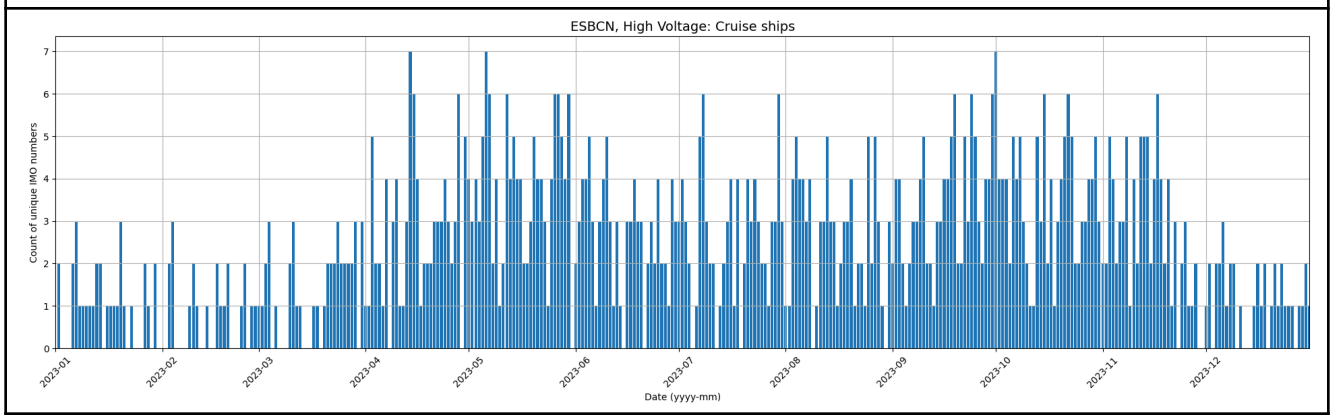




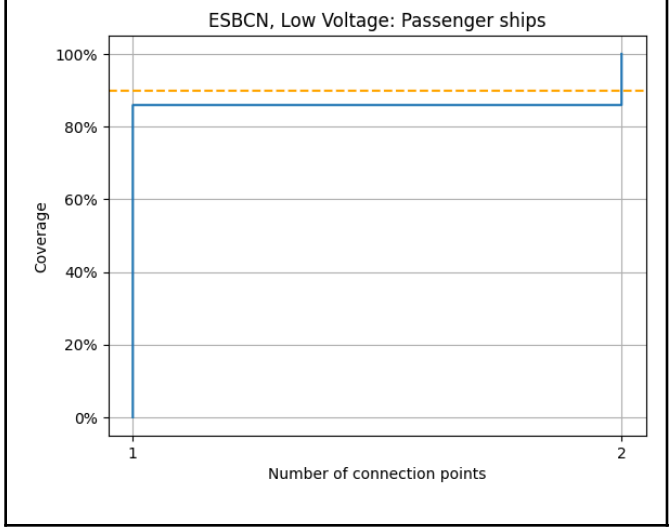
Barcelona	Low Voltage	High Voltage
Cruise ships – required connection points	1	5

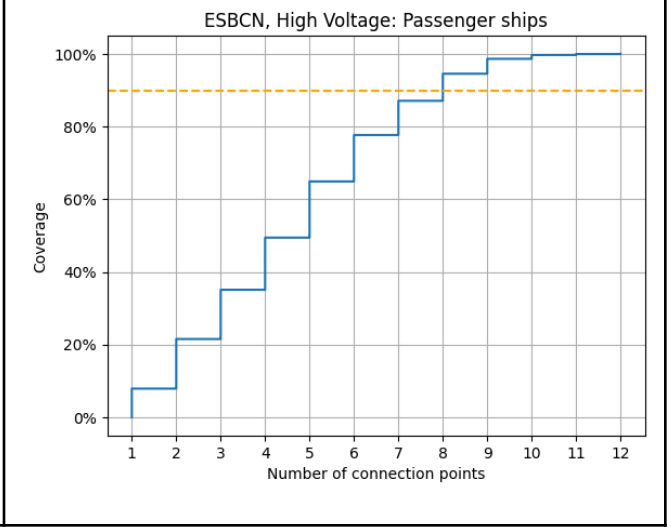


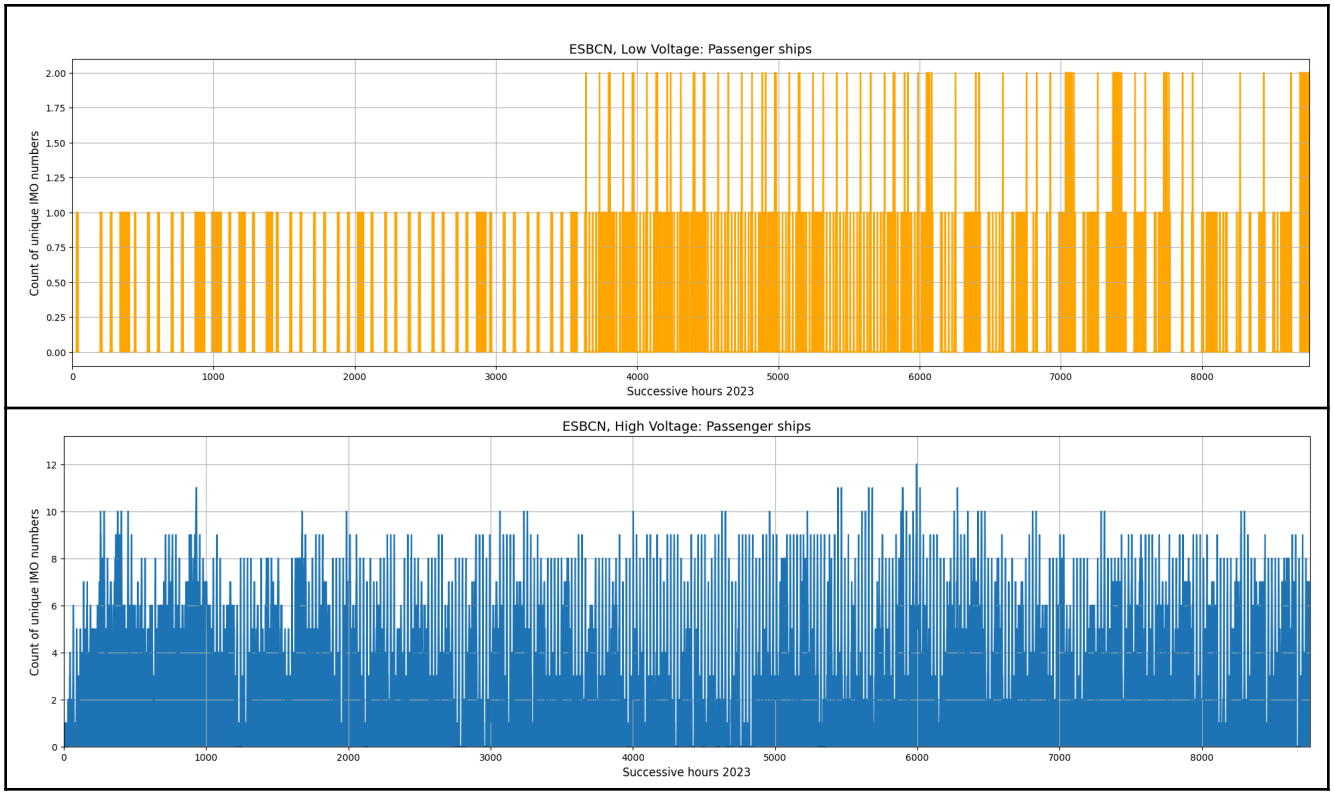




Barcelona	Low Voltage	High Voltage
Passenger ships – req. connection points	2	8







6.4.2 Current status and plans for onshore power supply

At the time of the interview, the port of Barcelona had no onshore power supply system in operation. However, the port was expecting to commission OPS systems for container ships by the first week of May and for ferries by mid December 2024 (Table 6-16). These will be portable OPS systems. Furthermore, the port plans to establish OPS on 7 cruise terminals by 2030, but these contracts have not been signed yet. The first cruise tender is planned to launch in May 2024 and planned commissioning at the first terminal is in 2026. The rest of the cruise tenders will commence soon after and commissioning at all 7 terminals is expected to be completed by 2030. The main focus of the port until 2030 is on developing onshore power supply for the container, cruise, and ferry terminals.

Capacity in the local electricity grid

According to the port, a total capacity of 80 MW to the port from the national grid is needed to comply with 2030 demands, including 50 MW for the cruise terminals. This requires grid developments. Currently, there is a public tender out on building the substation from the national 220 kV grid to the 20 kV grid distributing the energy to the rest of the port.

Table 6-16 Contracted OPS in the port of Barcelona.

Berth name	Max. no. of simultaneous ships	Types of ships	Max. system power capacity [kW]	System voltage	System frequency [Hz]	Standard	Operational from
BEST Terminal	2	Container	9 000	6.6 kV	50 and 60	IEC 80005-1	May 2024
FERRIES Terminal	1	Passenger	3 500	6.6-11 kV	50 and 60	IEC 80005-1	Dec 2024

6.5 Port of Bremerhaven, Germany

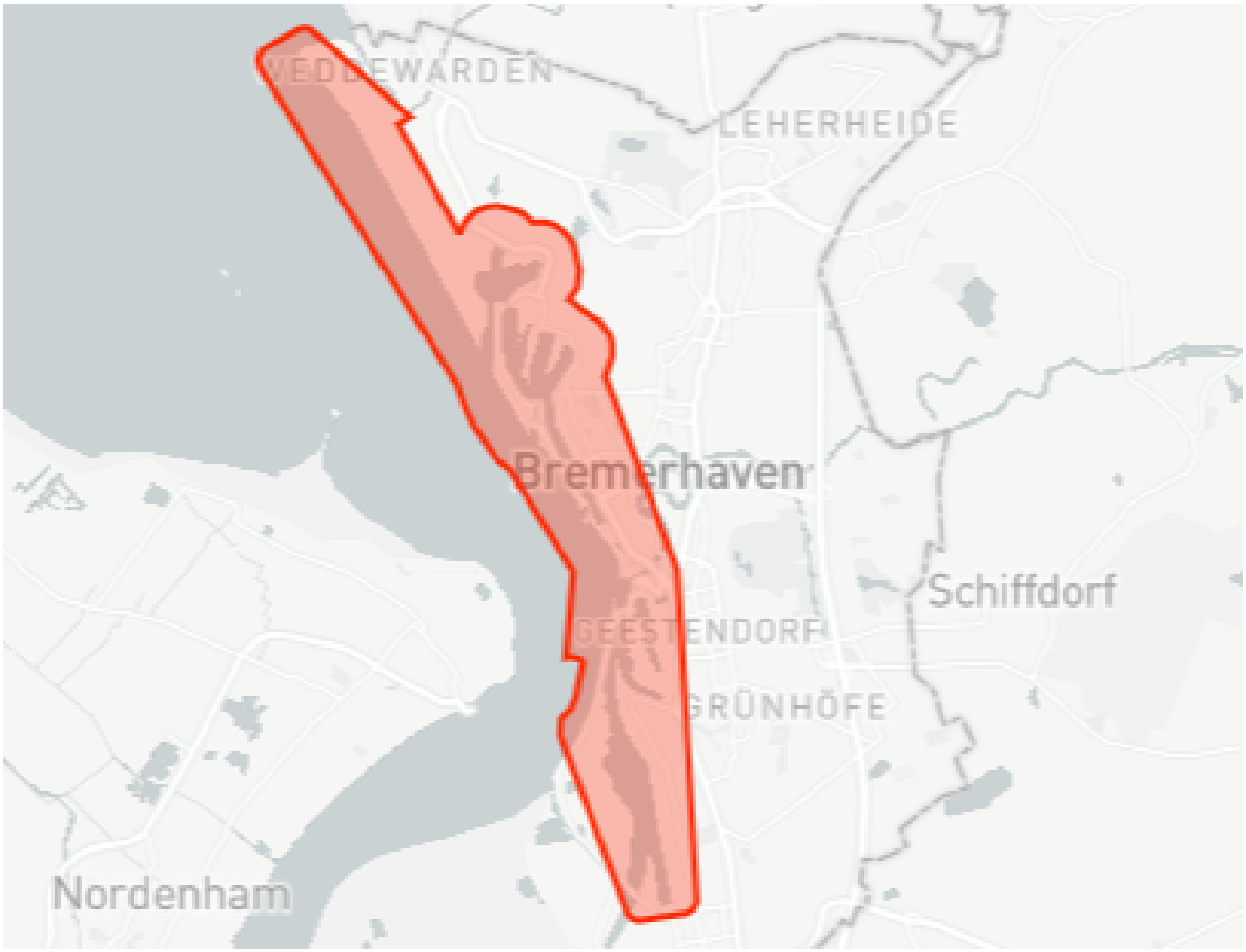


Figure 6-5 Port shape for Bremerhaven (DEBRV).

6.5.1 Current ship activity and energy requirements

Table 6-17 shows the effective hours in port per ship segment and size category for the port of Bremerhaven in 2023. There are around 58 000 effective hours in port for container ships larger than 5000 GT. For cruise ships larger than 5000 GT there are more than 5 000 effective hours in port, and for passenger ships larger than 5000 GT there are no effective hours in port.

Table 6-17 Effective hours in port per ship segment and size category.

Bremerhaven	400 - 999 GT	1000 - 4999 GT	5000 - 9999 GT	10000 - 24999 GT	25000 - 49999 GT	50000 - 99999 GT	100000 GT <	Total
Bulk carriers		145	18		425			588
Chemical tankers		3 378	1 537	365	716			5 996
Container ships		1 011	8 205	10 967	12 769	15 294	10 944	59 190
Crude oil tankers								0
Cruise ships			82	1 896	2 437	577	574	5 566
Fishing ships		5 679	352					6 031
Gas tankers		210	139	445				794

General cargo ships	158	10 762	4 091	6 037	2 409			23 457
Offshore supply ships	45	2 570	288					2 903
Oil product tankers	2 056	5 343		42				7 441
Other activities	56 746	16 415	4 415	1 201	53	90		78 920
Other service offshore ships	1 216	441					339	1 996
Passenger ships	974	29						1 003
Refrigerated cargo ships		9						9
Ro-Ro cargo ships	3		100	2 704	3 343	30 294		36 444
Total	61 198	45 992	19 227	23 657	22 152	46 255	11 857	230 338

Table 6-18 shows the estimated energy consumption per ship segment and power category for the port of Bremerhaven in 2023. Container ships account for more than 50% of the total estimated energy consumption in port. Both for container ships and cruise ships, most of the estimated energy consumption is in the power category 1-5 MW. Additionally, Ro-Ro cargo ships have a substantial energy consumption in port.

Table 6-18 Estimated energy consumption in port (MWh) per ship segment and power category.

Bremerhaven	**<100 kW**	**100-500 kW**	**500-1000 kW**	**1-5 MW**	**5-10 MW**	**>10 MW**	**Total**
Bulk carriers	0	187	0	0	0	0	187
Chemical tankers	0	438	1 223	1 324	0	0	2 985
Container ships	0	4 261	7 776	89 438	0	0	101 475
Crude oil tankers	0	0	0	0	0	0	0
Cruise ships	0	0	77	13 715	4 165	5 746	23 702
Fishing vessels	0	1 422	0	0	0	0	1 422
Gas tankers	0	80	0	697	0	0	777
General cargo ships	1 068	3 259	1 503	0	0	0	5 830
Offshore supply ships	3	555	149	0	0	0	707
Oil product tankers	115	1 288	30	0	0	0	1 433
Other activities	2 383	4 268	3 304	252	0	0	10 207
Other service offshore vessels	77	98	0	348	0	0	523
Passenger ships	58	10	0	0	0	0	69
Refrigerated cargo ships	0	2	0	0	0	0	2
Ro-Ro cargo ships	0	32	4 336	30 355	0	0	34 723
Total	3 705	15 900	18 398	136 129	4 165	5 746	184 043

Table 6-19 presents simultaneous port calls for quantification of the need for low and high voltage connection points for container, cruise, and passenger ships above 5000 GT. There were some days in 2023 with more than 10 **container ships** requiring low voltage connection points in the port, but 8 such connection points would be sufficient for 90% coverage. Similarly, there were some days in 2023 with more than 15 container ships requiring high voltage connection points in the port, but 11 such connection points would be sufficient for 90% coverage.

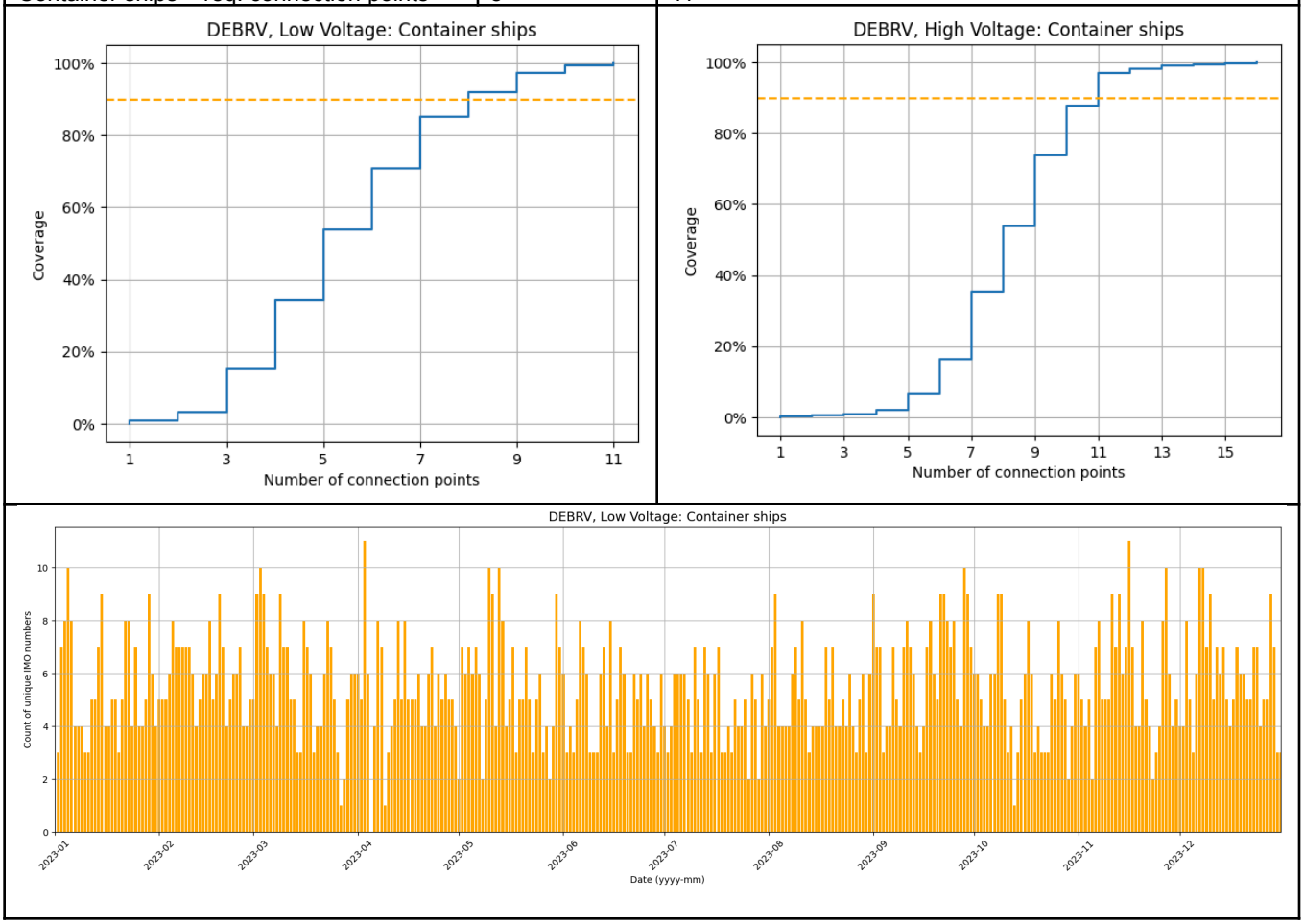
For 90% coverage, there is an estimated need for one low voltage connection point for **cruise ships**, although there were only a few days with such traffic in the port in 2023. Unless a significant increase in the cruise traffic to the port is expected

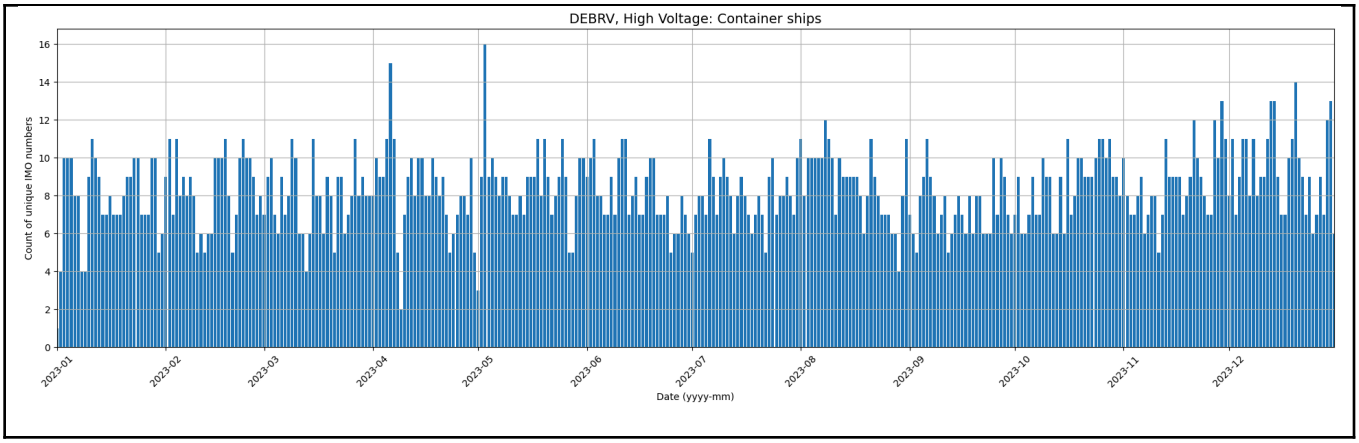
towards 2030, the port should not invest in such a connection point. There were some days with a need for 3 high voltage connection points for cruise ships, but 2 such connection points would be sufficient for 90% coverage.

For **passenger ships**, there was no traffic in the port in 2023, hence there is no estimated need for any connection points. In total, there is an estimated need for 19 connection points for container ships and 3 connection points for cruise ships.

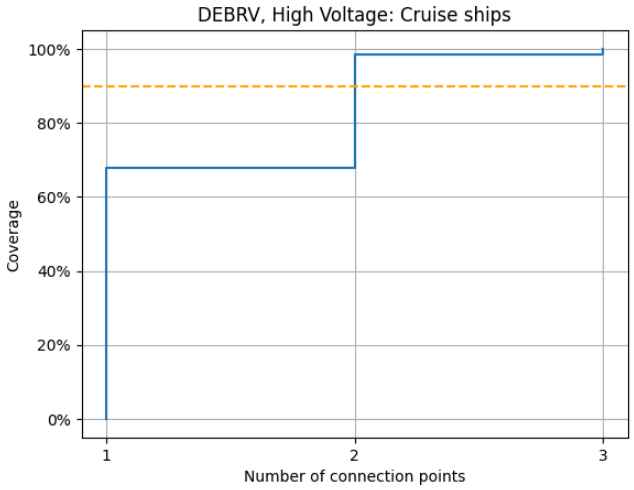
Table 6-19 Number of container and cruise ships at any day and passenger ships at any hour in 2023, and the estimated number of required connection points – split on low and high voltage.

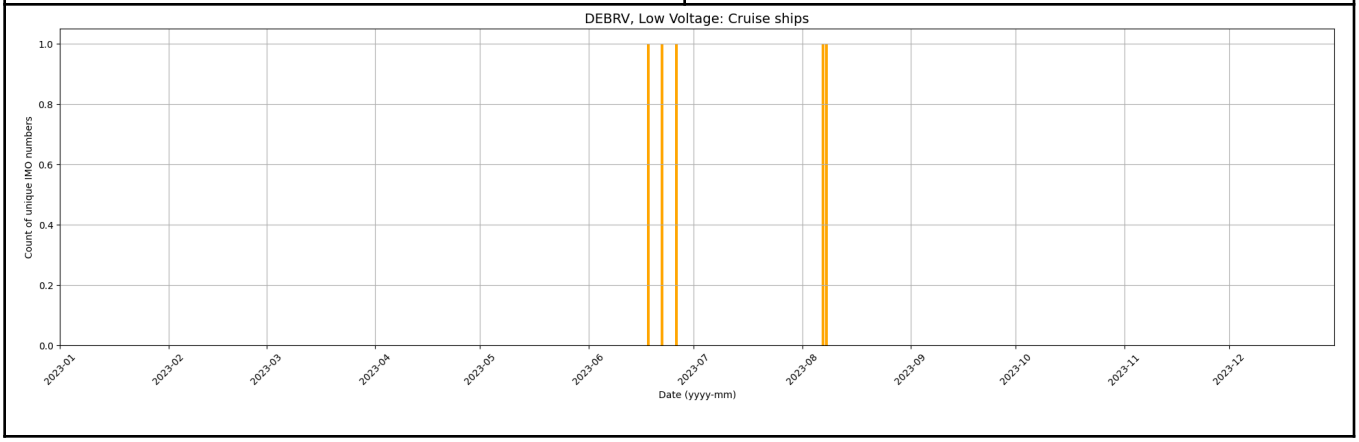
Bremerhaven	Low Voltage	High Voltage
Container ships – req. connection points	8	11

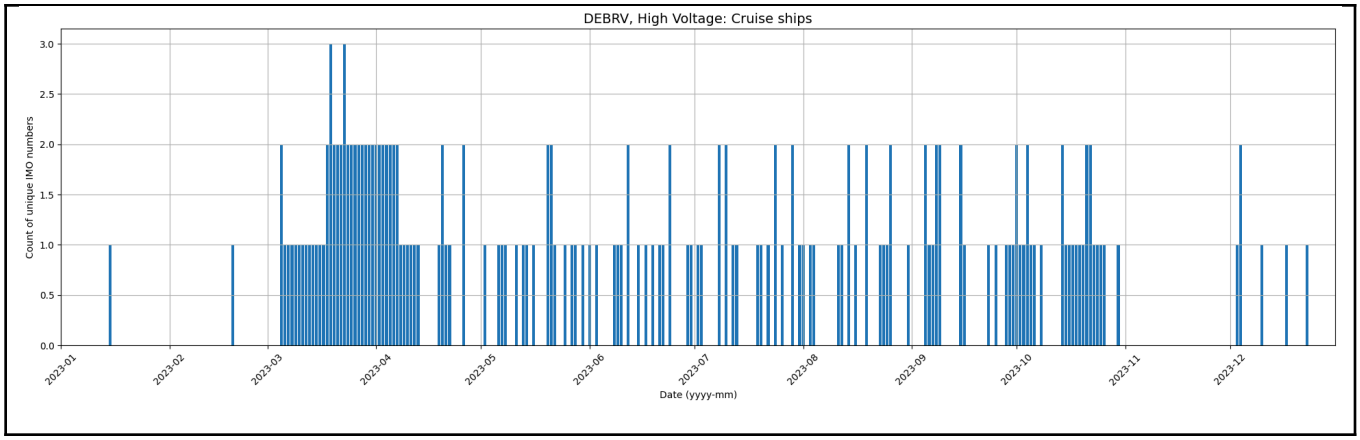




Bremerhaven	Low Voltage	High Voltage
Cruise ships – required connection points	1	2







Bremerhaven	Low Voltage	High Voltage
Passenger ships – req. connection points	0	0
No results		

6.5.2 Current status and plans for onshore power supply

There are currently no OPS systems in operation in the port of Bremerhaven, but the port has placed orders for systems to be delivered in 2025. The contracted OPS systems are listed in Table 6-20. The OPS systems for container ships will be portable, with sockets that can be moved along the berth. For cruise ships, a heavy crane connection system with 5 connectors is planned.

Capacity in the local electricity grid

According to the port, there is sufficient grid capacity for the first OPS installations, but this will be a challenge later when extending the systems, and a new main substation will be required.

Table 6-20 Contracted OPS in the port of Bremerhaven.

Max. no. of simultaneous ships	Types of ships	Max. system power capacity [kW]	System voltage	System frequency [Hz]	Standard	Operational from
3	Container	8 000	6.6-11 kV	50 and 60	IEC 80005-1	2025
1	Ro-Ro cargo (car carriers)	4 000	6.6-11 kV	50 and 60	IEC 80005-1	2025
1	Cruise	16 000	6.6-11 kV	50 and 60	IEC 80005-1	2025
3	Research	170 / 550	0,4 kV	50	IEC 80005-3	2023

6.6 Port of Constanța, Romania

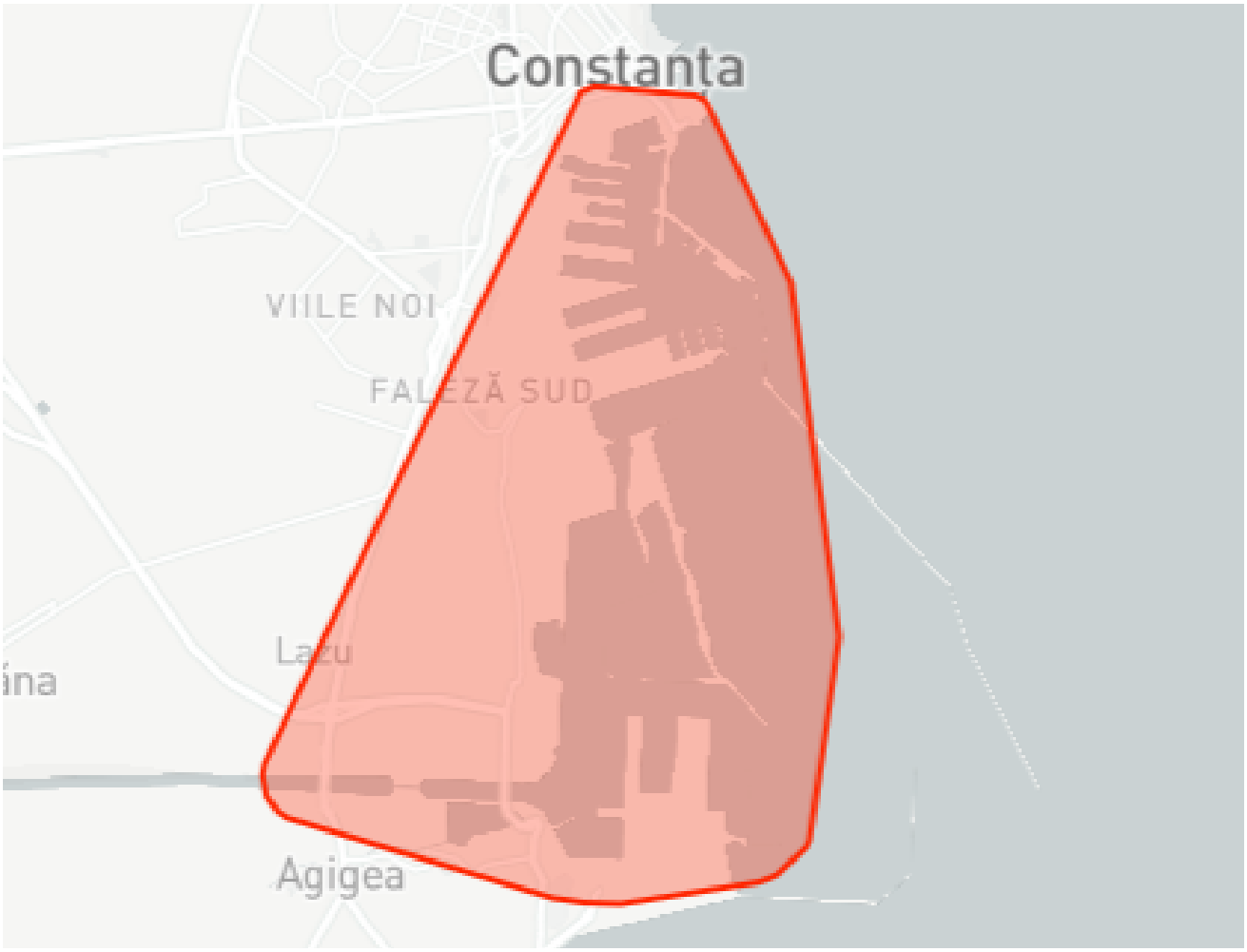


Figure 6-6 Port shape for Constanta (ROCND).

6.6.1 Current ship activity and energy requirements

Table 6-21 shows the effective hours in port per ship segment and size category for the port of Constanța in 2023. There are more than 18 000 effective hours in port for container ships larger than 5000 GT. For cruise ships larger than 5000 GT there are no effective hours in port, and for passenger ships larger than 5000 GT there are around 800 effective hours in port. Other segments with a high number of effective hours in the port are bulk carriers, chemical tankers, general cargo ships and other activities.

Table 6-21 Effective hours in port per ship segment and size category.

Constanta	400 - 999 GT	1000 - 4999 GT	5000 - 9999 GT	10000 - 24999 GT	25000 - 49999 GT	50000 - 99999 GT	100000 GT <	Total
Bulk carriers	1 645	1 429	8 831	72 427	85 052	8 431	42	177 857
Chemical tankers		17 319	9 362	20 752	7 739			55 172
Container ships		3 964	1 042	4 043	10 299	2 698	343	22 389
Crude oil tankers		66			79	5 009		5 154

Cruise ships		1 325						1 325
Fishing ships								0
Gas tankers		118	22					140
General cargo ships	3 423	113 258	37 505	18 416	263			172 865
Offshore supply ships	11 760	4 385	2 323					18 468
Oil product tankers		18 956	619		580			20 155
Other activities	36 622	7 139	1 000					44 761
Other service offshore ships			517	551				1 068
Passenger ships				813				813
Refrigerated cargo ships								0
Ro-Ro cargo ships		532	351	87	1 963	207		3 140
Total	53 450	168 491	61 572	117 089	105 975	16 345	385	523 307

Table 6-22 shows the estimated energy consumption per ship segment and power category for the port of Constanța in 2023. Most of the estimated energy consumption for container ships and all for passenger ships is in the power category 1-5 MW. Additionally, bulk carriers, chemical tankers and general cargo ships represents a large fraction of the total energy consumption in port.

Table 6-22 Estimated energy consumption in port (MWh) per ship segment and power category.

Constanta	<100 kW	100-500 kW	500-1000 kW	1-5 MW	5-10 MW	>10 MW	Total
Bulk carriers	64	56 621	4 454	0	0	0	61 139
Chemical tankers	0	1 716	7 452	32 546	0	0	41 714
Container ships	0	1 235	2 866	20 732	0	0	24 833
Crude oil tankers	0	16	77	6 261	0	0	6 354
Cruise ships	0	542	0	0	0	0	542
Fishing vessels	0	0	0	0	0	0	0
Gas tankers	0	45	0	22	0	0	67
General cargo ships	11 278	15 547	164	0	0	0	26 988
Offshore supply ships	800	947	1 203	0	0	0	2 950
Oil product tankers	0	4 568	889	0	0	0	5 457
Other activities	1 538	1 856	516	0	0	0	3 910
Other service offshore vessels	0	195	345	0	0	0	540
Passenger ships	0	0	0	1 390	0	0	1 390
Refrigerated cargo ships	0	0	0	0	0	0	0
Ro-Ro cargo ships	0	187	1 613	207	0	0	2 007
Total	13 680	83 476	19 579	61 158	0	0	177 893

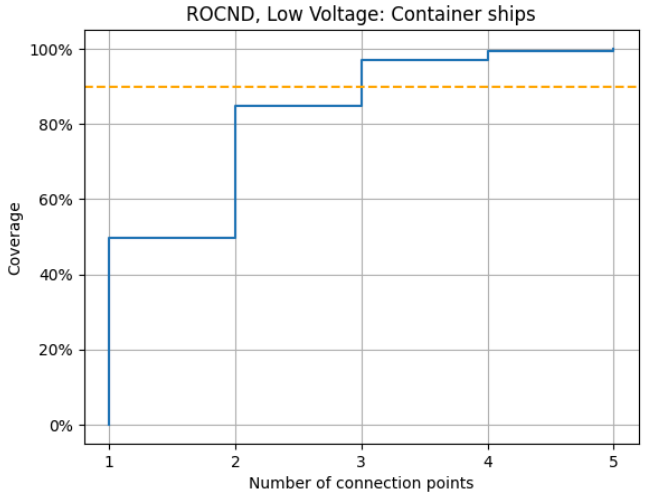
Table 6-23 presents simultaneous port calls for quantification of the need for low and high voltage connection points for container, cruise, and passenger ships above 5000 GT. There were some days in 2023 with 5 **container ships** requiring low voltage connection points in the port, but 3 such connection points would be sufficient for 90% coverage. Similarly, there

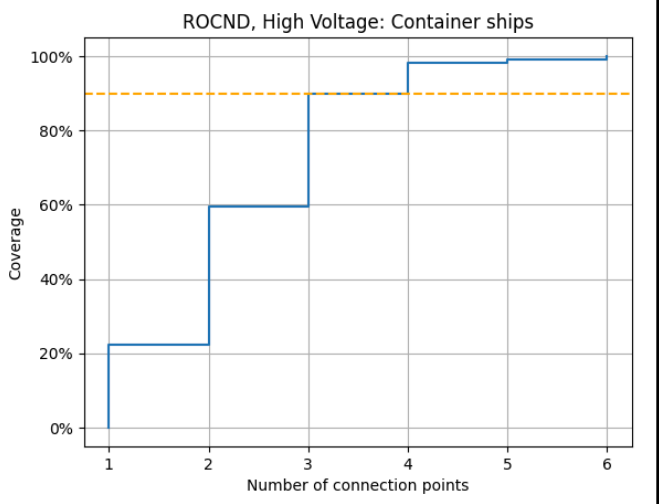
were some days in 2023 with more than 6 container ships requiring high voltage connection points in the port, but 3 such connection points would be sufficient for 90% coverage.

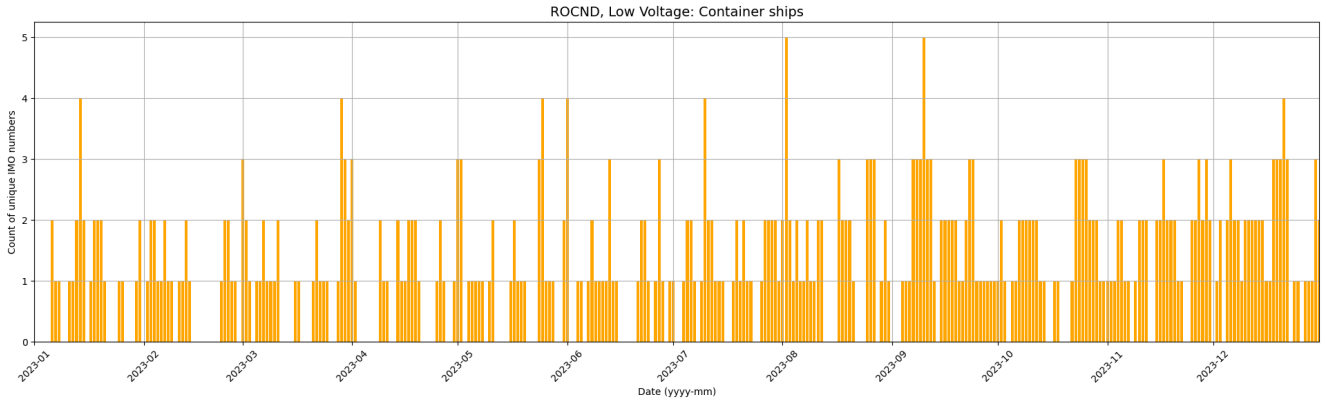
For **cruise ships**, there was no traffic in the port in 2023, hence there is no estimated need for any connection points. Since there were less than 40 port calls from **passenger ships** in 2023, it is assumed that there is no need for connection points for this segment either.

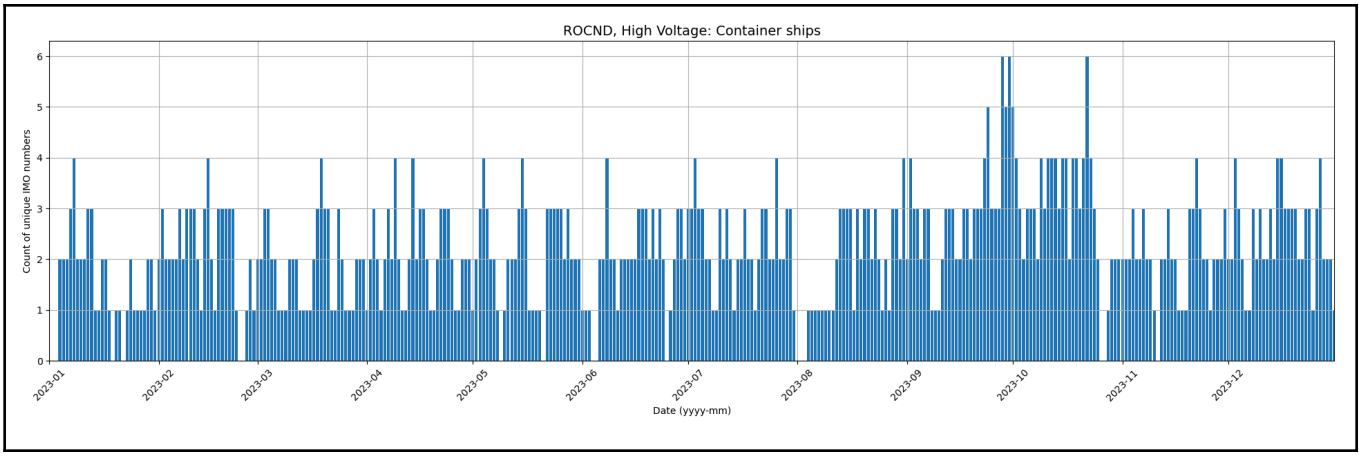
Table 6-23 Number of container and cruise ships at any day and passenger ships at any hour in 2023, and the estimated number of required connection points – split on low and high voltage.

Constanța	Low Voltage	High Voltage
Container ships – req. connection points	3	3



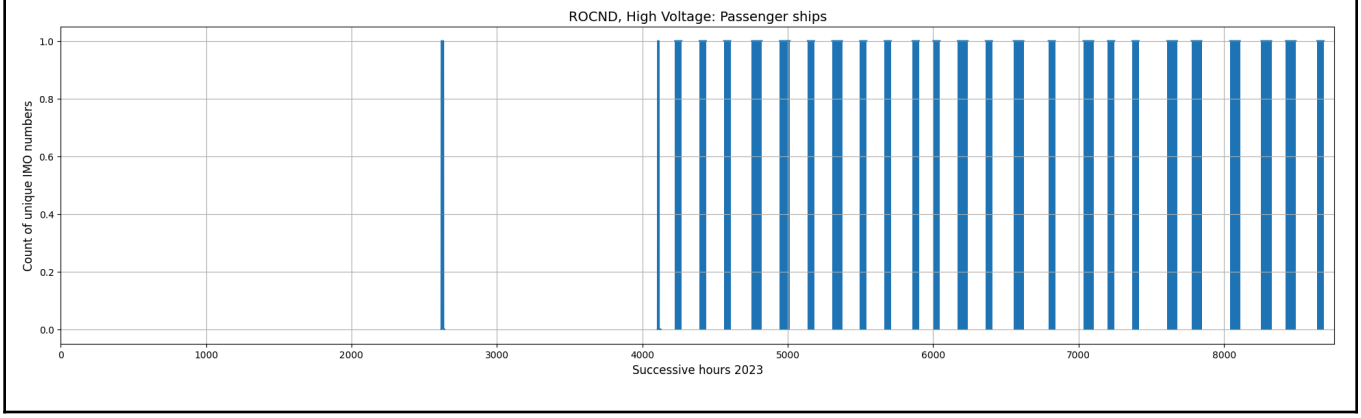






Constanța	Low Voltage	High Voltage
Cruise ships – required connection points	0	0
No results		

Constanța	Low Voltage	High Voltage
Passenger ships – req. connection points	0	0



6.6.2 Current status and plans for onshore power supply

In the port of Constanta, there are no OPS systems installed yet, and no concrete plans to install OPS either. However, the port is carrying out works for 10 berths, in order to connect all ships to shore power. A feasibility study has been performed, and the port plans to relaunch the design and execution procurement procedure during April 2024, following which the technical project will be elaborated. The plans include:

- 2 high voltage OPS systems for container ships;
- 1 high voltage OPS system for passenger ships;
- 2 high voltage OPS systems for tankers;
- 2 low voltage OPS systems for Ro-Ro ships;
- 1 low voltage OPS system for bulk carriers;
- 3 multipurpose low voltage OPS systems.

6.7 Port of Dublin, Ireland

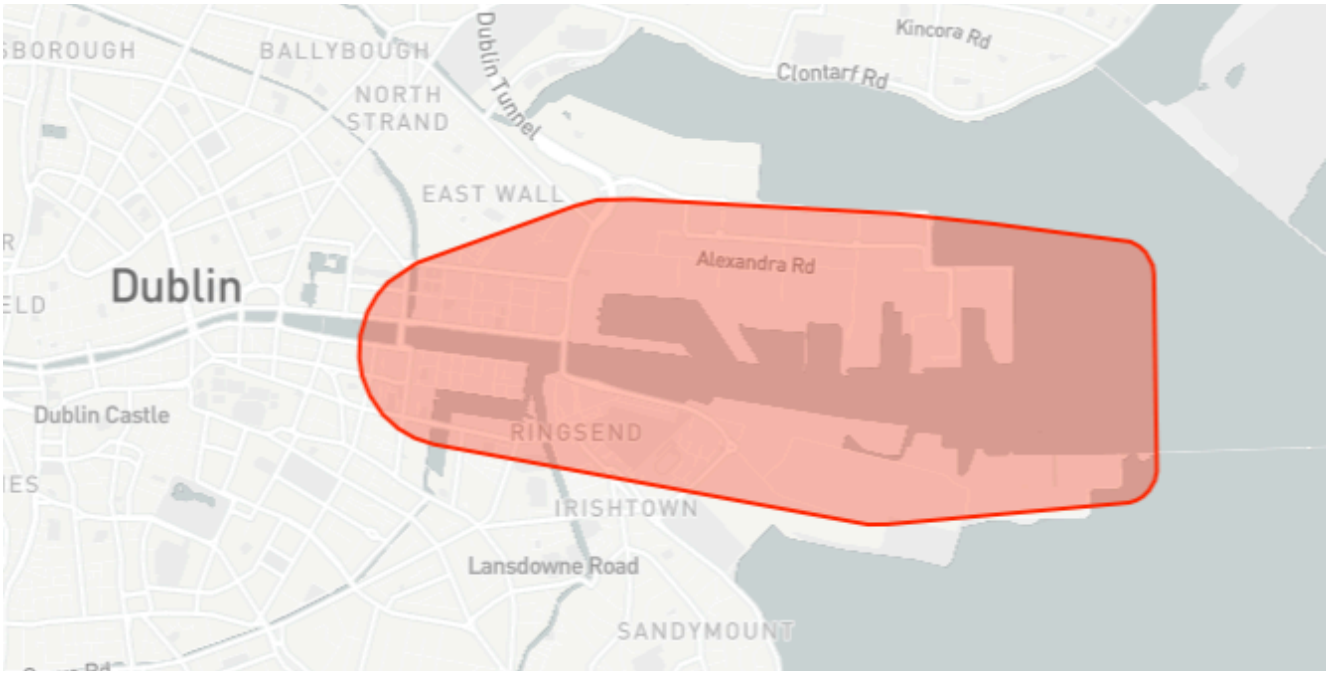


Figure 6-7 Port shape for Dublin (IEDUB).

6.7.1 Current ship activity and energy requirements

Table 6-24 shows the effective hours in port per ship segment and size category for the port of Dublin (Baile Átha Cliath) in 2023. There are around 28 000 effective hours in port for container ships larger than 5000 GT. For cruise ships larger than 5000 GT there are around 500 effective hours in port, and for passenger ships larger than 5000 GT there are more than 16 000 effective hours in port. Another segment with a substantial amount of effective hours in port is Ro-Ro cargo ships.

Table 6-24 Effective hours in port per ship segment and size category.

Dublin	400 - 999 GT	1000 - 4999 GT	5000 - 9999 GT	10000 - 24999 GT	25000 - 49999 GT	50000 - 99999 GT	100000 GT <	Total
Bulk carriers	607	1 839	245	1 877	1 858			6 426
Chemical tankers		2 784	280	7 167	461			10 692
Container ships			18 669	9 169				27 838
Crude oil tankers								0
Cruise ships		64	205	94	192			555
Fishing ships								0
Gas tankers		710	150					860
General cargo ships		6 527	1 922	412				8 861
Offshore supply ships		560						560
Oil product tankers		340	411	396				1 147
Other activities	451	1 392						1 843
Other service offshore ships								0

Passenger ships			3 407	3 726	5 930	3 578		16 641
Refrigerated cargo ships								0
Ro-Ro cargo ships			563	10 091	1 359	3 142		15 155
Total	1 058	14 216	25 852	32 932	9 800	6 720	0	90 578

Table 6-25 shows the estimated energy consumption per ship segment and power category for the port of Dublin (Baile Átha Cliath) in 2023. For container ships, the estimated energy consumption is split between the power categories 100-500 kW and 500-1000 kW. For cruise ships and passenger ships, however, most of the energy consumption is in the power category 1-5 MW. Additionally, for passenger ships, there is a notable portion of energy consumption in the power category 5-10 MW. Ro-Ro cargo ships also have a notable portion of energy consumption in port.

Table 6-25 Estimated energy consumption in port (MWh) per ship segment and power category.

Dublin	<100 kW	100-500 kW	500-1000 kW	1-5 MW	5-10 MW	>10 MW	Total
Bulk carriers	24	1 550	0	0	0	0	1 573
Chemical tankers	0	0	223	8 374	0	0	8 597
Container ships	0	9 278	6 501	0	0	0	15 779
Crude oil tankers	0	0	0	0	0	0	0
Cruise ships	0	26	191	972	0	0	1 189
Fishing vessels	0	0	0	0	0	0	0
Gas tankers	0	271	0	150	0	0	421
General cargo ships	646	590	0	0	0	0	1 237
Offshore supply ships	0	121	0	0	0	0	121
Oil product tankers	0	82	500	0	0	0	582
Other activities	19	362	0	0	0	0	381
Other service offshore vessels	0	0	0	0	0	0	0
Passenger ships	0	0	2 777	27 607	22 538	0	52 921
Refrigerated cargo ships	0	0	0	0	0	0	0
Ro-Ro cargo ships	0	180	7 356	3 148	0	0	10 684
Total	689	12 460	17 547	40 251	22 538	0	93 484

Table 6-26 presents simultaneous port calls for quantification of the need for low and high voltage connection points for container, cruise, and passenger ships above 5000 GT. There were some days in 2023 with 10 **container ships** requiring low voltage connection points in the port, but 8 such connection point would be sufficient for 90% coverage. There were no container ships requiring high voltage connection points in the port in 2023.

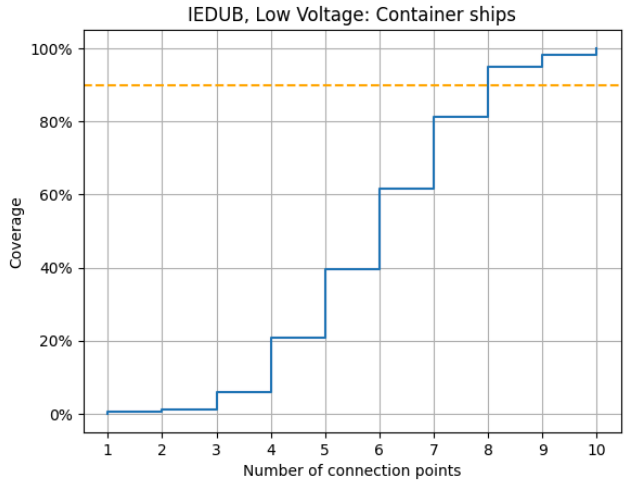
For 90% coverage, there is an estimated need for one low voltage and one high voltage connection point for **cruise ships**, although there were only a few days with such traffic in the port in 2023. The port should consider the expected increase in the cruise traffic to the port towards 2030, before investing in such connection points.

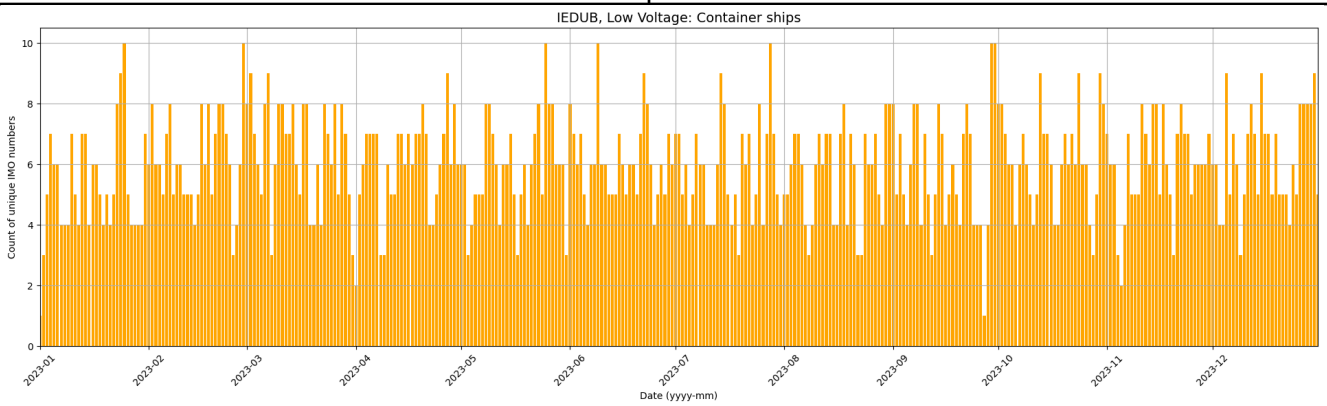
For **passenger ships**, there were some hours with a need for 2 low voltage connection points and one hour with a need for 7 high voltage connection points. However, 1 low voltage and 5 high voltage connection points would be sufficient for 90% coverage. In total, there is an estimated need for 8 connection points for container ships, 2 connection points for cruise ships, and 6 connection points for passenger ships.

Table 6-26 Number of container and cruise ships at any day and passenger ships at any hour in 2023, and the estimated number of required connection points – split on low and high voltage.

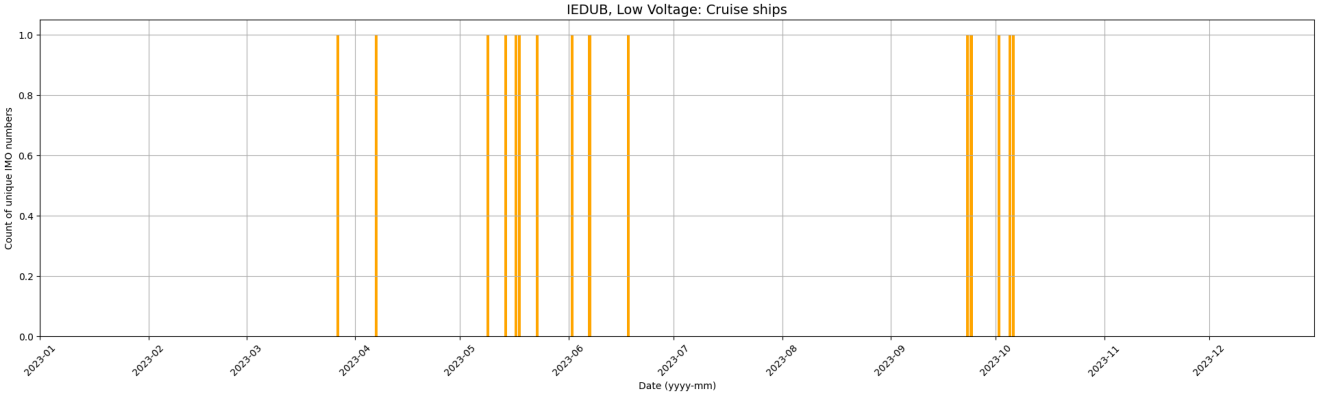
Dublin	Low Voltage	High Voltage

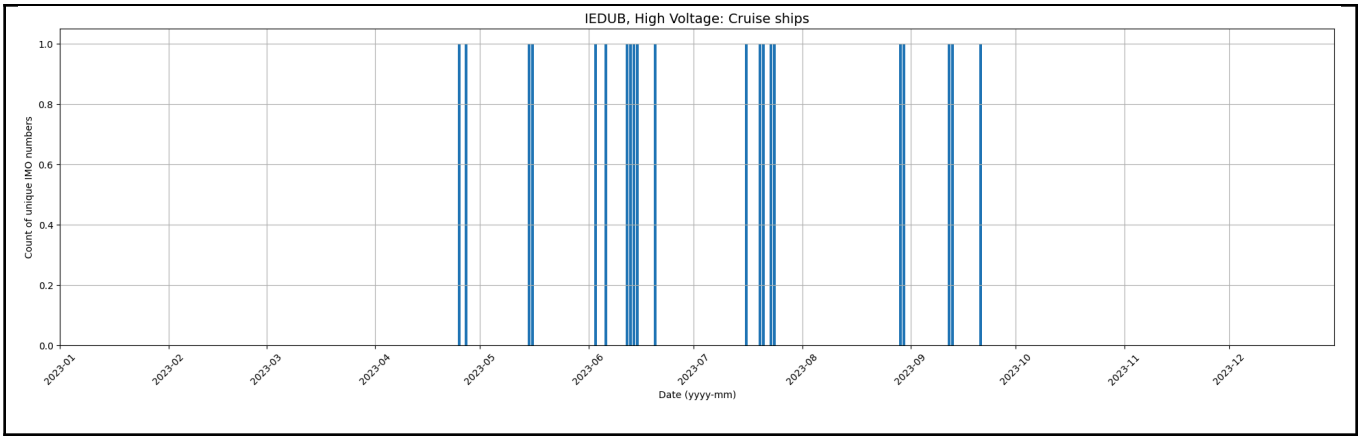
Container ships – req. connection points	8	0



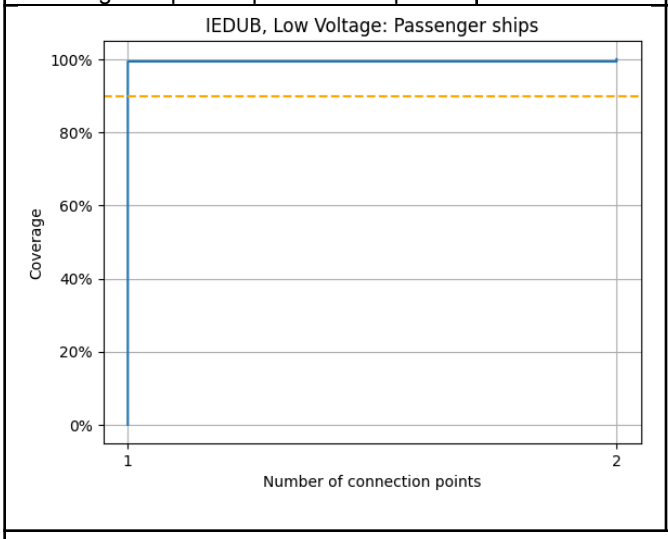


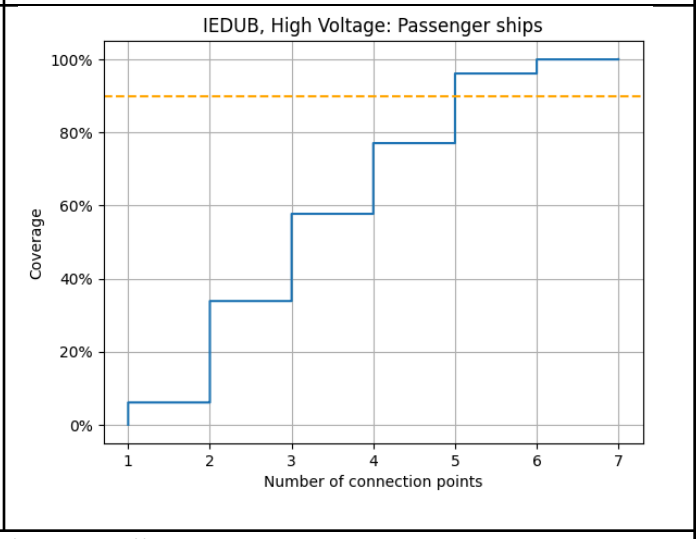
Dublin	**Low Voltage**	**High Voltage**
Cruise ships – required connection points	1	1

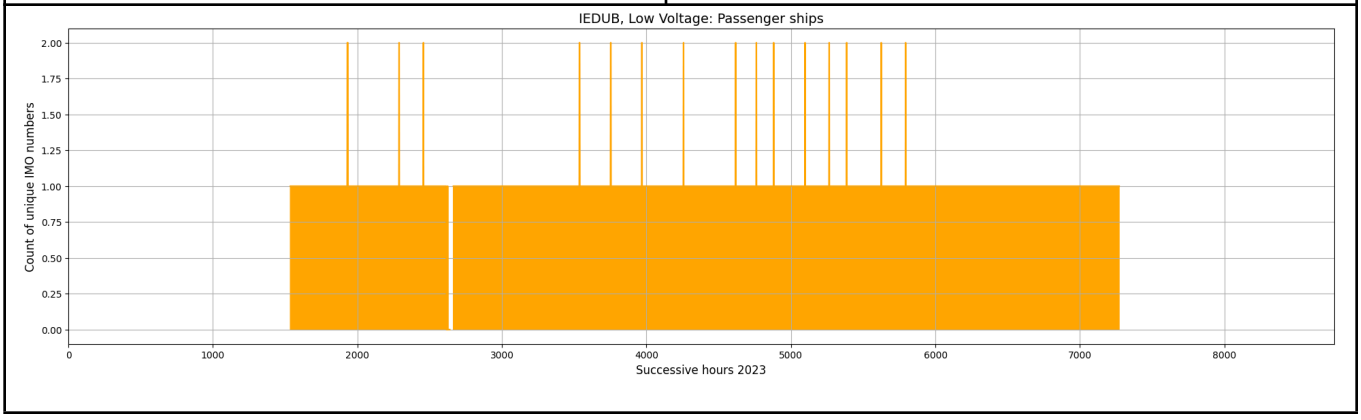


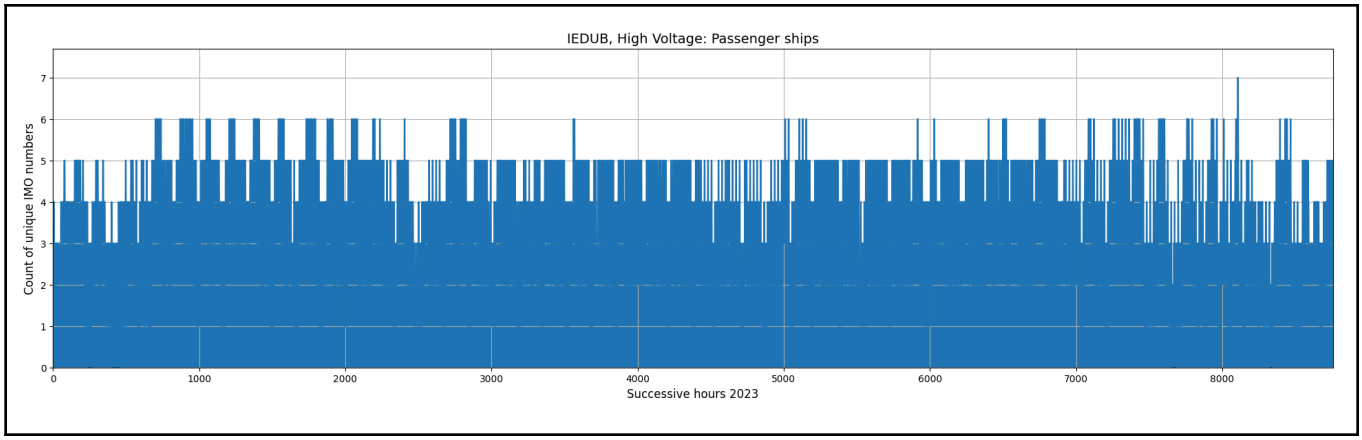


Dublin	Low Voltage	High Voltage
Passenger ships – req. connection points	1	5









6.7.2 Current status and plans for onshore power supply

In the port of Dublin, there are no OPS systems installed yet and no concrete plans regarding shore power. The port has a long-term plan of supplying OPS by 2030 and is currently in the preparation phase. The port is running feasibility studies, one regarding funding, as the electrical grid will need significant upgrading and costs are estimated to be high (100 million EUR range). In addition, one feasibility study is mapping the power demand to fully understand the total electricity consumption in the port.

Capacity in the local electricity grid

According to the port, the grid is fully utilized, so grid upgrades are needed. Today, the grid voltage level is 10 kV. There is ongoing refurbishment of the local grid, which might include a new 110 kVA transformer.

6.8 Port of Gdansk, Poland

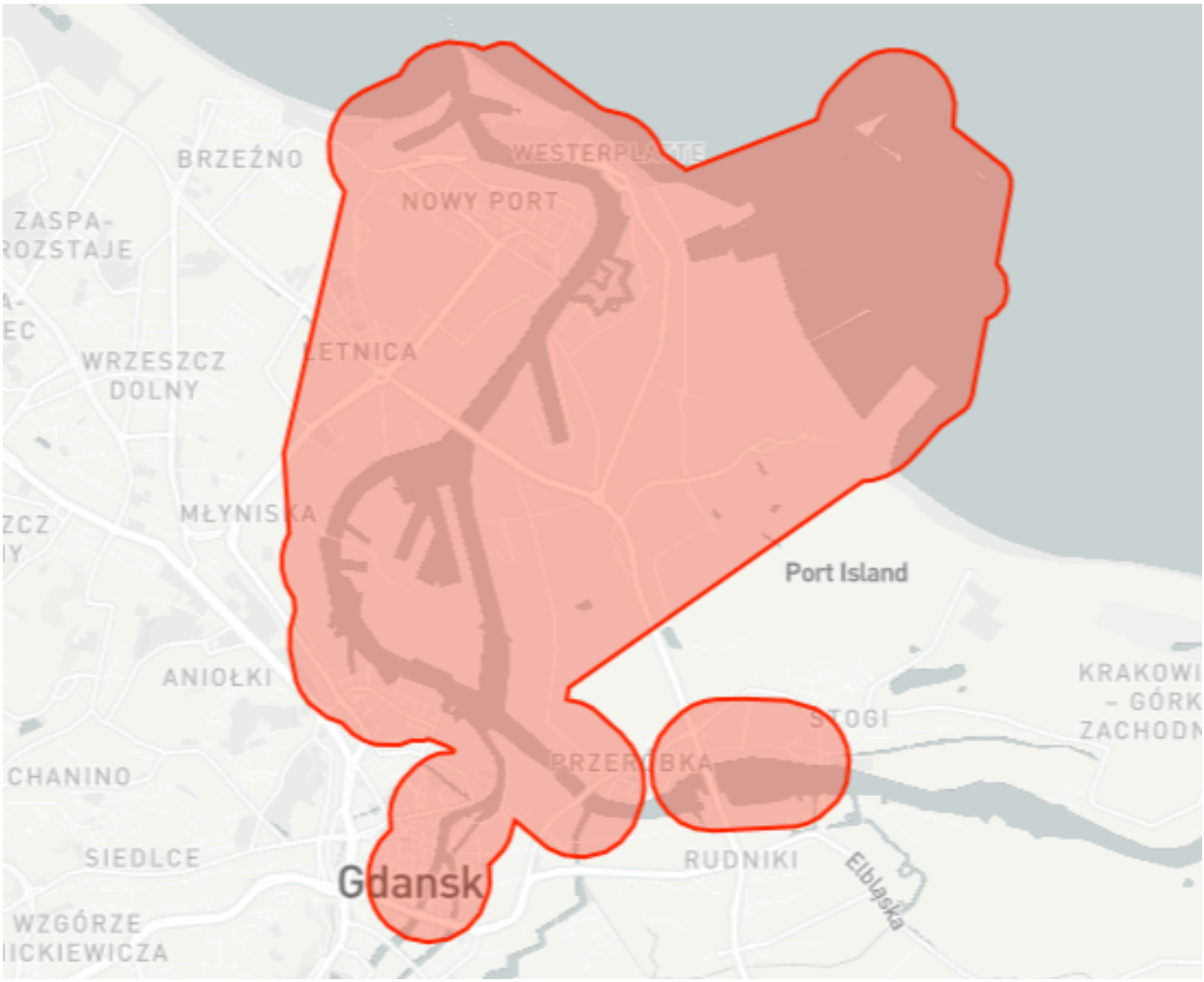


Figure 6-8 Port shape for Gdansk (PLGDN).

6.8.1 Current ship activity and energy requirements

Table 6-27 shows the effective hours in port per ship segment and size category for the port of Gdansk in 2023. There are around 19 000 effective hours in port for container ships larger than 5000 GT. For cruise ships larger than 5000 GT there are just above 300 effective hours in port, and for passenger ships larger than 5000 GT there are a little less than 8 000 effective hours in port. Other segments with a high number of effective hours in the port are bulk carriers, general cargo ships and other activities.

Table 6-27 Effective hours in port per ship segment and size category.

Gdansk	400 - 999 GT	1000 - 4999 GT	5000 - 9999 GT	10000 - 24999 GT	25000 - 49999 GT	50000 - 99999 GT	100000 GT <	Total
Bulk carriers		857	1 050	20 354	16 857	4 198		43 316
Chemical tankers		5 466	1 860	6 771	1 433			15 530
Container ships		664	931	4 689	4 406	181	8 785	19 656

Crude oil tankers				677	37	10 653	323	11 690
Cruise ships		104	92	35	209	8		448
Fishing ships								0
Gas tankers		1 491	2 224	1 344	2 344			7 403
General cargo ships	5 448	39 894	18 279	8 543	472			72 636
Offshore supply ships	1 075	11 140	33					12 248
Oil product tankers	4 741	1 388	1 056	159	478	110		7 932
Other activities	21 552	17 713	2 524	699		69		42 557
Other service offshore ships	557	407	234					1 198
Passenger ships	4 603			282	6 923	401		12 209
Refrigerated cargo ships		1 399	3 697	4 018				9 114
Ro-Ro cargo ships		139	1 695	1 901	1 182	53		4 970
Total	37 976	80 662	33 675	49 472	34 341	15 673	9 108	260 907

Table 6-28 shows the estimated energy consumption per ship segment and power category for the port of Gdansk in 2023. For the ship segments relevant for the upcoming regulations, most of the estimated energy consumption is in the power category 1-5 MW. Container and passenger ships represent about 45% of the total energy consumption. Other segments with substantial energy consumption in the port are bulk carriers, crude oil tankers, and general cargo ships.

Table 6-28 Estimated energy consumption in port (MWh) per ship segment and power category.

Gdansk	<100 kW	100-500 kW	500-1000 kW	1-5 MW	5-10 MW	>10 MW	Total
Bulk carriers	0	12 927	2 204	0	0	0	15 131
Chemical tankers	0	288	1 481	9 204	0	0	10 972
Container ships	0	583	3 325	36 369	0	0	40 277
Crude oil tankers	0	0	519	13 816	0	0	14 335
Cruise ships	0	43	86	926	58	0	1 112
Fishing vessels	0	0	0	0	0	0	0
Gas tankers	0	568	0	7 703	0	0	8 271
General cargo ships	4 053	7 409	295	0	0	0	11 757
Offshore supply ships	73	2 406	17	0	0	0	2 496
Oil product tankers	265	335	1 134	138	0	0	1 872
Other activities	905	4 605	1 899	133	0	0	7 543
Other service offshore vessels	35	179	0	0	0	0	214
Passenger ships	276	0	0	25 273	2 526	0	28 076
Refrigerated cargo ships	0	2 089	3 267	0	0	0	5 356
Ro-Ro cargo ships	0	560	2 121	53	0	0	2 734
Total	5 608	31 991	16 347	93 616	2 584	0	150 145

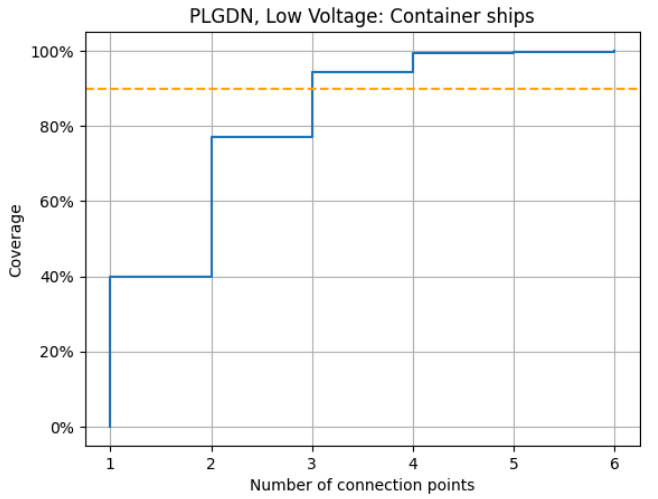
Table 6-29 presents simultaneous port calls for quantification of the need for low and high voltage connection points for container, cruise, and passenger ships above 5000 GT. There were some days in 2023 with 5 or 6 **container ships** requiring low voltage connection points in the port, but 3 such connection points would be sufficient for 90% coverage. Similarly, there were some days in 2023 with 5 or 6 container ships requiring high voltage connection points in the port, but 3 such connection points would be sufficient for 90% coverage.

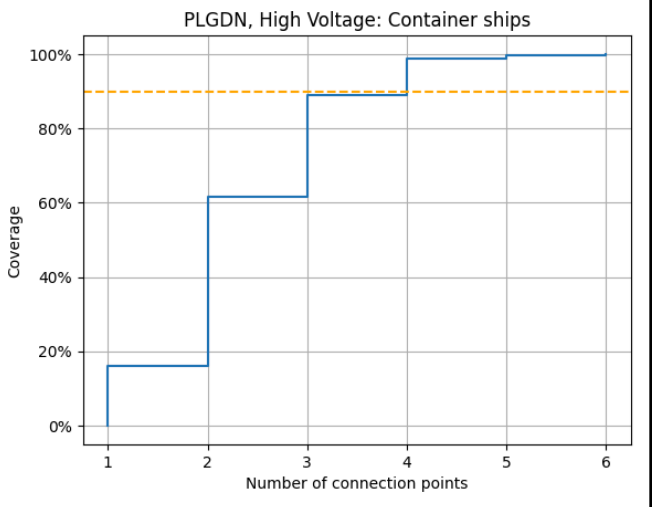
For 90% coverage, there is an estimated need for one low voltage connection point for **cruise ships**, although there were only a few days with such traffic in the port in 2023. The port should consider the expected increase in the cruise traffic to the port towards 2030, before investing in such a connection point. There were some days with a need for 2 high voltage connection points for cruise ships, but 1 such connection point would be sufficient for 90% coverage.

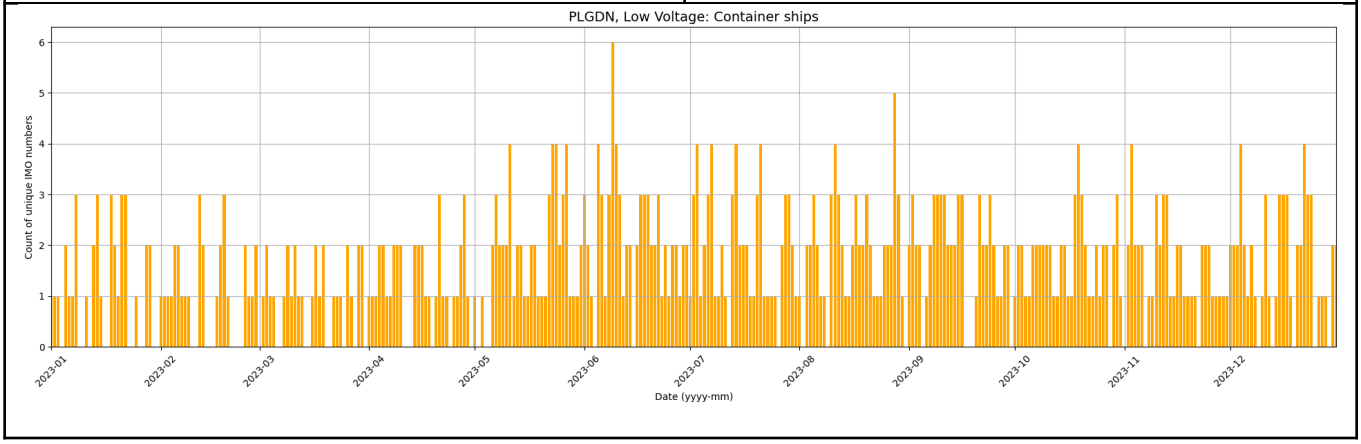
For **passenger ships**, there were some days in 2023 with a need for 4 or 5 high voltage connection points in the port, but 3 such connection points would be sufficient for 90% coverage. In total, there is an estimated need for 7 connection points for container ships, 2 connection points for cruise ships, and 3 connection points for passenger ships.

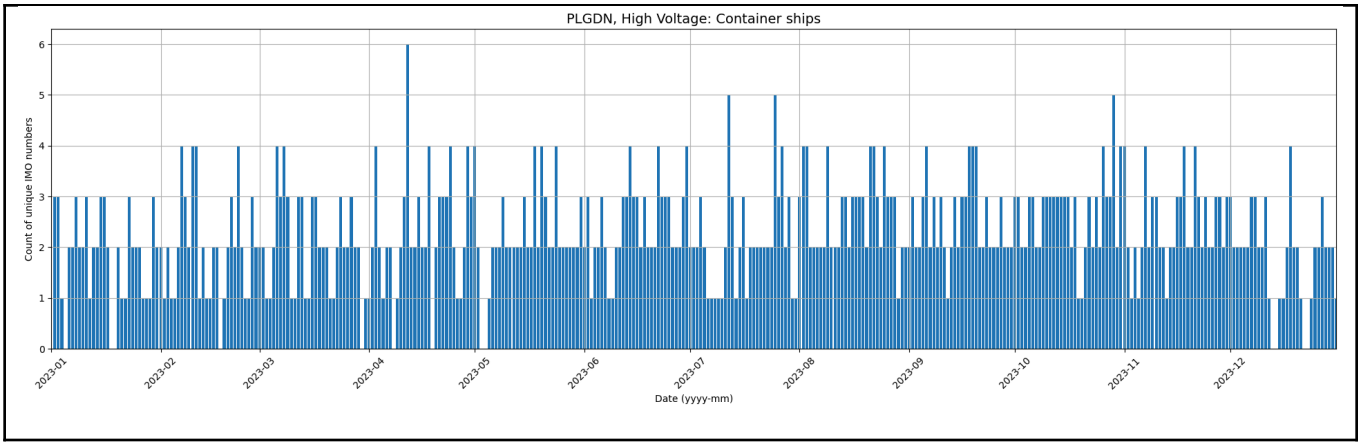
Table 6-29 Number of container and cruise ships at any day and passenger ships at any hour in 2023, and the estimated number of required connection points – split on low and high voltage.

Gdansk	Low Voltage	High Voltage
Container ships – req. connection points	3	4

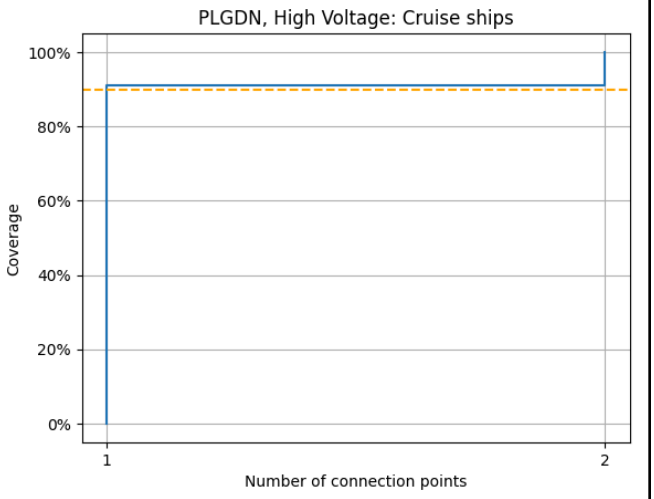


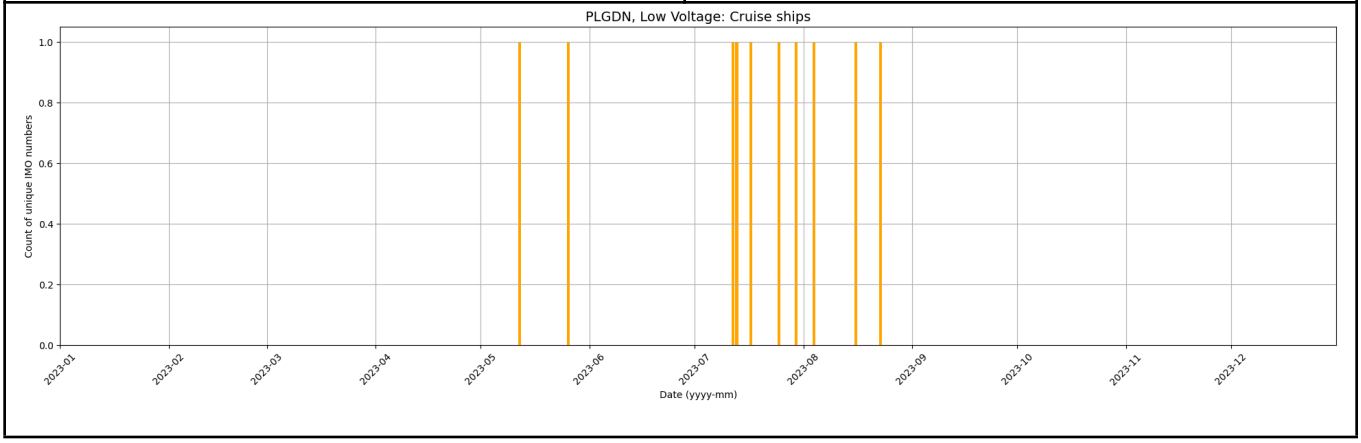


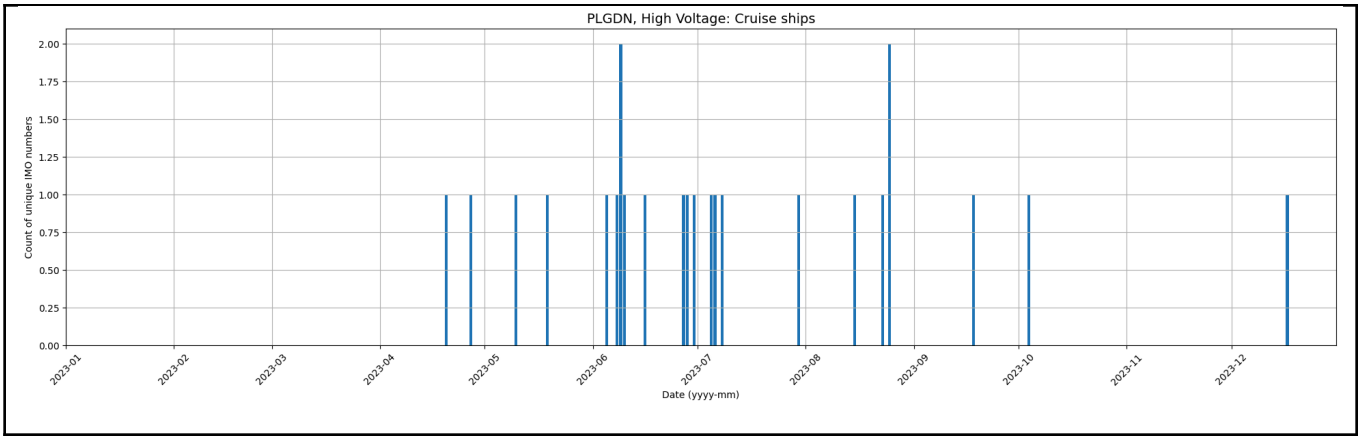




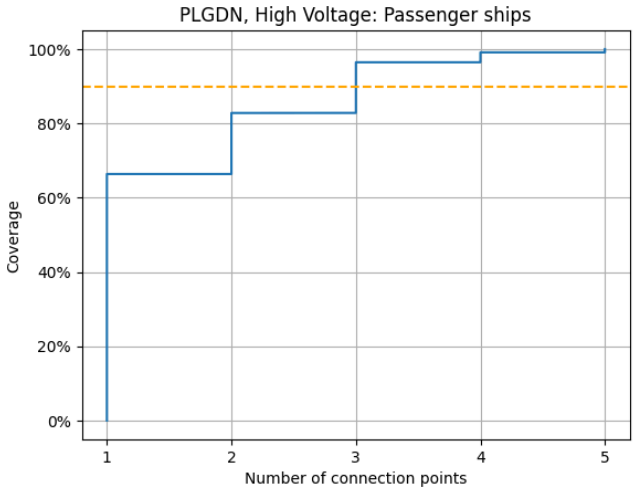
Gdansk	Low Voltage	High Voltage
Cruise ships – required connection points	1	1

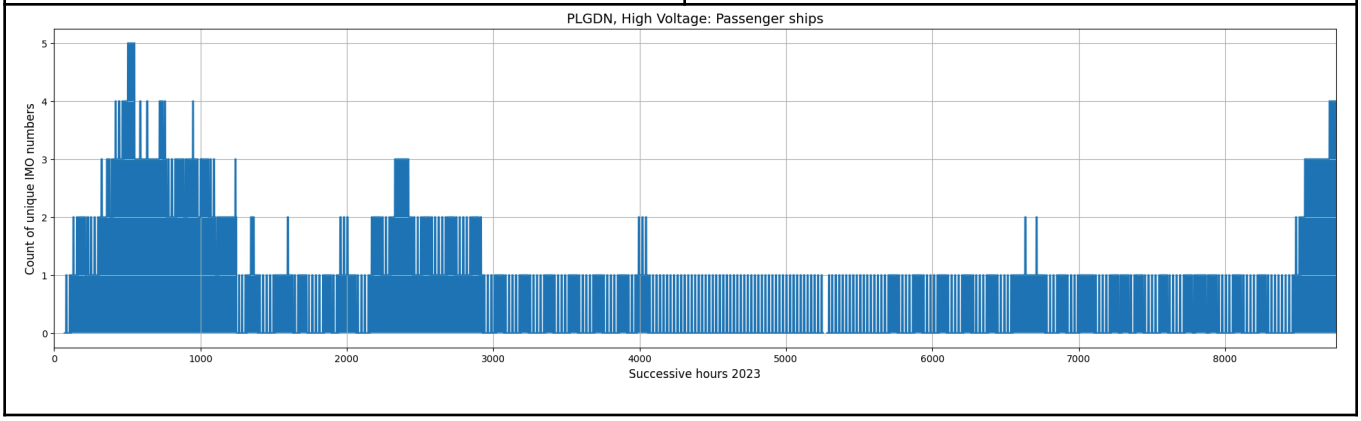






Gdansk	Low Voltage	High Voltage
Passenger ships – req. connection points	0	3





6.8.2 Current status and plans for onshore power supply

The port of Gdansk does not have any OPS systems in place. However, the port is currently rebuilding two quays and two more are out on public tender. The quays will be built so that OPS can be implemented. The main activity in the port is from container ships, hence the container terminal will likely be the first quay to offer OPS. The port has applied for EU funds.

Capacity in the local electricity grid

According to the port, one of the main challenges is the electricity grid, including the availability of renewable energy. Most of the available power today comes from coal plants, but the government is in a process of implementing new power plants, including offshore wind farms in the Baltic Sea.

6.9 Port of Genoa, Italy

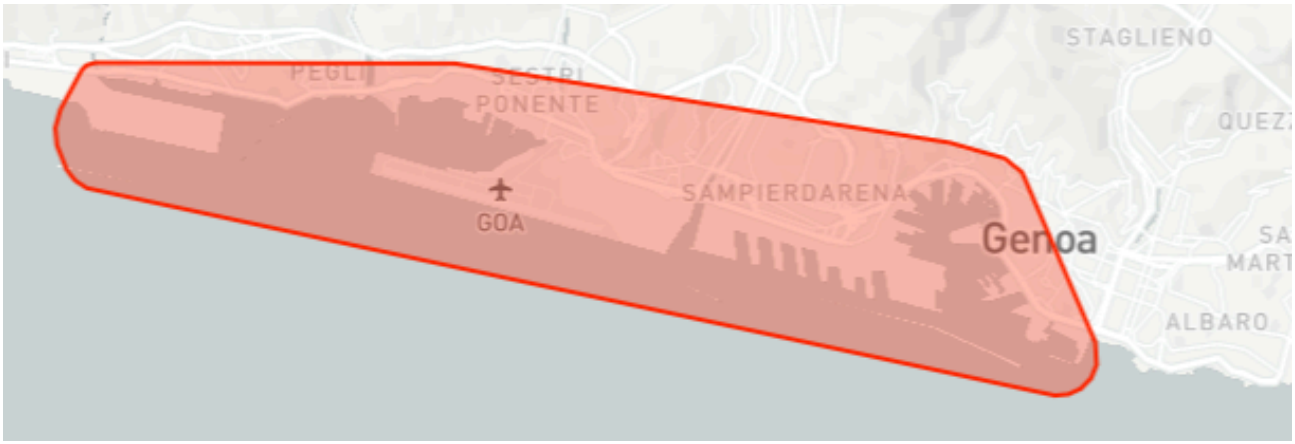


Figure 6-9 Port shape for Genoa (ITGEO).

6.9.1 Current ship activity and energy requirements

Table 6-30 shows the effective hours in port per ship segment and size category for the port of Genoa in 2023. There are around 40 000 effective hours in port for container ships larger than 5000 GT. For cruise ships larger than 5000 GT there are around 5000 effective hours in port, and for passenger ships larger than 5000 GT there are more than 30 000 effective hours in port. Other segments with a notable number of effective hours in the port are general cargo ships, oil product tankers and other activities.

Table 6-30 Effective hours in port per ship segment and size category.

Genoa	400 - 999 GT	1000 - 4999 GT	5000 - 9999 GT	10000 - 24999 GT	25000 - 49999 GT	50000 - 99999 GT	100000 GT <	Total
Bulk carriers		151	1 250	1 084	2 653			5 138
Chemical tankers		2 996	2 231	6 494	3 930			15 651
Container ships			2 841	7 032	7 935	12 896	9 503	40 207
Crude oil tankers					214	5 713		5 927
Cruise ships		48	12	335	589	1 914	2 186	5 084
Fishing ships								0
Gas tankers				661	1 272			1 933
General cargo ships	6 345	9 436	6 899	4 705	516			27 901
Offshore supply ships	166	56						222
Oil product tankers		28 844		167	793			29 804
Other activities	92 853	43 904	1 646		1 238			139 641
Other service offshore ships								0

Passenger ships	330	1 982	675	4 813	25 741	225		33 766
Refrigerated cargo ships								0
Ro-Ro cargo ships			446	7 962	6 413	5 410		20 231
Total	99 694	87 417	16 000	33 253	51 294	26 158	11 689	325 505

Table 6-31 shows the estimated energy consumption per ship segment and power category for the port of Genoa in 2023. For container ships and passenger ships, most of the estimated energy consumption is in the power category 1-5 MW. For cruise ships, most of the estimated energy consumption is in the highest power category (> 10 MW). The three main ship segments represent more than 75% of the total estimated energy consumption in port. Other segments with substantial energy consumption in the port are other activities, Ro-Ro cargo ships, and chemical tankers.

Table 6-31 Estimated energy consumption in port (MWh) per ship segment and power category.

Genoa	<100 kW	100-500 kW	500-1000 kW	1-5 MW	5-10 MW	>10 MW	Total
Bulk carriers	0	1 625	0	0	0	0	1 625
Chemical tankers	0	0	1 776	12 139	0	0	13 915
Container ships	0	1 412	4 986	72 694	0	0	79 092
Crude oil tankers	0	0	207	7 141	0	0	7 349
Cruise ships	0	20	11	3 073	13 815	21 882	38 801
Fishing vessels	0	0	0	0	0	0	0
Gas tankers	0	0	0	2 888	0	0	2 888
General cargo ships	1 055	3 371	322	0	0	0	4 748
Offshore supply ships	11	12	0	0	0	0	23
Oil product tankers	0	6 951	888	0	0	0	7 839
Other activities	3 900	11 415	849	1 835	0	0	17 999
Other service offshore vessels	0	0	0	0	0	0	0
Passenger ships	20	708	550	100 409	1 417	0	103 104
Refrigerated cargo ships	0	0	0	0	0	0	0
Ro-Ro cargo ships	0	142	10 044	5 421	0	0	15 607
Total	4 986	25 656	19 634	205 600	15 233	21 882	292 989

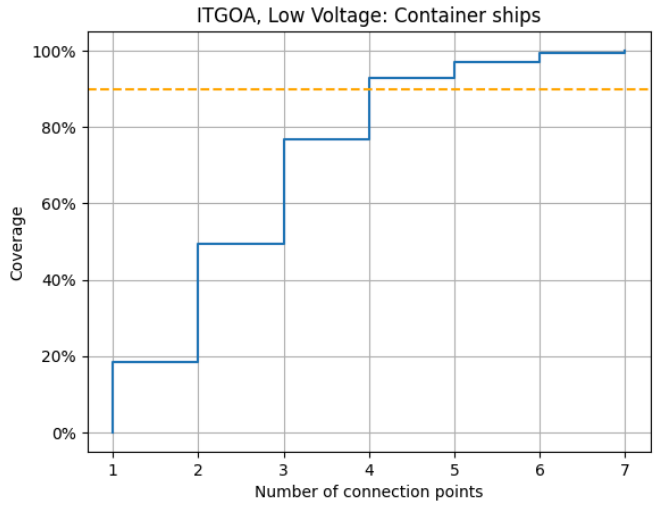
Table 6-32 presents simultaneous port calls for quantification of the need for low and high voltage connection points for container, cruise, and passenger ships above 5000 GT. There were some days in 2023 with 6 or 7 **container ships** requiring low voltage connection points in the port, but 4 such connection points would be sufficient for 90% coverage. Similarly, there were some days in 2023 with more than 10 container ships requiring high voltage connection points in the port, but 8 such connection points would be sufficient for 90% coverage.

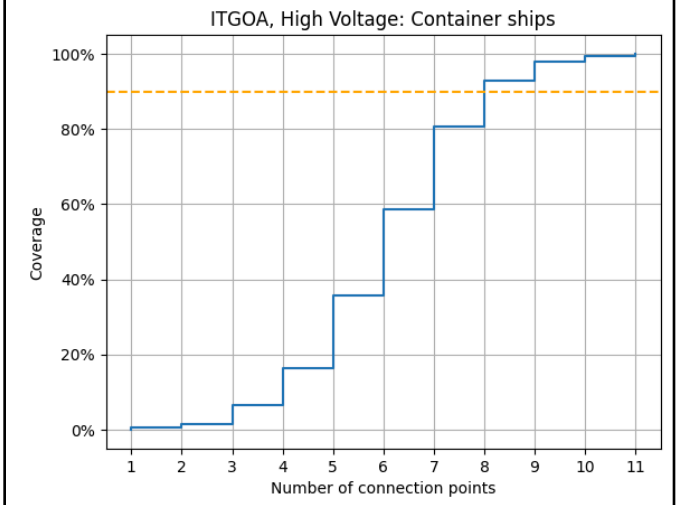
For 90% coverage, there is an estimated need for one low voltage connection point for **cruise ships**, although there were only a few days with such traffic in the port in 2023. Unless a significant increase in the cruise traffic to the port is expected towards 2030, the port should not invest in such a connection point. There were some days with a need for 5 high voltage connection points for cruise ships, but 3 such connection points would be sufficient for 90% coverage.

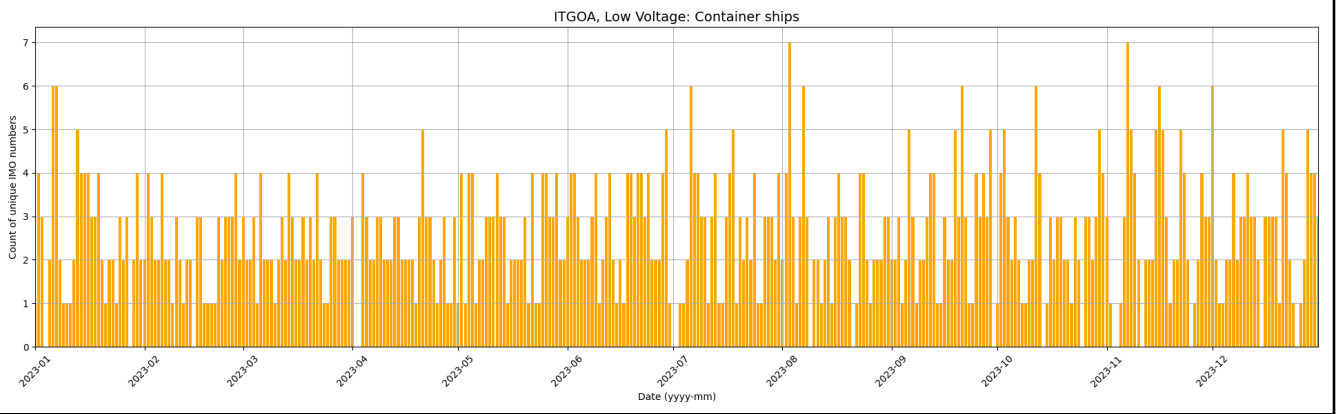
For passenger **ships**, 1 low voltage connection point is needed for 90% coverage, although there were only a few hours with such traffic in 2023. There were some hours with a need for more than 12 high voltage connection points for passenger ships, but 8 such connection points would be sufficient for 90% coverage. In total, there is an estimated need for 12 connection points for container ships, 4 connection points for cruise ships, and 9 connection points for passenger ships.

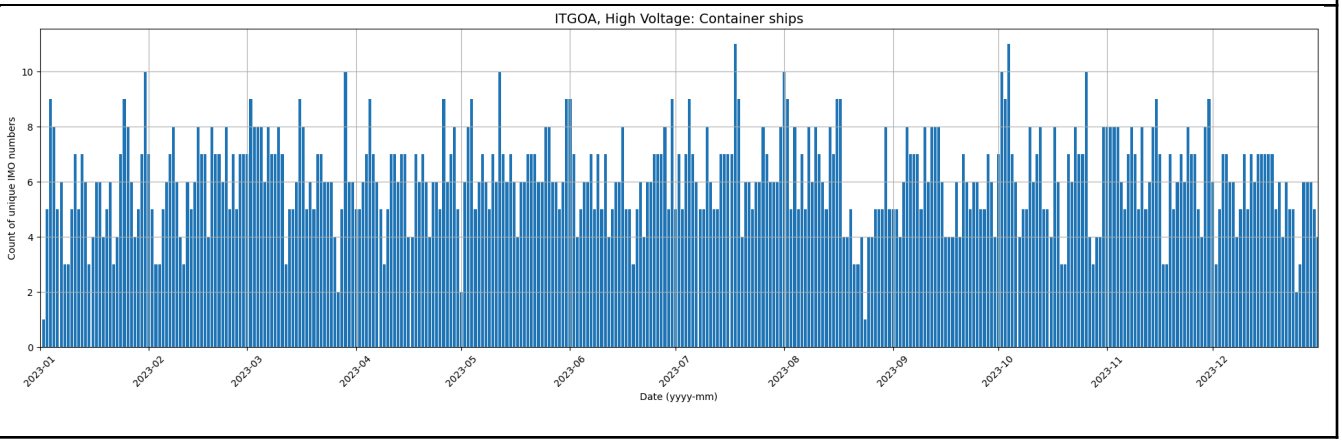
Table 6-32 Number of container and cruise ships at any day and passenger ships at any hour in 2023, and the estimated number of required connection points – split on low and high voltage.

Genoa	Low Voltage	High Voltage
Container ships – req. connection points	4	8

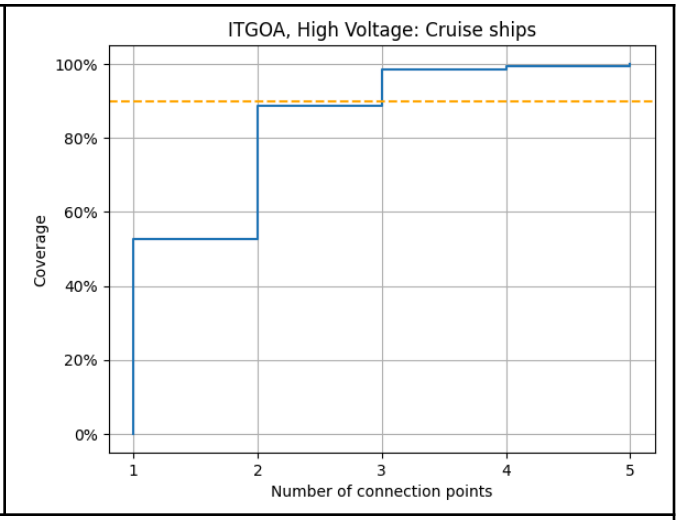


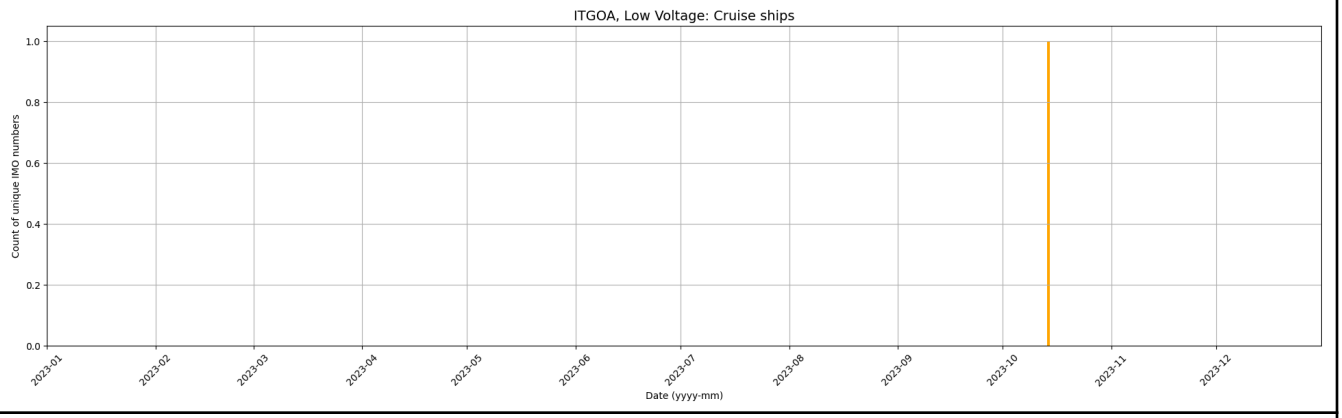


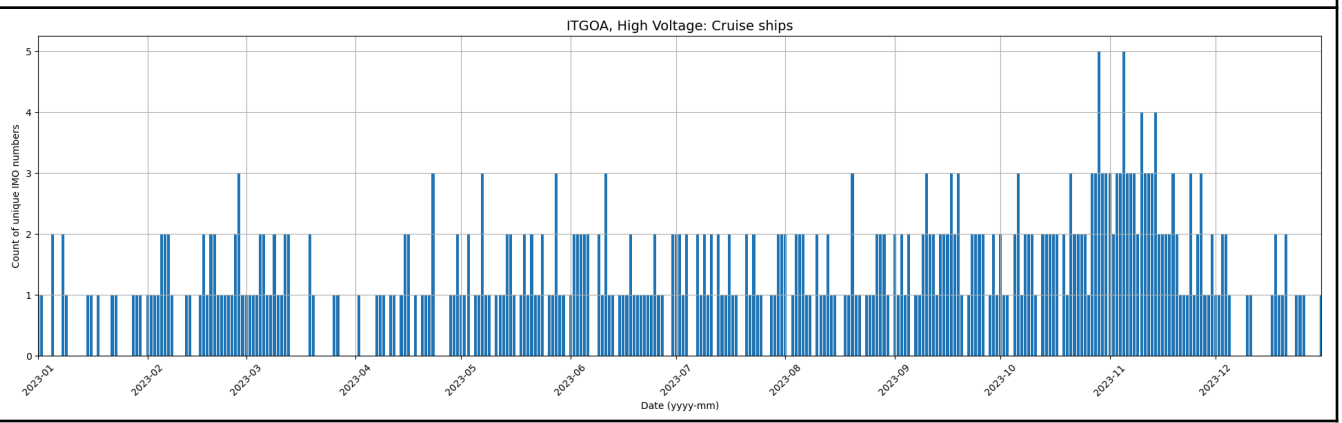




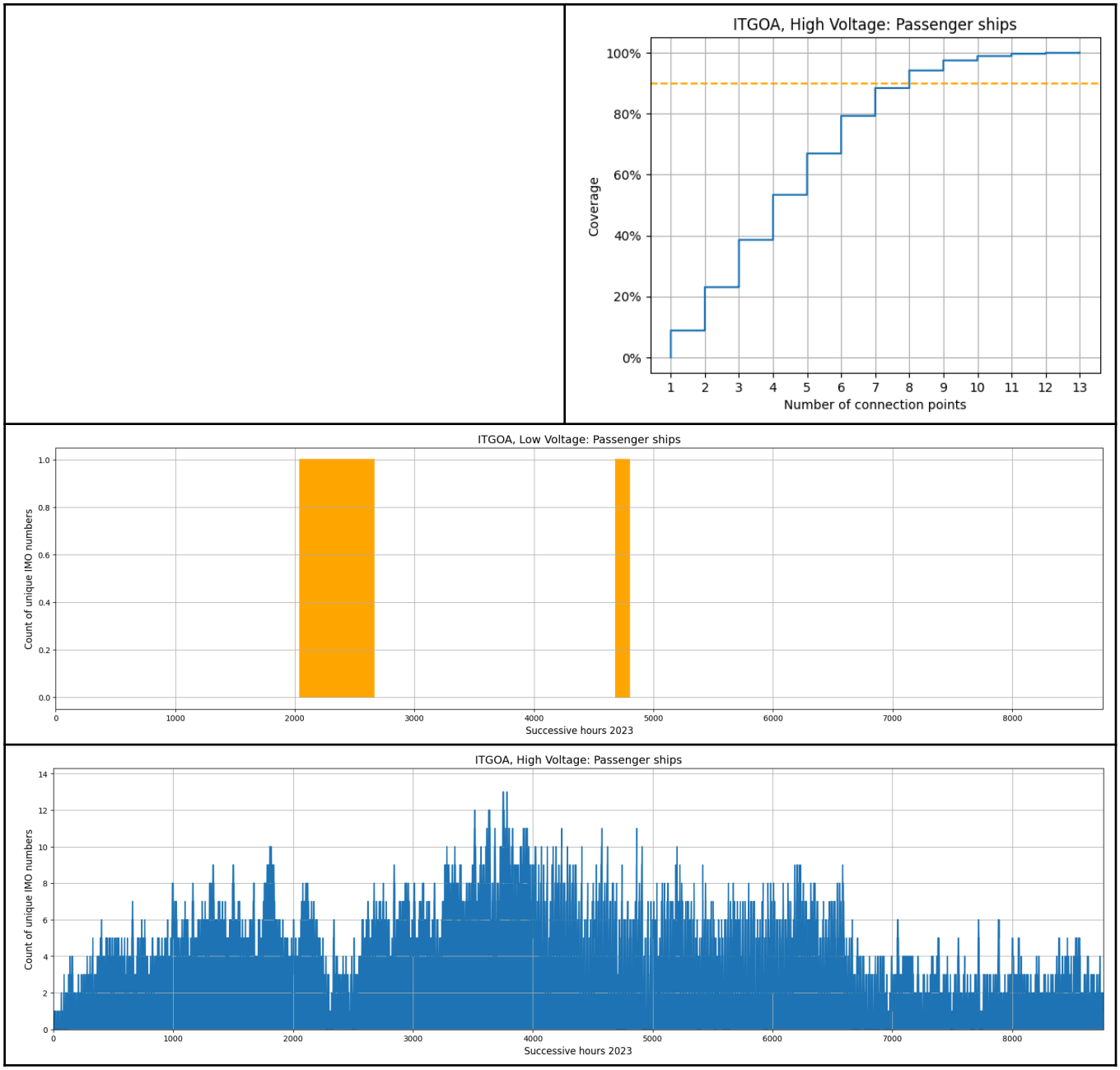
Genoa	Low Voltage	High Voltage
Cruise ships – required connection points	1	3







Genoa	Low Voltage	High Voltage
Passenger ships – req. connection points	1	8



6.9.2 Current status and plans for onshore power supply

In the port of Genoa, low voltage OPS systems have been in operation at the repair quay since 2018 (Table 6-33). A total of 15 simultaneous ships of all types can be served by these systems. However, they are not counted in this analysis, since they cannot be used by ships in normal operation. The port has contracted high voltage OPS systems for container, cruise, and passenger ships, as shown in Table 6-33.

Capacity in the local electricity grid

According to the port, the maximum power available from the grid at the repair quay is 12 MW. At the container terminal, the maximum power available from the grid is 10 MW, while at the cruise and passenger terminal there is a total of 42 MW available.

Table 6-33 Installed and contracted OPS in the port of Genoa.

Berth name	Max. power from grid [MW]	Max. no. of simulta-neous ships	Types of ships	Max. system power cap. [kW]	System voltage	System freq. [Hz]	Standard	Availa-bility	Opera-tive from
Riparazio-ni navali	12	6	All types (repair quay)	10 000	400-690 V	50 and 60	IEC 80005-3	Public	2018
Riparazio-ni navali	12	4	All types (repair quay)	2 000	400-690 V	50 and 60	IEC 80005-3	Public	2018
Riparazio-ni navali	12	3	All types (repair quay)	800	400-690 V	50 and 60	IEC 80005-3	Public	2018
Riparazio-ni navali	12	2	All types (repair quay)	800	400-690 V	50 and 60	IEC 80005-3	Public	2018
Voltri Terminal Europa Container	10	4	Container	6 500	6.6-11 kV	50 and 60	IEC 80005-1	Public	2024
Terminal crociere e traghetti	42	3	Cruise	10 000	6.6-11 kV	50 and 60	IEC 80005-1	Public	2025-26
Terminal crociere e traghetti	42	4	Passenger	6 500	6.6-11 kV	50 and 60	IEC 80005-1	Public	2026

6.10 Port of Ghent, Belgium

Ghent is organized together with Terneuzen and Vlissingen as Northsea Port, but the results presented here relate to the port with UN/LOCODE BEGNE (Figure 6-10).

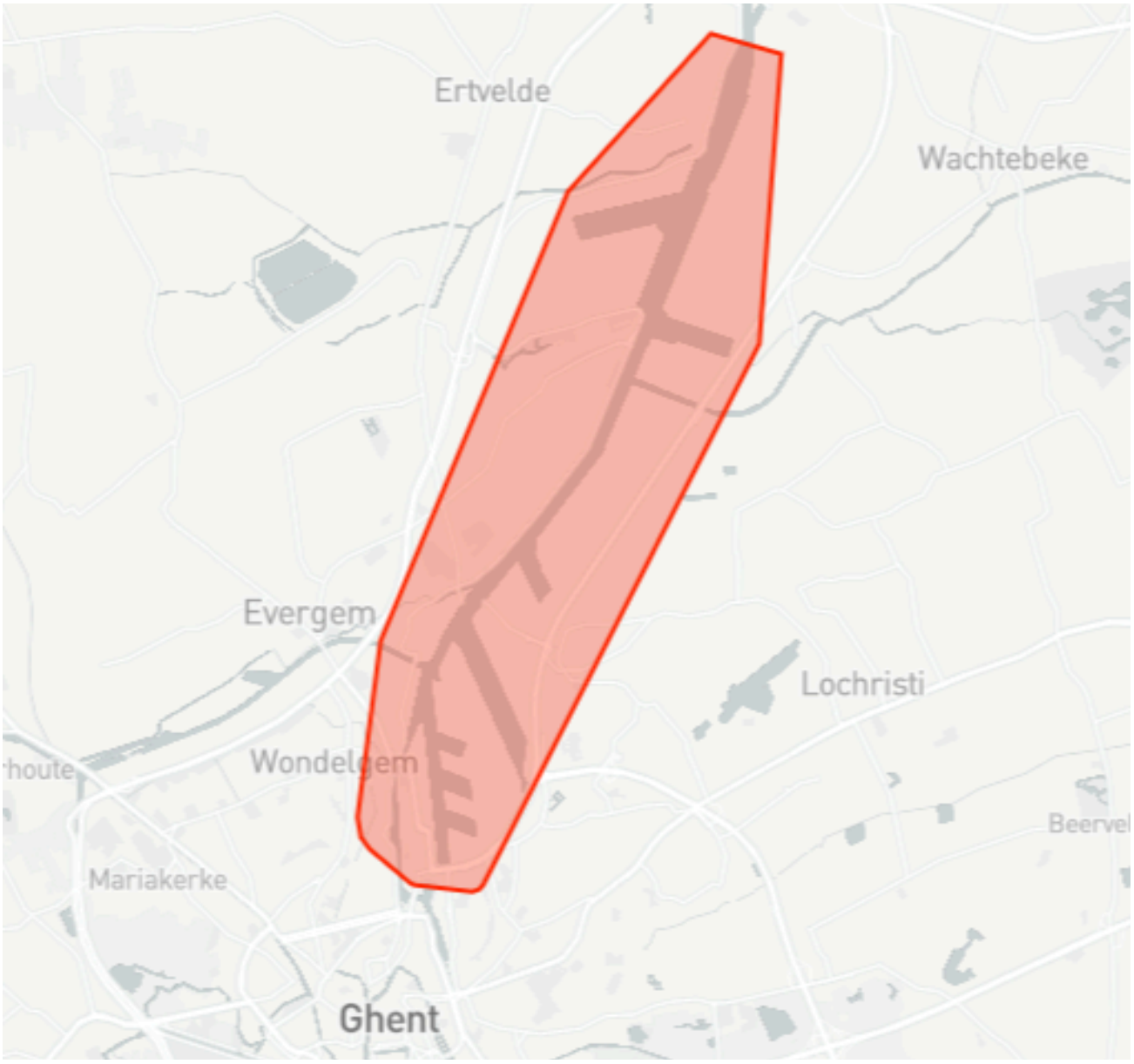


Figure 6-10 Port shape for Ghent (BEGNE).

6.10.1 Current ship activity and energy requirements

Table 6-34 shows the effective hours in port per ship segment and size category for the port of Ghent in 2023. There are around 200 effective hours in port for container ships larger than 5000 GT. For cruise ships and passenger ships larger than 5000 GT there are no effective hours in port. Other segments with a high number of effective hours in the port are bulk carriers, chemical tankers and general cargo ships.

Table 6-34 Effective hours in port per ship segment and size category.

Ghent	400 - 999 GT	1000 - 4999 GT	5000 - 9999 GT	10000 - 24999 GT	25000 - 49999 GT	50000 - 99999 GT	100000 GT <	Total
Bulk carriers	119	1 283	1 139	13 492	39 140			55 173
Chemical tankers	2 012	37 560	7 117	5 633	4 970			57 292

Container ships		1 252	220					1 472
Crude oil tankers			228					228
Cruise ships		726						726
Fishing ships	6	2						8
Gas tankers								
General cargo ships	1 716	59 645	13 399	3 250	956			78 966
Offshore supply ships								
Oil product tankers	1 229	4 653	237	38	113			6 270
Other activities	3 819	1 071	95					4 985
Other service offshore ships			275	265				540
Passenger ships								
Refrigerated cargo ships								
Ro-Ro cargo ships		169	78		1 915	792		2 955
Total	8 901	106 360	22 787	22 678	47 094	792		208 614

Table 6-35 shows the estimated energy consumption per ship segment and power category for the port of Ghent in 2023. For both cruise and container ships, all the estimated energy consumption is in the power category 100-500 kW. However, the main contributors to the total energy consumption are bulk carriers, chemical tankers and general cargo ships, representing around 90% of the total consumption.

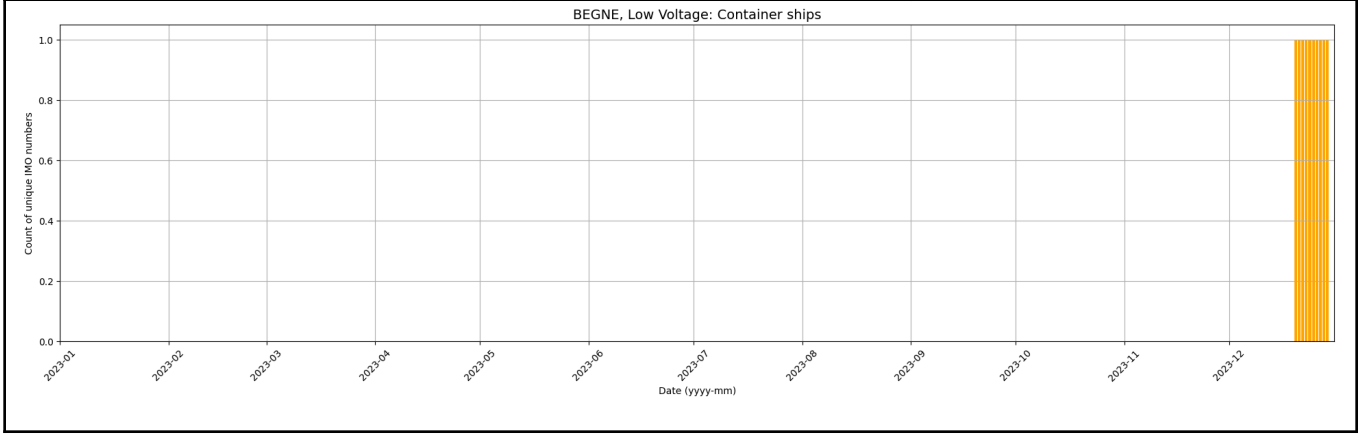
Table 6-35 Estimated energy consumption in port (MWh) per ship segment and power category.

Ghent	<100 kW	100-500 kW	500-1000 kW	1-5 MW	5-10 MW	>10 MW	Total
Bulk carriers	5	19 677	0	0	0	0	19 681
Chemical tankers	0	542	5 665	12 553	0	0	18 760
Container ships	0	336	0	0	0	0	336
Crude oil tankers	0	0	120	0	0	0	120
Cruise ships	0	297	0	0	0	0	297
Fishing vessels	0	0	0	0	0	0	1
Gas tankers	0	0	0	0	0	0	0
General cargo ships	5 937	4 262	597	0	0	0	10 796
Offshore supply ships	0	0	0	0	0	0	0
Oil product tankers	69	1 121	262	0	0	0	1 452
Other activities	160	278	49	0	0	0	488
Other service offshore vessels	0	104	166	0	0	0	270
Passenger ships	0	0	0	0	0	0	0
Refrigerated cargo ships	0	0	0	0	0	0	0
Ro-Ro cargo ships	0	49	1 521	794	0	0	2 363
Total	6 172	26 667	8 379	13 347	0	0	54 564

Table 6-36 presents simultaneous port calls for quantification of the need for low and high voltage connection points for container, cruise, and passenger ships above 5000 GT. Since there were less than 100 port calls from **container ships** in 2023, it is assumed that there is no need for connection points for this segment in the port of Ghent. For **cruise ships** and **passenger ships**, there was no traffic in the port in 2023, hence there is no estimated need for any connection points.

Table 6-36 Number of container and cruise ships at any day and passenger ships at any hour in 2023, and the estimated number of required connection points – split on low and high voltage.

Ghent	Low Voltage	High Voltage
Container ships – required connection points	0	0



Ghent	Low Voltage	High Voltage
Cruise ships – required connection points	0	0
No data		

Ghent	Low Voltage	High Voltage
Passenger ships – req. connection points	0	0
No data		

6.10.2 Current status and plans for onshore power supply

The main activities in the port of Ghent are inland shipping and river cruise. There are thus no maritime OPS systems in operation. The port has installed cabinets for inland cruise ships, but these fall out of the scope of this study.

Table 6-37 Contracted OPS in the port of Ghent.

Max. no. of simultaneous ships	Types of ships	Max. system power capacity [kW]	System voltage [V]	System frequency [Hz]	Standard	Operational from
4	Cruise (inland)	1 600	400-690	50	IEC 80005-3	Sep 2024

6.11 Port of Gothenburg, Sweden

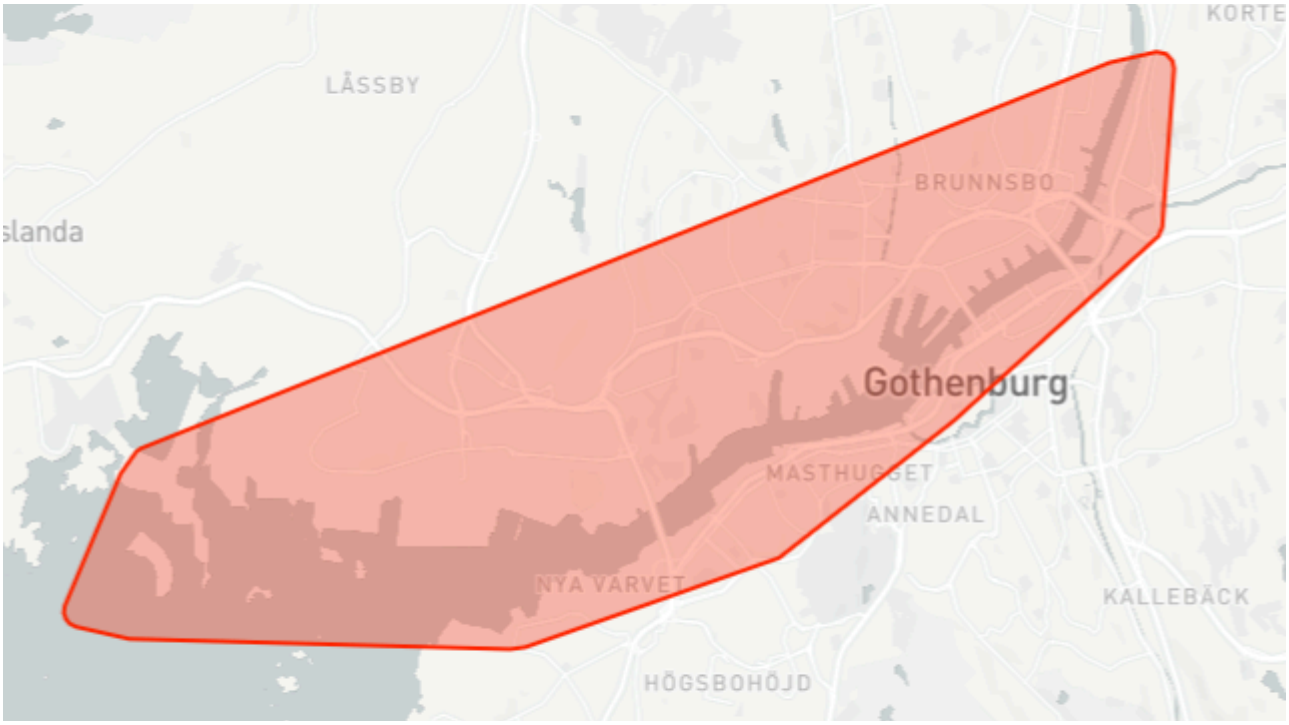


Figure 6-11 Port shape for Gothenburg (SEGOT).

6.11.1 Current ship activity and energy requirements

Table 6-38 shows the effective hours in port per ship segment and size category for the port of Gothenburg in 2023. There are around 12 000 effective hours in port for container ships larger than 5000 GT. For cruise ships larger than 5000 GT there are around 800 effective hours in port, and for passenger ships larger than 5000 GT there are more than 9 000 effective hours in port.

Table 6-38 Effective hours in port per ship segment and size category.

Gothenburg	400 - 999 GT	1000 - 4999 GT	5000 - 9999 GT	10000 - 24999 GT	25000 - 49999 GT	50000 - 99999 GT	100000 GT <	Total
Bulk carriers		21						21
Chemical tankers		7 513	7 652	13 199	1 625			29 989
Container ships		1 135	2 693	4 900	860	577	2 846	13 011
Crude oil tankers			28	89	74	2 435	467	3 093
Cruise ships	488	33	30	11	190	558		1 310
Fishing ships		40						40
Gas tankers		729	467					1 196
General cargo ships	37	2 556	9	883				3 485
Offshore supply ships	7	92						99
Oil product tankers	3 189	10 878	788	347	371			15 573
Other activities	30 951	3 559	342	71				34 923

Other service offshore ships								0
Passenger ships	117			551	5 775	3 237		9 680
Refrigerated cargo ships								0
Ro-Ro cargo ships			60	279	8 716	5 032		14 087
Total	34 789	26 556	12 069	20 330	17 611	11 839	3 313	126 507

Table 6-39 shows the estimated energy consumption per ship segment and power category for the port of Gothenburg in 2023. Most of the estimated energy consumption is in the power category 1-5 MW for container ships, the power category 5-10 MW for cruise ships, and split between these two power categories for passenger ships. The three main ship segments represent more than 50% of the total energy consumption in the port. Additionally, chemical tankers and Ro-Ro cargo ships have substantial energy consumption.

Table 6-39 Estimated energy consumption in port (MWh) per ship segment and power category.

Gothenburg	**<100 kW**	**100-500 kW**	**500-1000 kW**	**1-5 MW**	**5-10 MW**	**>10 MW**	**Total**
Bulk carriers	0	2	0	0	0	0	2
Chemical tankers	0	491	6 091	16 427	0	0	23 009
Container ships	0	1 544	3 474	12 241	0	0	17 259
Crude oil tankers	0	0	150	3 767	0	0	3 917
Cruise ships	33	13	28	801	4 028	0	4 903
Fishing vessels	0	9	0	0	0	0	9
Gas tankers	0	278	0	467	0	0	745
General cargo ships	254	345	0	0	0	0	598
Offshore supply ships	0	20	0	0	0	0	20
Oil product tankers	179	2 622	1 023	0	0	0	3 824
Other activities	1 300	925	237	0	0	0	2 462
Other service offshore vessels	0	0	0	0	0	0	0
Passenger ships	7	0	0	21 622	20 390	0	42 019
Refrigerated cargo ships	0	0	0	0	0	0	0
Ro-Ro cargo ships	0	19	7 094	5 042	0	0	12 155
Total	1 773	6 269	18 098	60 368	24 418	0	110 924

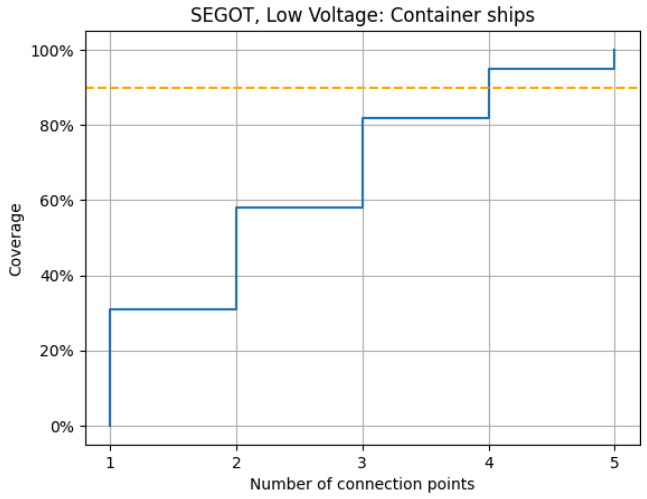
Table 6-40 presents simultaneous port calls for quantification of the need for low and high voltage connection points for container, cruise, and passenger ships above 5000 GT. There were some days in 2023 with 5 **container ships** requiring low voltage connection points in the port, but 4 such connection points would be sufficient for 90% coverage. Similarly, there were some days in 2023 with 2 container ships requiring high voltage connection points in the port, but 1 such connection point would be sufficient for 90% coverage.

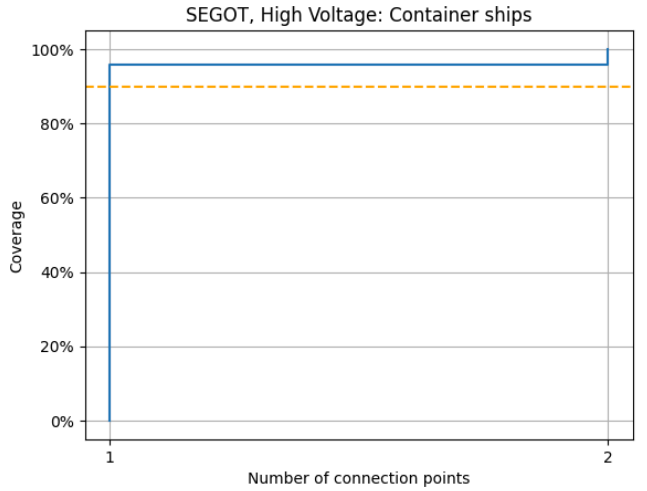
For 90% coverage, there is an estimated need for one low voltage connection point for **cruise ships**, although there were just a few days with such traffic in the port in 2023. Unless a significant increase in the cruise traffic to the port is expected towards 2030, the port should not invest in such a connection point. There were some days with a need for 2 high voltage connection points for cruise shops, but 1 such connection point would be sufficient for 90% coverage.

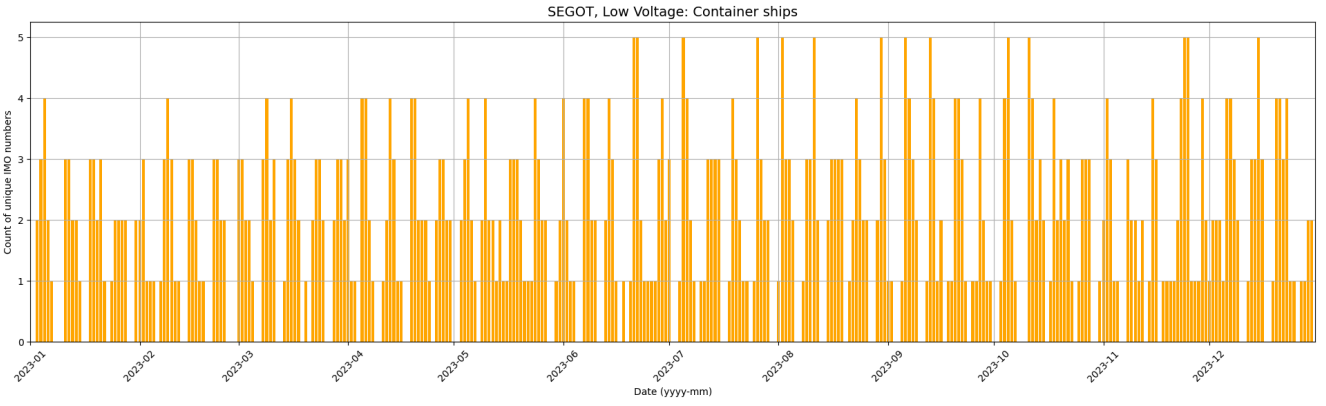
For **passenger ships**, there were some hours with a need for 4 high voltage connection points, but 3 such connection points would be sufficient for 90% coverage. In total, there is an estimated need for 5 connection points for container ships, 2 connection points for cruise ships, and 3 connection points for passenger ships.

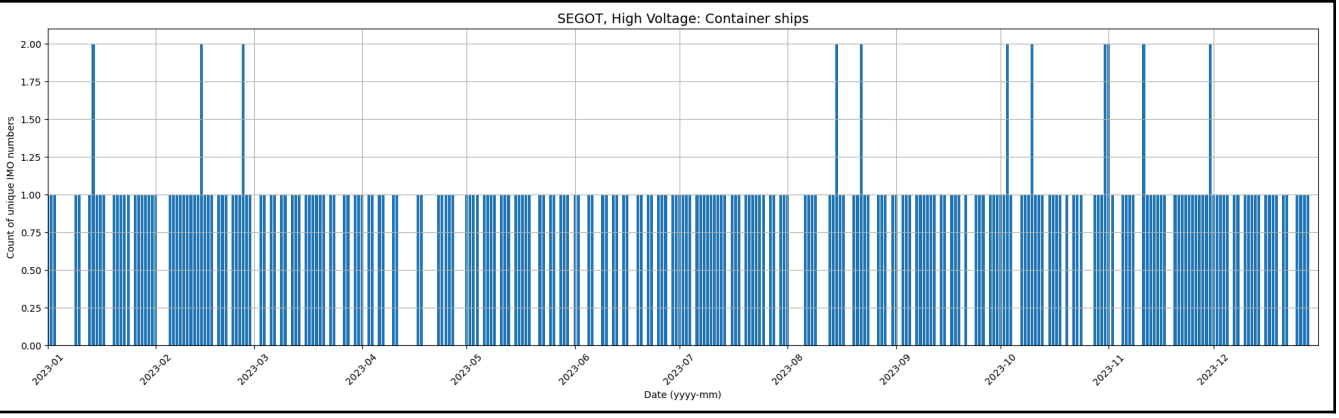
Table 6-40 Number of container and cruise ships at any day and passenger ships at any hour in 2023, and the estimated number of required connection points – split on low and high voltage.

Gothenburg	Low Voltage	High Voltage
Container ships – req. connection points	4	1

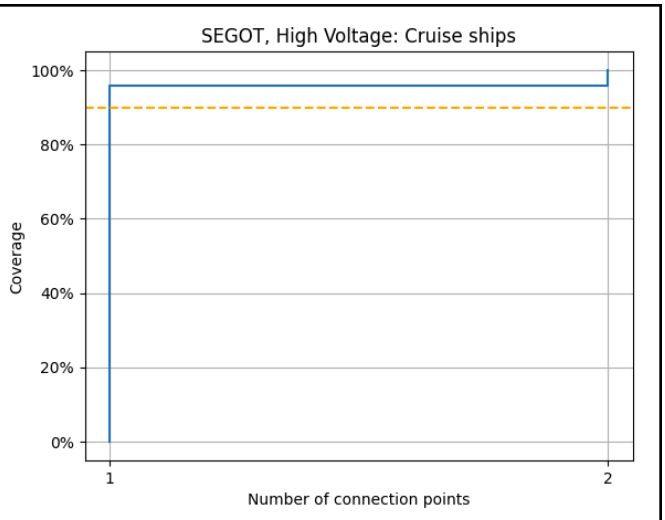


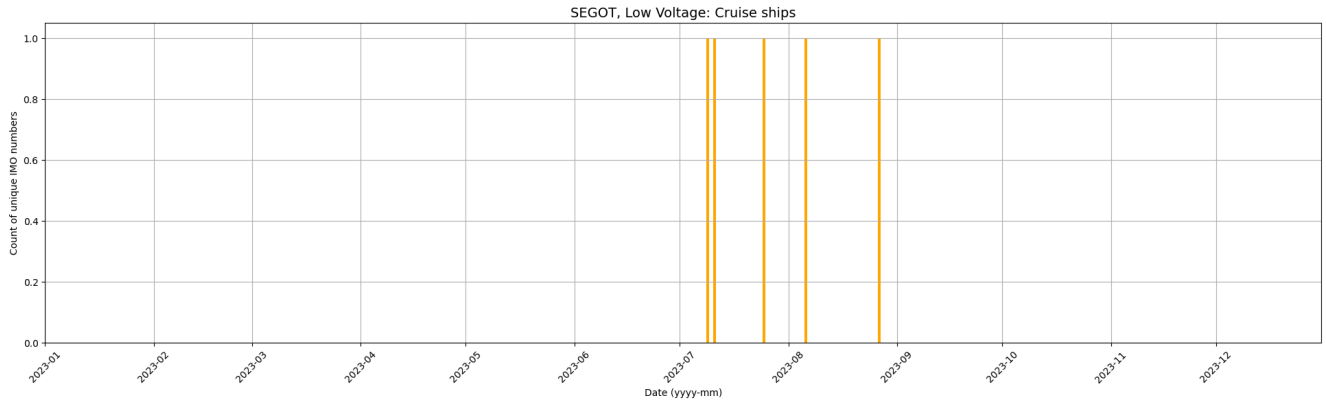


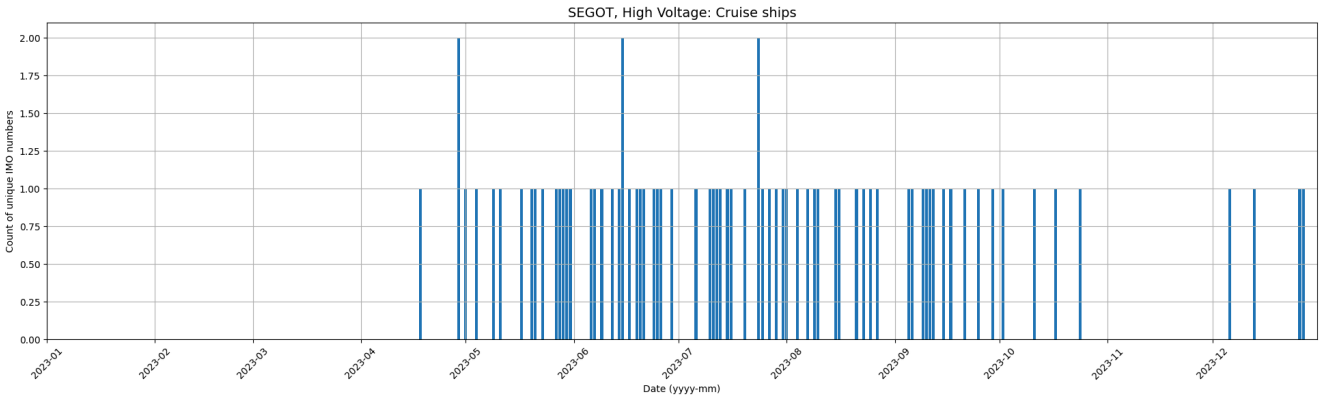




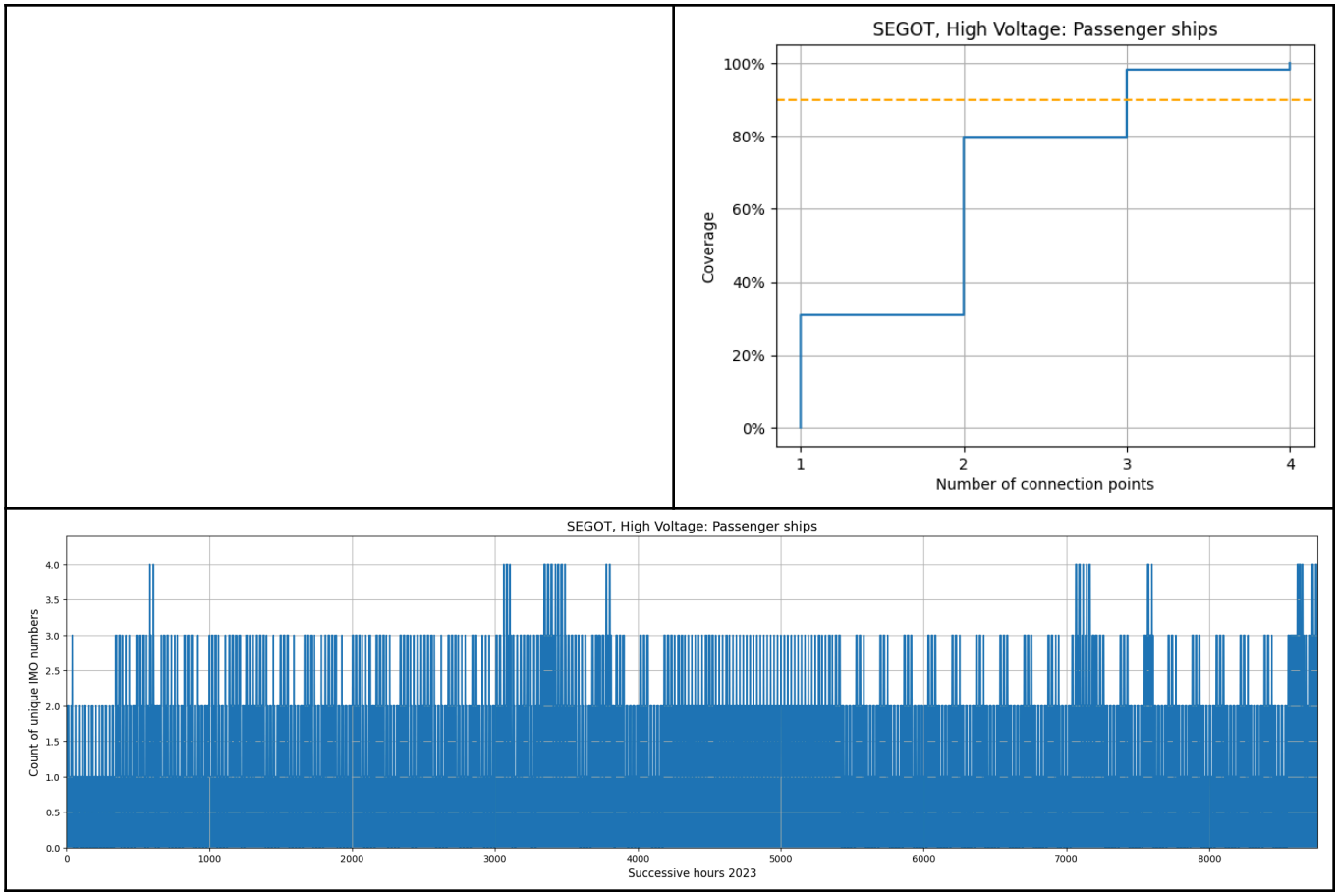
Gothenburg	Low Voltage	High Voltage
Cruise ships – required connection points	1	1







Gothenburg	Low Voltage	High Voltage
Passenger ships – req. connection points	0	3



6.11.2 Current status and plans for onshore power supply

In the port of Gothenburg, OPS systems have been in operation since 1997 for RoPax ships and since 2016 for Ro-Ro ships (Table 6-41). Furthermore, OPS systems for energy tankers will become operational this summer (2024). The port is running a “Program OPS”, where several parallel activities and study phases are being planned.

Capacity in the local electricity grid

According to the port, there is sufficient capacity in the local electricity grid.

Table 6-41 Installed and contracted OPS in the port of Gothenburg.

Max. no. of simultaneous ships	Types of ships	Max. system power capacity [kW]	System voltage	System frequency [Hz]	Standard	Operational from
3	Passenger (RoPax)	6 000	6.6-11 kV	50	IEC 80005-1	1997
1	Ro-Ro cargo	1 500	6.6-11 kV	50	IEC 80005-1	2016
2	Product tankers	3 000	6.6-11 kV	50	IEC 80005-1	Q4 2024

Planned OPS systems where contracts have not been signed yet include:

- RoPax relocation (the current RoPax connections will be shut down);

- Ro-Ro cargo: 2 more high voltage systems planned to be in operation from 2027;
- Container: Ongoing studies – planned operation from 2028/2029;
- Pure car carrier (PCC) & Ro-Ro cargo: 2 high voltage systems planned to be in operation from 2026-2028;
- Crude oil tankers (energy tankers): Plans for 5 more systems before 2035.

6.12 Port of Hamburg, Germany

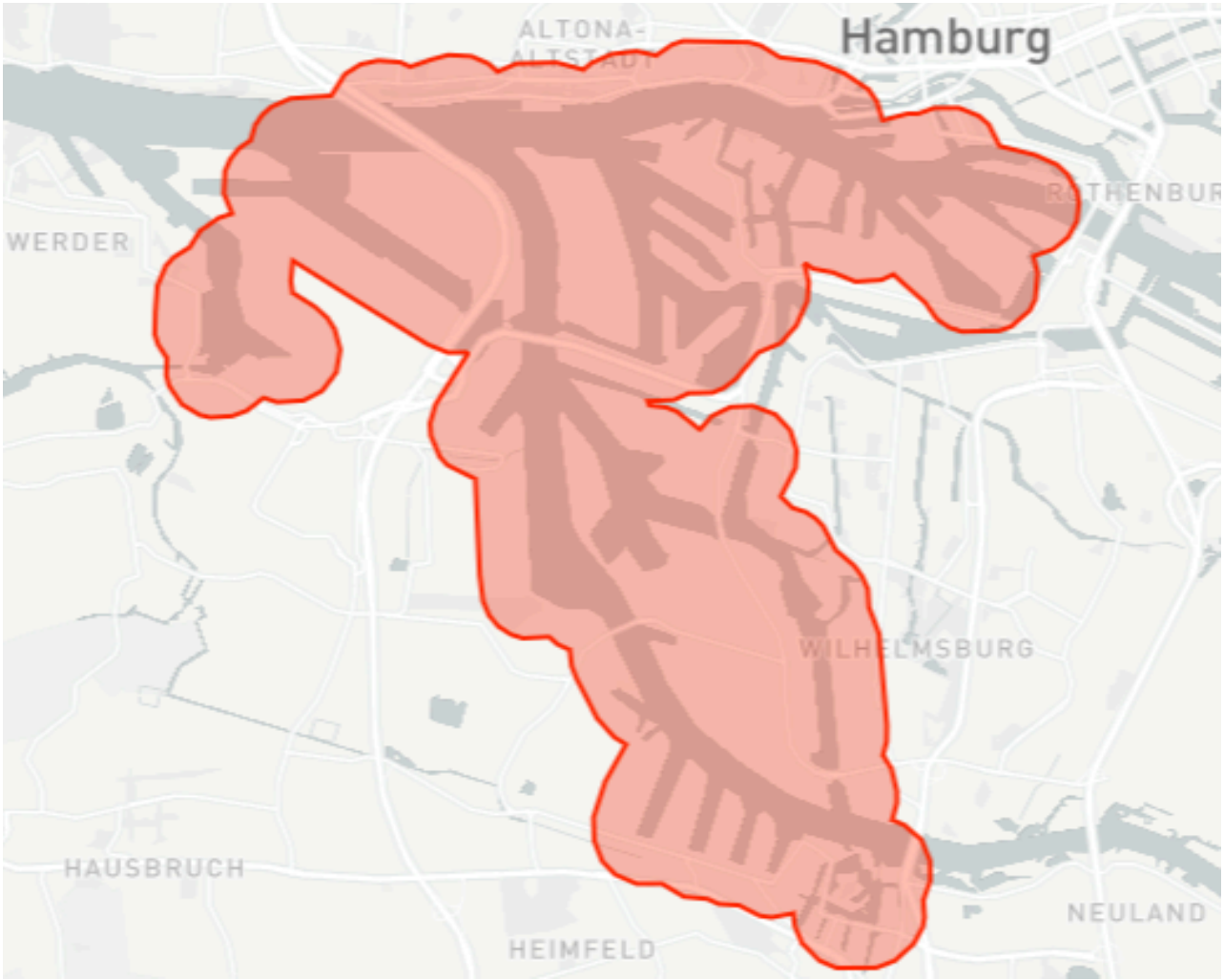


Figure 6-12 Port shape for Hamburg (DEHAM).

6.12.1 Current ship activity and energy requirements

Table 6-42 shows the effective hours in port per ship segment and size category for the port of Hamburg in 2023. There are around 100 000 effective hours in port for container ships larger than 5000 GT. For cruise ships larger than 5000 GT there are around 4 000 effective hours in port, and for passenger ships larger than 5000 GT there are no effective hours in port.

Table 6-42 Effective hours in port per ship segment and size category.

Hamburg	400 - 999 GT	1000 - 4999 GT	5000 - 9999 GT	10000 - 24999 GT	25000 - 49999 GT	50000 - 99999 GT	100000 GT <	Total

Bulk carriers		16	103	10 839	15 112	4 995	909	31 974
Chemical tankers	8 627	19 554	4 863	9 306	3 687			46 037
Container ships		3 084	15 333	26 731	9 112	19 799	29 455	103 514
Crude oil tankers			91	105	76	1 499		1 771
Cruise ships	1 128		71	521	533	1 095	1 938	5 286
Fishing ships								0
Gas tankers		266	115					381
General cargo ships	1 834	47 998	8 119	6 979	1 398			66 328
Offshore supply ships	35		39					74
Oil product tankers	1 369	12 790	347	601	683	28		15 818
Other activities	43 945	9 013	1 692	627				55 277
Other service offshore ships	56		382					438
Passenger ships	8 891	3 957						12 848
Refrigerated cargo ships								0
Ro-Ro cargo ships		39	101	539	922	2 670	1 353	5 624
Total	65 885	96 717	31 256	56 248	31 523	30 086	33 655	345 370

Table 6-43 shows the estimated energy consumption per ship segment and power category for the port of Hamburg. For container ships, most of the estimated energy consumption is in the power category 1-5 MW. For cruise ships, most of the estimated energy consumption is in the highest power category (> 10 MW). Container and cruise ships account for nearly 80% of the total energy consumption among all power categories. Other segments with substantial energy consumption in the port are chemical tankers, bulk carriers, and general cargo.

Table 6-43 Estimated energy consumption in port (MWh) per ship segment and power category.

Hamburg	<100 kW	100-500 kW	500-1000 kW	1-5 MW	5-10 MW	>10 MW	Total
Bulk carriers	0	9 140	3 220	0	0	0	12 359
Chemical tankers	0	1 335	3 871	14 875	0	0	20 082
Container ships	0	8 179	18 952	158 811	0	0	185 942
Crude oil tankers	0	0	197	1 874	0	0	2 070
Cruise ships	77	0	66	3 208	7 904	19 399	30 654
Fishing vessels	0	0	0	0	0	0	0
Gas tankers	0	101	0	115	0	0	216
General cargo ships	4 787	4 527	872	0	0	0	10 186
Offshore supply ships	2	0	20	0	0	0	23
Oil product tankers	77	3 082	1 274	35	0	0	4 468
Other activities	1 846	2 343	1 409	0	0	0	5 598
Other service offshore vessels	4	144	0	0	0	0	148
Passenger ships	533	1 413	0	0	0	0	1 946

Refrigerated cargo ships	0	0	0	0	0	0	0
Ro-Ro cargo ships	0	38	1 067	4 169	0	0	5 274
Total	7 325	30 302	30 948	183 087	7 904	19 399	278 965

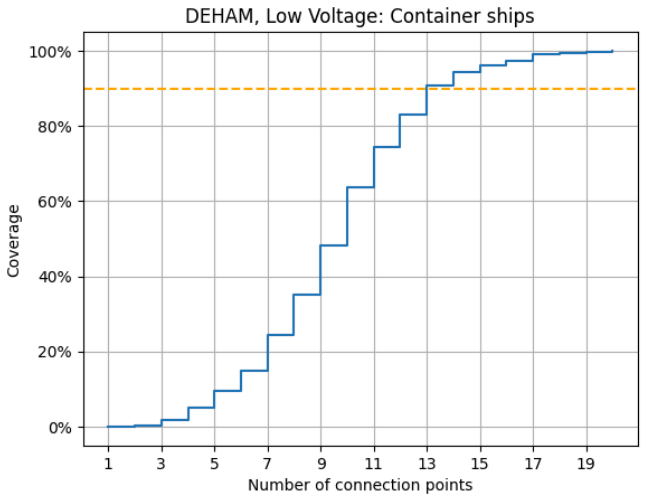
Table 6-44 presents simultaneous port calls for quantification of the need for low and high voltage connection points for container, cruise, and passenger ships above 5000 GT. There were some days in 2023 with 15-20 **container ships** requiring low voltage connection points in the port, but 13 such connection points would be sufficient for 90% coverage. Similarly, there were some days in 2023 with almost 20 container ships requiring high voltage connection points in the port, but 15 such connection points would be sufficient for 90% coverage.

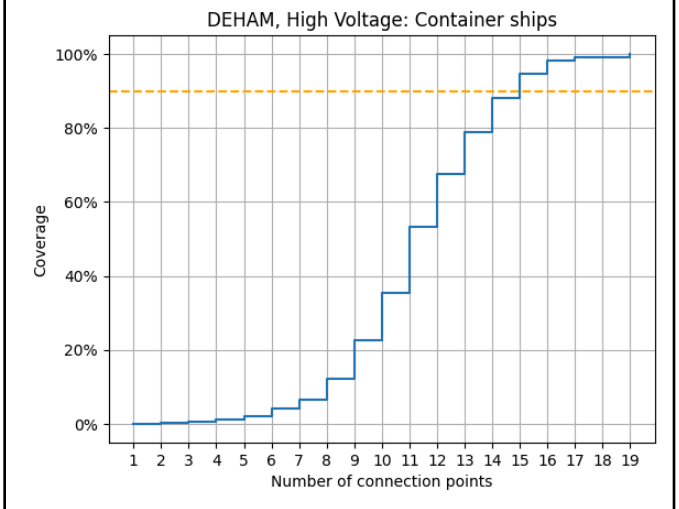
For 90% coverage, there is an estimated need for one low voltage connection point for **cruise ships**, although there were only a few days with such traffic in the port in 2023. Unless a significant increase in the cruise traffic to the port is expected towards 2030, the port should not invest in such a connection point. There were some days with a need for 3 high voltage connection points for cruise ships, but 2 such connection points would be sufficient for 90% coverage.

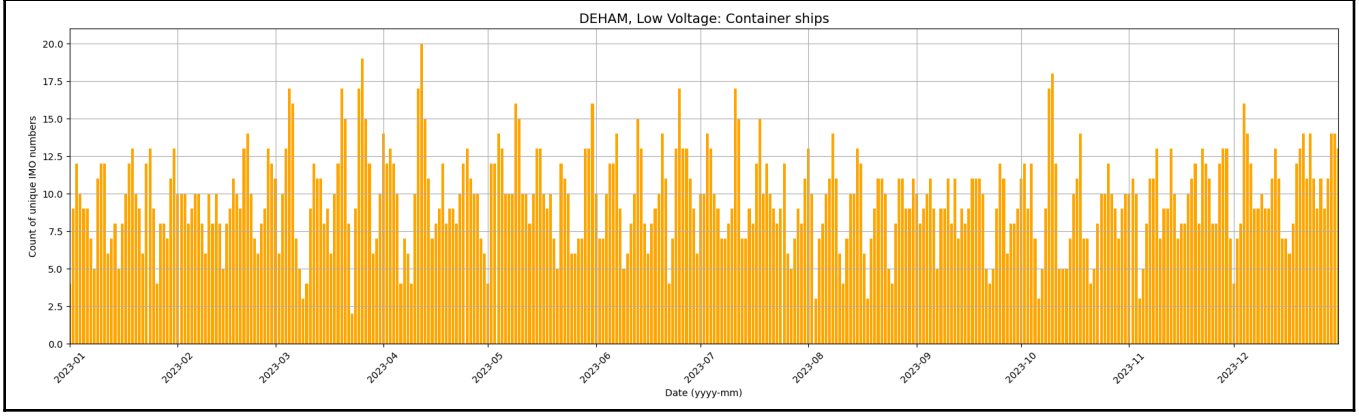
For **passenger ships**, there was no traffic in the port in 2023, hence there is no estimated need for any connection points. In total, there is an estimated need for 28 connection points for container ships and 3 connection points for cruise ships.

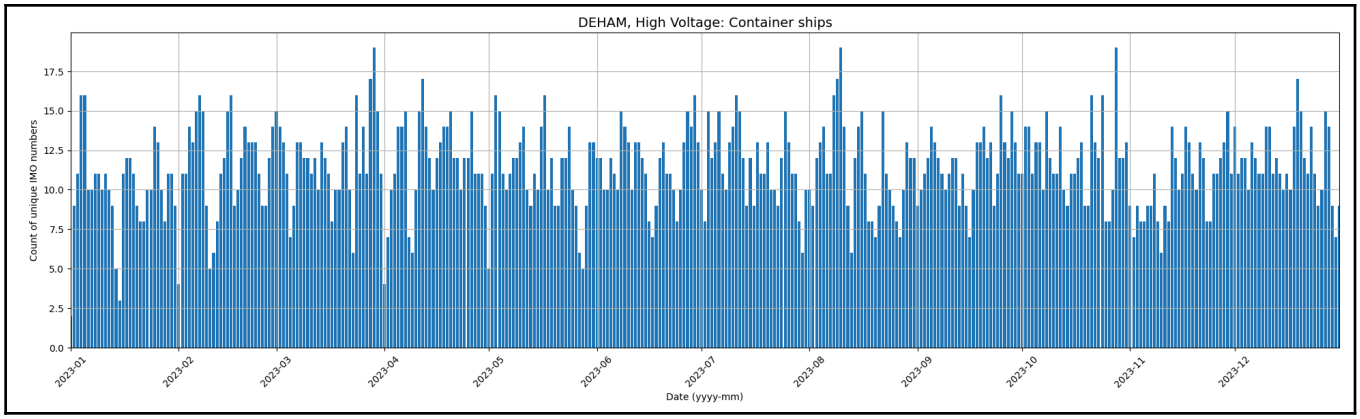
Table 6-44 Number of container and cruise ships at any day and passenger ships at any hour in 2023, and the estimated number of required connection points – split on low and high voltage.

Hamburg	Low Voltage	High Voltage
Container ships – req. connection points	13	15

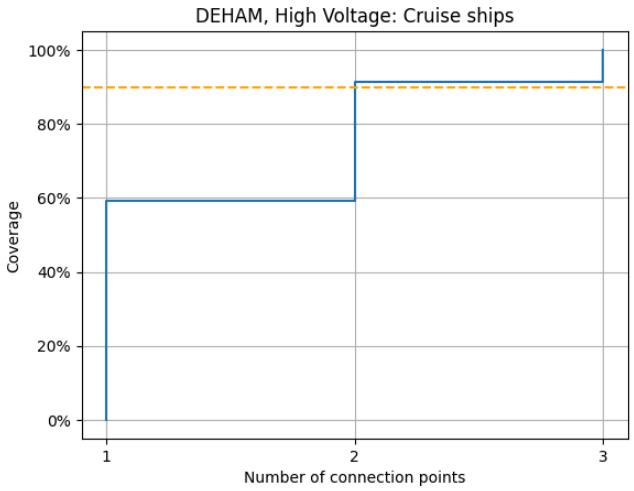


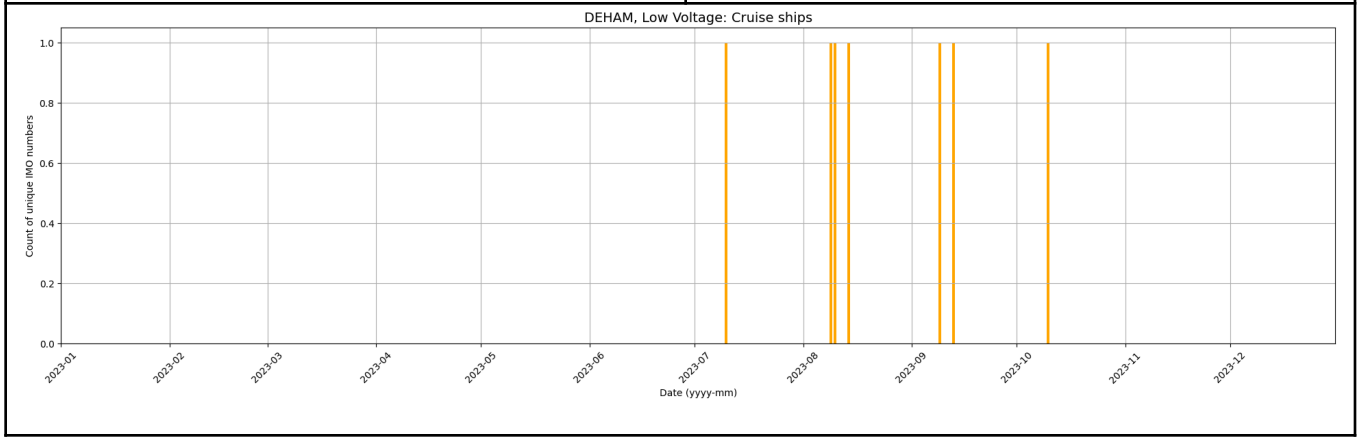


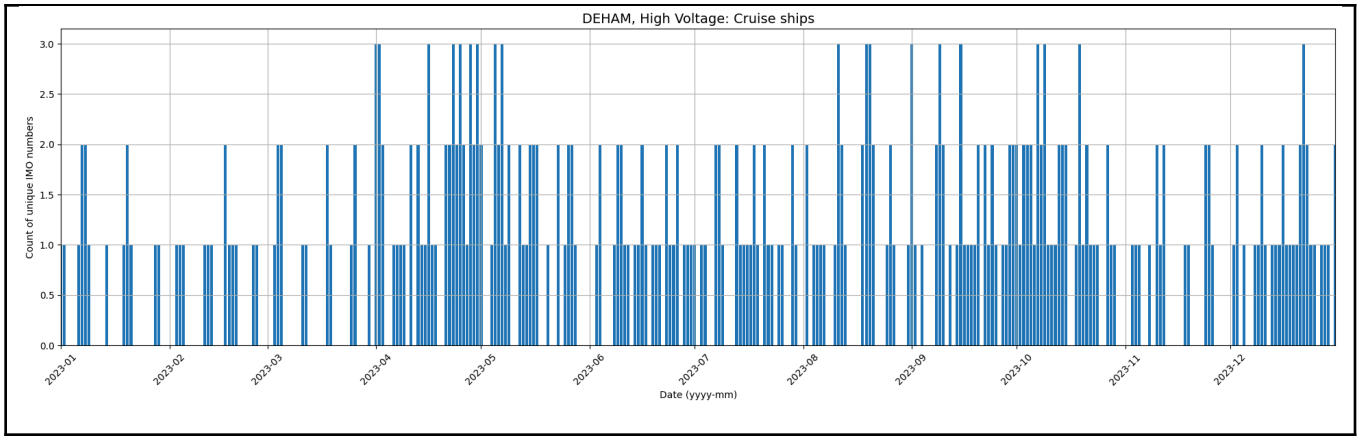




Hamburg	Low Voltage	High Voltage
Cruise ships – required connection points	1	2







Hamburg	Low Voltage	High Voltage
Passenger ships – req. connection points	0	0
No data		

6.12.2 Current status and plans for onshore power supply

The installed and contracted OPS systems in the port of Hamburg are listed in Table 6-45. One OPS system for cruise ships has been in operation since 2016 and one more will enter operation this year (2024). The port is currently building a new cruise terminal and two further connection points are planned to be in operation there from 2025. These facilities are expected to cover 100% of the demand from cruise ships. Furthermore, a total of 10 OPS systems for container ships will enter operation this year (2024) at four different terminals. The port has further plans for the required next steps for compliance with the upcoming regulations.

Capacity in the local electricity grid

According to the port, the grid capacity is sufficient to cover all OPS demands, since there is a lot of industry surrounding the area.

Table 6-45 Installed and contracted OPS in the port of Hamburg.

Berth name	Max. no. of simultaneous ships	Types of ships	Max. system power capacity [kW]	System voltage [kV]	System frequency [Hz]	Standard	Operational from
Altona	1	Cruise	12 000	6.6-11	50 and 60	IEC 80005-1	2016
Steinwerder	1	Cruise	16 000	6.6-11	50 and 60	IEC 80005-1	2024
HafenCity	2	Cruise	14 000	6.6-11	50 and 60	IEC 80005-1	2025
CTT	1	Container	7 500	6.6	50 and 60	IEC 80005-1	2024
CTH	3	Container	7 500	6.6	50 and 60	IEC 80005-1	2024
CTB	3	Container	7 500	6.6	50 and 60	IEC 80005-1	2025
CTA	3	Container	7 500	6.6	50 and 60	IEC 80005-1	2025

6.13 Port of Klaipėda, Lithuania

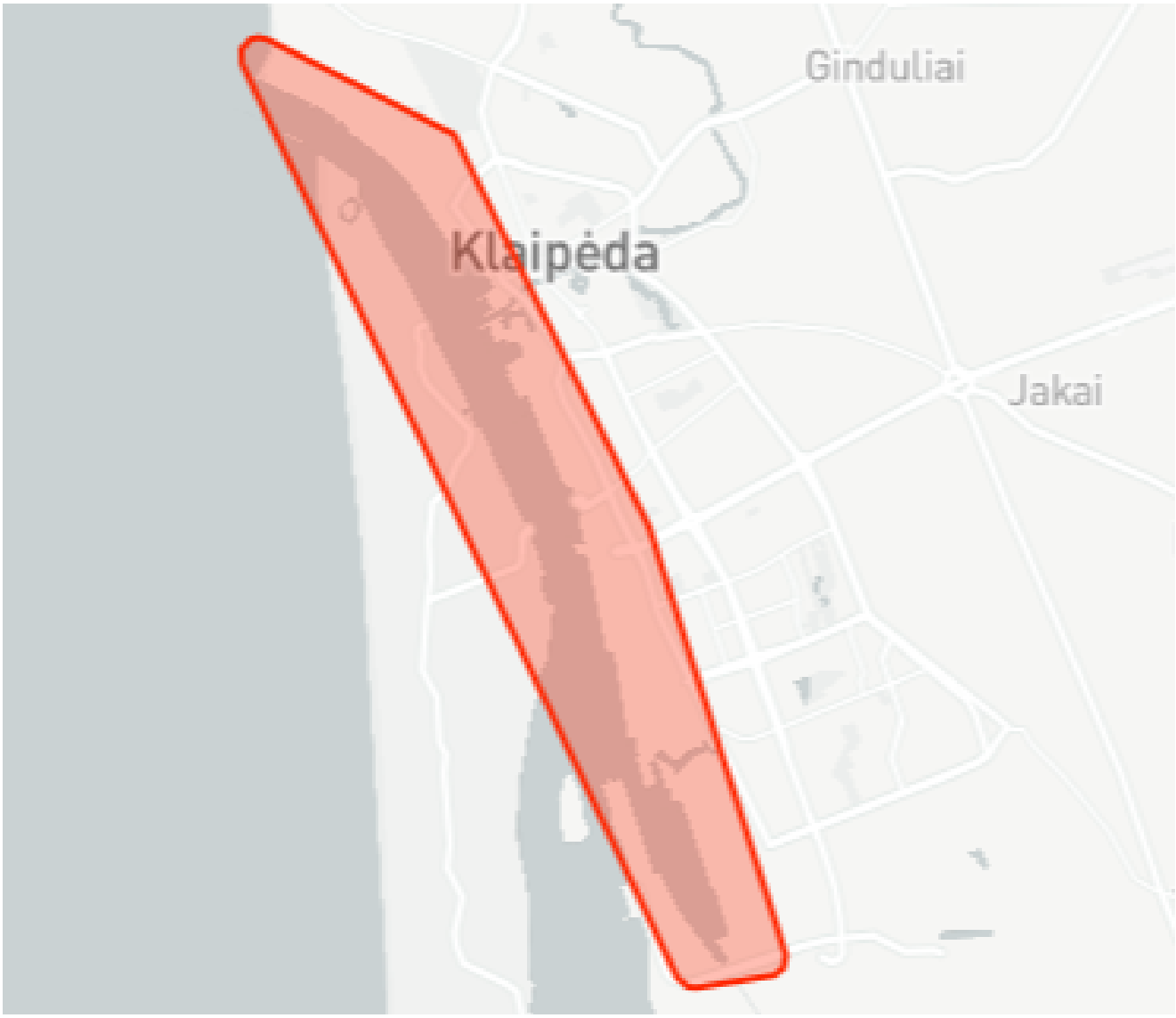


Figure 6-13 Port shape for Klaipeda (LTKLJ).

6.13.1 Current ship activity and energy requirements

Table 6-46 shows the effective hours in port per ship segment and size category for the port of Klaipėda in 2023. There are around 15 000 effective hours in port for container ships larger than 5000 GT. For cruise ships larger than 5000 GT there are around 250 effective hours in port, and for passenger ships larger than 5000 GT there are around 12 000 effective hours in port. Other segments with a high number of effective hours in port include bulk carriers, chemical tankers, general cargo ships and other activities.

Table 6-46 Effective hours in port per ship segment and size category.

Klaipeda	400 - 999 GT	1000 - 4999 GT	5000 - 9999 GT	10000 - 24999 GT	25000 - 49999 GT	50000 - 99999 GT	100000 GT <	Total
Bulk carriers		2 728	292	9 932	12 151	159		25 262
Chemical tankers		5 043	3 395	5 442	3 314			17 194

Container ships		89	1 870	6 519	4 614	1 324	565	14 981
Crude oil tankers				129	156	700		985
Cruise ships		79	45	17	40	136	18	335
Fishing ships			1 811					1 811
Gas tankers			2 418	509			1 155	4 082
General cargo ships	245	44 247	8 464	8 827	143			61 926
Offshore supply ships	1 114	139						1 253
Oil product tankers		9 004	353	144	363			9 864
Other activities	9 358	3 947	1 025	453				14 783
Other service offshore ships	2 242							2 242
Passenger ships	8 916			2 380	5 947	3 699		20 942
Refrigerated cargo ships		4 168	2 102	813				7 083
Ro-Ro cargo ships		859	34	3 539	18	608		5 058
Total	21 875	70 303	21 809	38 704	26 746	6 626	1 738	187 801

Table 6-47 shows the estimated energy consumption per ship segment and power category for the port of Klaipėda in 2023. Most of the estimated energy consumption is in the power category 1-5 MW for container ships, the power category 5-10 MW for cruise ships, and split between these two power categories for passenger ships. Passenger ships account for 40% of the total estimated consumption in port. Other segments with substantial energy consumption in the port are chemical tankers, general cargo ships, and gas tankers.

Table 6-47 Estimated energy consumption in port (MWh) per ship segment and power category.

Klaipeda	<100 kW	100-500 kW	500-1000 kW	1-5 MW	5-10 MW	>10 MW	Total
Bulk carriers	0	8 074	83	0	0	0	8 157
Chemical tankers	0	39	2 702	10 200	0	0	12 940
Container ships	0	945	4 622	10 970	0	0	16 537
Crude oil tankers	0	0	243	875	0	0	1 118
Cruise ships	0	32	42	197	982	180	1 434
Fishing vessels	0	773	0	0	0	0	773
Gas tankers	0	0	0	3 057	6 160	0	9 216
General cargo ships	4 385	5 321	89	0	0	0	9 795
Offshore supply ships	76	30	0	0	0	0	106
Oil product tankers	0	2 170	641	0	0	0	2 811
Other activities	393	1 026	916	0	0	0	2 335
Other service offshore vessels	141	0	0	0	0	0	141
Passenger ships	535	0	0	25 366	23 300	0	49 201
Refrigerated cargo ships	0	1 963	661	0	0	0	2 624
Ro-Ro cargo ships	0	132	2 216	609	0	0	2 957
Total	5 530	20 506	12 216	51 274	30 441	180	120 146

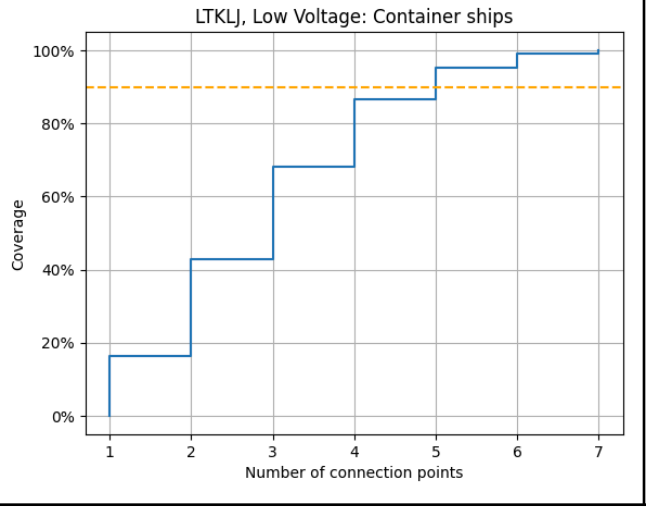
Table 6-48 presents simultaneous port calls for quantification of the need for low and high voltage connection points for container, cruise, and passenger ships above 5000 GT. There were some days in 2023 with 6 or 7 **container ships** requiring low voltage connection points in the port, but 5 such connection points would be sufficient for 90% coverage. Similarly, there were some days in 2023 with 4 container ships requiring high voltage connection points in the port, but 3 such connection points would be sufficient for 90% coverage.

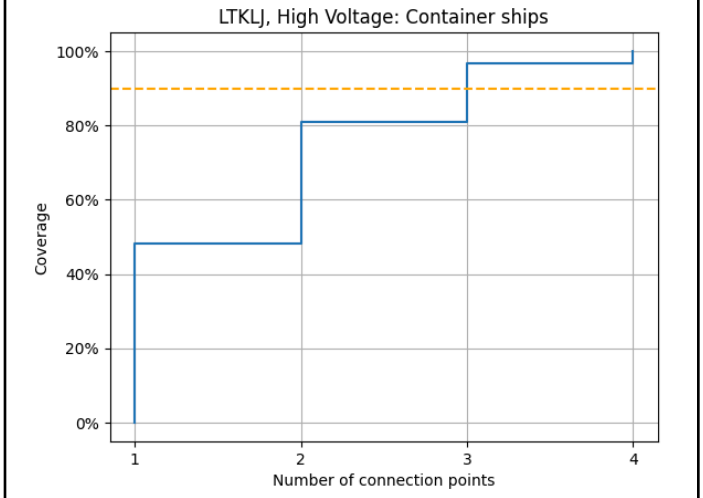
For 90% coverage, there is an estimated need for one low voltage and one high voltage connection point for **cruise ships**, although there was only traffic in the port on a few days in 2023. The port should consider the expected increase in the cruise traffic to the port towards 2030, before investing in such connection points.

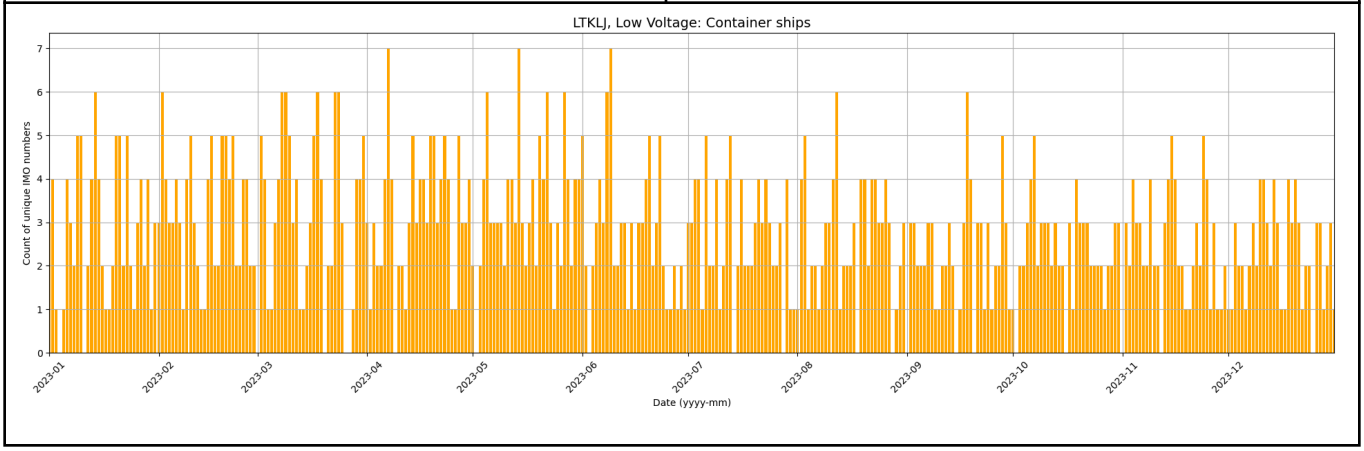
For **passenger ships**, there were some hours with a need for 6 high voltage connection points, but 4 such connection points would be sufficient for 90% coverage. In total, there is an estimated need for 8 connection points for container ships, 2 connection points for cruise ships, and 4 connection points for passenger ships.

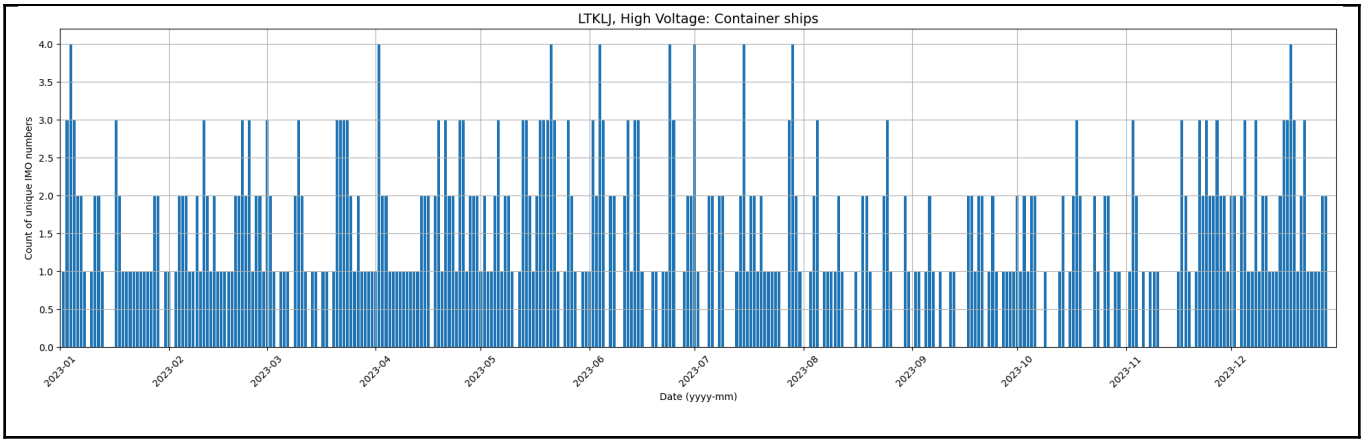
Table 6-48 Number of container and cruise ships at any day and passenger ships at any hour in 2023, and the estimated number of required connection points – split on low and high voltage.

Klaipėda	Low Voltage	High Voltage
Container ships – req. connection points	5	3

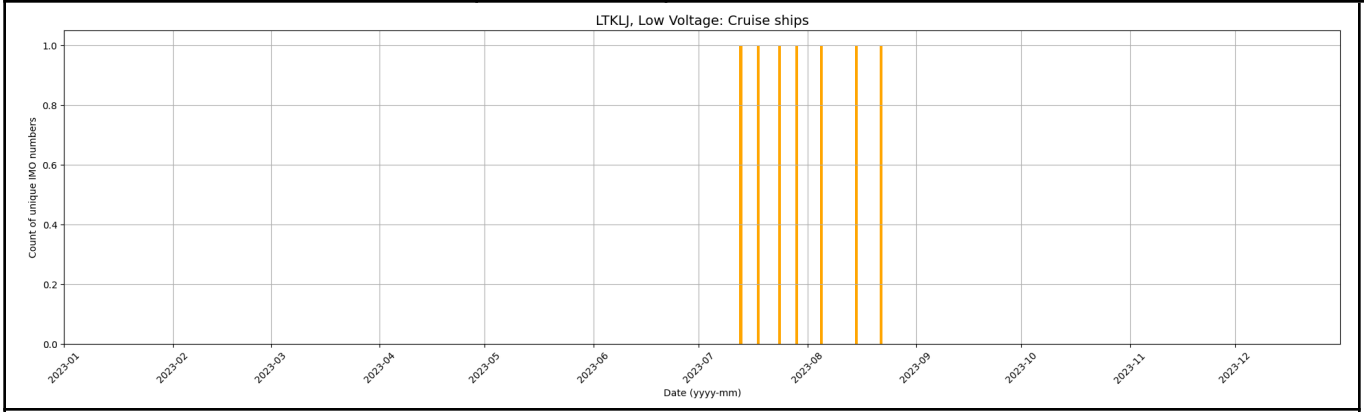


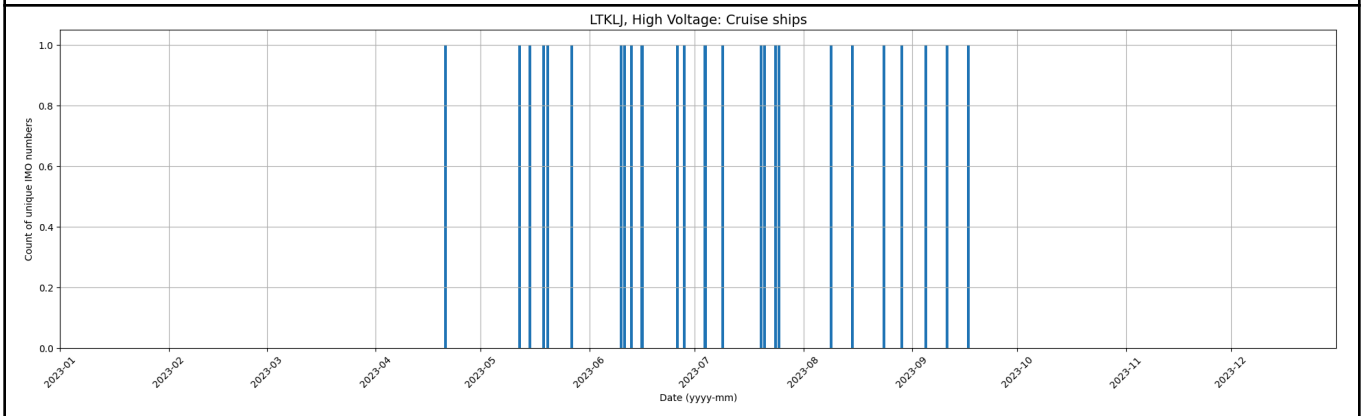




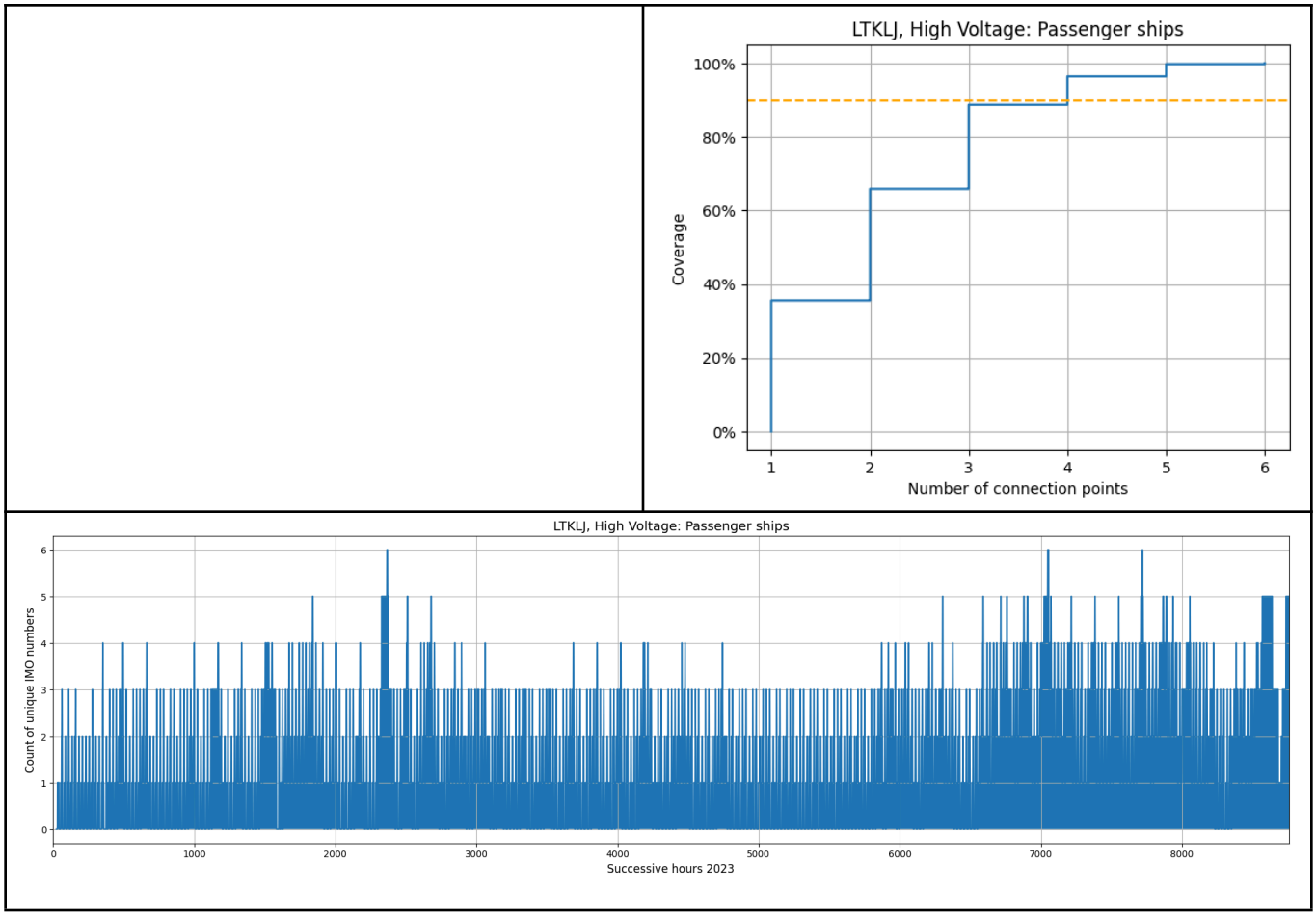


Klaipėda	Low Voltage	High Voltage
Cruise ships – required connection points	1	1





Klaipėda	Low Voltage	High Voltage
Passenger ships – req. connection points	0	4



6.13.2 Current status and plans for onshore power supply

In the port of Klaipeda, there are currently no OPS systems in operation. The port has concrete plans of installing OPS systems for RoPax ships by 2026, which will be able to connect four simultaneous ships at two different locations (Table 6-49). The port has applied for funding, the technical specifications have been prepared, and the procurement procedures have been initiated.

Capacity in the local electricity grid

According to the port, grid upgrades are planned for 2026.

Table 6-49 Contracted OPS in the port of Klaipeda.

Berth name	Max. no. of simultaneous ships	Types of ships	Max. system power capacity [kW]	System voltage [kV]	System frequency [Hz]	Standard	Operational from
Quay 128 (TT-Line)	1	Passenger (RoPax)	3 500	6.6-11	50	IEC 80005-1	2026
Quay 80A (DFDS)	1	Passenger (RoPax)	3 500	6.6-11	50	IEC 80005-1	2026
Quay 81A (DFDS)	1	Passenger (RoPax)	3 500	6.6-11	50	IEC 80005-1	2026

Quay 80 (DFDS)	1	Passenger (RoPax)	3 500	6.6-11	50 and 60	IEC 80005-1	2026

6.14 Port of Koper, Slovenia

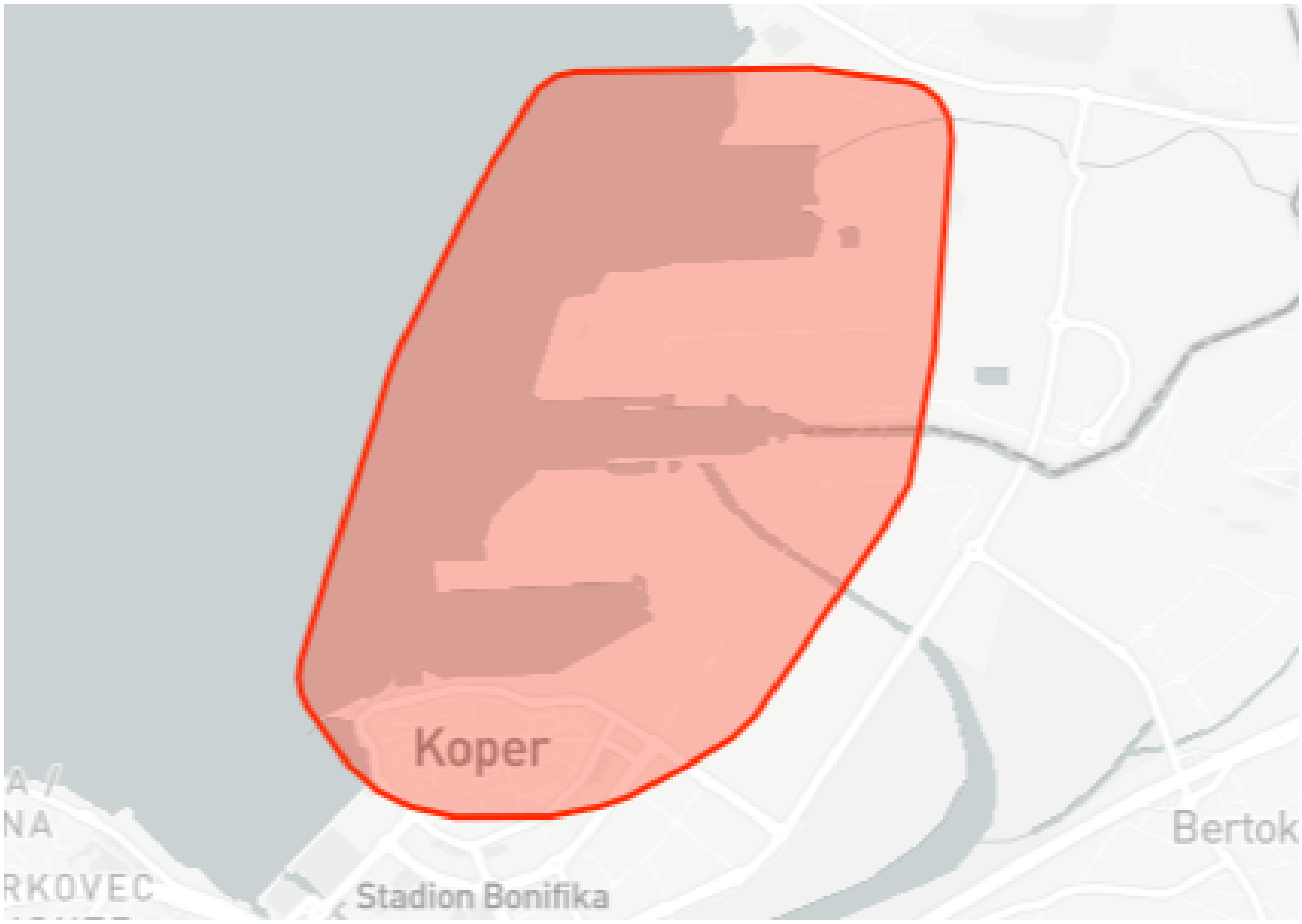


Figure 6-14 Port shape for Koper (SIKOP).

6.14.1 Current ship activity and energy requirements

Table 6-50 shows the effective hours in port per ship segment and size category for the port of Koper in 2023. There are more than 14 000 effective hours in port for container ships larger than 5000 GT. For cruise ships larger than 5000 GT there are around 750 effective hours in port, and for passenger ships larger than 5000 GT there are no effective hours in port. Other segments with a high number of effective hours in the port are bulk carriers, general cargo ships, other activities and Ro-Ro cargo ships.

Table 6-50 Effective hours in port per ship segment and size category.

Koper	400 – 999 GT	1000 - 4999 GT	5000 - 9999 GT	10000 - 24999 GT	25000 - 49999 GT	50000 - 99999 GT	100000 GT <	Total
Bulk carriers		203	219	2 731	7 493	3 688	138	14 472
Chemical tankers		220	119	3 278	2 633			6 250
Container ships		44	1 122	2 888	3 641	2 221	4 360	14 276

Crude oil tankers					204			204
Cruise ships		14			275	442	31	762
Fishing ships								0
Gas tankers								0
General cargo ships		9 499	6 957	1 751	214			18 421
Offshore supply ships								0
Oil product tankers				46	355			401
Other activities	19 528		71		49			19 648
Other service offshore ships								0
Passenger ships		43						43
Refrigerated cargo ships		62						62
Ro-Ro cargo ships		31	30	712	7 912	4 605		13 290
Total	19 528	10 116	8 518	11 406	22 776	10 956	4 529	87 829

Table 6-51 shows the estimated energy consumption per ship segment and power category for the port of Koper. For container ships, most of the estimated energy consumption is in the power category 1-5 MW. For cruise ships, most of the estimated energy consumption is in the power category 5-10 MW. These two segments represent more than 50% of the total energy consumption in port. Other segments with a substantial energy consumption in the port are bulk carriers, chemical tankers and Ro-Ro cargo ships.

Table 6-51 Estimated energy consumption in port (MWh) per ship segment and power category.

Koper	<100 kW	100-500 kW	500-1000 kW	1-5 MW	5-10 MW	>10 MW	Total
Bulk carriers	0	3 806	2 027	0	0	0	5 833
Chemical tankers	0	19	95	6 969	0	0	7 083
Container ships	0	566	2 048	24 842	0	0	27 455
Crude oil tankers	0	0	198	0	0	0	198
Cruise ships	0	6	0	1 128	3 190	310	4 635
Fishing vessels	0	0	0	0	0	0	0
Gas tankers	0	0	0	0	0	0	0
General cargo ships	940	2 238	134	0	0	0	3 312
Offshore supply ships	0	0	0	0	0	0	0
Oil product tankers	0	0	377	0	0	0	377
Other activities	820	0	37	73	0	0	929
Other service offshore vessels	0	0	0	0	0	0	0
Passenger ships	0	15	0	0	0	0	15
Refrigerated cargo ships	0	14	0	0	0	0	14
Ro-Ro cargo ships	0	14	6 725	4 614	0	0	11 353
Total	1 761	6 678	11 639	37 626	3 190	310	61 203

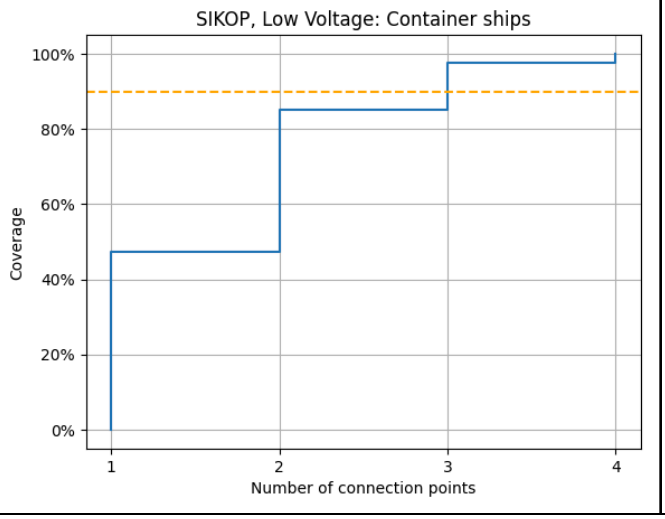
Table 6-52 presents simultaneous port calls for quantification of the need for low and high voltage connection points for container, cruise, and passenger ships above 5000 GT. There were some days in 2023 with 4 **container ships** requiring low

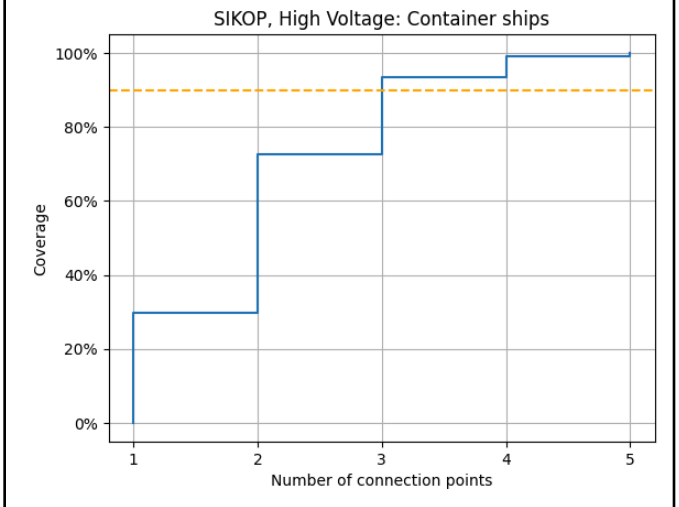
voltage connection points in the port, but 3 such connection points would be sufficient for 90% coverage. Similarly, there were some days in 2023 with 5 container ships requiring high voltage connection points in the port, but 3 such connection points would be sufficient for 90% coverage.

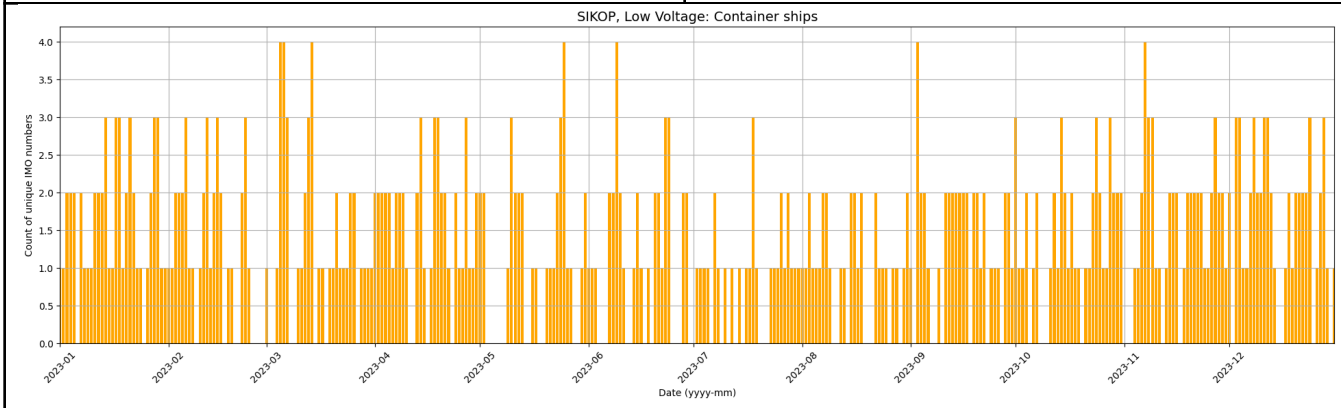
For **cruise ships**, there was one day with a need for 4 high voltage connection points, but 1 such connection point would be sufficient for 90% coverage. For **passenger ships**, there was no traffic in the port in 2023, hence there is no estimated need for any connection points. In total, there is an estimated need for 6 connection points for container ships and 1 connection point for cruise ships.

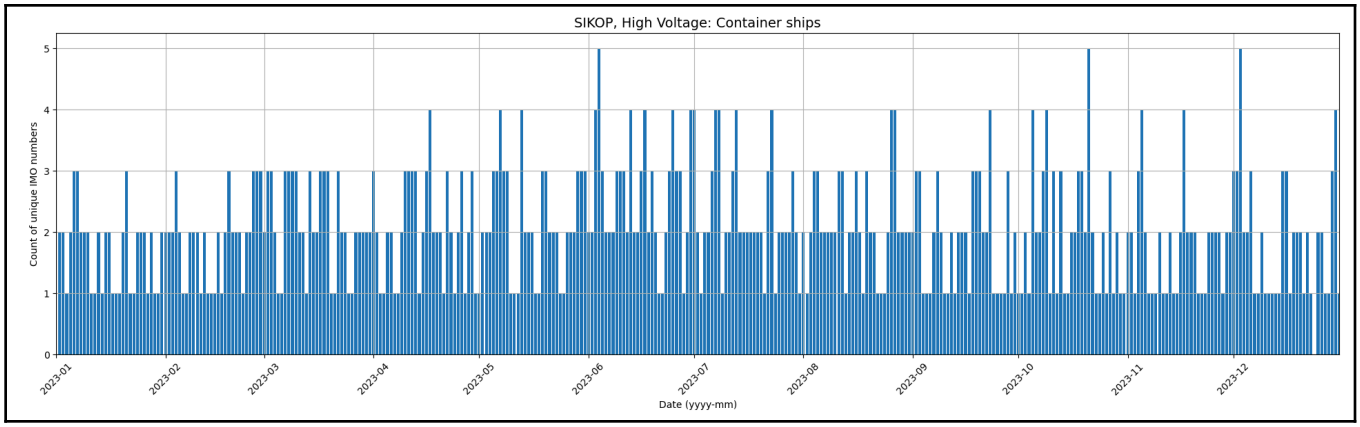
Table 6-52 Number of container and cruise ships at any day and passenger ships at any hour in 2023, and the estimated number of required connection points – split on low and high voltage.

Koper	Low Voltage	High Voltage
Container ships – req. connection points	3	3

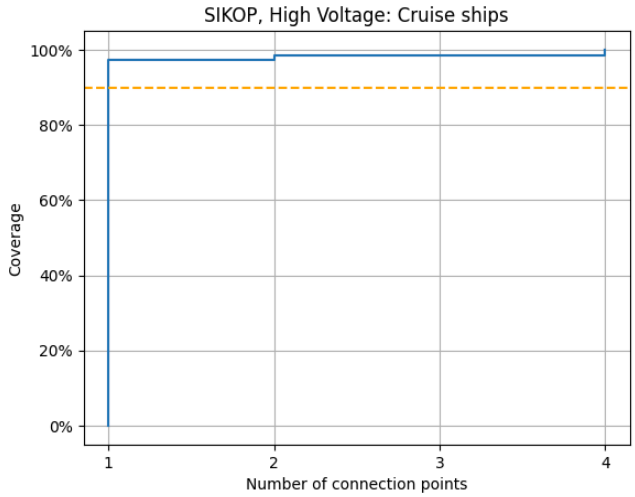


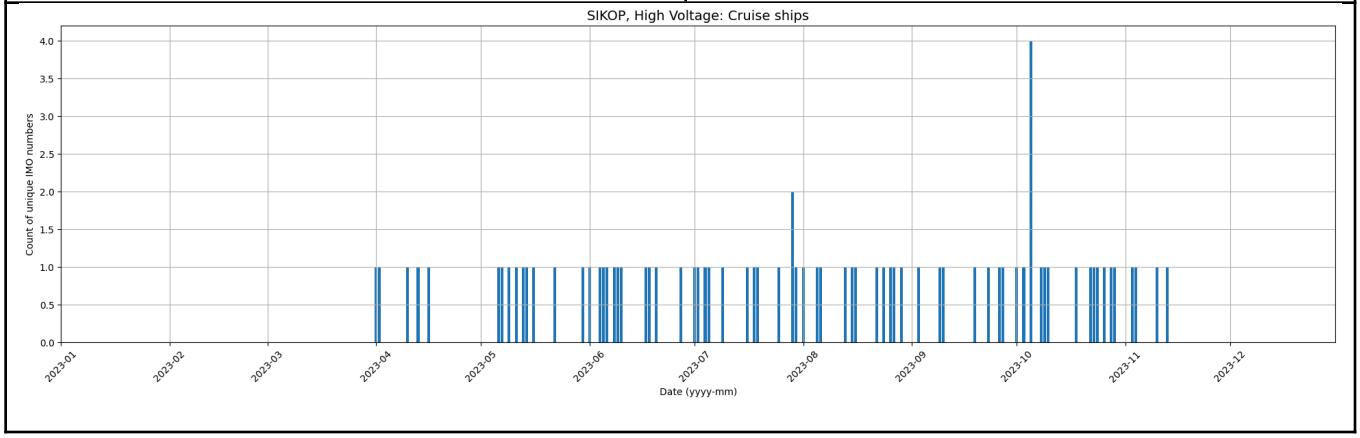






Koper	Low Voltage	High Voltage
Cruise ships – required connection points	0	1





Koper	High Voltage	Low Voltage
Passenger ships – req. connection points	0	0
No Results		

6.14.2 Current status and plans for onshore power supply

In the port of Koper, there are no OPS systems installed yet, and no concrete plans to install OPS either.

Capacity in the local electricity grid

According to the port, they would like to have OPS capability at their passenger and cruise berths, but it will not be possible before 2030, as a 110 kV power line must be built from the national grid to the port area. Currently, they barely have enough power for electrifying port operations.

6.15 Port of Le Havre, France

Le Havre is organized together with Rouen and Paris as HAROPA PORT, but the results presented here relate to the port with UN/LOCODE FRLEH (Figure 6-15).

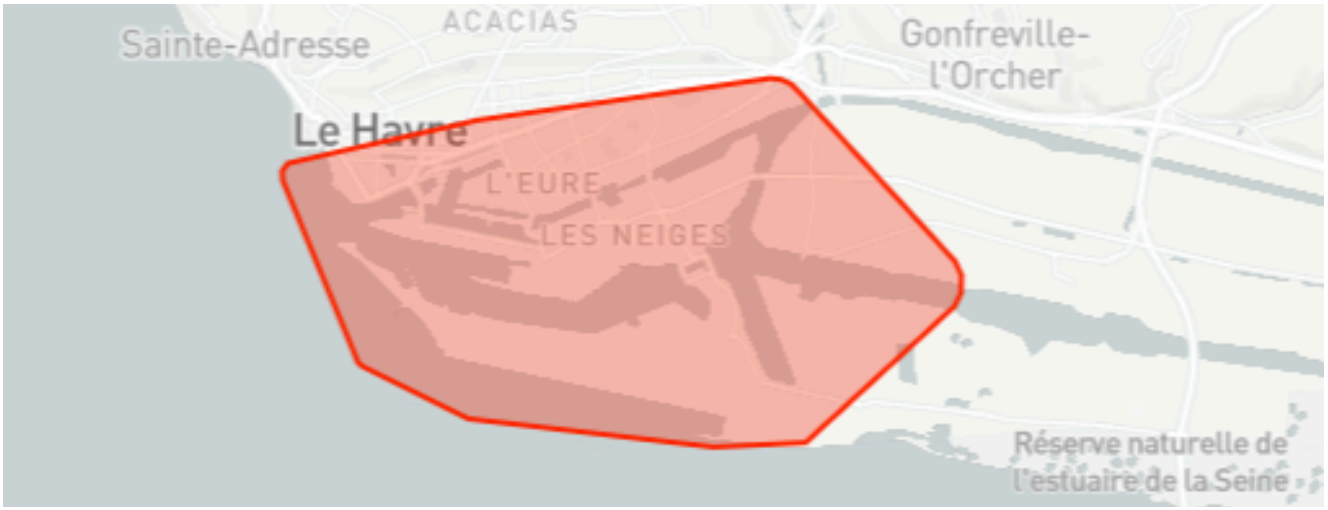


Figure 6-15 Port shape for Le Havre (FRLEH).

6.15.1 Current ship activity and energy requirements

Table 6-53 shows the effective hours in port per ship segment and size category for the port of Le Havre. There are more than 41 000 effective hours in port for container ships larger than 5000 GT. For cruise ships larger than 5000 GT there are around 2 000 effective hours in port, and for passenger ships larger than 5000 GT there are more than 2000 effective hours in port. Other segments with a high number of effective hours in the port are chemical tankers and other activities.

Table 6-53 Effective hours in port per ship segment and size category.

Le Havre	400 - 999 GT	1000 - 4999 GT	5000 - 9999 GT	10000 - 24999 GT	25000 - 49999 GT	50000 - 99999 GT	100000 GT <	Total
Bulk carriers				45		10		55
Chemical tankers		36 658	1 989	7 188	3 572			49 407
Container ships			2 227	2 705	8 029	15 086	13 089	41 136
Crude oil tankers				55	696	9 478	609	10 838
Cruise ships		281		29	81	624	1 187	2 202
Fishing ships	172		2					174
Gas tankers		1 918	1 109	558	1 625	88	358	5 656
General cargo ships	1 427	4 641	1 261	2 725	24			10 078

Offshore supply ships		501						501
Oil product tankers	3 073	467	112	229	410	116		4 407
Other activities	21 923	10 705	233	117				32 978
Other service offshore ships	199	299	775	1 786				3 059
Passenger ships				1 824	360			2 184
Refrigerated cargo ships								0
Ro-Ro cargo ships			1 349	1 847	2 038	2 877		8 111
Total	26 794	55 470	9 057	19 108	16 835	28 279	15 243	170 786

Table 6-54 shows the estimated energy consumption per ship segment and power category for the port of Le Havre. For container ships and passenger ships, most of the energy consumption is in the power category 1-5 MW. Container ships account for more than 55% of the total energy consumption in the port. For cruise ships, most of the estimated energy consumption is in the highest power category (> 10 MW).

Table 6-54 Estimated energy consumption in port (MWh) per ship segment and power category.

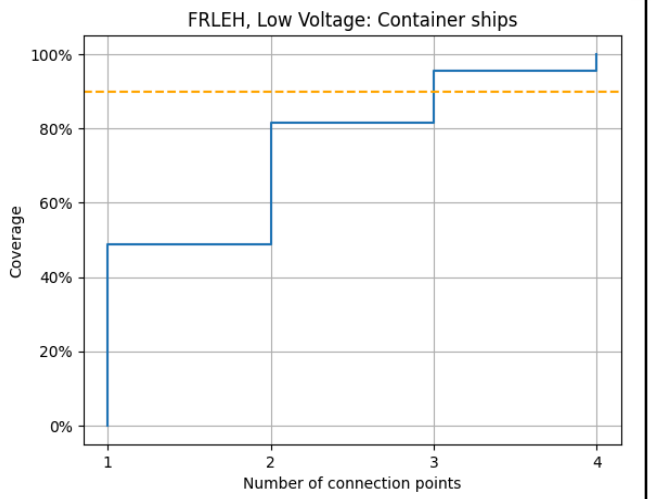
Le Havre	<100 kW	100-500 kW	500-1000 kW	1-5 MW	5-10 MW	>10 MW	Total
Bulk carriers	0	13	5	0	0	0	19
Chemical tankers	0	0	1 583	12 428	0	0	14 012
Container ships	0	1 107	1 918	90 206	0	0	93 231
Crude oil tankers	0	0	714	12 790	0	0	13 504
Cruise ships	0	115	0	389	4 504	11 882	16 890
Fishing vessels	11	1	0	0	0	0	12
Gas tankers	0	731	0	4 810	1 909	0	7 450
General cargo ships	487	1 340	15	0	0	0	1 841
Offshore supply ships	0	108	0	0	0	0	108
Oil product tankers	172	113	620	145	0	0	1 050
Other activities	921	2 783	220	0	0	0	3 924
Other service offshore vessels	13	359	1 118	0	0	0	1 489
Passenger ships	0	0	0	4 408	0	0	4 408
Refrigerated cargo ships	0	0	0	0	0	0	0
Ro-Ro cargo ships	0	430	2 767	2 883	0	0	6 080
Total	1 603	7 100	8 960	128 060	6 413	11 882	164 018

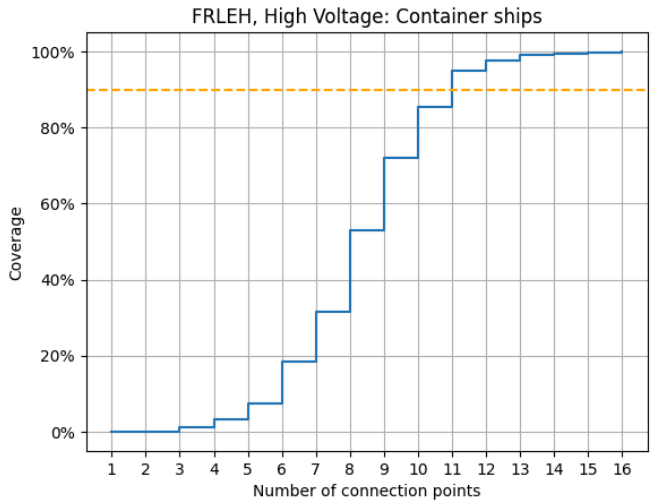
Table 6-55 presents simultaneous port calls for quantification of the need for low and high voltage connection points for container, cruise, and passenger ships above 5000 GT. There were some days in 2023 with 4 **container ships** requiring low voltage connection points in the port, but 3 such connection points would be sufficient for 90% coverage. Similarly, there were some days in 2023 with around 15 container ships requiring high voltage connection points in the port, but 11 such connection points would be sufficient for 90% coverage.

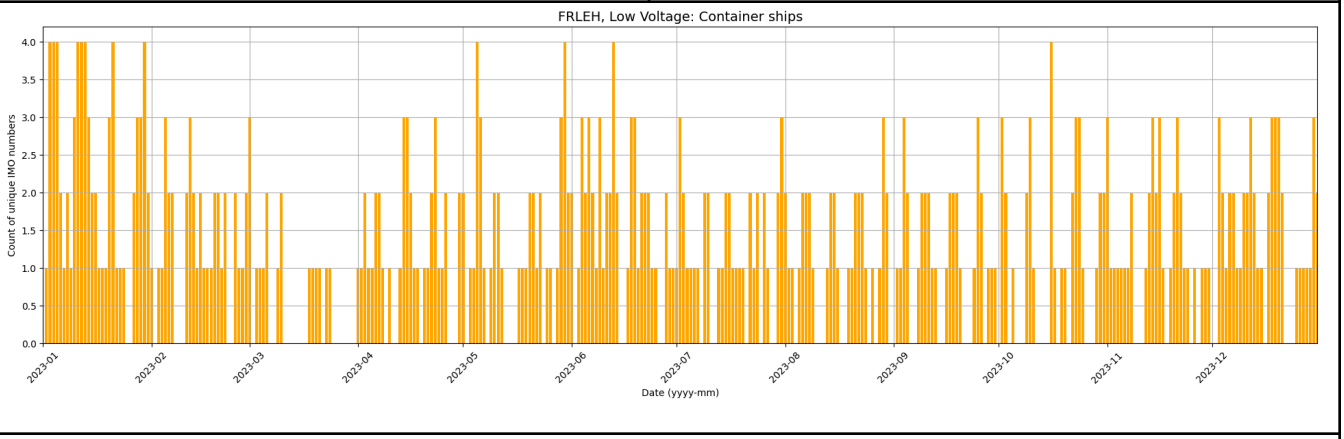
For **cruise ships**, there were some days with a need for 3 high voltage connection points, but 2 such connection point would be sufficient for 90% coverage. For **passenger ships**, one high voltage connection point is required. In total, there is an estimated need for 14 connection points for container ships, 1 connection point for cruise ships, and 1 connection point for passenger ships.

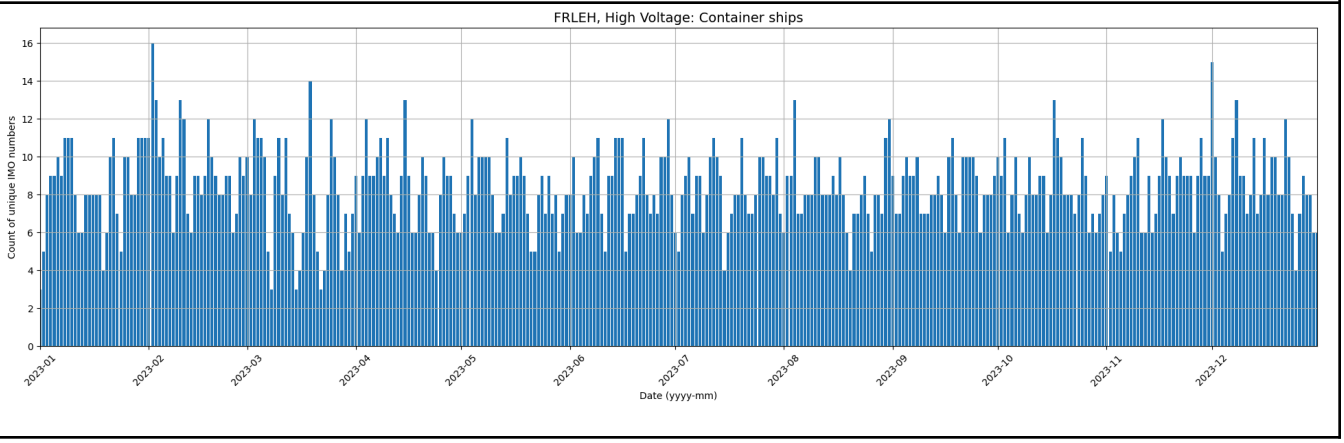
Table 6-55 Number of container and cruise ships at any day and passenger ships at any hour in 2023, and the estimated number of required connection points – split on low and high voltage.

Le Havre	Low Voltage	High Voltage
Container ships – req. connection points	3	11

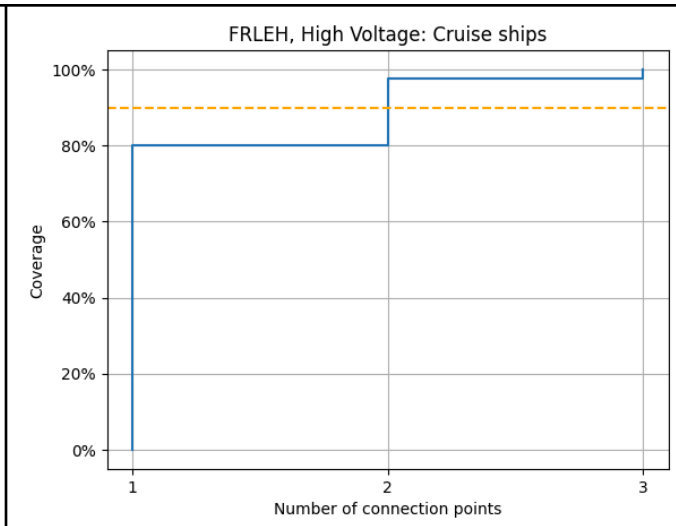


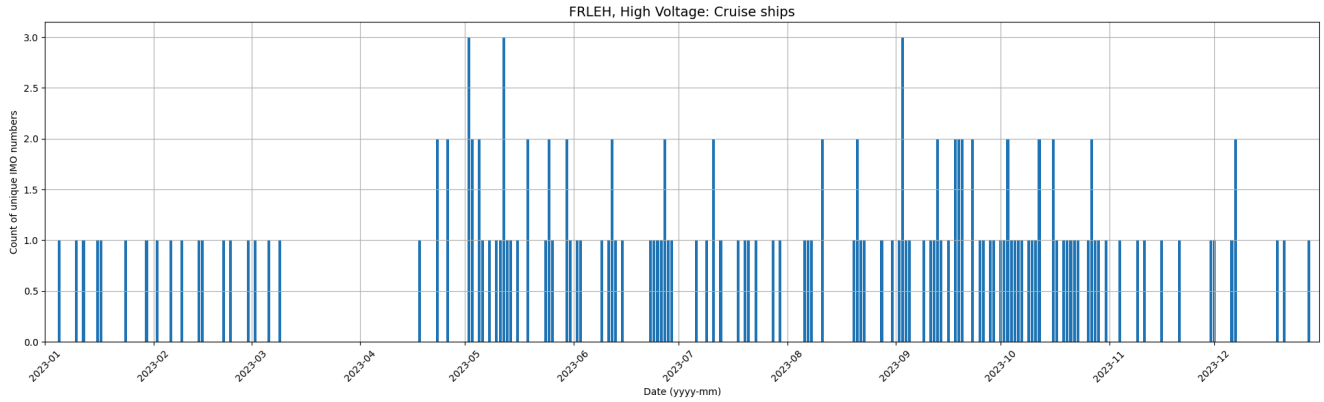




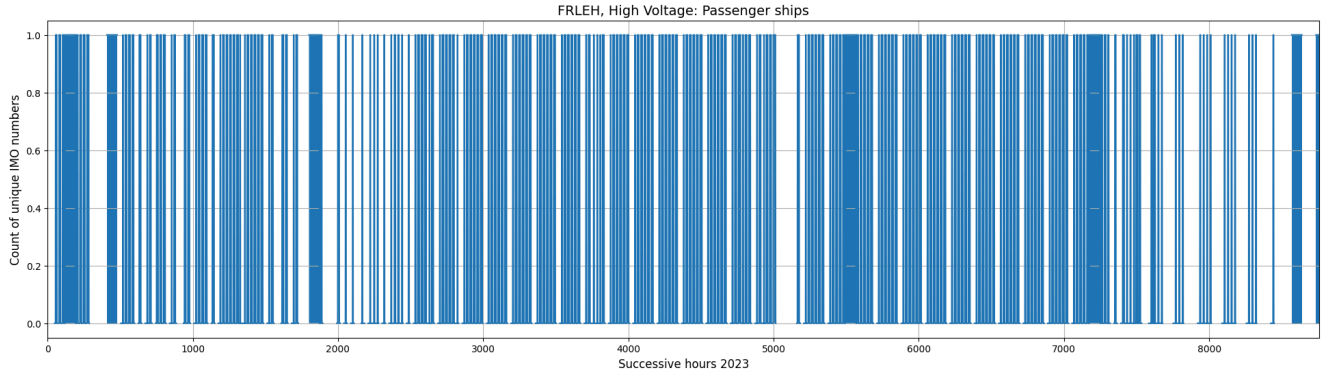


Le Havre	Low Voltage	High Voltage
Cruise ships – req. connection points	0	2





Le Havre	Low Voltage	High Voltage
Passenger ships – req. connection points	0	1



6.15.2 Current status and plans for onshore power supply

In the port of Le Havre, there are no OPS systems in operation yet. There are three contracted connection points for cruise ships (Table 6-56), to be connected to the grid with a new cable. The capacity of each connection point is 16 MW, but the

total maximum capacity is 30 MW. The first connection point is planned to open in 2025, the second by the end of 2025, and the third in early 2026.

Table 6-56 Contracted OPS in the port of Le Havre.

Maximum power from grid [MW]	Max. no. of simultaneous ships	Types of ships	Max. system power capacity [kW]	System voltage [kV]	System freq. [Hz]	Standard	Operational from
30	3	Cruise	3 x 16 000	6.6-11	50 and 60	IEC 80005-1	2025-26

Other planned connection points with no contract yet include:

- One connection point for container ships by 2025 (7 500 kW, 6.6 kV, 50 Hz/60 Hz, 8 MW in total);
- Two connection points for container ships by 2026 (7 500 kW, 6.6 kV, 50 Hz/60 Hz, 8 MW in total);
- 8 connection points for container ships by 2028 (7 500 kW, 6.6 kV, 50 Hz/60 Hz, 24 MW in total);
- One connection point for ferries by 2030 (6 500 kW, 11 kV, 50 Hz/60 Hz, 8 MW in total).

6.16 Port of Lisbon, Portugal

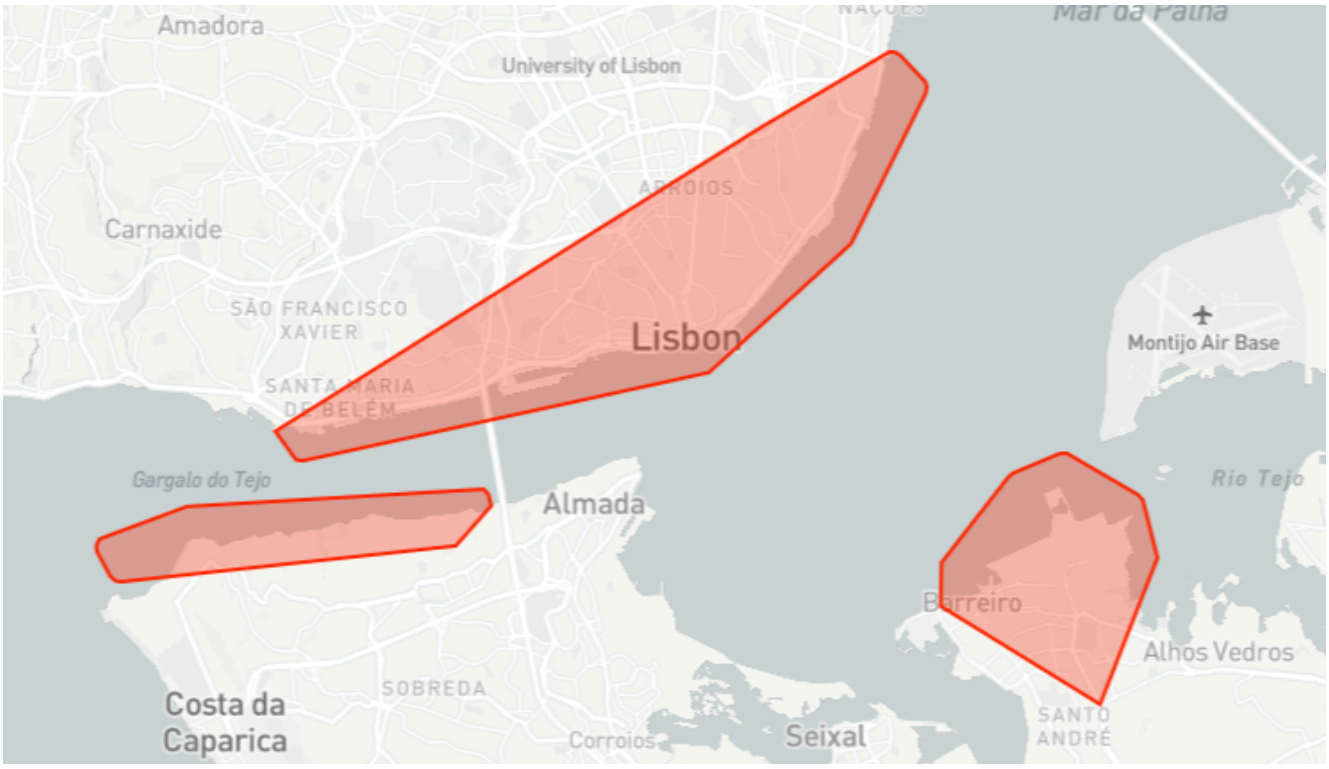


Figure 6-16 Port shape for Lisbon (PTLIS).

6.16.1 Current ship activity and energy requirements

Table 6-57 shows the effective hours in port per ship segment and size category for the port of Lisbon (Lisbon Metropolitan Area) in 2023. There are nearly 20 000 effective hours in port for container ships larger than 5000 GT. For cruise ships larger than 5000 GT there are around 5 500 effective hours in port, and for passenger ships larger than 5000 GT there are no

effective hours in port. Other segments with a high number of effective hours in the port are bulk carriers and general cargo ships.

Table 6-57 Effective hours in port per ship segment and size category.

Lisbon	400 - 999 GT	1000 - 4999 GT	5000 - 9999 GT	10000 - 24999 GT	25000 - 49999 GT	50000 - 99999 GT	100000 GT <	Total
Bulk carriers		118	1 093	7 833	6 914			15 958
Chemical tankers		1 355	1 541	1 911	154			4 961
Container ships		1 495	12 071	6 000	1 436	389	28	21 419
Crude oil tankers								0
Cruise ships		617	907	480	943	1 942	1 301	6 190
Fishing ships								0
Gas tankers		231	351	368				950
General cargo ships	42	14 081	8 149	2 269				24 541
Offshore supply ships		661						661
Oil product tankers		7 095	164	32	40			7 331
Other activities	1 176	919	326	200				2 621
Other service offshore ships		37		19				56
Passenger ships	1039							1 039
Refrigerated cargo ships			26	36				62
Ro-Ro cargo ships				5				5
Total	2 257	26 609	24 628	19 153	9 487	2 331	1 329	85 794

Table 6-58 shows the estimated energy consumption per ship segment and power category for the port of Lisbon in 2023. For container ships, the energy consumption is spread across the power categories 100-500 kW, 500-1000 kW, and 1-5 MW, with a shift towards the lower power categories. For cruise ships, the majority of the estimated energy consumption is in the highest power categories (5-10 MW and > 10 MW). Cruise ships represent more than 50% of the total energy consumption in port.

Table 6-58 Estimated energy consumption in port (MWh) per ship segment and power category.

Lisbon	<100 kW	100-500 kW	500-1000 kW	1-5 MW	5-10 MW	>10 MW	Total
Bulk carriers	0	5 253	0	0	0	0	5 253
Chemical tankers	0	647	1 227	2 273	0	0	4 147
Container ships	0	6 270	4 254	2 852	0	0	13 376
Crude oil tankers	0	0	0	0	0	0	0
Cruise ships	0	252	846	4 810	14 017	13 023	32 949
Fishing vessels	0	0	0	0	0	0	0
Gas tankers	0	88	0	813	0	0	901
General cargo ships	1 395	2 706	0	0	0	0	4 101
Offshore supply ships	0	143	0	0	0	0	143

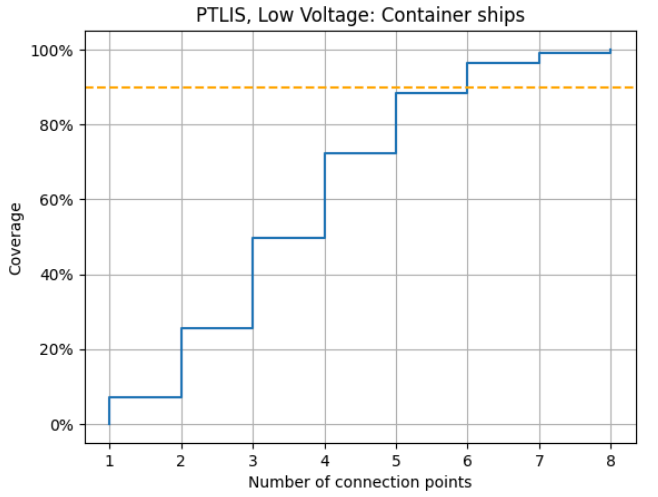
Oil product tankers	0	1 710	148	0	0	0	1 858
Other activities	49	239	339	0	0	0	627
Other service offshore vessels	0	8	12	0	0	0	20
Passenger ships	62	0	0	0	0	0	62
Refrigerated cargo ships	0	12	29	0	0	0	42
Ro-Ro cargo ships	0	0	3	0	0	0	3
Total	1 507	17 329	6 858	10 748	14 017	13 023	63 482

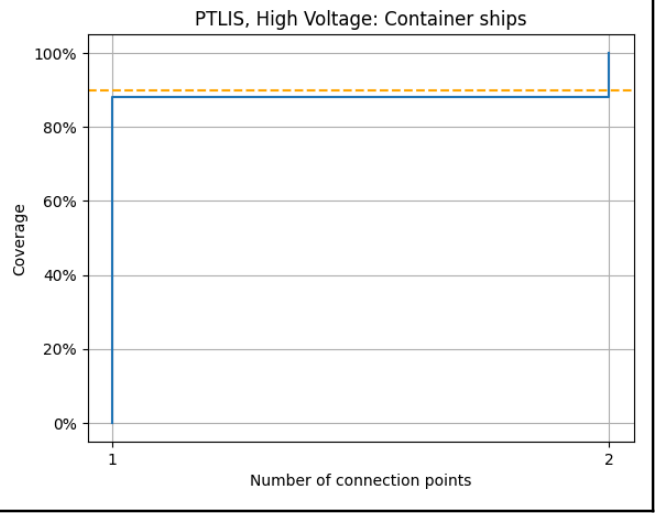
Table 6-19 presents simultaneous port calls for quantification of the need for low and high voltage connection points for container, cruise, and passenger ships above 5000 GT. There were some days in 2023 with 8 **container ships** requiring low voltage connection points in the port, but 6 such connection points would be sufficient for 90% coverage. 2 high voltage connection points for container ships are needed for 90% coverage.

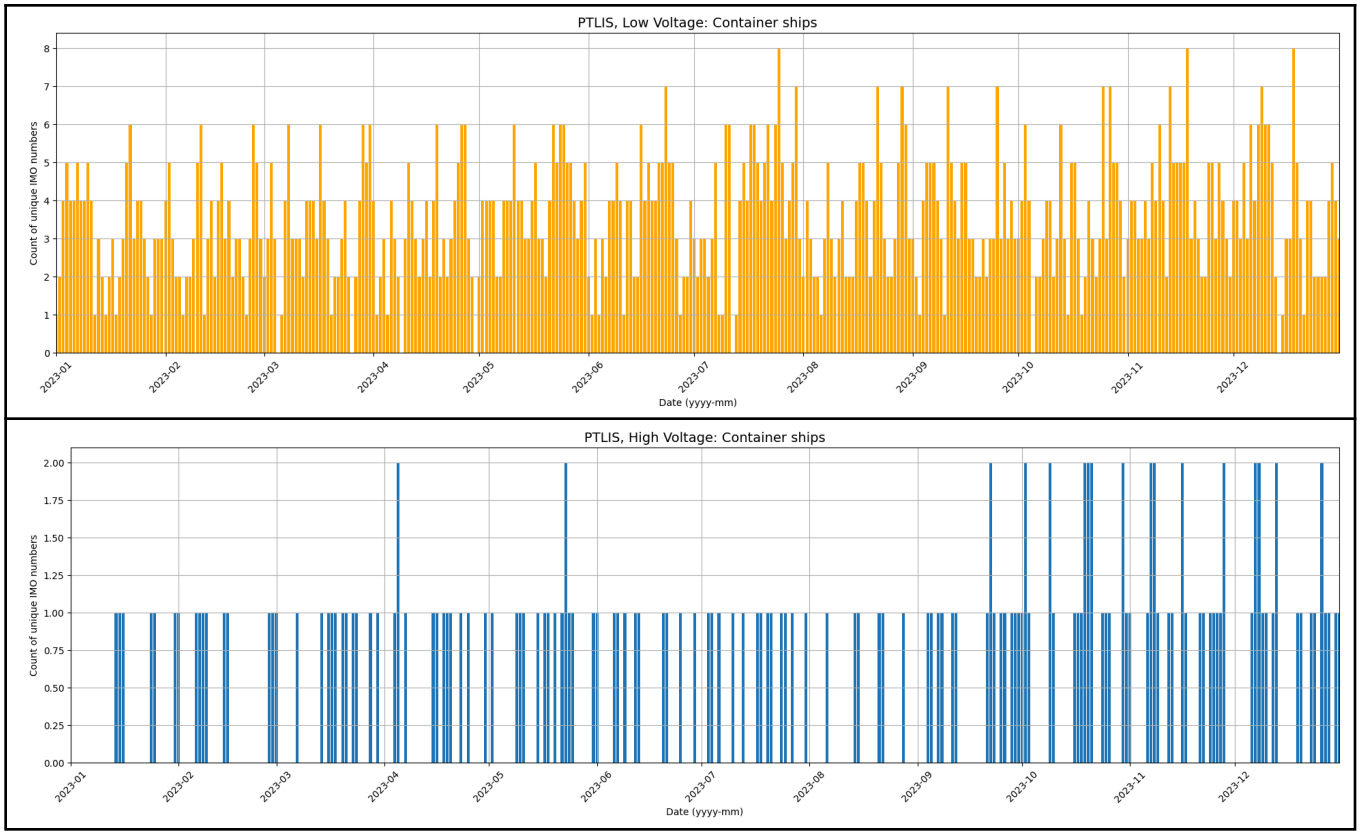
For **cruise ships**, there was one day with a need for 3 low voltage connection points and some days with a need for 4 high voltage connection points. However, 2 low voltage and 3 high voltage connection points would be sufficient for 90% coverage. For **passenger ships,** there was no traffic in the port in 2023, hence there is no estimated need for any connection points. In total, there is an estimated need for 8 connection points for container ships and 5 connection points for cruise ships.

Table 6-59 Number of container and cruise ships at any day and passenger ships at any hour in 2023, and the estimated number of required connection points – split on low and high voltage.

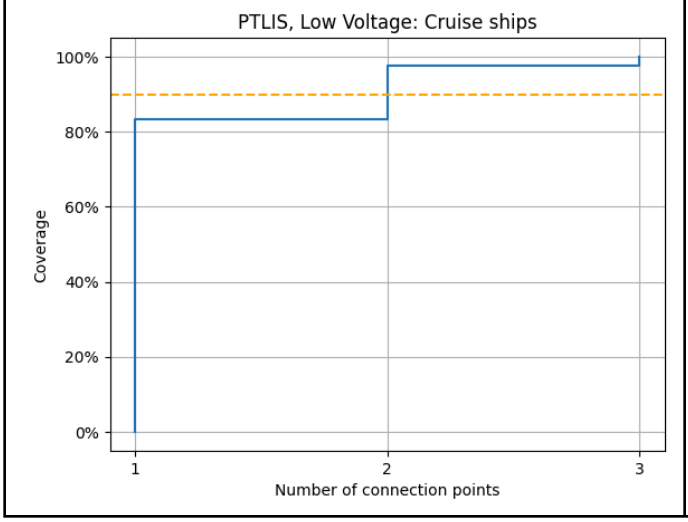
Lisbon	Low Voltage	High Voltage
Container ships – req. connection points	6	2

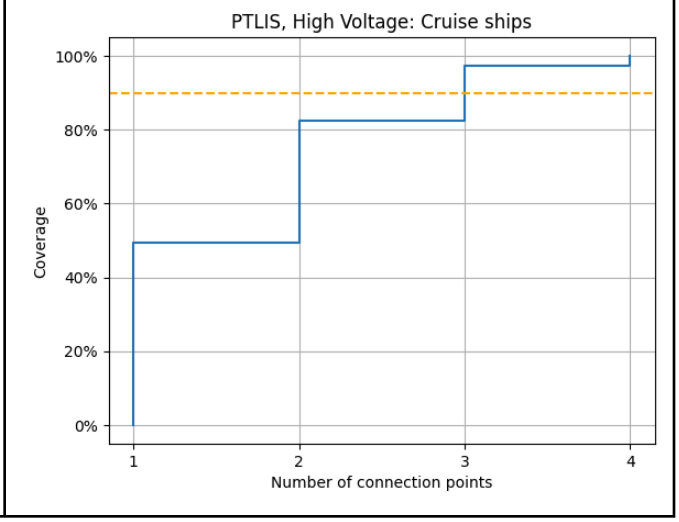


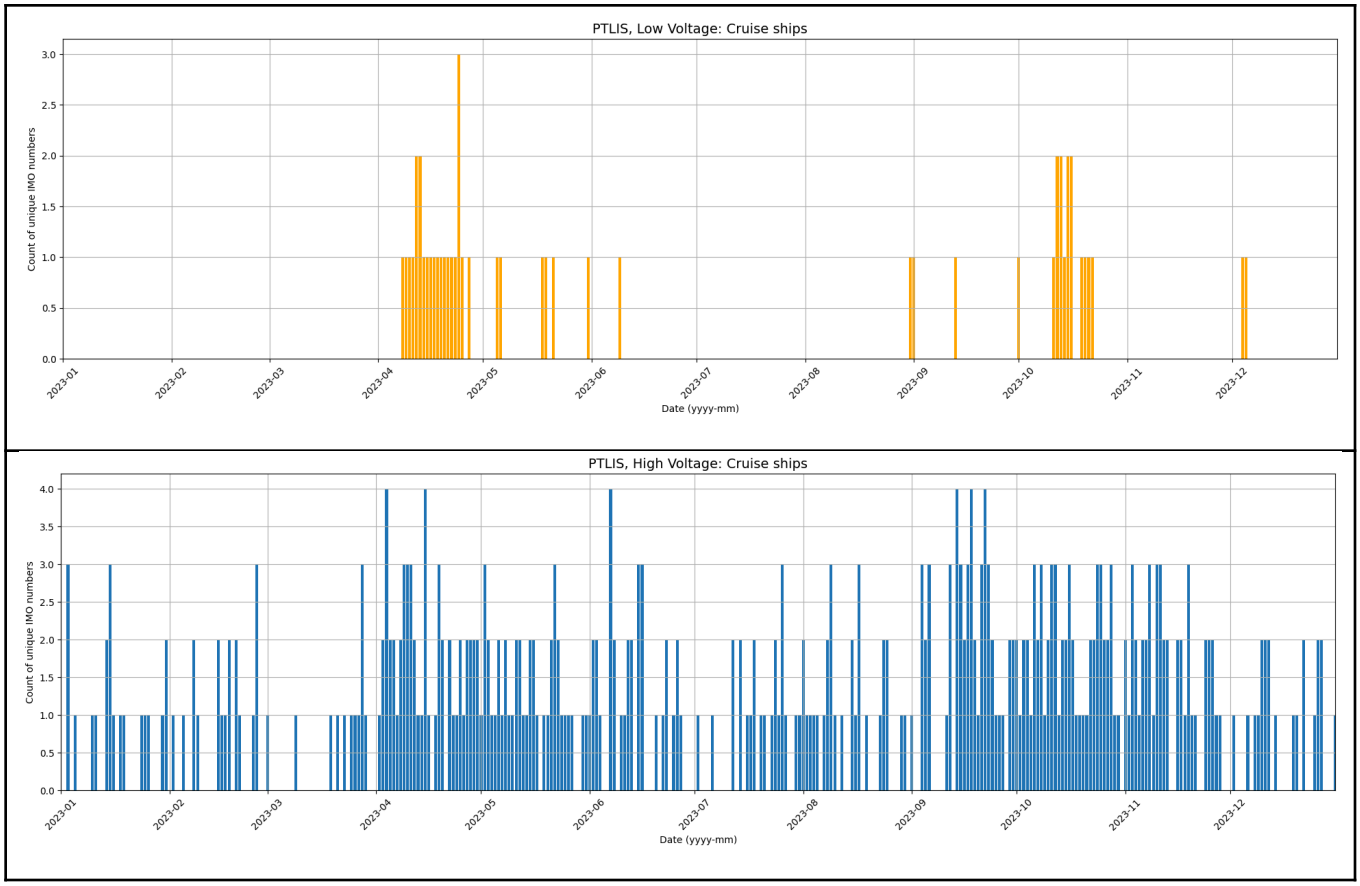




Lisbon	Low Voltage	High Voltage
Cruise ships – required connection points	2	3







Lisbon	Low Voltage	High Voltage
Passenger ships – req. connection points	0	0
No data		

6.16.2 Current status and plans for onshore power supply

Currently, the Port of Lisbon does not have any implementation of OPS or any public tenders regarding this matter. A feasibility study has been conducted regarding OPS for their cruise terminal. 48 kVA was estimated to be the necessary capacity if the system is to operate at peak traffic and maximum demand. The works for the HV connection to the national grid are ongoing and the same happens with the detailed design for the main substation and for the MV internal grid.OPS is expected to become available at their container terminals at Alcantara, but there are no concrete plans yet.

Capacity in the local electricity grid

According to the port, one of the main barriers is the grid capacity, which is not sufficient for the expected OPS demand. The total cost for the necessary grid developments is expected to be around 31 million EUR.

6.17 Port of Livorno, Italy

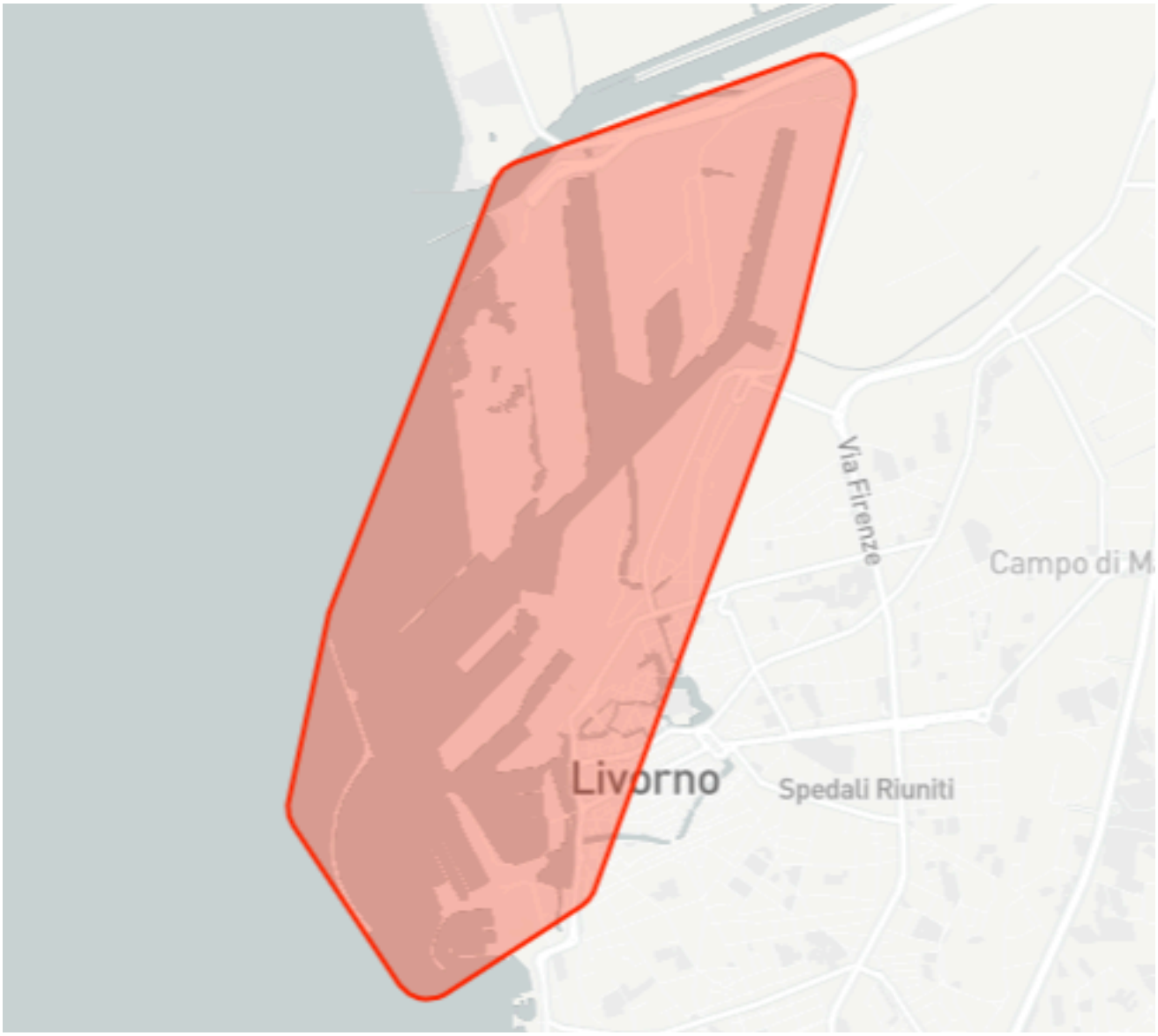


Figure 6-17 Port shape for Livorno (ITLIV).

6.17.1 Current ship activity and energy requirements

Table 6-60 shows the effective hours in port per ship segment and size category for the port of Livorno in 2023. There are close to 14 000 effective hours in port for container ships larger than 5000 GT. For cruise ships larger than 5000 GT there are near 5000 effective hours in port, and for passenger ships larger than 5000 GT there are around 22 000 effective hours in port. Other segments with a high number of hours in the port are chemical tankers, general cargo ships, oil product tankers, other activities and Ro-Ro cargo ships.

Table 6-60 Effective hours in port per ship segment and size category.

Livorno	400 - 999 GT	1000 - 4999 GT	5000 - 9999 GT	10000 - 24999 GT	25000 - 49999 GT	50000 - 99999 GT	100000 GT <	Total
Bulk carriers		58	774	820	700			2 352

Chemical tankers		10 799	4 109	4 769	3 710			23 387
Container ships			1 006	938	2 844	8 517	476	13 781
Crude oil tankers						2 769		2 769
Cruise ships		105	94	75	1 644	1 168	1 727	4 813
Fishing ships								0
Gas tankers				1 359	518			1 877
General cargo ships	2 017	5 551	6 329	1 536	5 965			21 398
Offshore supply ships		1 798						1 798
Oil product tankers		23 168	179	43	423			23 813
Other activities	65 402	12 606	101					78 109
Other service offshore ships								0
Passenger ships	1 134	8 836		7 964	10 703	4 056		32 693
Refrigerated cargo ships								0
Ro-Ro cargo ships			279	5 099	6 484	7 396		19 258
Total	68 553	62 921	12 871	22 603	32 991	23 906	2 203	226 048

Table 6-61 shows the estimated energy consumption per ship segment and power category for the port of Livorno in 2023. For container ships and passenger ships, most of the estimated energy consumption is in the power category 1-5 MW. Additionally, for passenger ships, there is a notable portion of energy consumption in the power category 5-10 MW. For cruise ships, most of the estimated energy consumption is in the highest power category (> 10 MW). The three main ship segments represent about 70% of the total estimated energy consumption in port.

Table 6-61 Estimated energy consumption in port (MWh) per ship segment and power category.

Livorno	<100 kW	100-500 kW	500-1000 kW	1-5 MW	5-10 MW	>10 MW	Total
Bulk carriers	0	677	0	0	0	0	677
Chemical tankers	0	0	3 271	9 983	0	0	13 253
Container ships	0	500	665	24 936	0	0	26 102
Crude oil tankers	0	0	0	3 461	0	0	3 461
Cruise ships	0	43	88	6 892	8 431	17 287	32 741
Fishing vessels	0	0	0	0	0	0	0
Gas tankers	0	0	0	2 544	0	0	2 544
General cargo ships	588	2 014	3 722	0	0	0	6 324
Offshore supply ships	0	388	0	0	0	0	388
Oil product tankers	0	5 583	535	0	0	0	6 119
Other activities	2 747	3 278	52	0	0	0	6 077
Other service offshore vessels	0	0	0	0	0	0	0
Passenger ships	68	3 154	0	51 946	25 549	0	80 717
Refrigerated cargo ships	0	0	0	0	0	0	0
Ro-Ro cargo ships	0	89	8 320	7 411	0	0	15 820
Total	3 403	15 727	16 653	107 173	33 979	17 287	194 222

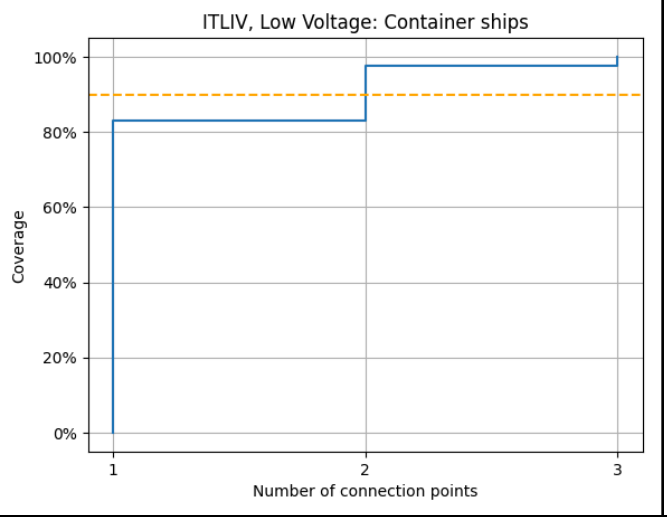
Table 6-62 presents simultaneous port calls for quantification of the need for low and high voltage connection points for container, cruise, and passenger ships above 5000 GT. There were some days in 2023 with 3 **container ships** requiring low voltage connection points in the port, but 2 such connection points would be sufficient for 90% coverage. Similarly, there were some days in 2023 with 6 container ships requiring high voltage connection points in the port, but 4 such connection points would be sufficient for 90% coverage.

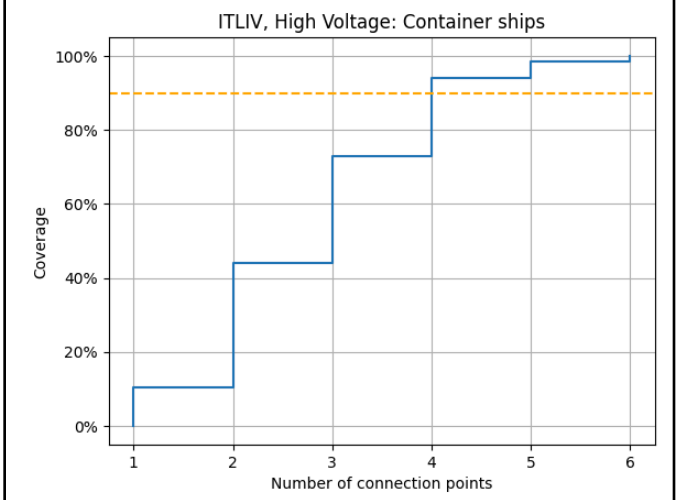
For 90% coverage, there is an estimated need for one low voltage connection point for **cruise ships**, although there were only a few days with such traffic in the port in 2023. Unless a significant increase in the cruise traffic to the port is expected towards 2030, the port should not invest in such a connection point. There were some days with a need for 4 or 5 high voltage connection points for cruise ships, but 3 such connection points would be sufficient for 90% coverage.

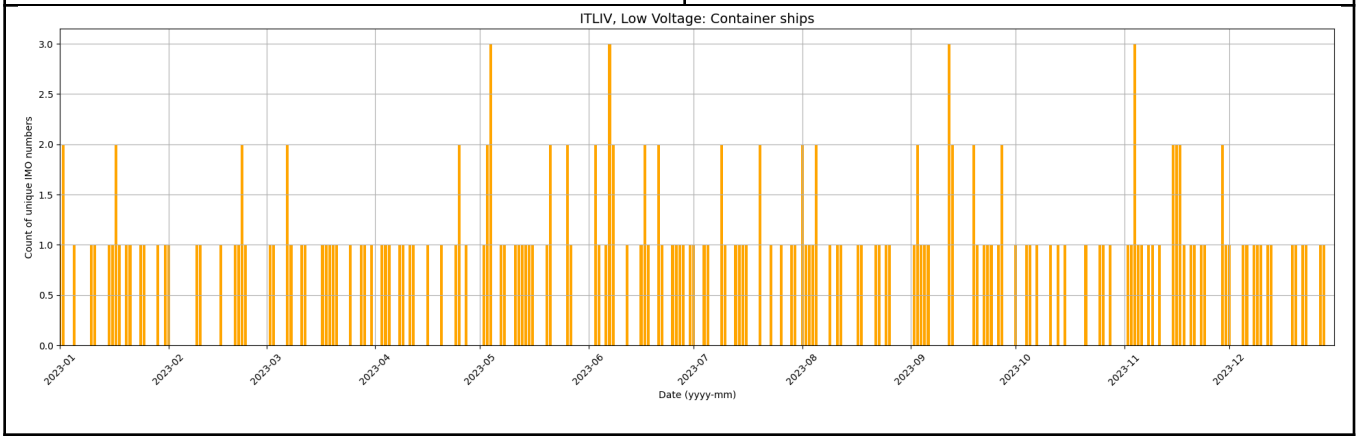
For **passenger ships**, there were some hours with a need for around 8 high voltage connection points, but 5 such connection points would be sufficient for 90% coverage. In total, there is an estimated need for 6 connection points for container ships, 4 connection points for cruise ships, and 5 connection points for passenger ships.

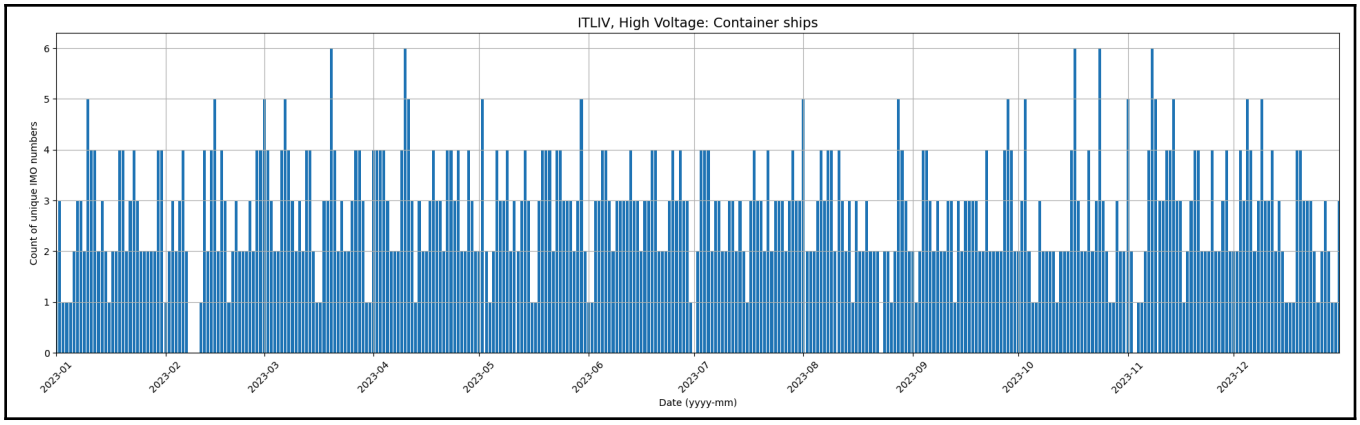
Table 6-62 Number of container and cruise ships at any day and passenger ships at any hour in 2023, and the estimated number of required connection points – split on low and high voltage.

Livorno	Low Voltage	High Voltage
Container ships – req. connection points	2	4

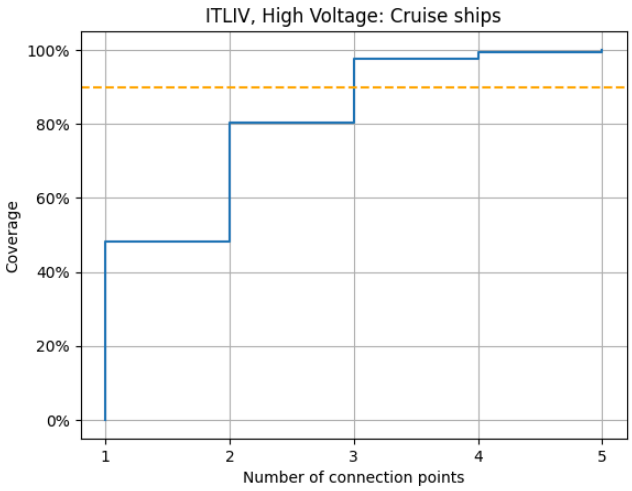


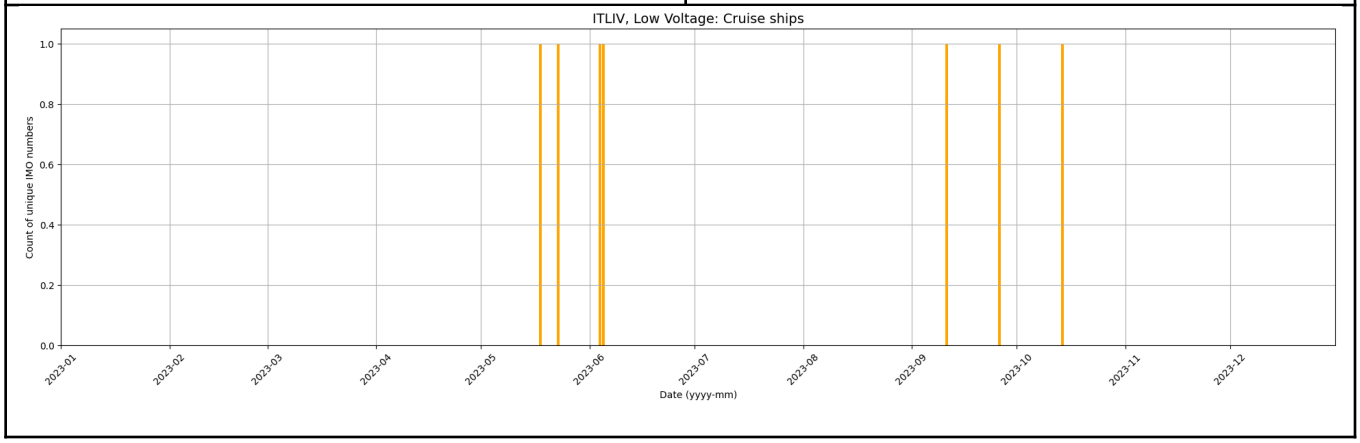


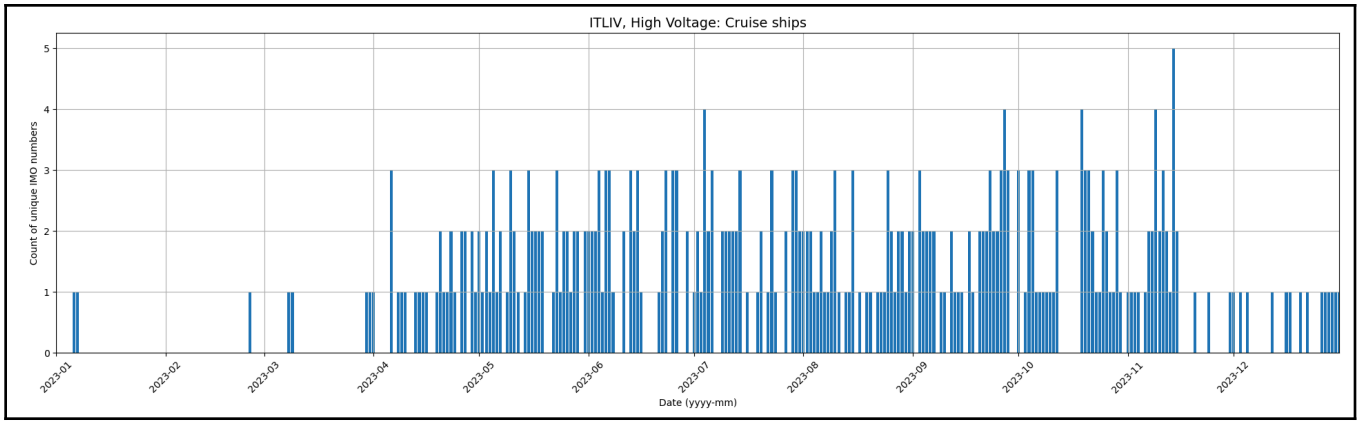




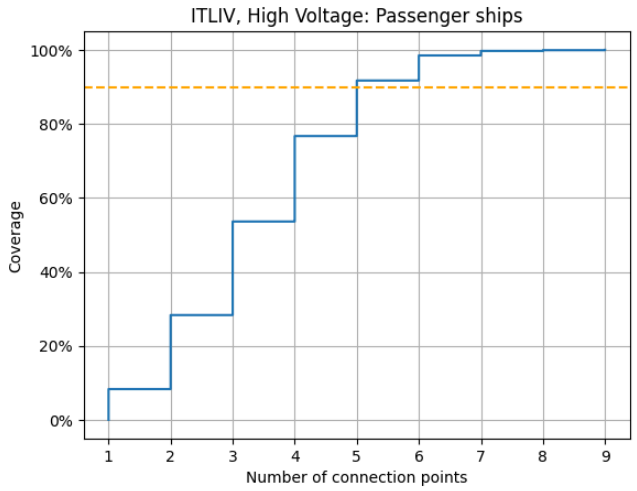
Livorno	Low Voltage	High Voltage
Cruise ships – required connection points	1	3

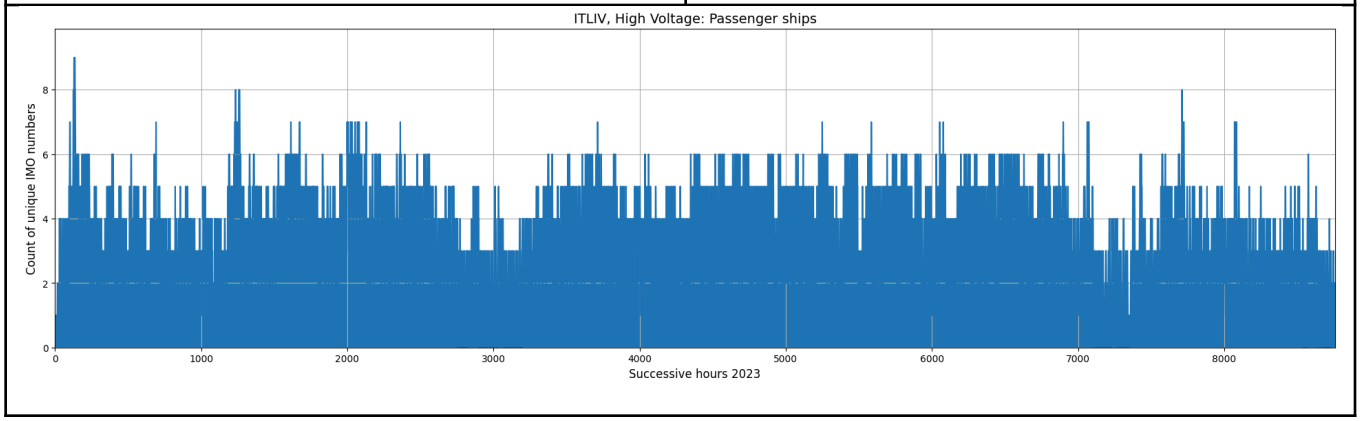






Livorno	Low Voltage	High Voltage
Passenger ships – reg. connection points	0	5





6.17.2 Current status and plans for onshore power supply

In the port of Livorno, there are currently no installed OPS systems. On 8th April 2024, a contract was signed for the installation of the OPS systems listed in Table 6-63.

Table 6-63 Contracted OPS in the port of Livorno.

Berth name	Max. power from grid [MW]	Max. no. of simul-ta neous ships	Types of ships	Max. system power capacity [kW]	System voltage [kV]	System freq. [Hz]	Standard	Opera-tive from
Banchina Alto Fondale	60	2	Cruise	16 000	6.6-11	50 and 60	IEC 80005-1	2026
Calata Punto Franco	60	1	Passenger (ferry)	6 500	6.6-11	50 and 60	IEC 80005-1	2026
Calata Sgarallino	60	1	Passenger (ferry)	6 500	6.6-11	50 and 60	IEC 80005-1	2026
Molo Capitaneria	60	2	Passenger (ferry)	6500	11	50 and 60	IEC 80005-1	2026
			Cruise	16000	11	50 and 60	IEC 80005-1	2026
Banchina Darsena Toscana sponda Est	60	1	Container	7 500	6.6-11	50 and 60	IEC 80005-1	2026
Banchina Darsena Toscana sponda Ovest	60	2	Container	7500	6.6-11	50 and 60	IEC 80005-1	2026

6.18 Port of Palma de Mallorca, Spain

The Port of Palma de Mallorca is currently managed by the Port Authority of the Balearic Islands, along with four other ports, but the results presented here relate to the port with UN/LOCODE ESPMI (Figure 6-18).

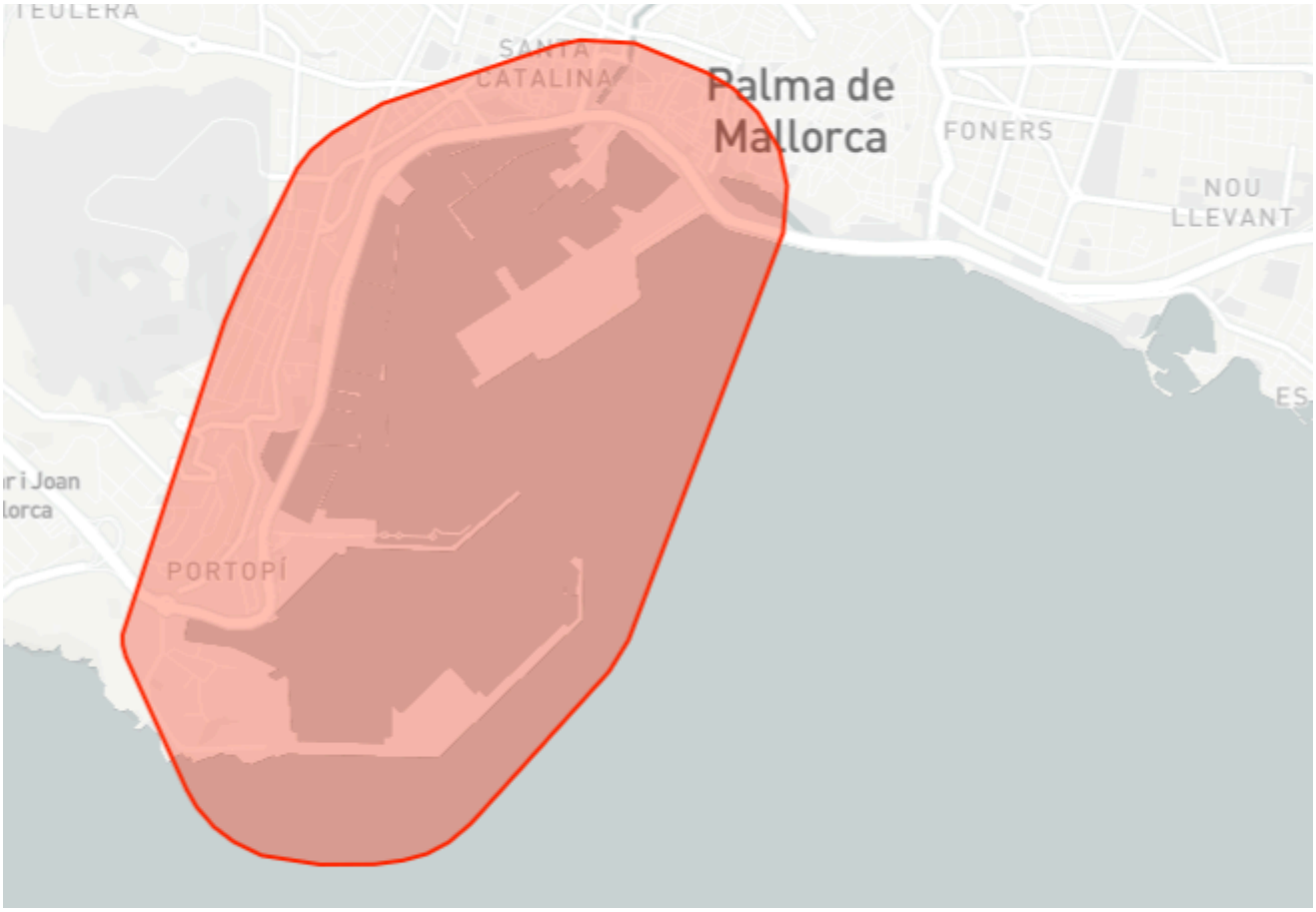


Figure 6-18 Port shape for Palma de Mallorca (ESPMI).

6.18.1 Current ship activity and energy requirements

Table 6-64 shows the effective hours in port per ship segment and size category for the port of Palma de Mallorca in 2023. There are no effective hours in port for container ships larger than 5000 GT. For cruise ships larger than 5000 GT there are more than 6000 effective hours in port, and for passenger ships larger than 5000 GT there are around 18 000 effective hours in port.

Table 6-64 Effective hours in port per ship segment and size category.

Palma de Mallorca	400 - 999 GT	1000 - 4999 GT	5000 - 9999 GT	10000 - 24999 GT	25000 - 49999 GT	50000 - 99999 GT	100000 GT <	Total
Bulk carriers		1 434						1 434
Chemical tankers				1 261	437			1 698
Container ships								0
Crude oil tankers								0
Cruise ships		136	126	120	380	2 200	3 388	6 350
Fishing ships								0
Gas tankers								0
General cargo ships			687	663	99			1 449

Offshore supply ships		239						239
Oil product tankers				164	49			213
Other activities	88 884	19 386	79	49				108 398
Other service offshore ships		11						11
Passenger ships		2	1 547	5 829	10 982			18 360
Refrigerated cargo ships								0
Ro-Ro cargo ships					18	392		410
Total	88 884	21 208	2 439	8 086	11 965	2 592	3 388	138 562

Table 6-65 shows the estimated energy consumption per ship segment and power category for the port of Palma de Mallorca in 2023. For cruise ships, most of the estimated energy consumption is in the highest power category (> 10 MW). For passenger ships, most of the estimated energy consumption is in the power category 1-5 MW. These two segments represent around 90% of the total energy consumption in the port.

Table 6-65 Estimated energy consumption in port (MWh) per ship segment and power category.

Palma de Mallorca	<100 kW	100-500 kW	500-1000 kW	1-5 MW	5-10 MW	>10 MW	Total
Bulk carriers	0	171	0	0	0	0	171
Chemical tankers	0	0	0	1 935	0	0	1 935
Container ships	0	0	0	0	0	0	0
Crude oil tankers	0	0	0	0	0	0	0
Cruise ships	0	56	118	1 794	15 880	33 914	51 761
Fishing vessels	0	0	0	0	0	0	0
Gas tankers	0	0	0	0	0	0	0
General cargo ships	0	411	62	0	0	0	473
Offshore supply ships	0	52	0	0	0	0	52
Oil product tankers	0	0	165	0	0	0	165
Other activities	3 733	5 040	83	0	0	0	8 856
Other service offshore vessels	0	2	0	0	0	0	2
Passenger ships	0	1	1 261	49 294	0	0	50 556
Refrigerated cargo ships	0	0	0	0	0	0	0
Ro-Ro cargo ships	0	0	14	393	0	0	407
Total	3 733	5 733	1 702	53 416	15 880	33 914	114 377

Table 6-66 presents simultaneous port calls for quantification of the need for low and high voltage connection points for container, cruise, and passenger ships above 5000 GT. For **container ships**, there was no traffic in the port in 2023, hence there is no estimated need for any connection points.

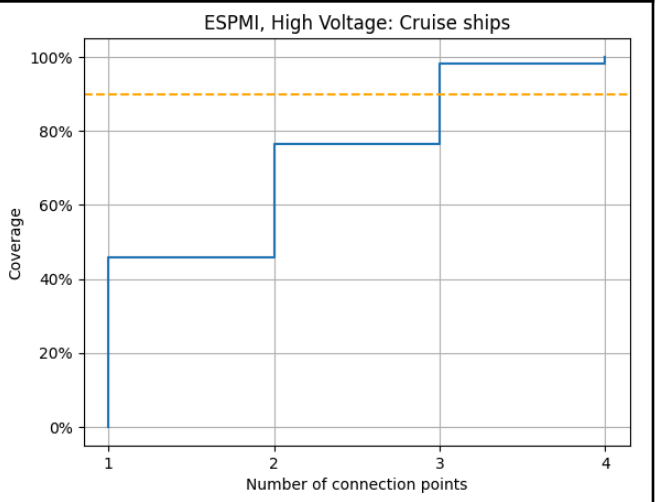
For 90% coverage, there is an estimated need for one low voltage connection point for **cruise ships**, although there were only a few days with such traffic in the port in 2023. The port should consider the expected increase in the cruise traffic to the port towards 2030, before investing in such connection points. There were some days with a need for 4 high voltage connection points for cruise ships, but 3 such connection points would be sufficient for 90% coverage.

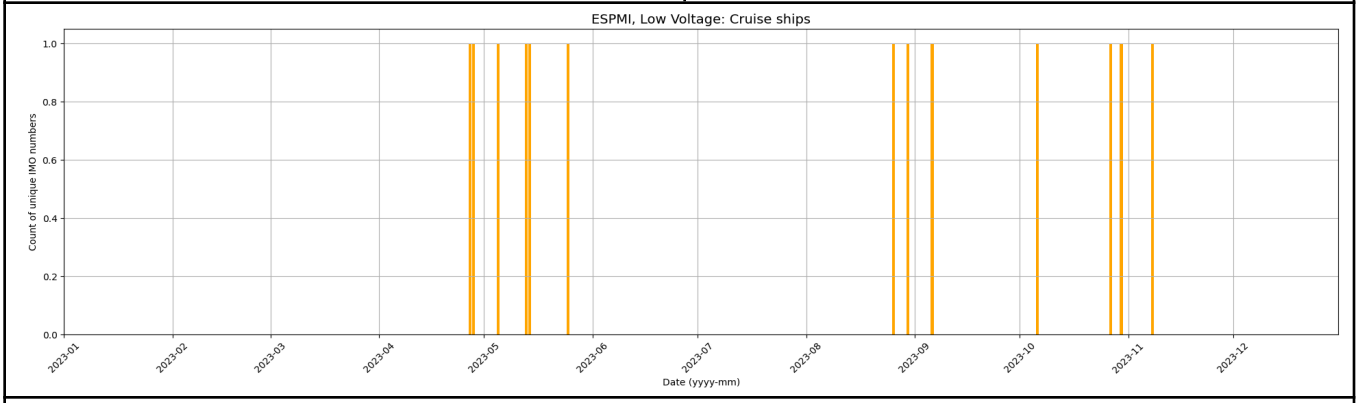
There were some hours in 2023 with 2 **passenger ships** requiring low voltage connection points in the port, but 1 such connection point would be sufficient for 90% coverage. Similarly, there were some hours in 2023 with 10 passenger ships requiring high voltage connection points in the port, but 8 such connection points would be sufficient for 90% coverage. In total, there is an estimated need for 4 connection points for cruise ships and 9 connection points for passenger ships.

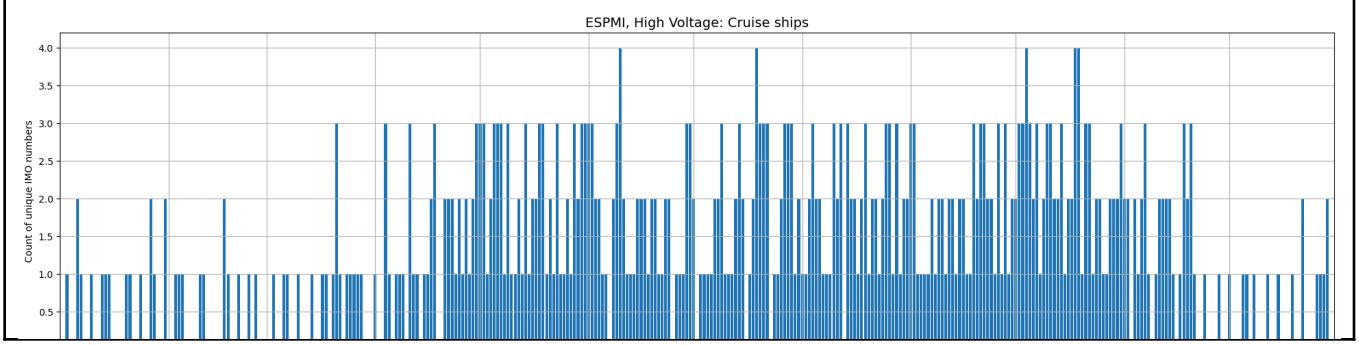
Table 6-66 Number of container and cruise ships at any day and passenger ships at any hour in 2023, and the estimated number of required connection points – split on low and high voltage.

Palma de Mallorca	Low Voltage	High Voltage
Container ships – req. connection points	0	0
No data		

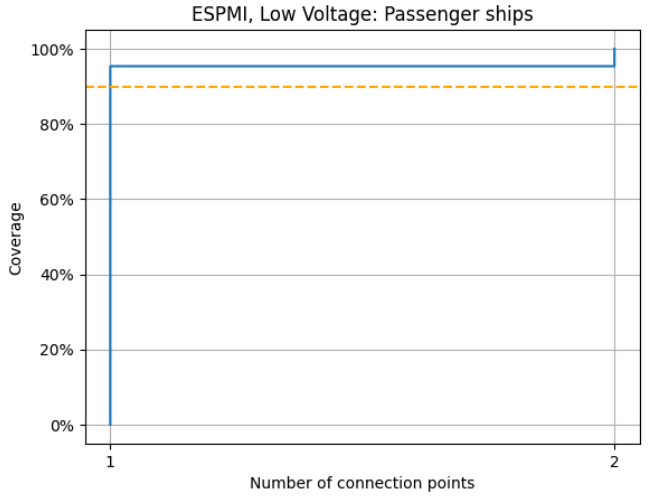
Palma de Mallorca	Low Voltage	High Voltage
Cruise ships – required connection points	1	3

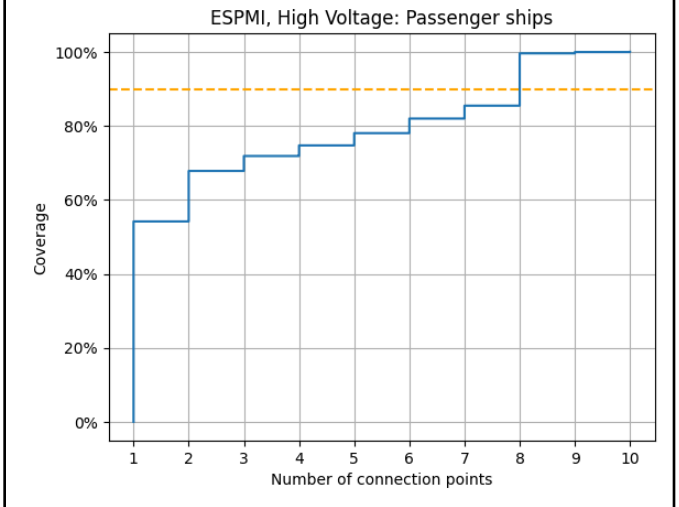


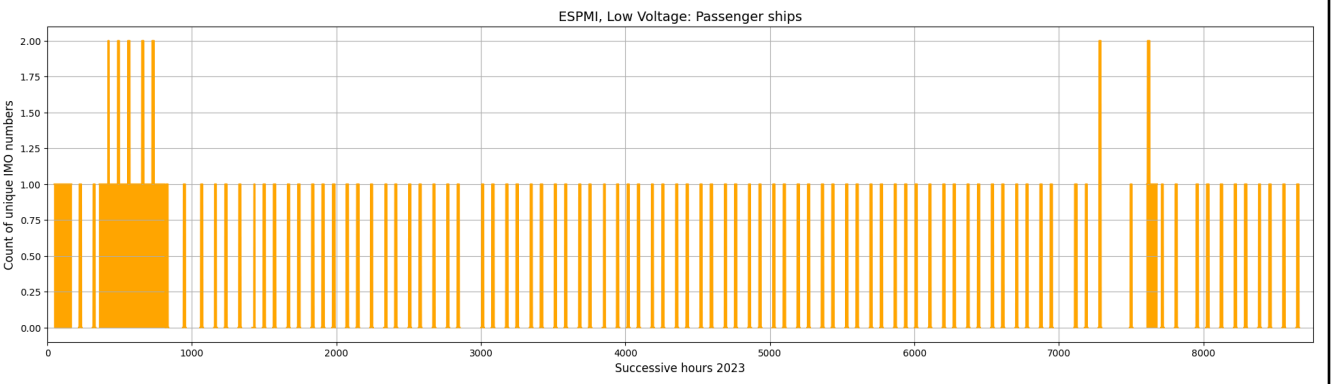


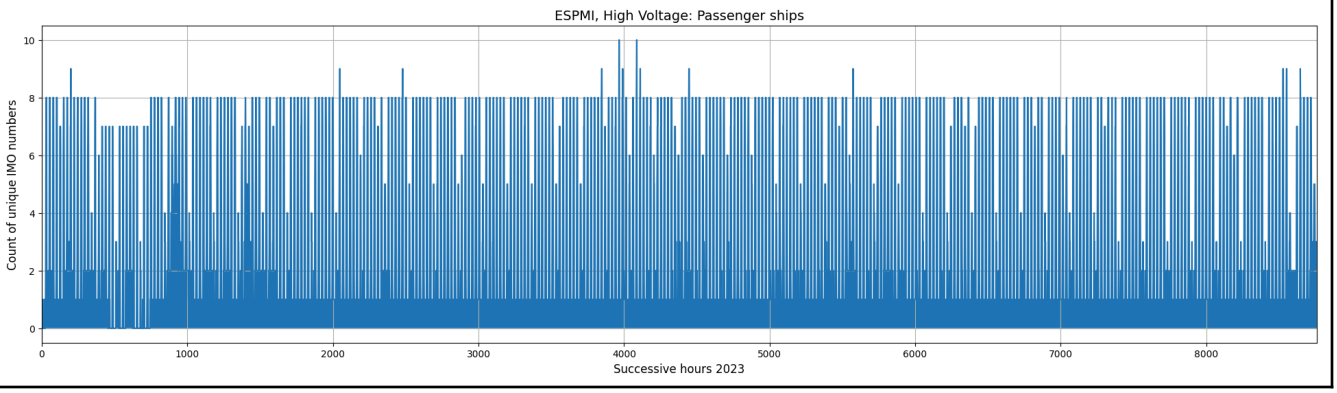


Palma de Mallorca	Low Voltage	High Voltage
Passenger ships – req. connection points	1	8









6.18.2 Current status and plans for onshore power supply

The Port of Palma de Mallorca currently has one OPS system in operation for ferries (Table 6-67). Furthermore, the port has a grant to finance another project for connecting ferries to OPS. They are currently preparing all the documentation and the contract will go out on public tender soon.

Capacity in the local electricity grid

According to the port, the current surplus capacity in the electricity grid is sufficient for ferries, but not for cruise ships. This is a limiting factor for further implementation of OPS in the port.

Table 6-67 Installed OPS in the port of Palma de Mallorca.

Max. no. of simultaneous ships	Types of ships	Max. system power capacity [kW]	System voltage	Standard
1	Passenger (ferries)	1 600	11 kV	IEC 80005-1

6.19 Port of Rotterdam, Netherlands

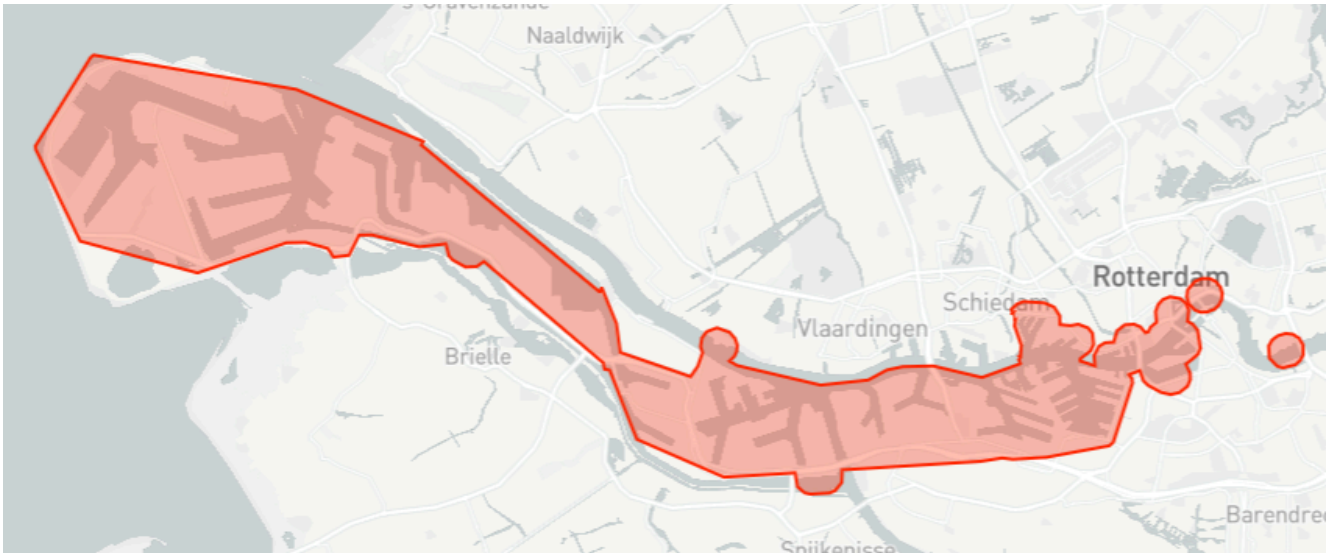


Figure 6-19 Port shape for Rotterdam (NLRTM).

6.19.1 Current ship activity and energy requirements

Table 6-68 shows the effective hours in port per ship segment and size category for the port of Rotterdam in 2023. There are around 201 000 effective hours in port for container ships larger than 5000 GT. For cruise ships larger than 5000 GT there are more than 2000 effective hours in port, and for passenger ships larger than 5000 GT there are a little less than 6000 effective hours in port. Other segments with a high number of effective hours in the port are oil product tankers, crude oil tankers, gas tankers and other activities.

Table 6-68 Effective hours in port per ship segment and size category.

Rotterdam	400 - 999 GT	1000 - 4999 GT	5000 - 9999 GT	10000 - 24999 GT	25000 - 49999 GT	50000 - 99999 GT	100000 GT <	Total
Bulk carriers	131	755	583	21 386	49 651	23 973	6 767	103 246
Chemical tankers	41 223	402 875	63 845	109 341	63 930			681 214
Container ships		5 010	65 488	55 398	13 625	23 317	43 483	206 321
Crude oil tankers			416	3 505	5 308	47 726	12 994	69 949
Cruise ships		1 941	15	10	76	265	1 869	4 176
Fishing ships	2							2
Gas tankers	556	33 230	8 599	5 203	1 560	69	4 909	54 126

General cargo ships	11 084	122 311	30 148	23 107	6 450	1 816		194 916
Offshore supply ships	713	20 548	589					21 850
Oil product tankers	8 597	42 661	8 358	1 039	3 897	301		64 853
Other activities	94 195	14 827	11 702	3 724	2 254	821	2 568	130 091
Other service offshore ships	375	16 806	2 985	5 900	201		255	26 522
Passenger ships	3874	234		720	874	4 190		9 892
Refrigerated cargo ships		44	635	360				1 039
Ro-Ro cargo ships		52	1 335	9 965	13 234	6 665		31 251
Total	160 750	661 294	194 698	239 658	161 060	109 143	72 845	1 599 448

Table 6-69 shows the estimated energy consumption per ship segment and power category for the port of Rotterdam in 2023. The estimated energy consumption is highest in the power category 1-5 MW for container ships, > 10 MW for cruise ships, and 5-10 MW for passenger ships. Additionally, chemical tankers have a substantial energy consumption.

Table 6-69 Estimated energy consumption in port (MWh) per ship segment and power category.

Rotterdam	<100 kW	100-500 kW	500-1000 kW	1-5 MW	5-10 MW	>10 MW	Total
Bulk carriers	5	25 950	17 032	0	0	0	42 987
Chemical tankers	0	2 169	50 821	201 488	0	0	254 478
Container ships	0	33 454	39 277	221 055	0	0	293 787
Crude oil tankers	0	0	7 866	79 772	0	0	87 638
Cruise ships	0	794	14	331	1 913	18 709	21 761
Fishing vessels	0	0	0	0	0	0	0
Gas tankers	0	12 753	0	17 944	26 180	0	56 877
General cargo ships	12 319	15 719	5 601	0	0	0	33 639
Offshore supply ships	48	4 438	305	0	0	0	4 792
Oil product tankers	481	10 281	8 931	376	0	0	20 070
Other activities	3 956	3 855	9 219	11 082	0	0	28 112
Other service offshore vessels	24	4 873	3 867	262	0	0	9 025
Passenger ships	232	84	0	4 361	26 393	0	31 070
Refrigerated cargo ships	0	314	293	0	0	0	606
Ro-Ro cargo ships	0	433	16 706	6 678	0	0	23 818
Total	17 067	115 118	159 930	543 351	54 485	18 709	908 660

Table 6-70 presents simultaneous port calls for quantification of the need for low and high voltage connection points for container, cruise, and passenger ships above 5000 GT. There were some days in 2023 with 35 **container ships** requiring low voltage connection points in the port, but 31 such connection points would be sufficient for 90% coverage. Similarly, there were some days in 2023 with almost 25 container ships requiring high voltage connection points in the port, but 20 such connection points would be sufficient for 90% coverage.

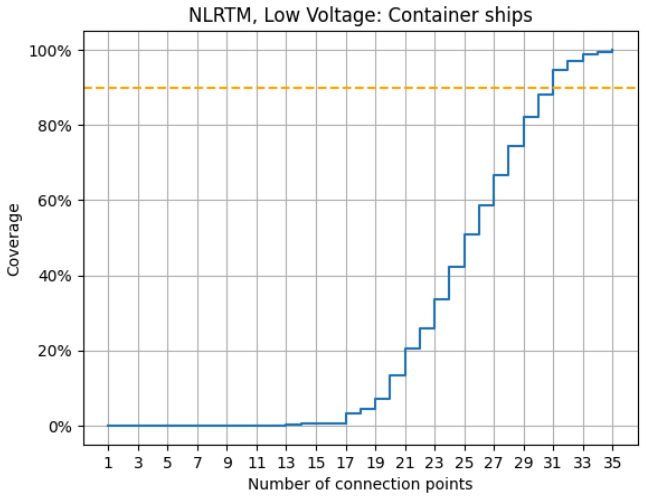
For 90% coverage, there is an estimated need for one low voltage connection point for **cruise ships**, although there were just a few days with such traffic in the port in 2023. Unless a significant increase in the cruise traffic to the port is expected

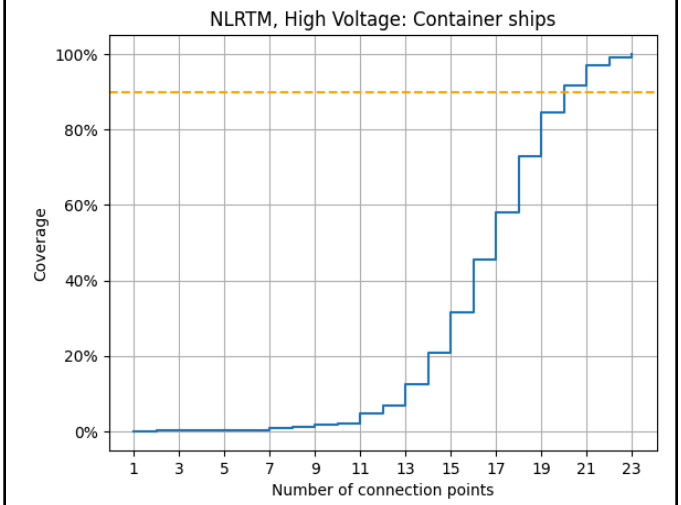
towards 2030, the port should not invest in such a connection point. There were some days with a need for 3 or 4 high voltage connection points for cruise ships, but 2 such connection points would be sufficient for 90% coverage.

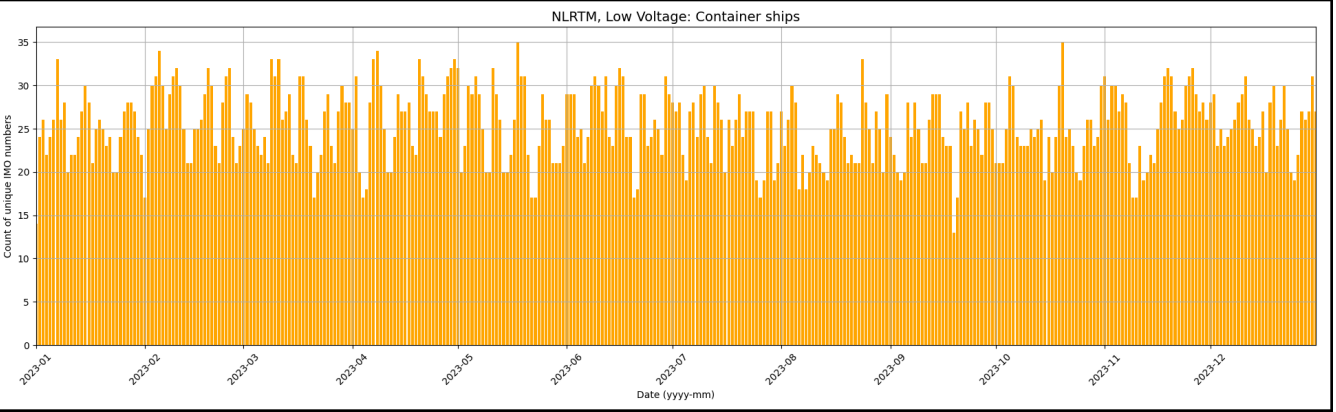
For **passenger ships**, there were some hours with a need for 3 high voltage connection points, but 2 such connection points would be sufficient for 90% coverage. In total, there is an estimated need for 51 connection points for container ships, 3 connection points for cruise ships, and 2 connection points for passenger ships.

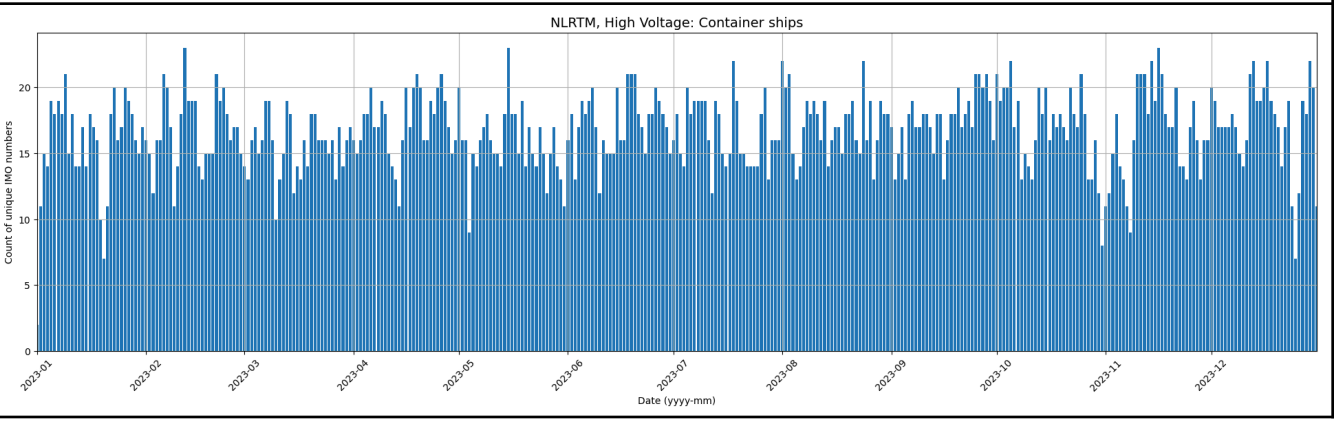
Table 6-70 Number of container and cruise ships at any day and passenger ships at any hour in 2023, and the estimated number of required connection points – split on low and high voltage.

Rotterdam	Low Voltage	High Voltage
Container ships – req. connection points	31	20

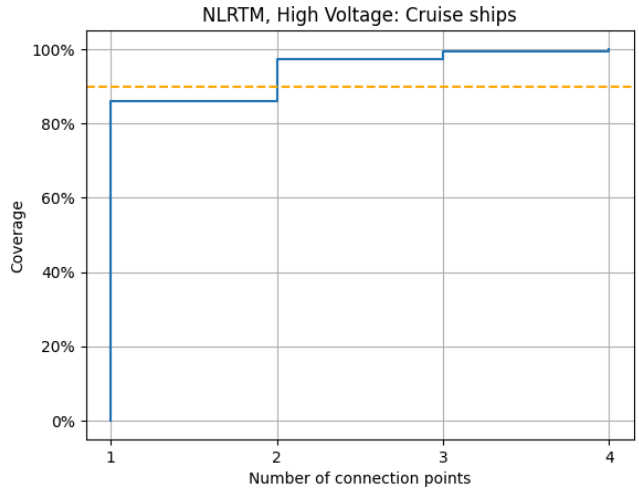


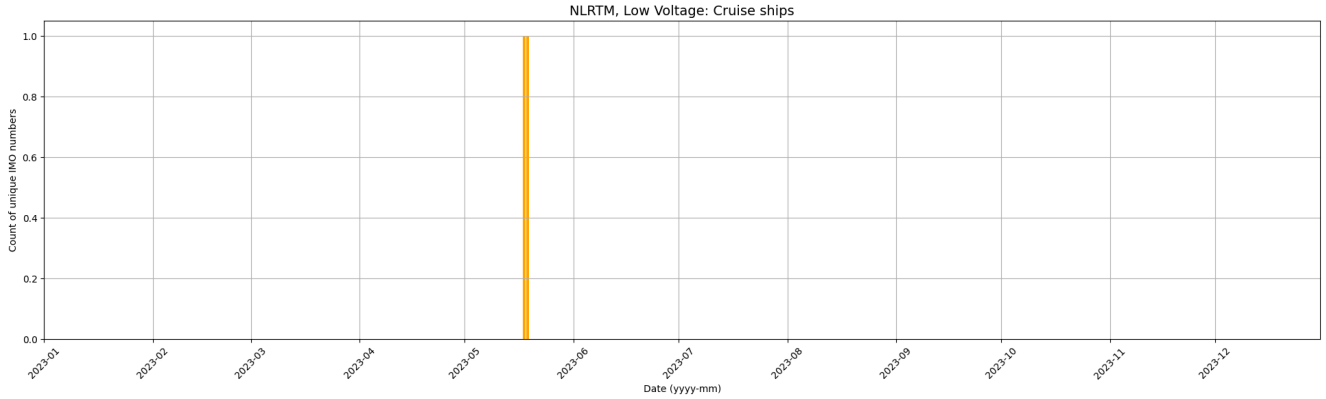


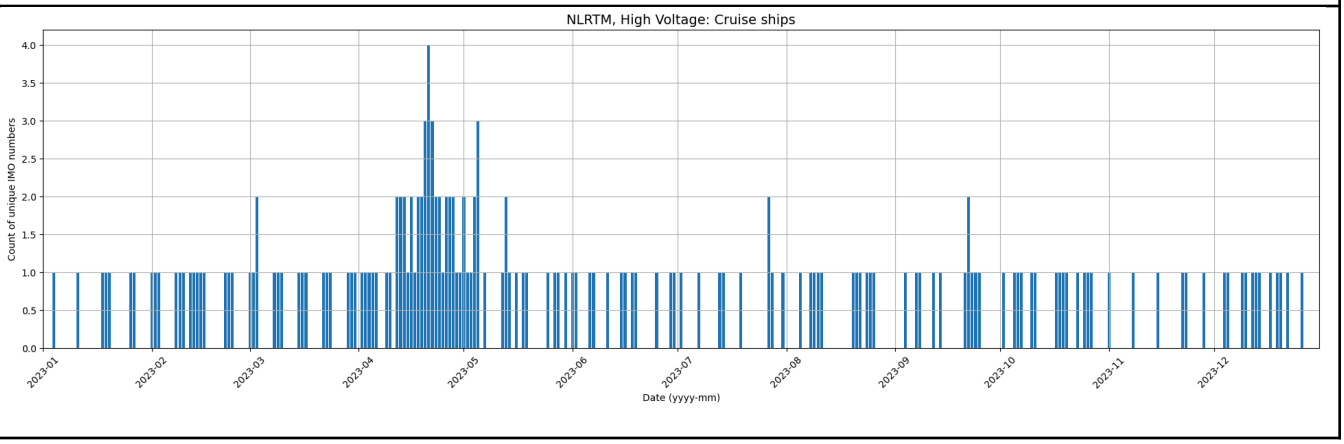




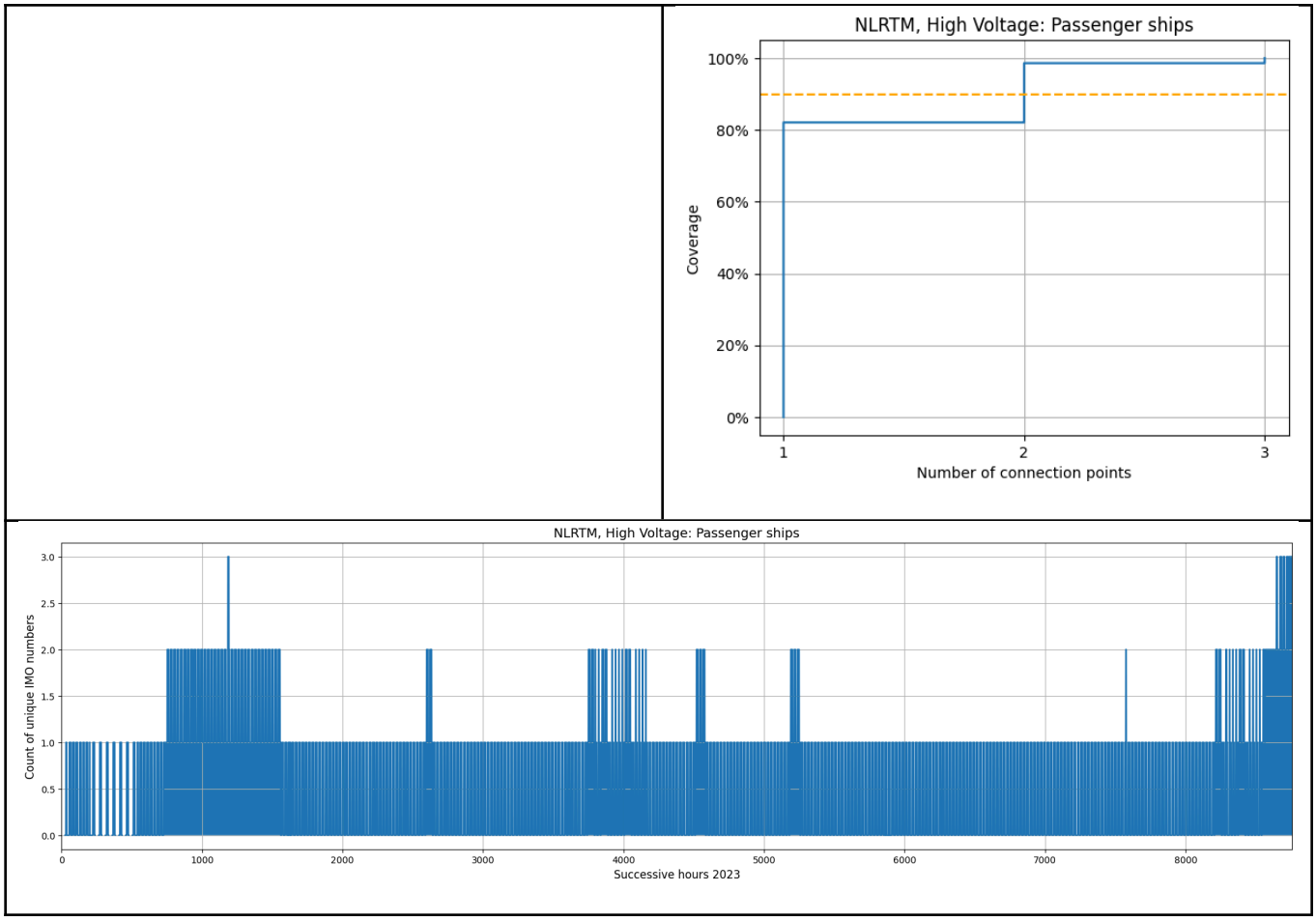
Rotterdam	Low Voltage	High Voltage
Cruise ships – required connection points	1	2







Rotterdam	Low Voltage	High Voltage
Passenger ships – req. connection points	0	2



6.19.2 Current status and plans for onshore power supply

In the port of Rotterdam, there are 6 operational OPS systems and one that is under construction at present (Table 6-71). The first OPS system was operational already in 2012, at the Stena Line berth. In 2023, 8.3 GWh of energy was delivered through this OPS system.

Capacity in the local electricity grid

According to the port, there is sufficient power available in the grid for the installed and contracted OPS systems, but limited surplus capacity in the grid (Table 6-71).

Table 6-71 Installed and contracted OPS in the port of Rotterdam.

Berth name	Max. power from grid [MW]	Max. no. of simulta-neous ships	Types of ships	Max. system power capacity [kW]	System freq. [Hz]	Standard	Availa-bility	Opera-tive from
Stena Line Hoek van Holland	Unknown	2	Ro-Ro cargo, passenger	3 500	50 and 60	IEC 80005-1	Private	2012
Heerema	24	2	Offshore supply	20 000	50 and 60	IEC 80005-1	Private	2022

DFDS	2	1	Ro-Ro cargo	1 800	50 and 60	IEC 80005-1	Private	2024
Cruise	10	1	Cruise	16 000	50 and 60	IEC 80005-1	Public	2025
Boskalis	1.75	2	Offshore supply	1 500	50 and 60	IEC 80005-3	Private	2023
Rotterdam Shortsea Terminals	0.2	1	Container	200	50	IEC 80005-3	Private	2023
Royal Roos	0.2	1	Other service offshore	200	50 and 60	IEC 80005-3	Private	2023
Parkkade	0.4	4	General cargo	400	50	IEC 80005-3	Public	End 2025

It should be noted that there are other activities in relation to shore power, that are taking place in Rotterdam, either by the port authority or by others in the area, including the following:

- There are approximately 100 companies in the port with a water-faced location where they receive seagoing ships. Six of these companies already have shore power at one or multiple berths (Table 6-71), while 20-25 companies are conducting shore power feasibility studies. The Port of Rotterdam, together with the municipality of Rotterdam, is actively participating in the feasibility phase and the shore power program team within the port authority helps the companies in the port with the request of subsidies, procurement planning, financing etc.
- In order to ease the investment for companies in the port, the Port of Rotterdam has set up a joint venture with the energy company Eneco. The joint venture is called Rotterdam Shore Power (RSP), and designs, constructs, finances, operates, and maintains shore power installations on behalf of companies in the port. Three out of six operational shore power installations in Rotterdam are operated by RSP.
- The port is actively involved in technical discussions regarding standardization processes for liquid bulk and dry bulk (both high voltage and low-voltage standards).
- The port is a member of EOPSA and in direct contact with the main suppliers of shore power equipment.
- The port has put forward successful proposals to national, regional, and local governments to organize subsidies.
- The port is in close contact, either through WPCAP, IAPH or directly with ports (Hamburg, Antwerp, Barcelona, Los Angeles, Vancouver) around the globe to exchange lessons learned and find common ground for technical solutions.
- Similarly, the port is actively pushing for shore power in national or EU legislation.

6.20 Port of Rouen, France

Rouen is organized together with Le Havre and Paris as HAROPA PORT, but the results presented here relate to the port with UN/LOCODE FRURO (Figure 6-20).

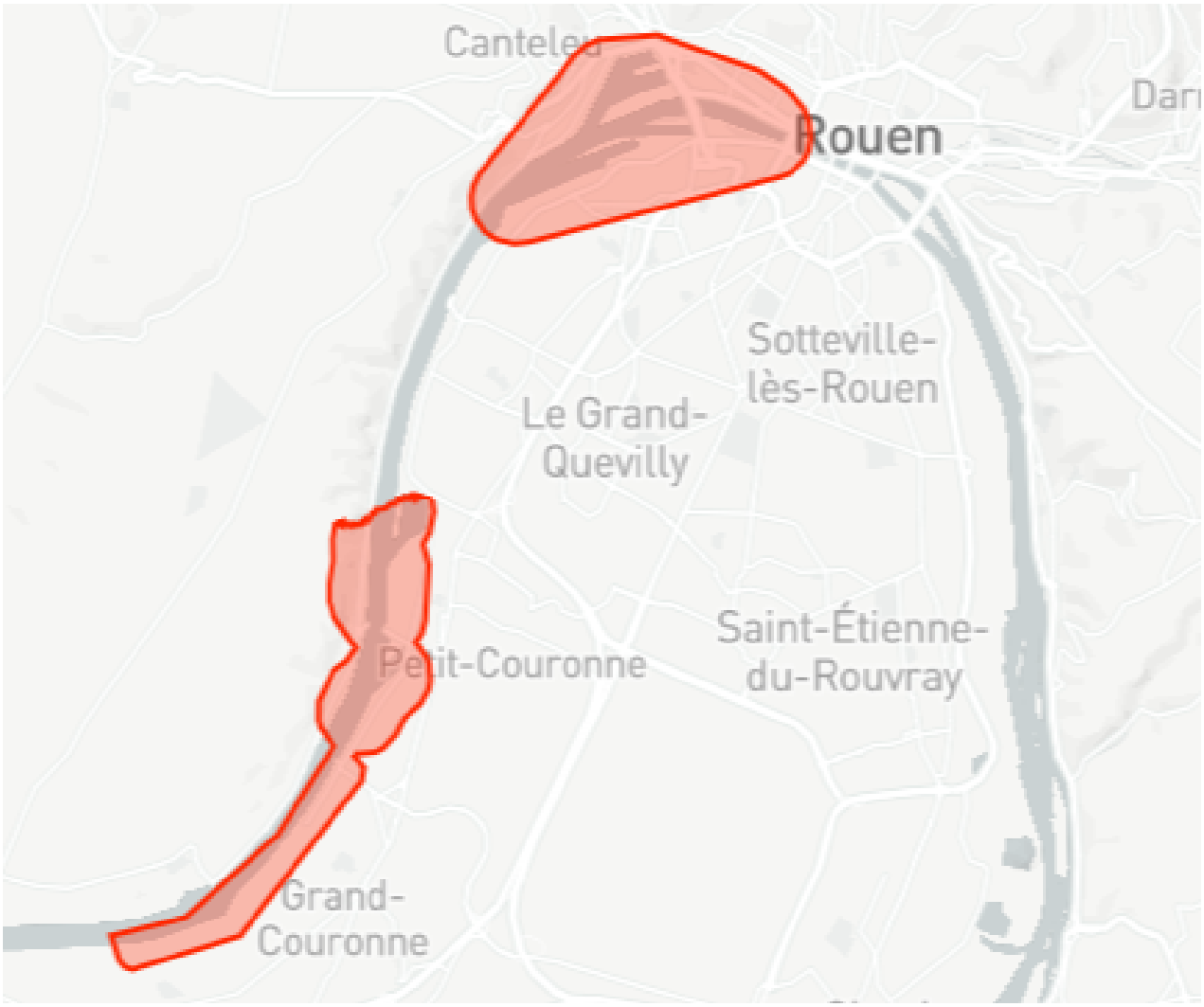


Figure 6-20 Port shape for Rouen (FRURO).

6.20.1 Current ship activity and energy requirements

Table 6-72 shows the effective hours in port per ship segment and size category for the port of Rouen in 2023. There are around 300 effective hours in port for cruise ships larger than 5000 GT. For cruise ships and passenger ships larger than 5000 GT there are no recorded effective hours in port.

Table 6-72 Effective hours in port per ship segment and size category.

Rouen	400 - 999 GT	1000 - 4999 GT	5000 - 9999 GT	10000 - 24999 GT	25000 - 49999 GT	50000 - 99999 GT	100000 GT <	Total
Bulk carriers			945	8 293	5 074			14 312
Chemical tankers		7 294	690	1 055	907			9 946
Container ships								0
Crude oil tankers								0
Cruise ships		1 952		65	260			2 277

Fishing ships								0
Gas tankers								0
General cargo ships	3 994	21 413	5 525	1 689				32 621
Offshore supply ships								0
Oil product tankers	6 943	28			210			7 181
Other activities	8 668	3 372	238					12 278
Other service offshore ships								0
Passenger ships								0
Refrigerated cargo ships								0
Ro-Ro cargo ships			59	143				202
Total	19 605	34 059	7 457	11 245	6 451	0	0	78 817

Table 6-73 shows the estimated energy consumption per ship segment and power category for the port of Rouen in 2023. The estimated energy consumption for cruise ships is split between the two power categories 100-500 kW and 1-5 MW. The two largest contributors to the total energy consumption are bulk carriers and general cargo ships.

Table 6-73 Estimated energy consumption in port (MWh) per ship segment and power category.

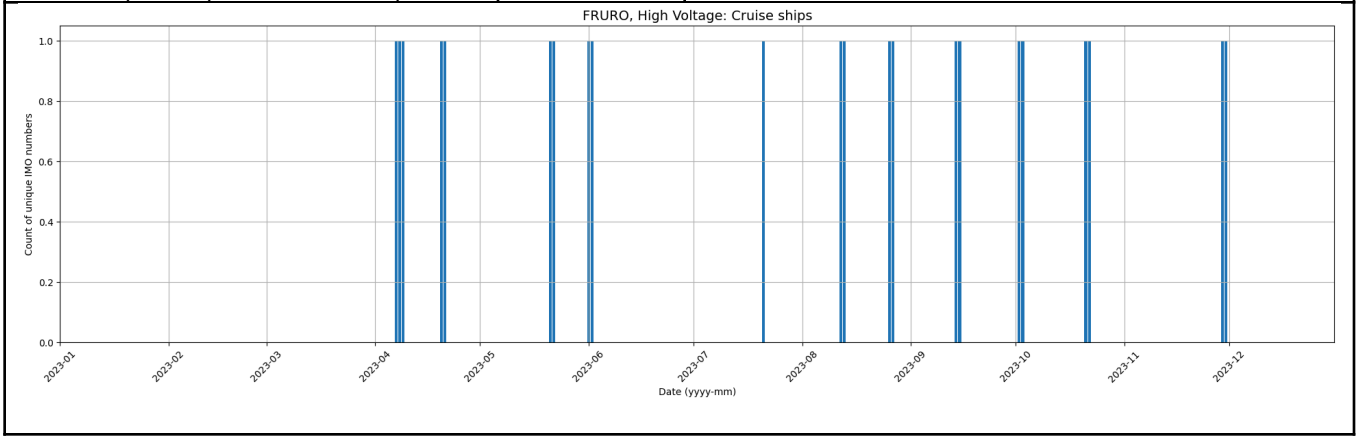
Rouen	<100 kW	100-500 kW	500-1000 kW	1-5 MW	5-10 MW	>10 MW	Total
Bulk carriers	0	4 627	0	0	0	0	4 627
Chemical tankers	0	0	549	2 320	0	0	2 869
Container ships	0	0	0	0	0	0	0
Crude oil tankers	0	0	0	0	0	0	0
Cruise ships	0	798	0	1 194	0	0	1 993
Fishing vessels	0	0	0	0	0	0	0
Gas tankers	0	0	0	0	0	0	0
General cargo ships	2 196	1 893	0	0	0	0	4 089
Offshore supply ships	0	0	0	0	0	0	0
Oil product tankers	389	7	203	0	0	0	599
Other activities	364	877	123	0	0	0	1 364
Other service offshore vessels	0	0	0	0	0	0	0
Passenger ships	0	0	0	0	0	0	0
Refrigerated cargo ships	0	0	0	0	0	0	0
Ro-Ro cargo ships	0	19	89	0	0	0	108
Total	2 949	8 220	964	3 514	0	0	15 648

Table 6-74 presents simultaneous port calls for quantification of the need for low and high voltage connection points for container, cruise, and passenger ships above 5000 GT. Since there were less than 25 port calls from **cruise ships** in 2023, it is assumed that there is no need for connection points for this segment in the port of Rouen. For **container and passenger ships,** there was no traffic in the port in 2023, hence there is no estimated need for any connection points.

Table 6-74 Number of container and cruise ships at any day and passenger ships at any hour in 2023, and the estimated number of required connection points – split on low and high voltage.

Rouen	Low Voltage	High Voltage
Container ships – req. connection points	0	0
No data		

Rouen	Low Voltage	High Voltage
Cruise ships – required connection points	0	0



Rouen	Low Voltage	High Voltage
Passenger ships – req. connection points	0	0
No data		

6.20.2 Current status and plans for onshore power supply

In the port of Rouen, there are currently no maritime OPS systems in operation. One OPS system dedicated to inland waterways cruise ships, which falls out of the scope of this study, has been contracted. The port is planning to also serve ocean-going cruise ships, but no contracts have been placed yet.

Capacity in the local electricity grid

According to the port, the power available from the grid will be upgraded to 5 MW with the current contract.

Table 6-75 Contracted OPS in the port of Rouen.

Max. power from grid [MW]	Max. no. of simultaneous ships	Types of ships	Max. system power capacity [kW]	System voltage	System frequency [Hz]	Standard	Operational from
5	1	Cruise (inland)	1	690 V and 6.6-11 kV	50	IEC 80005-1&3	2025-26

6.21 Port of Świnoujście, Poland

The port of Swinoujscie is organized together with the port of Szczecin as Port Szczecin-Swinoujscie, but the results presented here relate to the port with UN/LOCODE PLSWI (Figure 6-21).

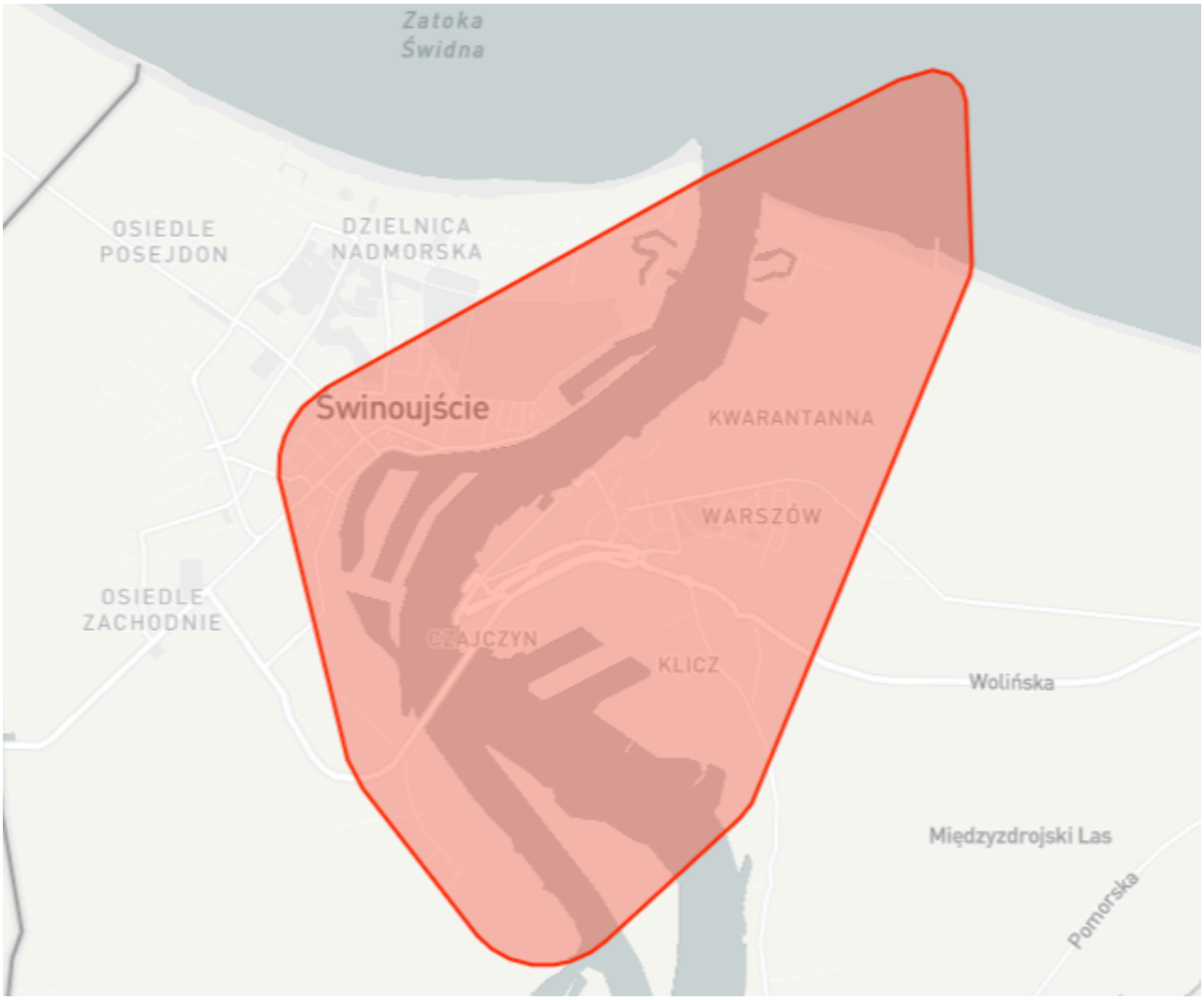


Figure 6-21 Port shape for Swinoujscie (PLSWI).

6.21.1 Current ship activity and energy requirements

Table 6-76 shows the effective hours in port per ship segment and size category for the port of Świnoujście in 2023. For passenger ships above 5000GT, there are around 20 000 effective hours in the port. For container and cruise ships, there are no recorded hours spent in the port.

Table 6-76 Effective hours in port per ship segment and size category.

Świnoujście	400 - 999 GT	1000 - 4999 GT	5000 - 9999 GT	10000 - 24999 GT	25000 - 49999 GT	50000 - 99999 GT	100000 GT <	Total
Bulk carriers		40	125	3 083	5 850	1 707		10 805
Chemical tankers		413	38	2 000	162			2 613
Container ships								0
Crude oil tankers				1 235	24			1 259
Cruise ships	13							13
Fishing ships		30						30

Gas tankers							1 529	1 529
General cargo ships	42	6 414	2 404	1 340				10 200
Offshore supply ships		312						312
Oil product tankers	126	27			34			187
Other activities	23 322	5 265			76			28 663
Other service offshore ships		154					25	179
Passenger ships	4 693			14 022	6 199	339		25 253
Refrigerated cargo ships		1 009	36					1 045
Ro-Ro cargo ships		564	1 413					1 977
Total	28 196	14 228	4 016	21 680	12 345	2 046	1 554	84 065

Table 6-77 shows the estimated energy consumption per ship segment and power category for the port of Świnoujście in 2023. For passenger ships, most of the estimated energy consumption is in the power category 1-5 MW. This segment represents roughly 70% of the total estimated energy consumption.

Table 6-77 Estimated energy consumption in port (MWh) per ship segment and power category.

Świnoujście	**<100 kW**	**100-500 kW**	**500-1000 kW**	**1-5 MW**	**5-10 MW**	**>10 MW**	**Total**
Bulk carriers	0	3 230	896	0	0	0	4 126
Chemical tankers	0	0	30	2 380	0	0	2 410
Container ships	0	0	0	0	0	0	0
Crude oil tankers	0	0	905	0	0	0	905
Cruise ships	1	0	0	0	0	0	1
Fishing vessels	0	7	0	0	0	0	7
Gas tankers	0	0	0	0	8 154	0	8 154
General cargo ships	636	1 058	0	0	0	0	1 694
Offshore supply ships	0	67	0	0	0	0	67
Oil product tankers	7	7	33	0	0	0	47
Other activities	980	1 369	0	113	0	0	2 461
Other service offshore vessels	0	34	0	26	0	0	60
Passenger ships	282	0	0	46 176	2 135	0	48 593
Refrigerated cargo ships	0	249	0	0	0	0	249
Ro-Ro cargo ships	0	530	0	0	0	0	530
Total	1 905	6 551	1 864	48 694	10 290	0	69 305

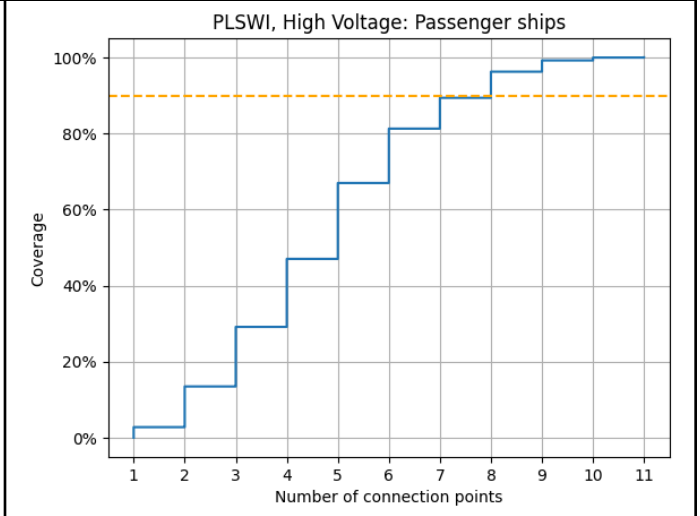
Table 6-78 presents simultaneous port calls for quantification of the need for low and high voltage connection points for container, cruise, and passenger ships above 5000 GT. For **container and cruise ships**, there was no traffic in the port in 2023, hence there is no estimated need for any connection points. For **passenger ships**, there were some hours with a need for around 10 high voltage connection points, but 8 such connection points would be sufficient for 90% coverage.

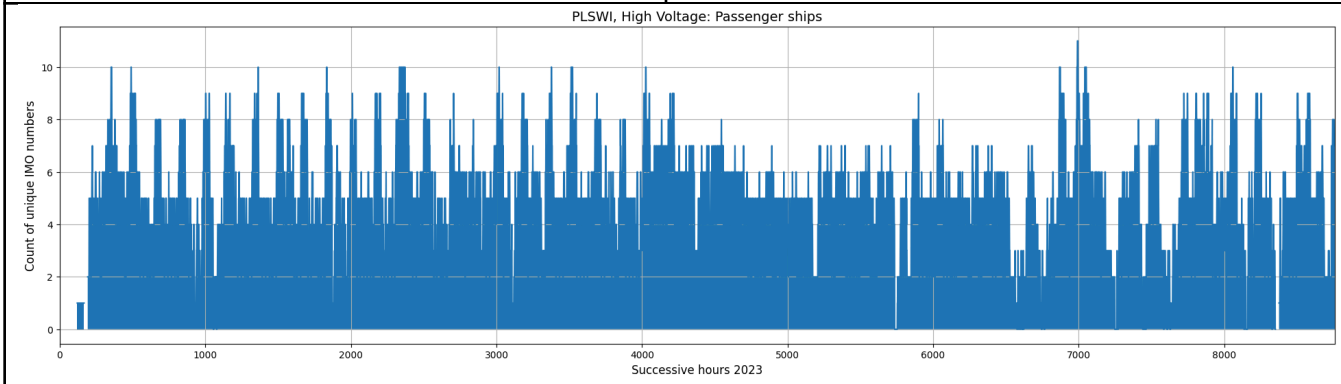
Table 6-78 Number of container and cruise ships at any day and passenger ships at any hour in 2023, and the estimated number of required connection points – split on low and high voltage.

Świnoujście	Low Voltage	High Voltage
Container ships – req. connection points	0	0
No Data		

Świnoujście	Low Voltage	High Voltage
Cruise ships – required connection points	0	0
No Data		

Świnoujście	Low Voltage	High Voltage
Passenger ships – req. connection points	0	8





6.21.2 Current status and plans for onshore power supply

In the port of Swinoujscie, a ferry terminal is being built with 5 berths, each with a capacity for one ship (Table 6-79). A mobile crane will also be installed, connected to the shore power supply points at 11 kV, equipped with a cable reel. Furthermore, the port is building a new container terminal expected to be finished by 2028. OPS will be supplied at the container terminal as well, but contracts have not been signed yet.

Capacity in the local electricity grid

According to the port, there are concrete plans to install a transformer station to provide sufficient power to all 5 ferry quays.

Table 6-79 Contracted OPS in the port of Swinoujscie.

Max. no. of simultaneous ships	Types of ships	Max. system power capacity [kW]	System voltage	System freq. [Hz]	Standard
5	Passenger (ferry)	3 000	11 kV	50 and 60	IEC 80005-1

6.22 Port of Szczecin, Poland

The port of Szczecin is organized together with the port of Swinoujscie as Port Szczecin-Swinoujscie, but the results presented here relate to the port with UN/LOCODE PLSZZ (Figure 6-22).

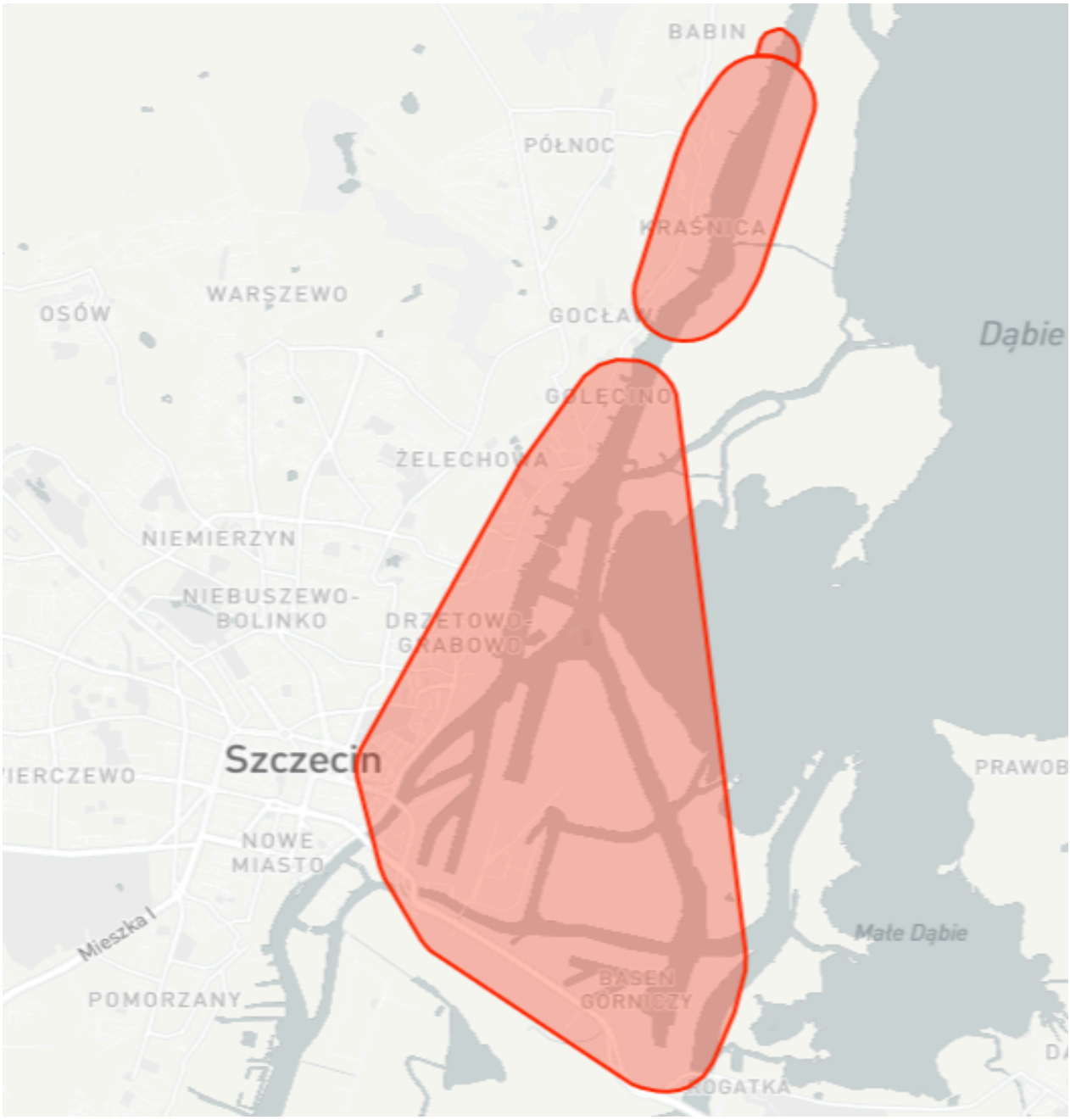


Figure 6-22 Port shape for Szczecin (PLSZZ).

6.22.1 Current ship activity and energy requirements

Table 6-80 shows the effective hours in port per ship segment and size category for the port of Szczecin in 2023. There are nearly 2500 effective hours in port for container ships larger than 5000 GT. For cruise ships larger than 5000 GT there are only 57 effective hours in port, and for passenger ships larger than 5000 GT there are 1750 effective hours in port. Other segments with a high number of effective hours in the port are bulk carriers, chemical tankers, and general cargo ships.

Table 6-80 Effective hours in port per ship segment and size category.

Szczecin	400 - 999 GT	1000 - 4999 GT	5000 - 9999 GT	10000 - 24999 GT	25000 - 49999 GT	50000 - 99999 GT	100000 GT <	Total
Bulk carriers		978	1 515	14 049	8 492			25 034
Chemical tankers		6 677	2 242	5 956	2 299			17 174
Container ships		8	2 017	466				2 491
Crude oil tankers								0
Cruise ships	419				57			476
Fishing ships								0
Gas tankers		1 809	1 513	582				3 904
General cargo ships	2 767	80 402	12 464	3 325	390			99 348
Offshore supply ships	426	2 640						3 066
Oil product tankers	1 833	1 599	26					3 458
Other activities	5 709	6 127						11 836
Other service offshore ships		434						434
Passenger ships	336			753	997			2 086
Refrigerated cargo ships		777	449					1 226
Ro-Ro cargo ships		227	221					448
Total	11 490	101 678	20 447	25 131	12 235	0	0	170 981

Table 6-81 shows the estimated energy consumption per ship segment and power category for the port of Szczecin in 2023. For container ships, most of the estimated energy consumption is in the power category 100-500 kW. For cruise and passenger ships, almost all the estimated energy consumption is in the power category 1-5 MW. However, the main energy consumption is from bulk carriers, chemical tankers, and general cargo ships, representing roughly 70% of the total energy consumption.

Table 6-81 Estimated energy consumption in port (MWh) per ship segment and power category.

Szczecin	<100 kW	100-500 kW	500-1000 kW	1-5 MW	5-10 MW	>10 MW	Total
Bulk carriers	0	7 897	0	0	0	0	7 897
Chemical tankers	0	3	1 785	9 442	0	0	11 230
Container ships	0	1 004	330	0	0	0	1 334
Crude oil tankers	0	0	0	0	0	0	0
Cruise ships	28	0	0	234	0	0	262
Fishing vessels	0	0	0	0	0	0	0
Gas tankers	0	689	0	2 243	0	0	2 933
General cargo ships	8 012	4 082	243	0	0	0	12 338
Offshore supply ships	29	570	0	0	0	0	599
Oil product tankers	103	385	14	0	0	0	502
Other activities	240	1 593	0	0	0	0	1 833
Other service offshore vessels	0	97	0	0	0	0	97

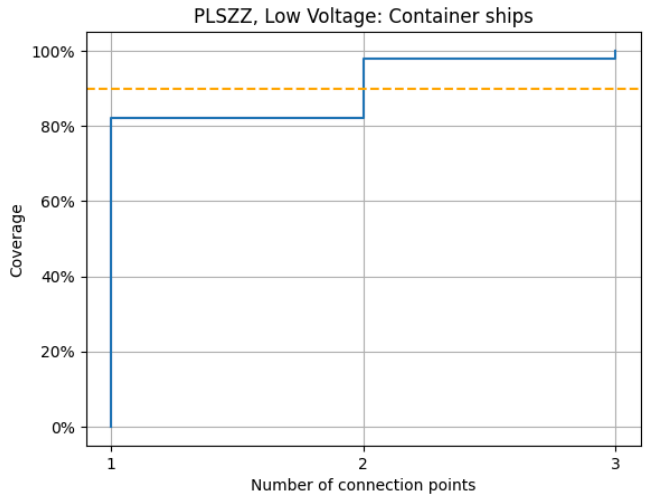
Passenger ships	20	0	0	4 858	0	0	4 878
Refrigerated cargo ships	0	393	0	0	0	0	393
Ro-Ro cargo ships	0	103	0	0	0	0	103
Total	8 432	16 817	2 372	16 777	0	0	44 398

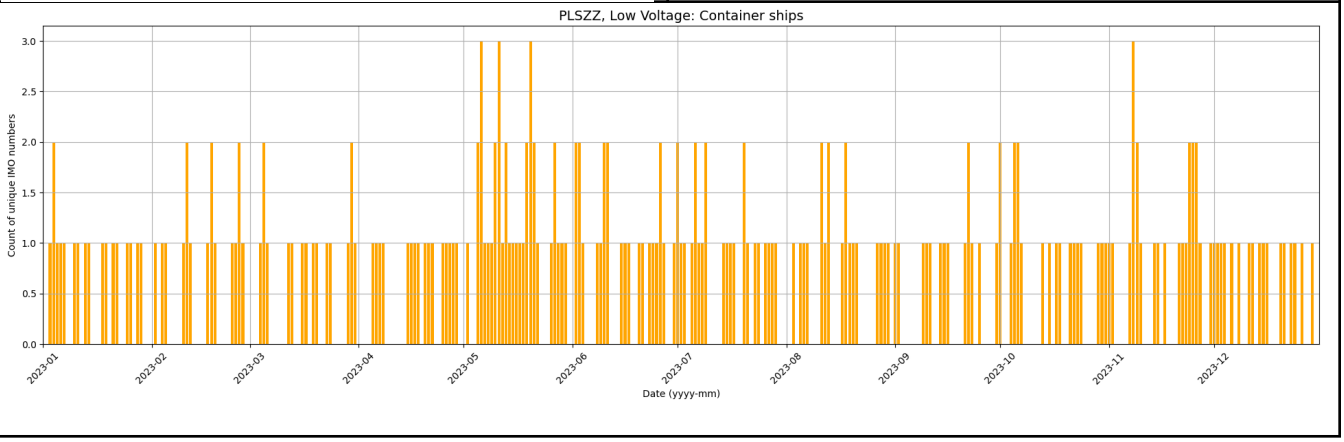
Table 6-82 presents simultaneous port calls for quantification of the need for low and high voltage connection points for container, cruise, and passenger ships above 5000 GT. There were some days in 2023 with 3 **container ships** requiring low voltage connection points in the port, but 2 such connection points would be sufficient for 90% coverage.

Since there were less than 25 port calls from **cruise ships** and less than 40 port calls from **passenger ships** in 2023, it is assumed that there is no need for connection points for these segments in the port of Szczecin.

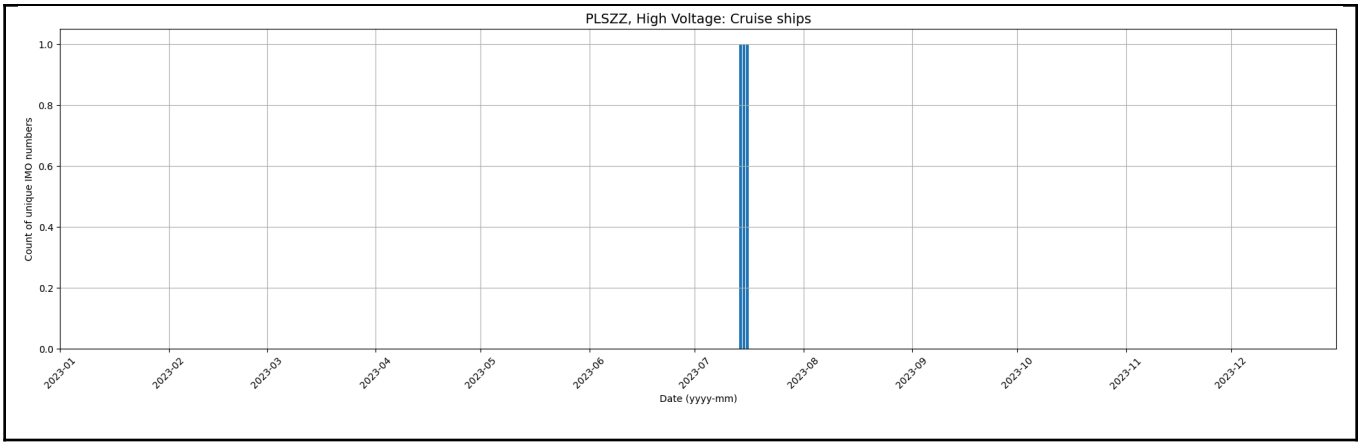
Table 6-82 Number of container and cruise ships at any day and passenger ships at any hour in 2023, and the estimated number of required connection points – split on low and high voltage.

Szczecin	Low Voltage	High Voltage
Container ships – req. connection points	2	0

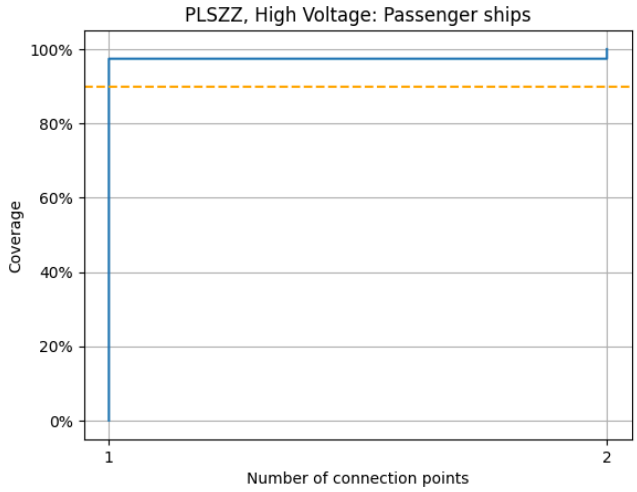


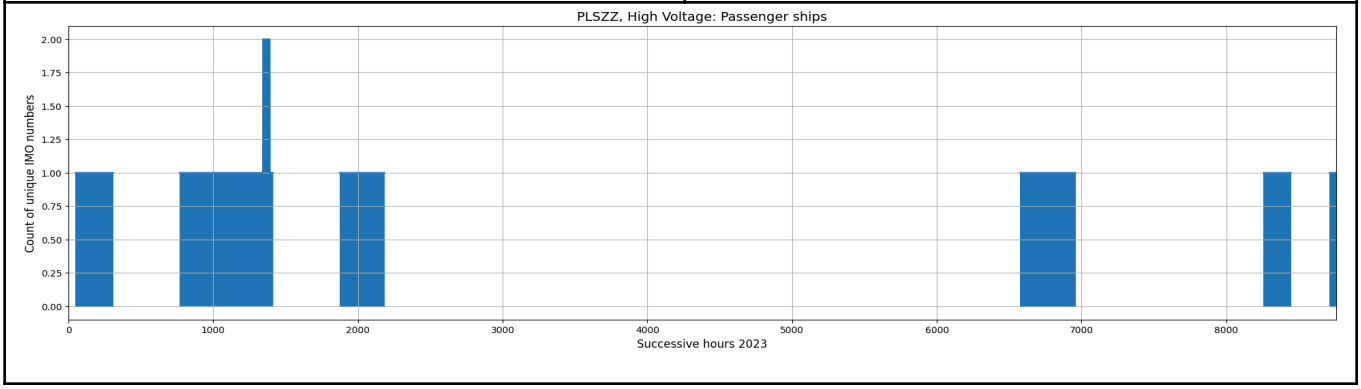


Szczecin	Low Voltage	High Voltage
Cruise ships – required connection points	0	0



Szczecin	Low Voltage	High Voltage
Passenger ships – req. connection points	0	0





6.22.2 Current status and plans for onshore power supply

In the port of Szczecin, there are no OPS systems installed yet, and no concrete plans to install OPS either.

6.23 Port of Taranto, Italy

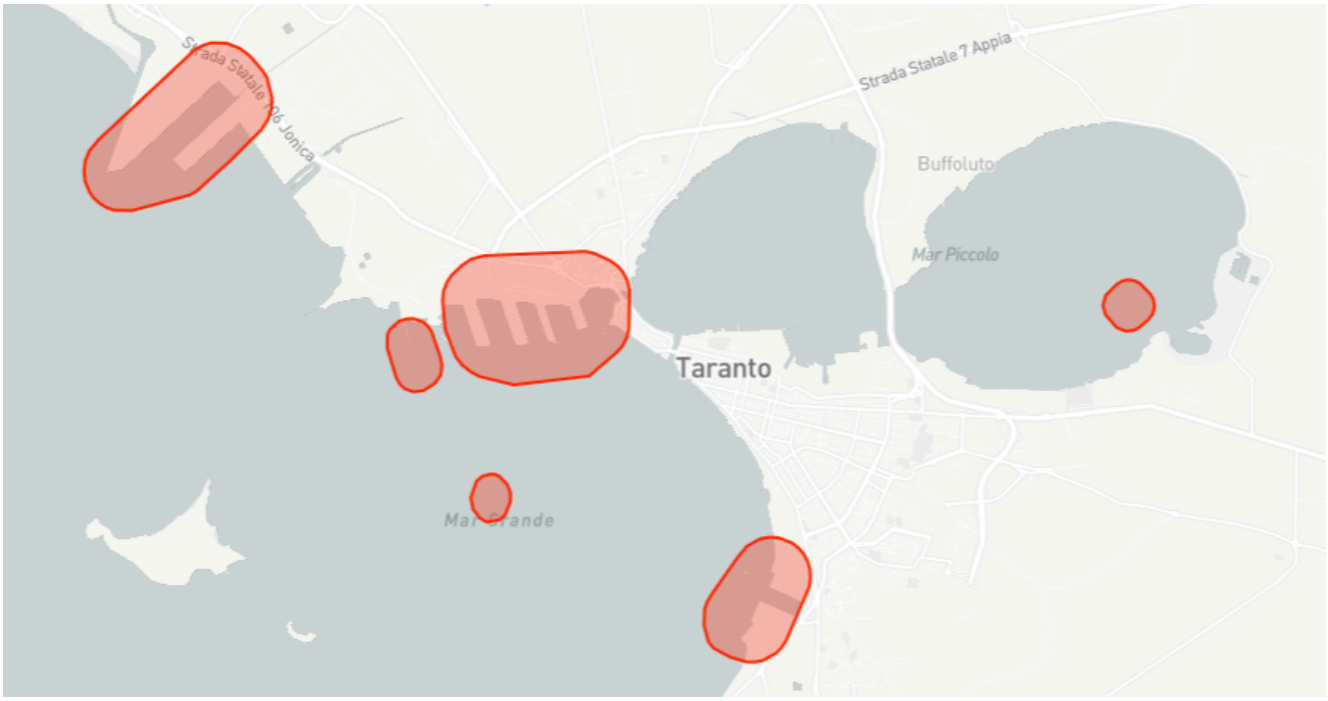


Figure 6-23 Port shape for Taranto (ITTAR).

6.23.1 Current ship activity and energy requirements

Table 6-83 shows the effective hours in port per ship segment and size category for the port of Taranto in 2023. There are nearly 1500 effective hours in port for container ships larger than 5000 GT. For cruise ships larger than 5000 GT there are only about 300 effective hours in port, and for passenger ships larger than 5000 GT there are no recorded effective hours in port. Other segments with a high number of effective hours in the port are bulk carriers, general cargo ships and other activities.

Table 6-83 Effective hours in port per ship segment and size category.

Taranto	400 - 999 GT	1000 - 4999 GT	5000 - 9999 GT	10000 - 24999 GT	25000 - 49999 GT	50000 - 99999 GT	100000 GT <	Total
Bulk carriers		300	322	1 723	15 605	5 890	612	24 452
Chemical tankers		335	940	3 341	2 763			7 379
Container ships		286	392	465	543			1 686
Crude oil tankers			84			927		1 011
Cruise ships		19				110	193	322
Fishing ships								0
Gas tankers								0
General cargo ships	31	9 778	13 431	2 821	242			26 303
Offshore supply ships		5						5
Oil product tankers	7 864	29	367	406	787			9 453

Other activities	26 672	5 890		266				32 828
Other service offshore ships								0
Passenger ships								0
Refrigerated cargo ships								0
Ro-Ro cargo ships						23		23
Total	34 567	16 642	15 536	9 022	19 940	6 950	805	103 462

Table 6-84 shows the estimated energy consumption per ship segment and power category for the port of Taranto in 2023. For container ships, most of the estimated energy consumption is in the power category 1-5 MW. For cruise ships and, most of the estimated energy consumption is in the highest power category (> 10 MW). However, the main contributors to the total energy consumption are bulk carriers, chemical tankers, and general cargo ships.

Table 6-84 Estimated energy consumption in port (MWh) per ship segment and power category.

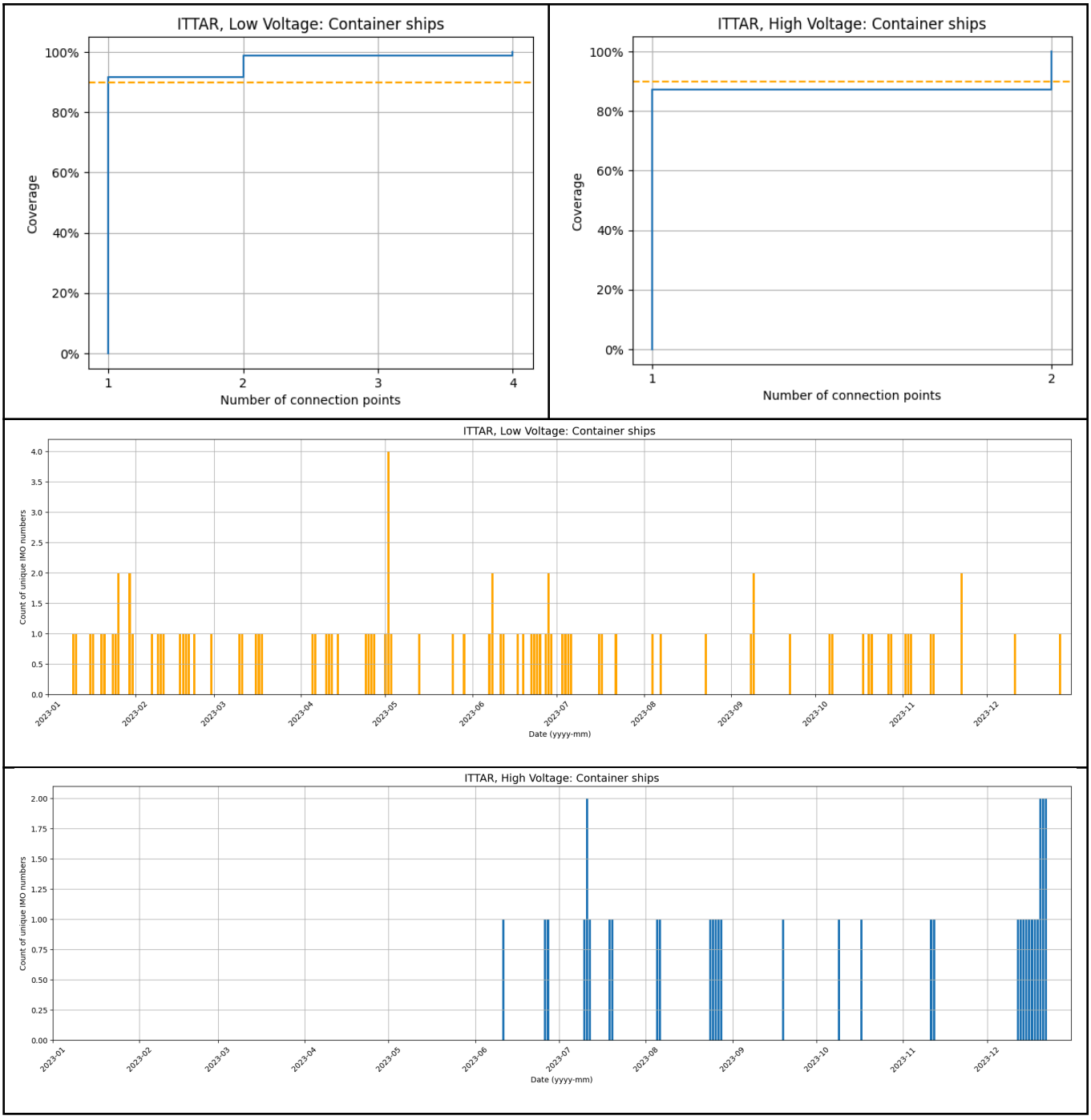
Taranto	<100 kW	100-500 kW	500-1000 kW	1-5 MW	5-10 MW	>10 MW	Total
Bulk carriers	0	6 711	3 494	0	0	0	10 206
Chemical tankers	0	124	748	7 206	0	0	8 078
Container ships	0	247	330	703	0	0	1 279
Crude oil tankers	0	0	44	1 159	0	0	1 203
Cruise ships	0	8	0	0	794	1 932	2 734
Fishing vessels	0	0	0	0	0	0	0
Gas tankers	0	0	0	0	0	0	0
General cargo ships	969	4 103	151	0	0	0	5 223
Offshore supply ships	0	1	0	0	0	0	1
Oil product tankers	440	7	1 246	0	0	0	1 694
Other activities	1 120	1 531	227	0	0	0	2 879
Other service offshore vessels	0	0	0	0	0	0	0
Passenger ships	0	0	0	0	0	0	0
Refrigerated cargo ships	0	0	0	0	0	0	0
Ro-Ro cargo ships	0	0	0	23	0	0	23
Total	2 529	12 732	6 241	9 091	794	1 932	33 319

Table 6-85 presents simultaneous port calls for quantification of the need for low and high voltage connection points for container, cruise, and passenger ships above 5000 GT. Since there were less than 100 port calls from **container ships** in 2023, it is assumed that there is no need for connection points for this segment in the port of Taranto.

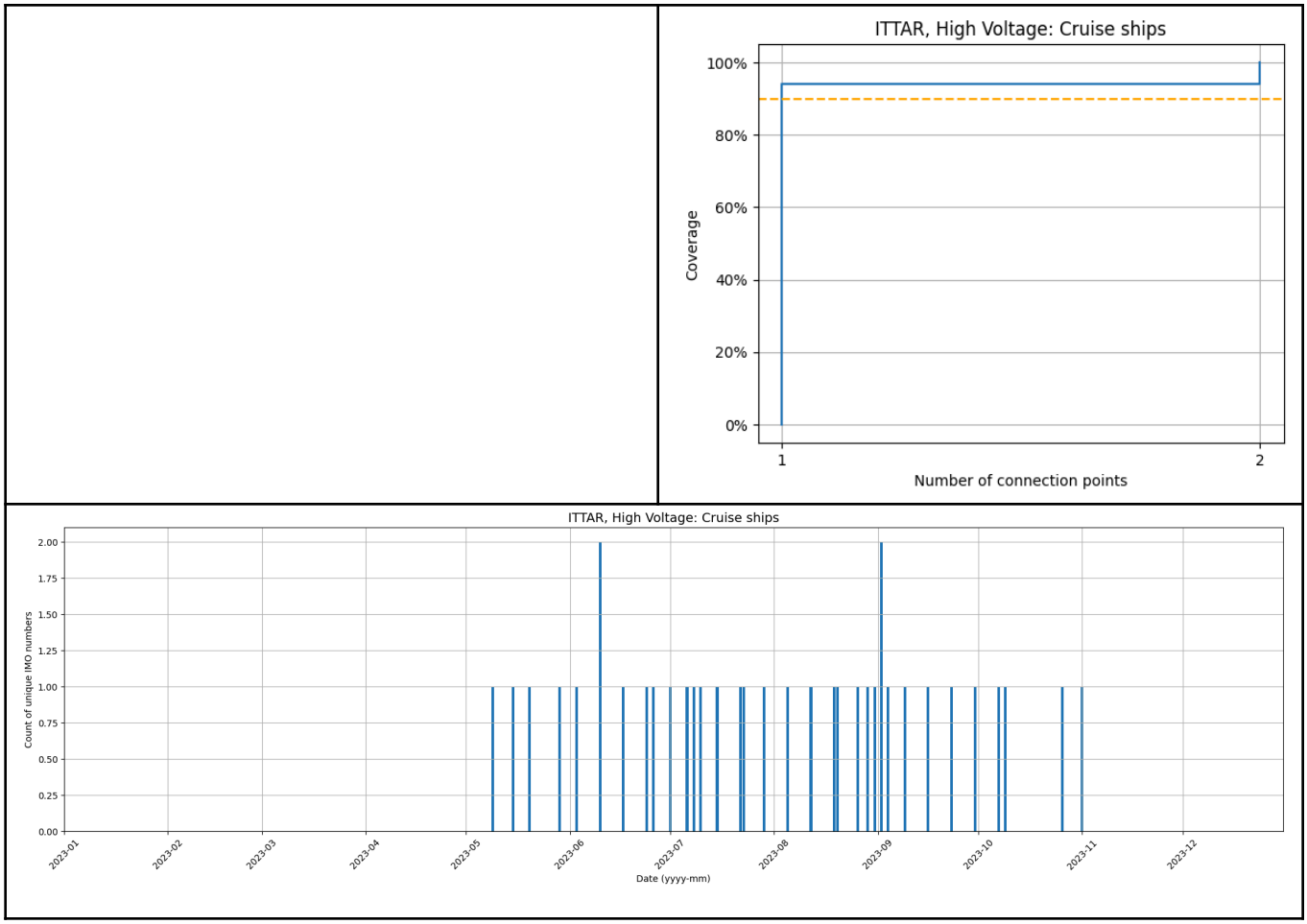
For **cruise ships**, there were some days with a need for 2 high voltage connection points, but 1 such connection point would be sufficient for 90% coverage. For **passenger ships**, there was no traffic in the port in 2023, hence there is no estimated need for any connection points.

Table 6-85 Number of container and cruise ships at any day and passenger ships at any hour in 2023, and the estimated number of required connection points – split on low and high voltage.

Taranto	Low Voltage	High Voltage
Container ships – req. connection points	0	0



Taranto	Low Voltage	High Voltage
Cruise ships – required connection points	0	1



Taranto	Low Voltage	High Voltage
Passenger ships – req. connection points	0	0
No data		

6.23.2 Current status and plans for onshore power supply

In the port of Taranto, there are currently no OPS systems in operation. The port is planning to install the following OPS systems by 2026, but contracts have not yet been signed:

- Two high-voltage connection points for cruise ships with a maximum system power capacity of 35 MW;
- Two high-voltage connection points for container ships with a maximum system power capacity of 12 MW;
- Two high-voltage connection points for oil product tankers with a maximum system power capacity of 8 MW.

Capacity in the local electricity grid

According to the port, the maximum power available from the grid is 17.6 MW, so grid upgrades are necessary for this development.

6.24 Port of Terneuzen, Netherlands

Terneuzen is organized together with Ghent and Vlissingen as Northsea Port, but the results presented here relate to the port with UN/LOCODE NLTNZ (Figure 6-24).

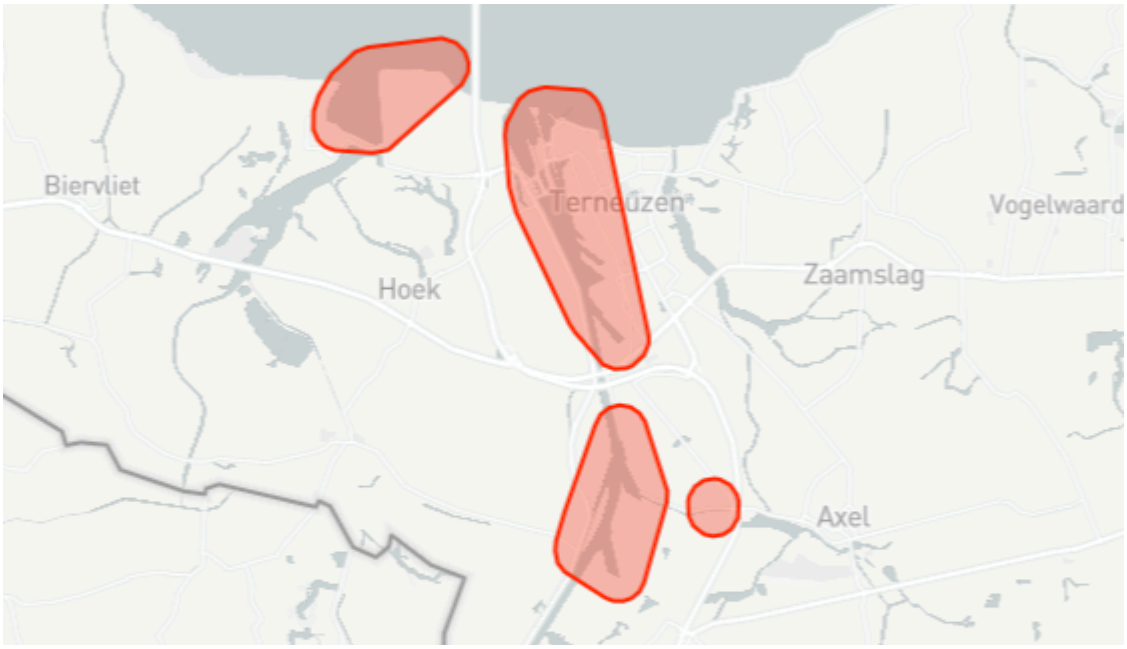


Figure 6-24 Port shape for Terneuzen (NLTNZ).

6.24.1 Current ship activity and energy requirements

Table 6-86 shows the effective hours in port per ship segment and size category for the port of Terneuzen in 2023. There are no effective hours in port for container ships, cruise ships, or passenger ships larger than 5000 GT.

Table 6-86 Effective hours in port per ship segment and size category.

Terneuzen	400 - 999 GT	1000 - 4999 GT	5000 - 9999 GT	10000 - 24999 GT	25000 - 49999 GT	50000 - 99999 GT	100000 GT <	Total
Bulk carriers		891	1 619	11 129	2 164			15 803
Chemical tankers	3 323	17 810	3 046	3 740	3 054			30 973
Container ships		56						56
Crude oil tankers			0		598	483		1 081
Cruise ships		71						71
Fishing ships	4							4
Gas tankers		9 333	6 397	1 820	3 509	345		21 404
General cargo ships	1 479	30 297	8 519	2 352	604			43 251
Offshore supply ships	15							15
Oil product tankers	56	2 066	0	132	403			2 657
Other activities	25 574	7 348	4 181					37 103
Other service offshore ships								0
Passenger ships	117							117
Refrigerated cargo ships								0
Ro-Ro cargo ships				1 073	4	1		1 078
Total	30 568	67 872	23 762	20 246	10 336	829	0	153 613

Table 6-87 shows the effective hours per ship segment and power category for the port of Terneuzen. The main estimated energy consumption are chemical tankers and gas tankers, with approximately 60% of the total estimated energy consumption.

Table 6-87 Estimated energy consumption in port (MWh) per ship segment and power category.

Terneuzen	<100 kW	100-500 kW	500-1000 kW	1-5 MW	5-10 MW	>10 MW	Total
Bulk carriers	0	4 569	0	0	0	0	4 569
Chemical tankers	0	24	2 425	8 016	0	0	10 465
Container ships	0	10	0	0	0	0	10
Crude oil tankers	0	0	579	604	0	0	1 183
Cruise ships	0	29	0	0	0	0	29
Fishing vessels	0	0	0	0	0	0	0
Gas tankers	0	3 556	0	15 816	0	0	19 372
General cargo ships	3 028	2 821	377	0	0	0	6 225
Offshore supply ships	1	0	0	0	0	0	1
Oil product tankers	3	498	485	0	0	0	986
Other activities	1 074	1 910	2 157	0	0	0	5 142
Other service offshore vessels	0	0	0	0	0	0	0
Passenger ships	7	0	0	0	0	0	7
Refrigerated cargo ships	0	0	0	0	0	0	0
Ro-Ro cargo ships	0	0	671	1	0	0	672
Total	4 113	13 417	6 694	24 437	0	0	48 661

For container ships, cruise ships, and passenger ships above 5000 GT, there was no traffic in the port in 2023, hence we cannot present port calls and simultaneity of ships for quantification of the need for low and high voltage connection points for these ship segments.

6.24.2 Current status and plans for onshore power supply

In the port of Terneuzen there is one OPS cabinet installed for inland cruise ships, delivering a total of 270 kW (Table 6-88). Along the river between Ghent and Terneuzen there are several small-scale OPS systems installed, with a total of 100 connection points for river cruise ships. Since these are regular 32 A or 63 A industrial plugs, they are not considered in this analysis. The main activities in the port of Terneuzen are inland shipping and river cruise.

Capacity in the local electricity grid

According to the port, the power grid in the area is saturated, so there is limited available capacity.

Table 6-88 Installed OPS in the port of Terneuzen.

Max. no. of simultaneous ships	Types of ships	Max. system power capacity [kW]	System voltage	Standard
1	Inland cruise	270	400-690 V	IEC 80005-3

6.25 Port of Thessaloniki, Greece

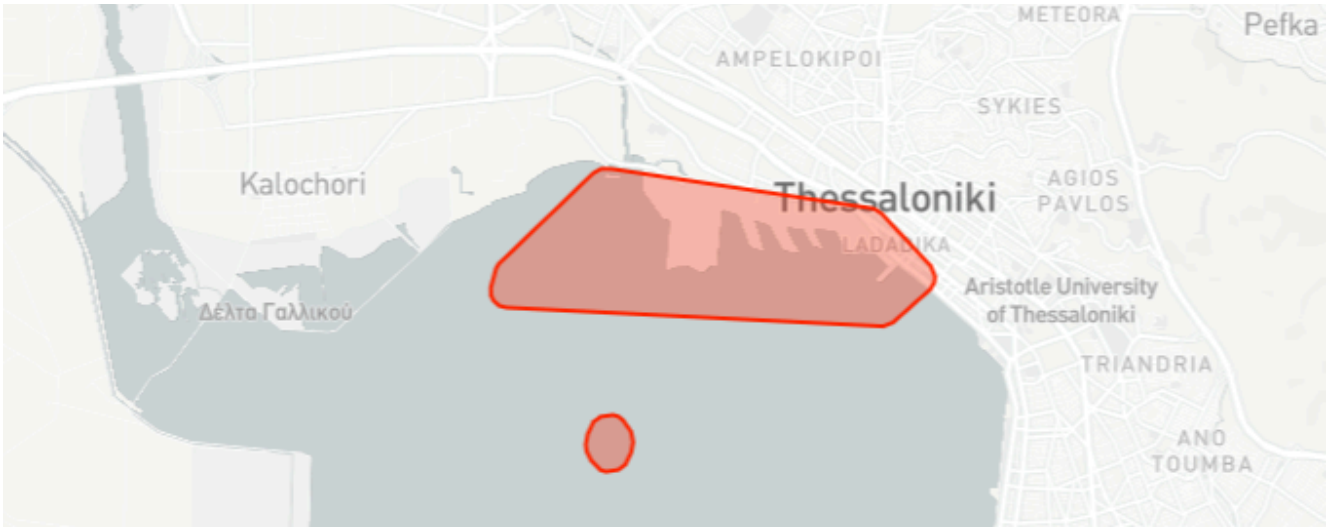


Figure 6-25 Port shape for Thessaloniki (GRSKG).

6.25.1 Current ship activity and energy requirements

Table 6-89 shows the effective hours in port per ship segment and size category for the port of Thessaloniki in 2023. There are around 8500 effective hours in port for container ships larger than 5000 GT. For cruise ships larger than 5000 GT there are around 700 effective hours in port, and for passenger ships larger than 5000 GT there are close to 1400 effective hours in port.

Table 6-89 Effective hours in port per ship segment and size category.

Thessaloniki	400-999 GT	1000 - 4999 GT	5000 - 9999 GT	10000 - 24999 GT	25000 - 49999 GT	50000 - 99999 GT	100000 GT <	Total
Bulk carriers		6 994	1 324	2 652	2 336			13 306
Chemical tankers		4 909	2 071	1 393	939			9 312
Container ships	266	3 167	5 928	1 583	1 173			12 117
Crude oil tankers				704	72	266		1 042
Cruise ships			10	10	546	142		708
Fishing ships								0
Gas tankers	12	1 003	1 587					2 602
General cargo ships	118	16 146	2 417	1 118				19 799
Offshore supply ships		87						87
Oil product tankers	195	1 137	300	172				1 804
Other activities	7 523	400	261	136				8 320
Other service offshore ships	10 108							10 108
Passenger ships	120	1 155	8	1 383				2 666

Refrigerated cargo ships								0
Ro-Ro cargo ships			443	2 203		62		2 708
Total	18 342	34 998	14 349	11 354	5 066	470	0	84 579

Table 6-90 shows the effective hours per ship segment and power category for the port of Thessaloniki in 2023. For container ships, the estimated energy consumption is distributed between the three power categories 100-500 kW, 500-1000kW, and 1-5 MW, with the majority in 100-500 kW. For cruise ships and passenger ships, most of the estimated energy consumption is in the power category 1-5 MW.

Table 6-90 Estimated energy consumption in port (MWh) per ship segment and power category.

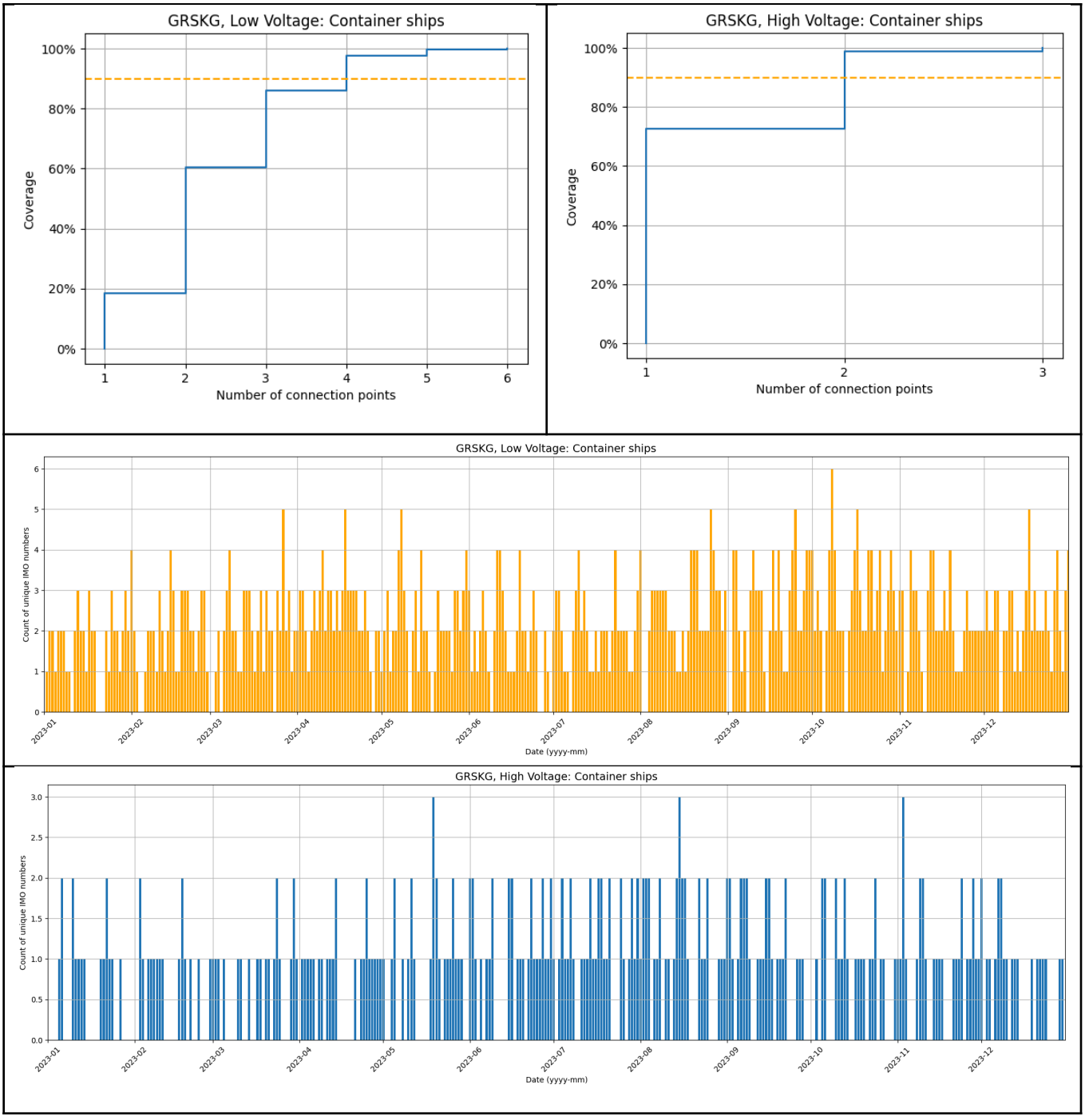
Thessaloniki	<100 kW	100-500 kW	500-1000 kW	1-5 MW	5-10 MW	>10 MW	Total
Bulk carriers	0	2 794	0	0	0	0	2 794
Chemical tankers	0	1 414	1 649	2 728	0	0	5 790
Container ships	12	3 519	1 122	1 519	0	0	6 173
Crude oil tankers	0	0	572	333	0	0	905
Cruise ships	0	0	9	2 260	1 025	0	3 294
Fishing vessels	0	0	0	0	0	0	0
Gas tankers	0	384	0	1 587	0	0	1 971
General cargo ships	1 601	975	0	0	0	0	2 576
Offshore supply ships	0	19	0	0	0	0	19
Oil product tankers	11	274	281	0	0	0	566
Other activities	316	104	251	0	0	0	671
Other service offshore vessels	637	0	0	0	0	0	637
Passenger ships	7	412	7	2 365	0	0	2 791
Refrigerated cargo ships	0	0	0	0	0	0	0
Ro-Ro cargo ships	0	141	1 370	62	0	0	1 574
Total	2 584	10 037	5 261	10 854	1 025	0	29 761

Table 6-91 presents simultaneous port calls for quantification of the need for low and high voltage connection points for container, cruise, and passenger ships above 5000 GT. There were some days in 2023 with 5 or 6 **container ships** requiring low voltage connection points in the port, but 4 such connection point would be sufficient for 90% coverage. Similarly, there were some days in 2023 with 3 container ships requiring low voltage connection points in the port, but 2 such connection point would be sufficient for 90% coverage.

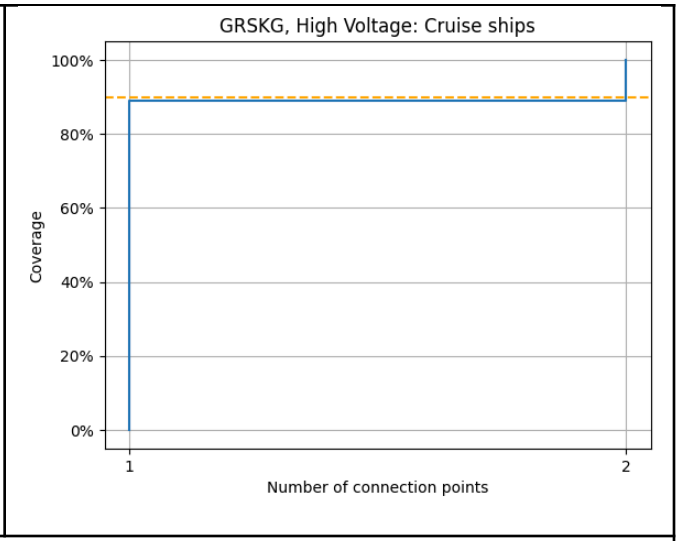
For 90% coverage, there is an estimated need for one low voltage connection point for **cruise ships** and one for **passenger ships**, although there were just a few days/hours with such traffic in the port in 2023. Unless a significant increase in the traffic to the port is expected towards 2030, the port should not invest in such connection points. 2 high voltage connection points for each of these segments are estimated to be sufficient for 90% coverage. In total, there is an estimated need for 6 connection points for container ships, 3 connection points for cruise ships, and 3 connection points for passenger ships.

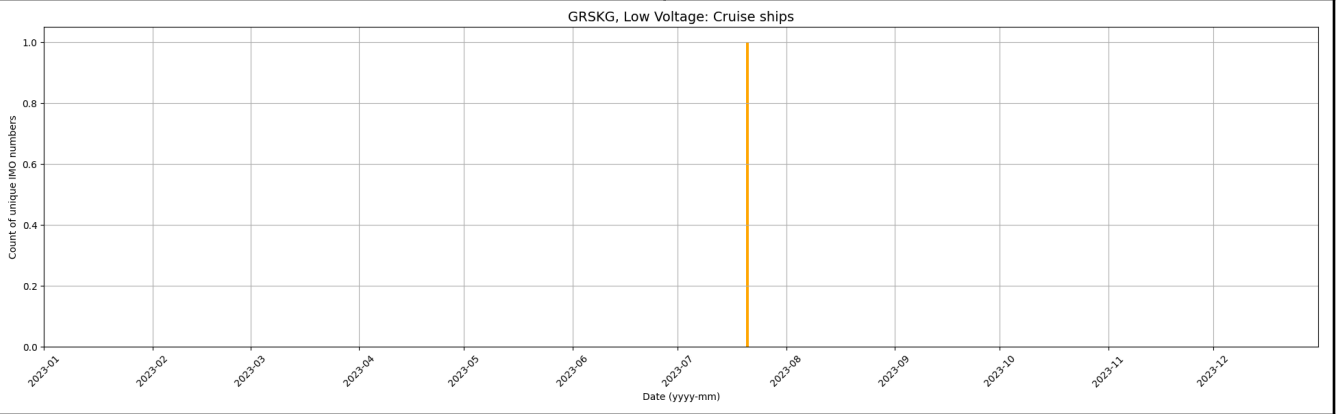
Table 6-91 Number of container and cruise ships at any day and passenger ships at any hour in 2023, and the estimated number of required connection points – split on low and high voltage.

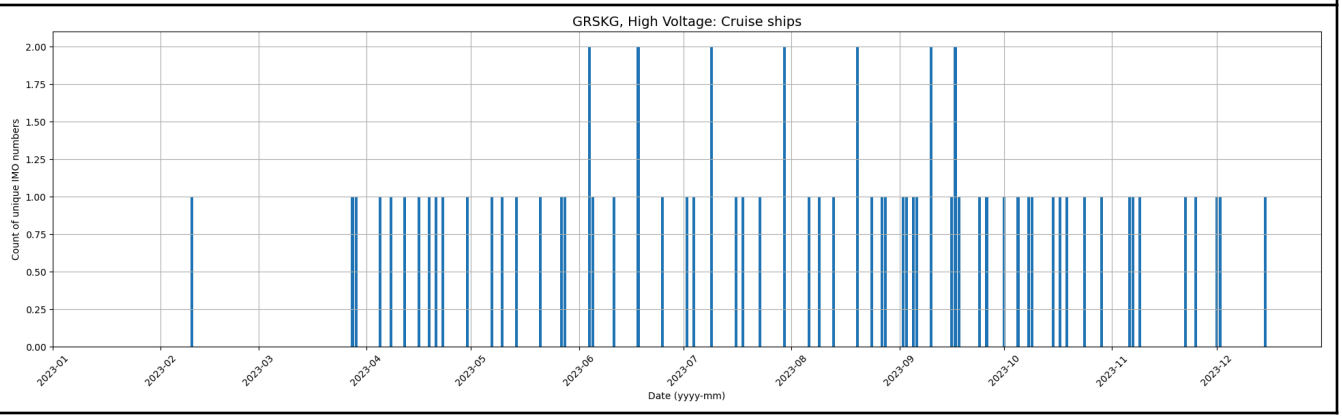
Thessaloniki	Low Voltage	High Voltage
Container ships – req. connection points	4	2



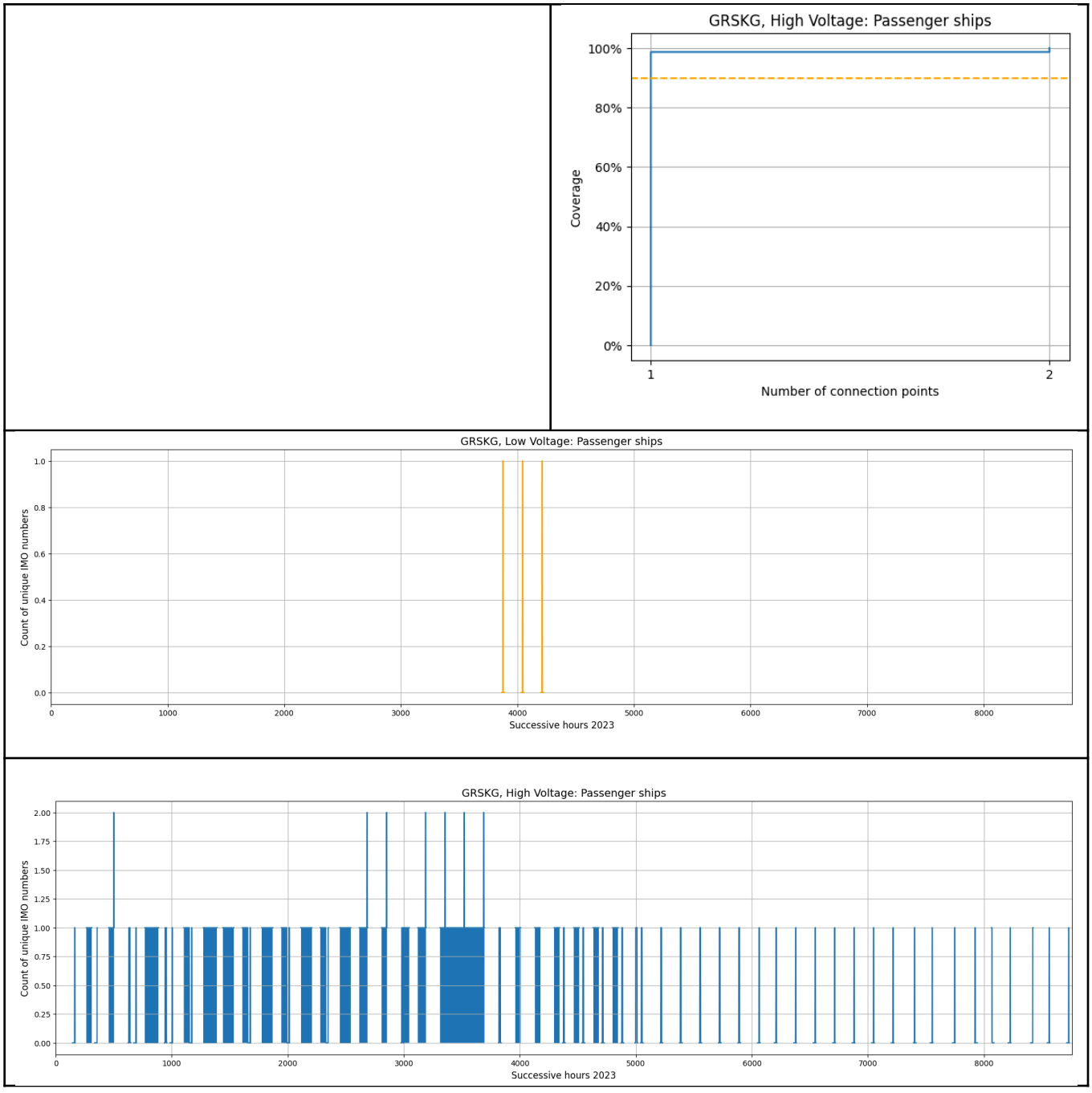
Thessaloniki	Low Voltage	High Voltage
Cruise ships – required connection points	1	2







Thessaloniki	Low Voltage	High Voltage
Passenger ships – req. connection points	1	2



6.25.2 Current status and plans for onshore power supply

Currently, there is no OPS in the port of Thessaloniki, except for small-scale connection points (220 V) available in specific docks of Pier 3, which are only used by tugs or other small support ships. There are no concrete plans to install OPS either. ThPA S.A., the managing authority of the Port of Thessaloniki, is currently investigating the technical and economic feasibility of onshore power supply, which will shape the port's future plans on OPS projects.

6.26 Port of Valencia, Spain

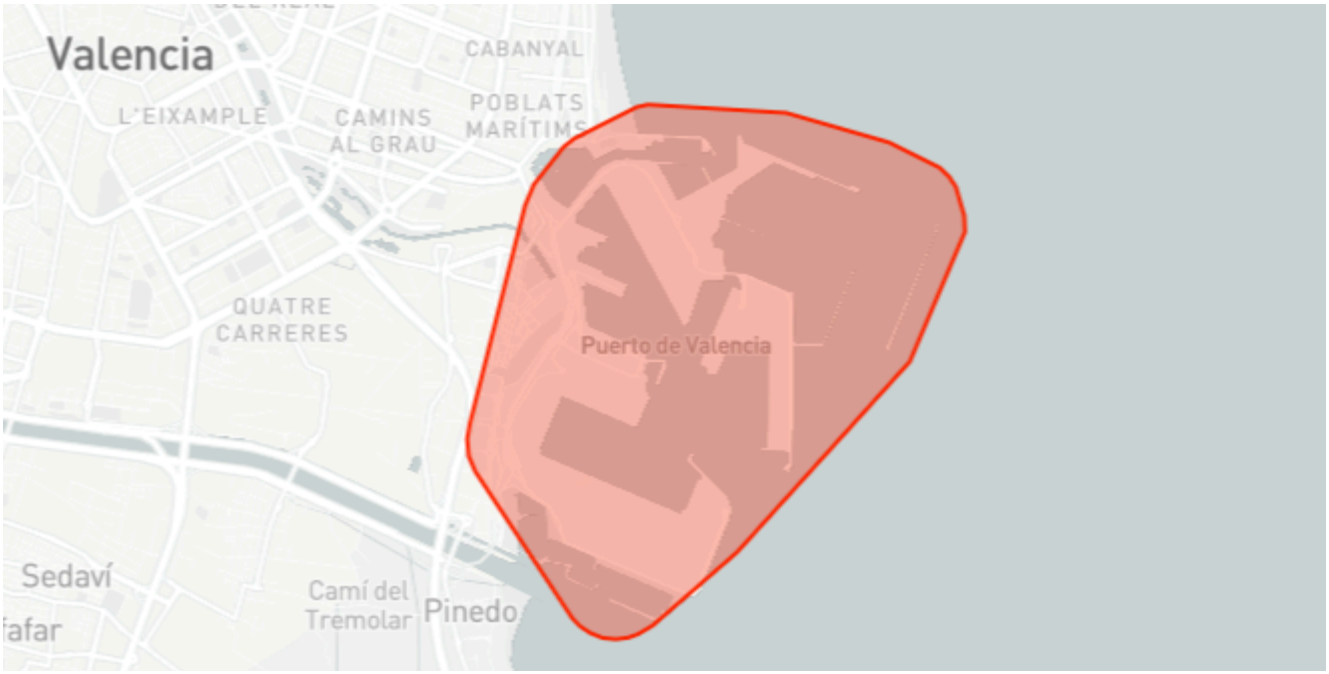


Figure 6-26 Port shape for Valencia (ESVLC).

6.26.1 Current ship activity and energy requirements

Table 6-92 shows the effective hours in port per ship segment and size category for the port of Valencia in 2023. There are around 71 000 effective hours in port for container ships larger than 5000 GT. For cruise ships larger than 5000 GT there are around 2500 effective hours in port, and for passenger ships larger than 5000 GT there are more than 13 500 effective hours in port.

Table 6-92 Effective hours in port per ship segment and size category.

Valencia	400 – 999 GT	1000 - 4999 GT	5000 - 9999 GT	10000 - 24999 GT	25000 - 49999 GT	50000 - 99999 GT	100000 GT <	Total
Bulk carriers			350	2 536	2 727			5 613
Chemical tankers		5 962	1 027	1 764	548			9 301
Container ships		70	11 065	7 604	15 158	23 470	13 627	70 994
Crude oil tankers						10		10
Cruise ships		129	150	50	357	885	1 072	2 643
Fishing ships								0
Gas tankers			49	13				62
General cargo ships		3 389	996	583	287			5 255
Offshore supply ships		364						364
Oil product tankers		7 065	160	32	65			7 322

Other activities	20 749	921	59		417			22 146
Other service offshore ships		299						299
Passenger ships			9	5 531	8 105			13 645
Refrigerated cargo ships								0
Ro-Ro cargo ships			24	210	2 309	6 465		9 008
Total	20 749	18 199	13 889	18 323	29 973	30 830	14 699	146 662

Table 6-93 shows the estimated energy consumption per ship segment and power category for the port of Valencia in 2023. For container ships and passenger ships, most of the estimated energy consumption is in the power category 1-5 MW. For cruise ships, most of the estimated energy consumption is in the highest power category (> 10 MW). The three main ship segments account for roughly 90% of the total estimated energy consumption in port.

Table 6-93 Estimated energy consumption in port (MWh) per ship segment and power category.

Valencia	<100 kW	100-500 kW	500-1000 kW	1-5 MW	5-10 MW	>10 MW	Total
Bulk carriers	0	1 887	0	0	0	0	1 887
Chemical tankers	0	30	817	2 624	0	0	3 472
Container ships	0	5 512	5 391	120 599	0	0	131 502
Crude oil tankers	0	0	0	13	0	0	13
Cruise ships	0	53	140	1 563	6 388	10 731	18 874
Fishing vessels	0	0	0	0	0	0	0
Gas tankers	0	0	0	65	0	0	65
General cargo ships	336	449	179	0	0	0	964
Offshore supply ships	0	79	0	0	0	0	79
Oil product tankers	0	1 703	170	0	0	0	1 873
Other activities	871	239	30	618	0	0	1 759
Other service offshore vessels	0	67	0	0	0	0	67
Passenger ships	0	0	7	38 482	0	0	38 489
Refrigerated cargo ships	0	0	0	0	0	0	0
Ro-Ro cargo ships	0	8	1 964	6 478	0	0	8 450
Total	1 207	10 026	8 700	170 441	6 388	10 731	207 493

Table 6-85 presents simultaneous port calls for quantification of the need for low and high voltage connection points for container, cruise, and passenger ships above 5000 GT. There were some days in 2023 with more than 10 **container ships** requiring low voltage connection points in the port, but 8 such connection points would be sufficient for 90% coverage. Similarly, there were some days in 2023 with 15-20 container ships requiring low voltage connection points in the port, but 14 such connection point would be sufficient for 90% coverage.

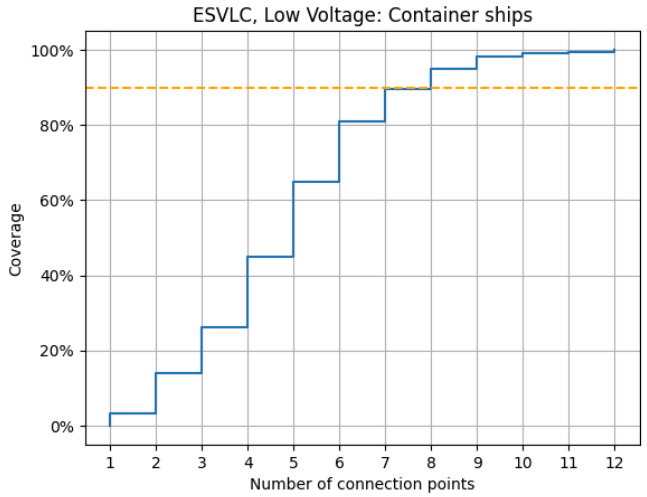
For **cruise ships**, there was one day with a need for two low voltage connection points and some days with a need for 3 or 4 high voltage connection points. However, 1 low voltage and 2 high voltage connection points would be sufficient for 90% coverage.

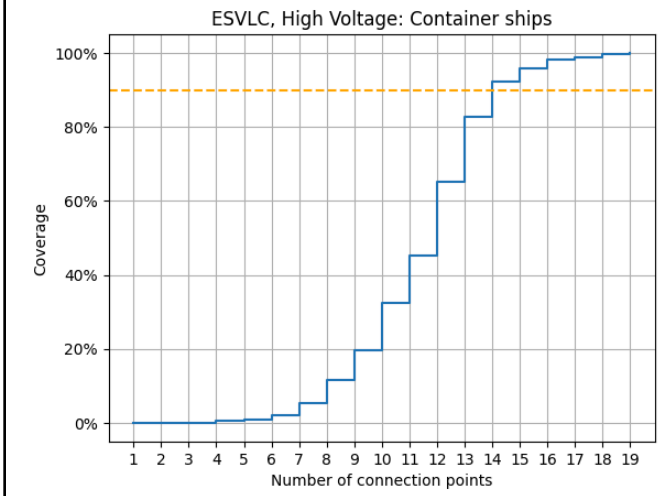
For 90% coverage, there is an estimated need for one low voltage connection point for **passenger ships**, although there were just a few hours with such traffic in the port in 2023. Unless a significant increase in the passenger traffic to the port is expected towards 2030, the port should not invest in such a connection point. There were some hours with a need for 8 high

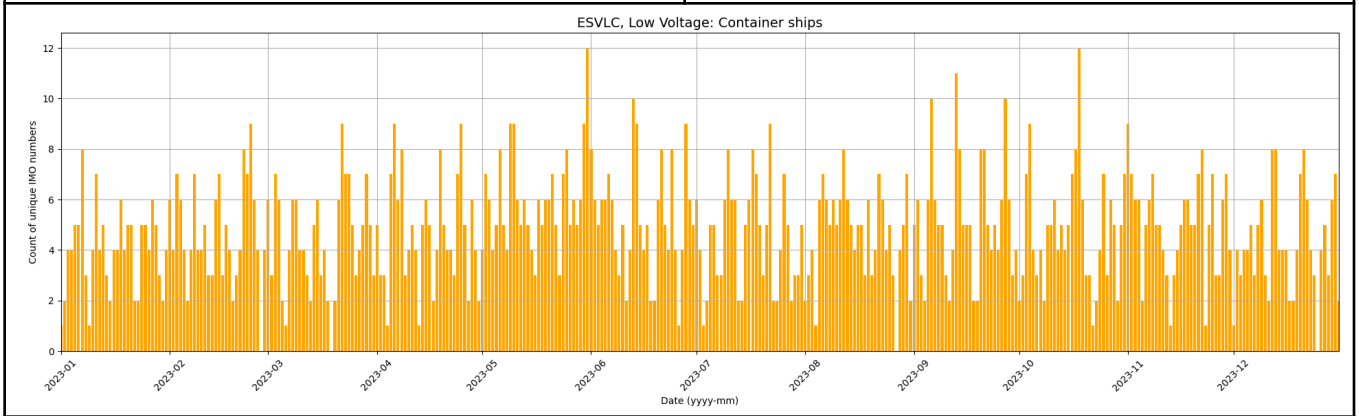
voltage connection points for passenger ships, but 6 such connection points would be sufficient for 90% coverage. In total, there is an estimated need for 22 connection points for container ships, 3 for cruise ships, and 7 for passenger ships.

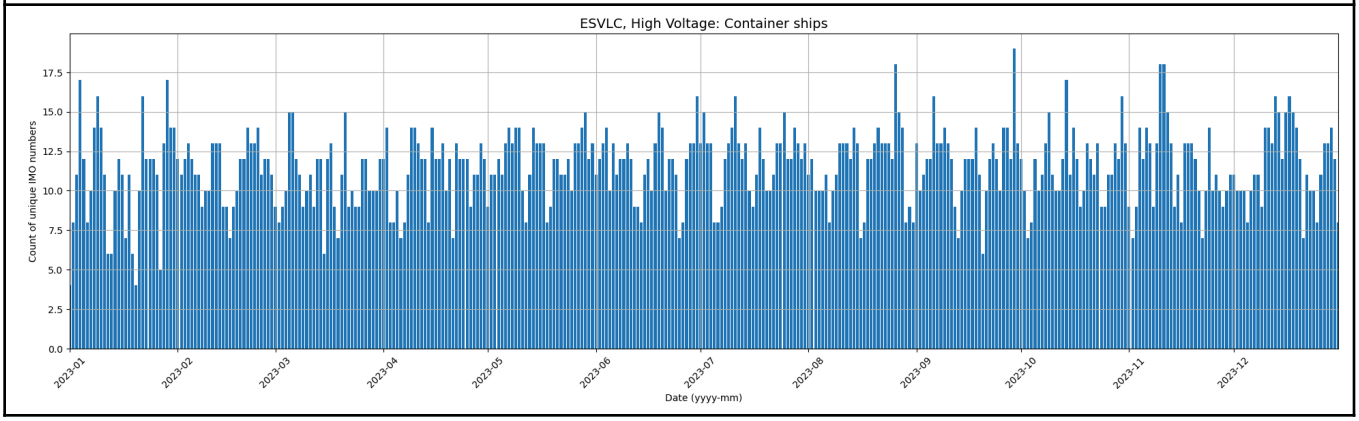
Table 6-94 Number of container and cruise ships at any day and passenger ships at any hour in 2023, and the estimated number of required connection points – split on low and high voltage.

Valencia	Low Voltage	High Voltage
Container ships – req. connection points	8	14

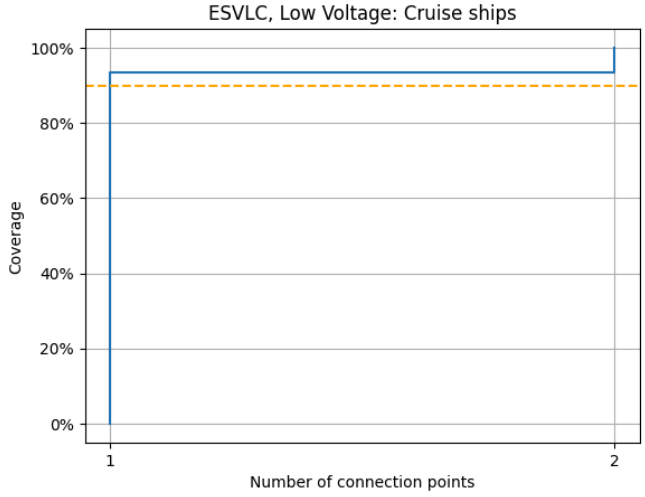


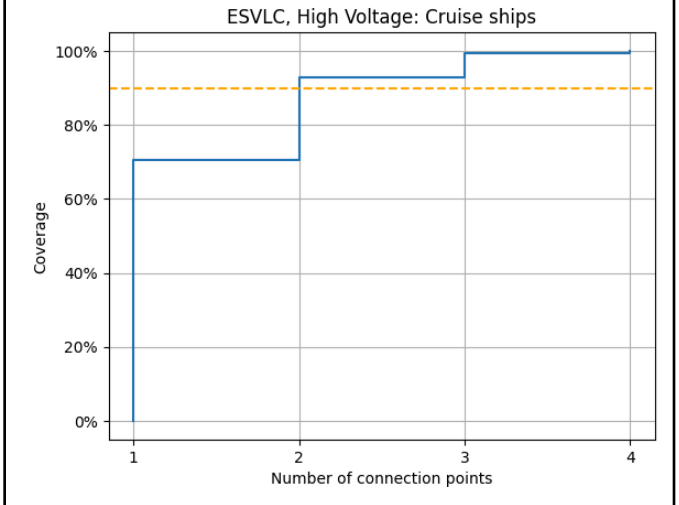


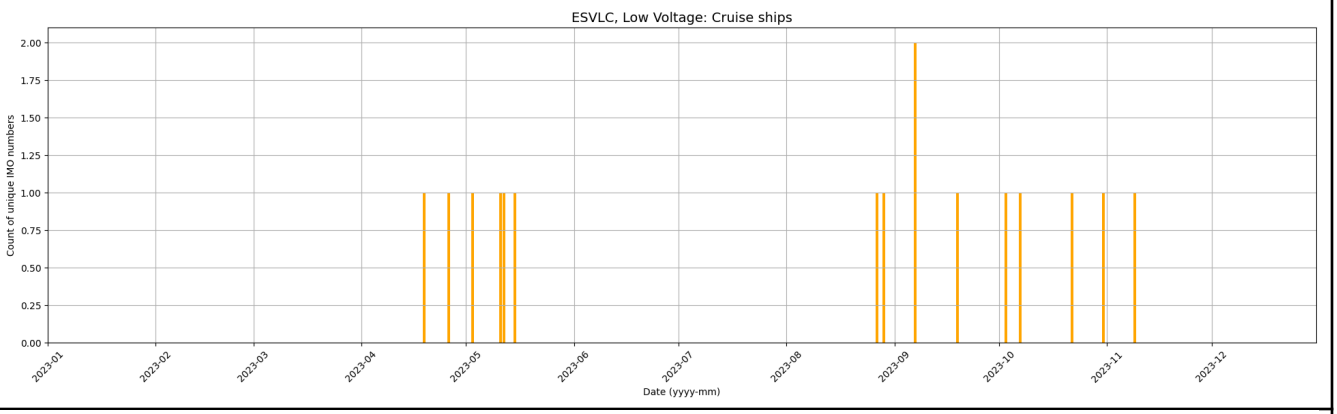


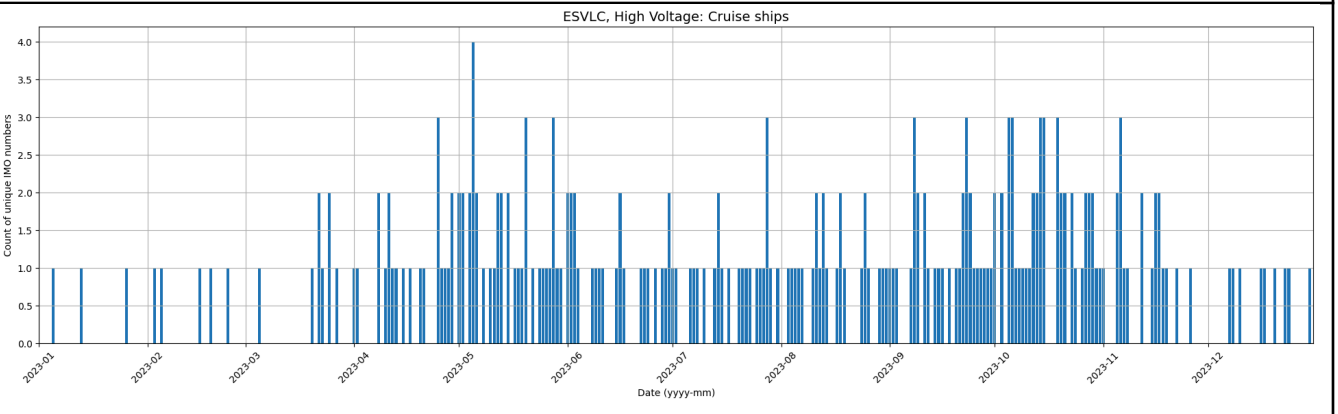


Valencia	Low Voltage	High Voltage
Cruise ships – required connection points	1	2

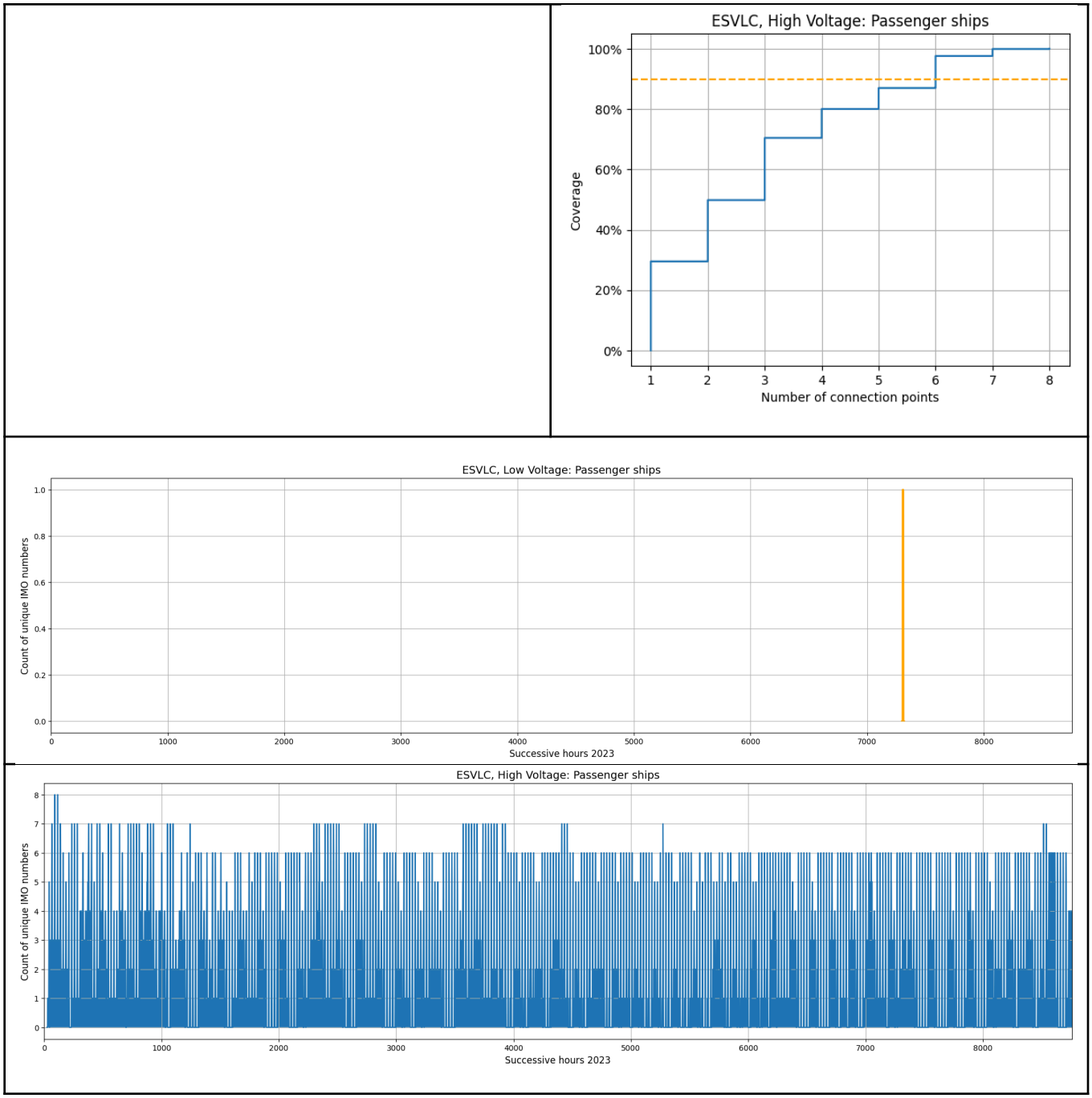








Valencia	Low Voltage	High Voltage
Passenger ships – req. connection points	1	6



6.26.2 Current status and plans for onshore power supply

There are currently no OPS systems in operation in the port of Valencia, but a contract is signed for the installation of two 7 500 kW connection points for container ships (Table 6-95). In the case of two simultaneous ships, no more than 5 000 kW can be delivered to each.

Table 6-95 Contracted OPS in the port of Valencia.

Max. power from grid [MW]	Berth name	Max. no. of simultaneous ships	Types of ships	Max. system power capacity [kW]	System voltage	Standard	Operational from
10	Container terminal MSCTV	2	Container	15 000	6.6-11 kV	IEC 80005-1	2025/26
16	Passenger terminal TRASMED	2	Cruise ships and ro-pax		6.6-11 kV	IEC 80005-1	2027/2028

There is also a new passenger terminal in the planning phase, with one 20 000 kW connection point for cruise ships, and one 4 000 kW connection point for ferries. Further in the future, the port plans multiple connection points for container, passenger and cruise ships.

Capacity in the local electricity grid

According to the port, the current capacity in the grid is not sufficient, thus the grid is being upgraded with 132/20kV, 2x110 000 kW (4x55 000 kW) substations to meet the demand. The port estimates that this should be sufficient for all power demands towards 2030.

6.27 Port of Valletta, Malta

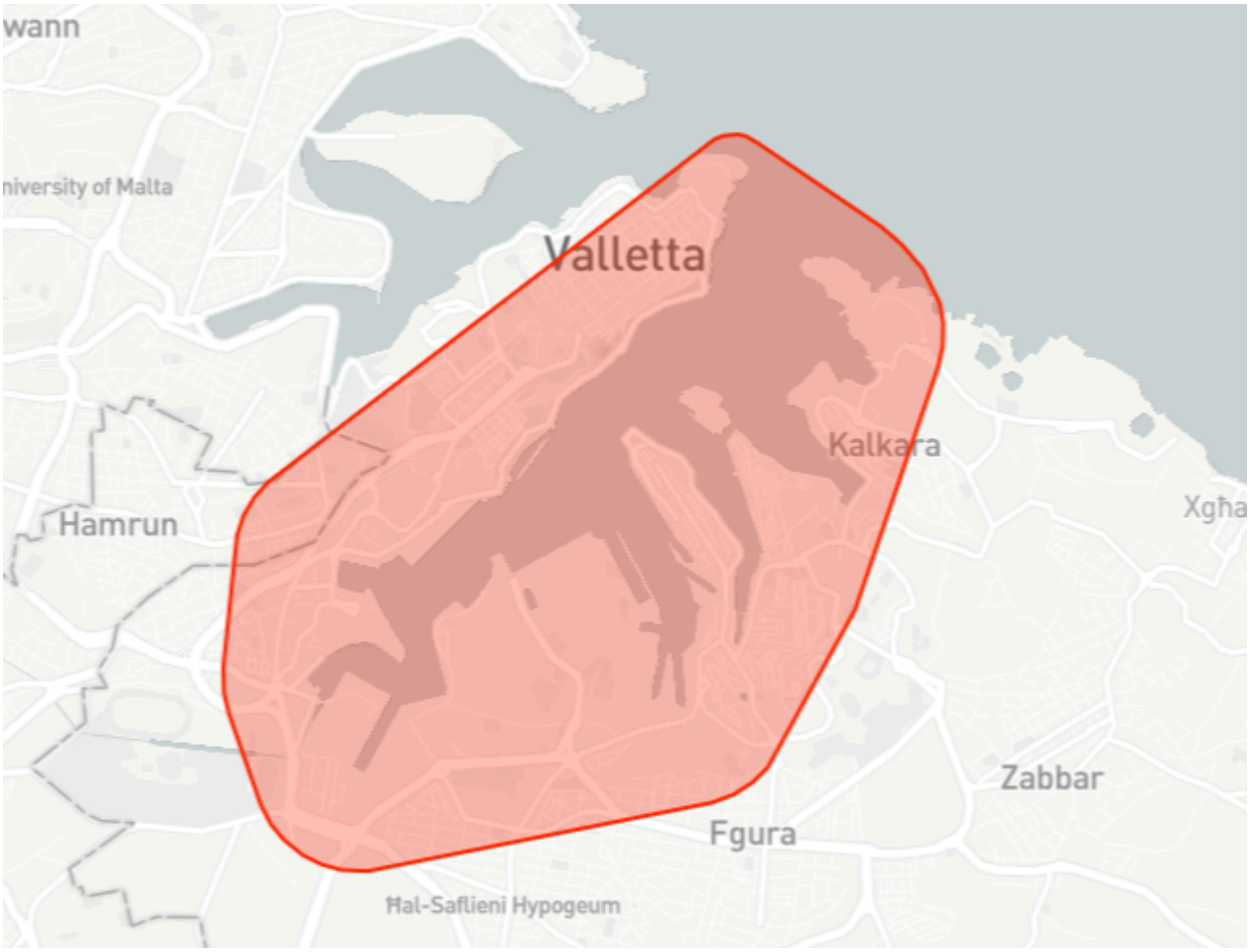


Figure 6-27 Port shape for Valletta (MTMLA).

6.27.1 Current ship activity and energy requirements

Table 6-96 shows the effective hours in port per ship segment and size category for the port of Valletta in 2023. There are around 4000 effective hours in port for container ships larger than 5000 GT. For cruise ships larger than 5000 GT there are around 5000 effective hours in port, and for passenger ships larger than 5000 GT there are more than 11 000 effective hours in port.

Table 6-96 Effective hours in port per ship segment and size category.

Valletta	400 - 999 GT	1000 - 4999 GT	5000 - 9999 GT	10000 - 24999 GT	25000 - 49999 GT	50000 - 99999 GT	100000 GT <	Total
Bulk carriers		1 901	104	145	1 810			3 960
Chemical tankers		2 915	1 825	171	93			5 004
Container ships			232	2 517	709	526		3 984
Crude oil tankers						724		724
Cruise ships		1 255	983	291	672	1 148	1 812	6 161
Fishing ships	1 630							1 630

Gas tankers								0
General cargo ships	149	15 576	490	560	12	833		17 620
Offshore supply ships		8 883	197					9 080
Oil product tankers	5 045	10 034	63	214				15 356
Other activities	26 355	13 115	1 170	400	425			41 465
Other service offshore ships	459	119	325	161				1 064
Passenger ships	4 371	129	11 055	17				15 572
Refrigerated cargo ships		1 861	1 299					3 160
Ro-Ro cargo ships			297	1 699	1 467	846		4 309
Total	38 009	55 788	18 040	6 175	5 188	4 077	1 812	129 089

Table 6-97 shows the effective hours per ship segment and power category for the port of Valletta in 2023. For container ships, most of the estimated energy consumption is in the power categories 500-1000 kW and 1-5 MW. For cruise ships, most of the estimated energy consumption is in the highest power category (> 10 MW). Cruise ships represent nearly half of the total energy consumption in port. For passenger ships, most of the estimated energy consumption is in the 500-1000 kW category.

Table 6-97 Estimated energy consumption in port (MWh) per ship segment and power category.

Valletta	**<100 kW**	**100-500 kW**	**500-1000 kW**	**1-5 MW**	**5-10 MW**	**>10 MW**	**Total**
Bulk carriers	0	998	0	0	0	0	998
Chemical tankers	0	0	1 453	306	0	0	1 759
Container ships	0	115	1 785	2 130	0	0	4 029
Crude oil tankers	0	0	0	905	0	0	905
Cruise ships	0	513	917	3 328	8 286	18 138	31 182
Fishing vessels	104	0	0	0	0	0	104
Gas tankers	0	0	0	0	0	0	0
General cargo ships	1 545	327	731	0	0	0	2 602
Offshore supply ships	0	1 919	102	0	0	0	2 021
Oil product tankers	283	2 418	186	0	0	0	2 887
Other activities	1 107	3 410	945	630	0	0	6 092
Other service offshore vessels	29	149	101	0	0	0	279
Passenger ships	262	46	9 010	29	0	0	9 347
Refrigerated cargo ships	0	1 049	0	0	0	0	1 049
Ro-Ro cargo ships	0	95	2 222	848	0	0	3 164
Total	3 330	11 039	17 451	8 175	8 286	18 138	66 418

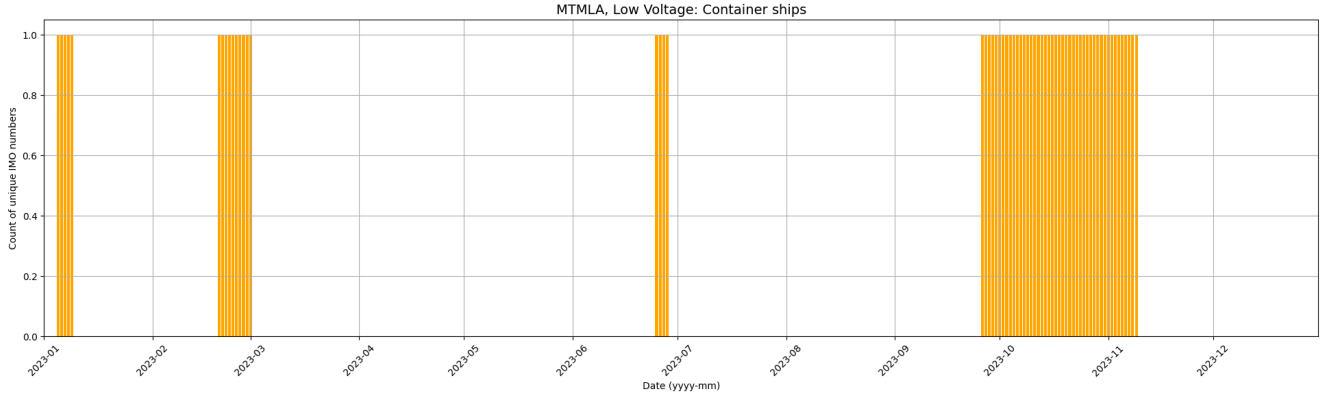
Table 6-98 presents simultaneous port calls for quantification of the need for low and high voltage connection points for container, cruise, and passenger ships above 5000 GT. Since there were less than 100 port calls from **container ships** in 2023, it is assumed that there is no need for connection points for this segment in the port of Valletta.

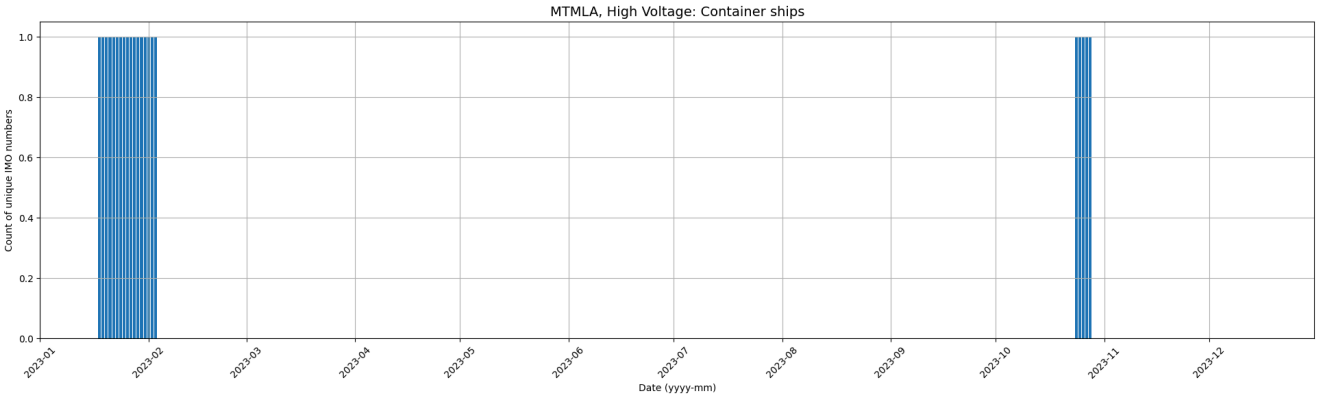
For **cruise ships**, 2 low voltage connection points are needed for 90% coverage. There were some days with a need for 3 or 4 high voltage connection points, but 2 such connection points would be sufficient for 90% coverage.

For **passenger ships**, 2 low voltage and 1 high voltage connection point are required for 90% coverage, although there were just a few hours in 2023 with passenger ships requiring high voltage connection points. Unless a significant increase in the passenger traffic to the port is expected towards 2030, the port should not invest in a high voltage connection point. In total, there is an estimated need for 4 connection points for cruise ships and 3 connection points for passenger ships.

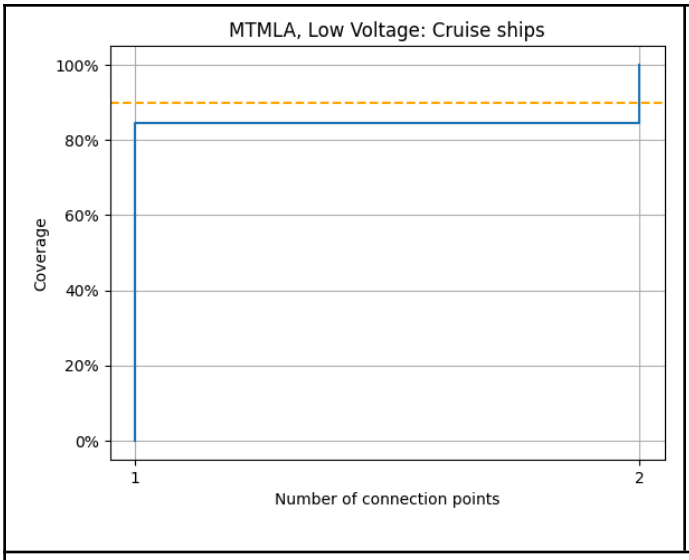
Table 6-98 Number of container and cruise ships at any day and passenger ships at any hour in 2023, and the estimated number of required connection points – split on low and high voltage.

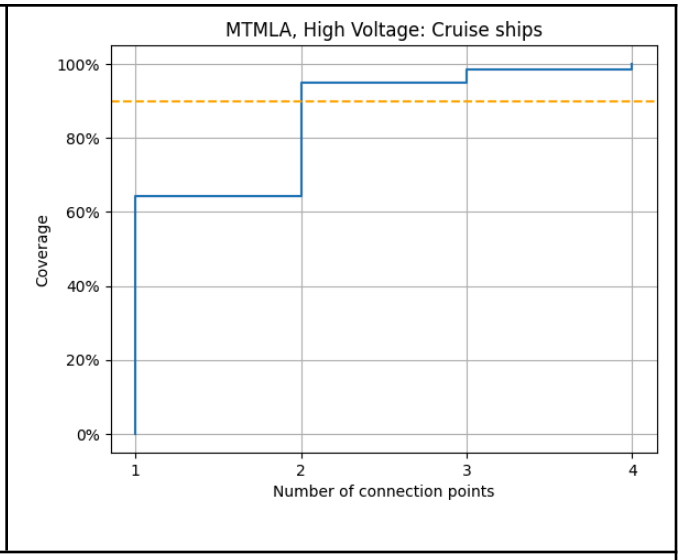
Valletta	Low Voltage	High Voltage
Container ships – req. connection points	0	0

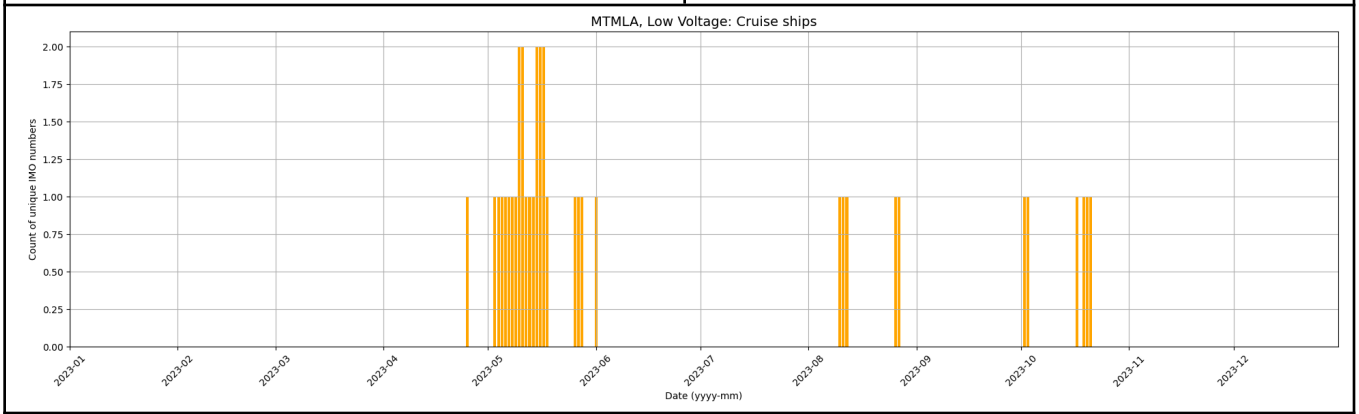


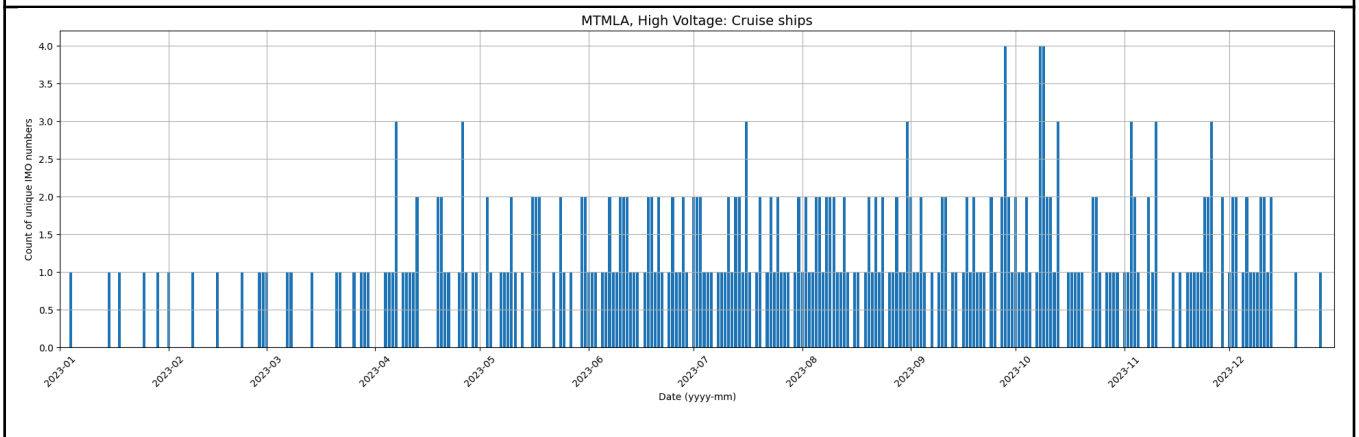


Valletta	Low Voltage	High Voltage
Cruise ships – required connection points	2	2

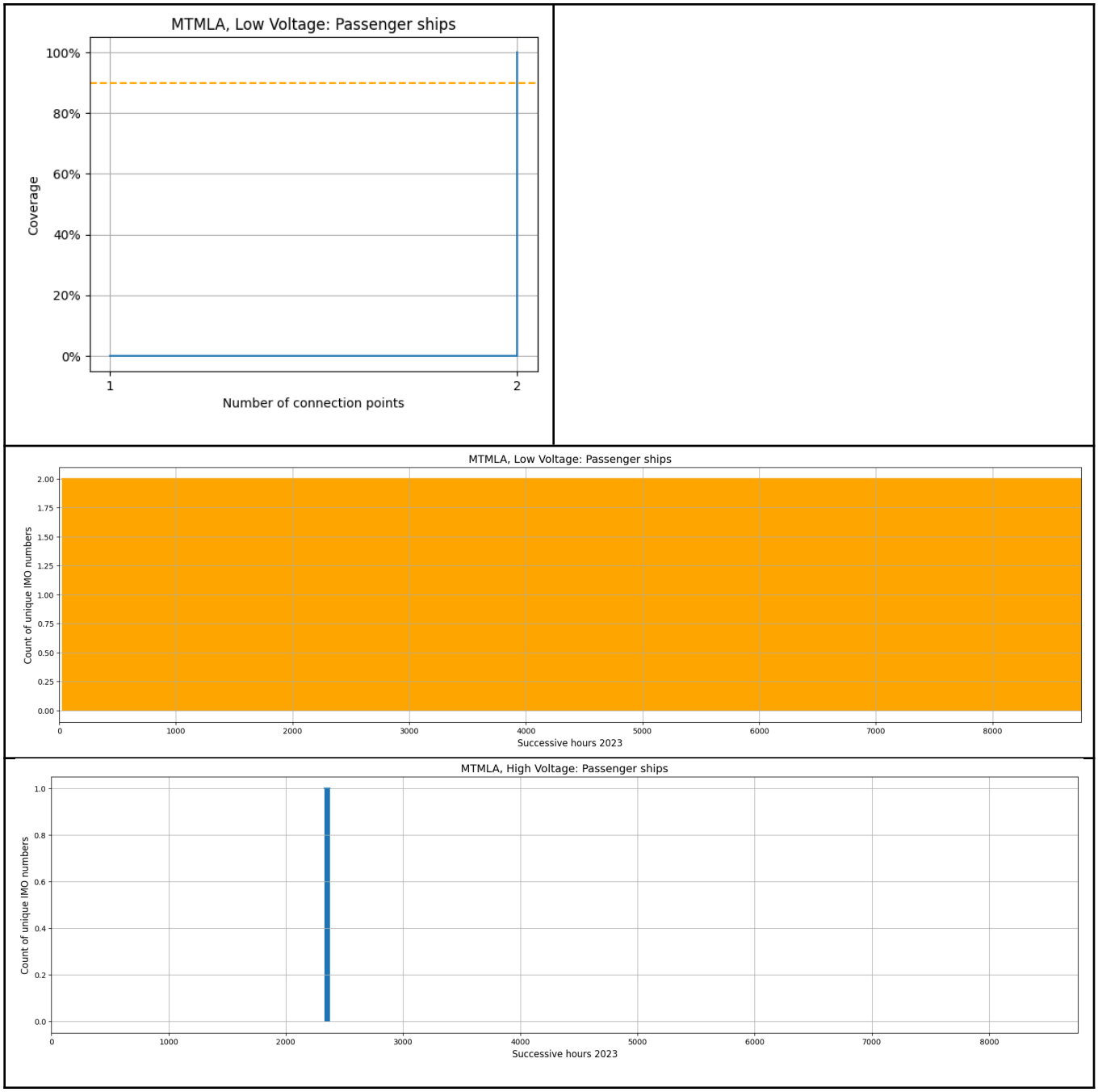








Valletta	Low Voltage	High Voltage
Passenger ships – req. connection points	2	1



6.27.2 Current status and plans for onshore power supply

In the port of Valletta, two OPS systems for cruise ships have been in operation since 2023 (Table 6-99). Three more OPS systems for cruise ships have been built, but not tested yet. The startup year for these systems is unknown.

Table 6-99 Installed and contracted OPS in the port of Valletta.

Berth name	Max. no. of simultaneous ships	Types of ships	Max. system power capacity [kW]	System voltage [kV]	System freq. [Hz]	Standard	Operational from

Terminal 1	1	Cruise	16 000	6.6-11	50 and 60	IEC 80005-1	2023
Terminal 2	1	Cruise	16 000	6.6-1	50 and 60	IEC 80005-1	2023
Terminal 3	1	Cruise	16 000	6.6-11	50 and 60	IEC 80005-1	-
Terminal 4	1	Cruise	16 000	6.6-11	50 and 60	IEC 80005-1	-
Terminal 5	1	Cruise	16 000	6.6-11	50 and 60	IEC 80005-1	-

6.28 Port of Venice, Italy

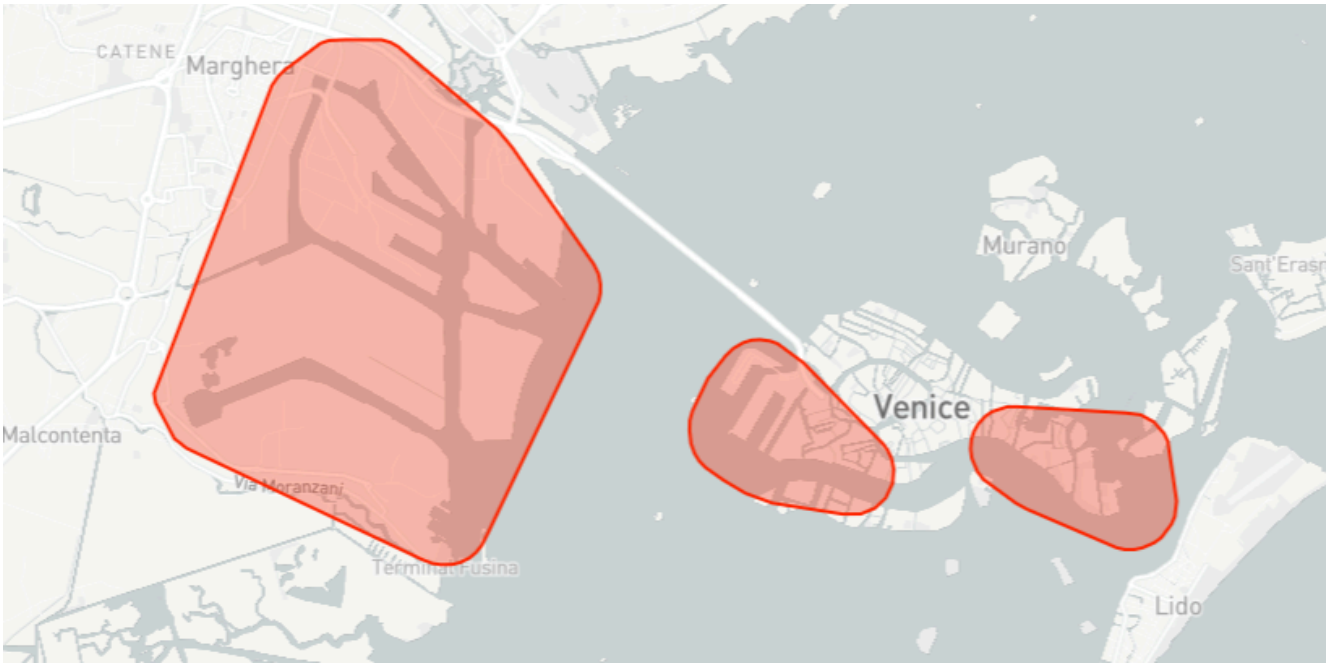


Figure 6-28 Port shape for Venice (ITVCE).

6.28.1 Current ship activity and energy requirements

Table 6-100 shows the effective hours in port per ship segment and size category for the port of Venice in 2023. There are more than 17 000 effective hours in port for container ships larger than 5000 GT. For cruise ships larger than 5000 GT there are around 3500 effective hours in port, and for passenger ships larger than 5000 GT there are around 700 effective hours in port.

Table 6-100 Effective hours in port per ship segment and size category.

Venice	400 - 999 GT	1000 - 4999 GT	5000 - 9999 GT	10000 - 24999 GT	25000 - 49999 GT	50000 - 99999 GT	100000 GT <	Total
Bulk carriers		4 406	4 733	12 862	19 581	95		41 677
Chemical tankers		1 210	2 594	4 353	3 458			11 615
Container ships		267	4 473	5 256	7 584			17 580
Crude oil tankers					47			47
Cruise ships		416	327	200	955	1 242	777	3 917

Fishing ships								0
Gas tankers		355	4 422					4 777
General cargo ships		9 207	7 525	6 569	835			24 136
Offshore supply ships								0
Oil product tankers	8 630							8 630
Other activities	66 795	6 200	474	106				73 575
Other service offshore ships		4						4
Passenger ships	16 069	134	23		673			16 899
Refrigerated cargo ships								0
Ro-Ro cargo ships				203	1 749	1 259		3 211
Total	91 494	22 199	24 571	29 549	34 882	2 596	777	206 068

Table 6-101 shows the estimated energy consumption per ship segment and power category for the port of Venice in 2023. For container ships and passenger ships, most of the estimated energy consumption is in the power category 1-5 MW. For cruise ships, most of the estimated energy consumption is in the highest power category (> 10 MW). In addition, bulk carriers and chemical tankers has substantial contributions to the total estimated energy consumption.

Table 6-101 Estimated energy consumption in port (MWh) per ship segment and power category.

Venice	<100 kW	100-500 kW	500-1000 kW	1-5 MW	5-10 MW	>10 MW	Total
Bulk carriers	0	12 930	50	0	0	0	12 979
Chemical tankers	0	116	2 065	9 205	0	0	11 385
Container ships	0	2 271	3 727	9 821	0	0	15 819
Crude oil tankers	0	0	46	0	0	0	46
Cruise ships	0	170	305	4 310	8 965	7 778	21 528
Fishing vessels	0	0	0	0	0	0	0
Gas tankers	0	135	0	4 422	0	0	4 557
General cargo ships	911	4 234	521	0	0	0	5 667
Offshore supply ships	0	0	0	0	0	0	0
Oil product tankers	483	0	0	0	0	0	483
Other activities	2 805	1 612	335	0	0	0	4 752
Other service offshore vessels	0	1	0	0	0	0	1
Passenger ships	964	48	19	2 410	0	0	3 441
Refrigerated cargo ships	0	0	0	0	0	0	0
Ro-Ro cargo ships	0	0	1 515	1 262	0	0	2 776
Total	5 164	21 517	8 582	31 430	8 965	7 778	83 435

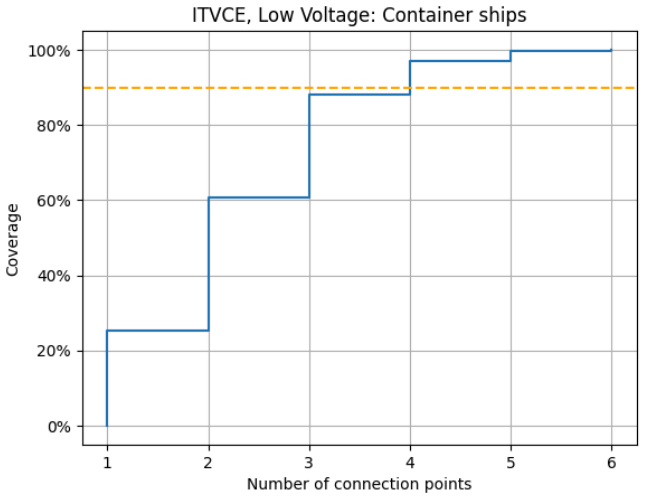
Table 6-102 presents simultaneous port calls for quantification of the need for low and high voltage connection points for container, cruise, and passenger ships above 5000 GT. There were some days in 2023 with 5 or 6 **container ships** requiring low voltage connection points in the port, but 4 such connection points would be sufficient for 90% coverage. Similarly, there were some days in 2023 with 4 or 5 container ships requiring high voltage connection points in the port, but 3 such connection points would be sufficient for 90% coverage.

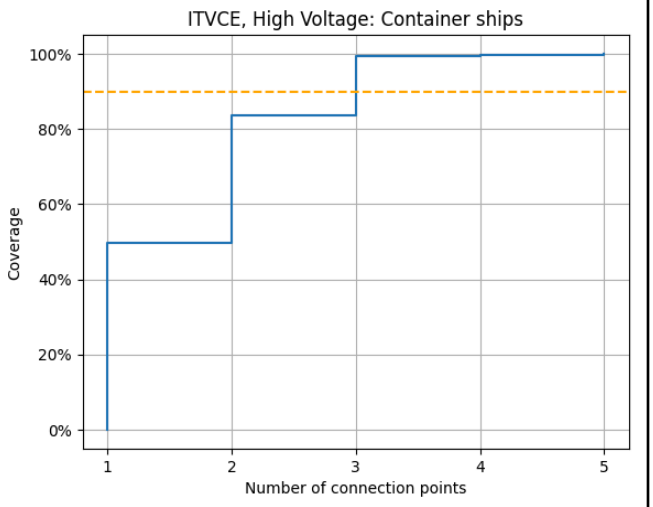
For **cruise ships**, there were some days with a need for 2 low voltage connection points and some days with a need for 3 or 4 high voltage connection points. However, 1 low voltage connection point and 2 high voltage connection points would be sufficient for 90% coverage.

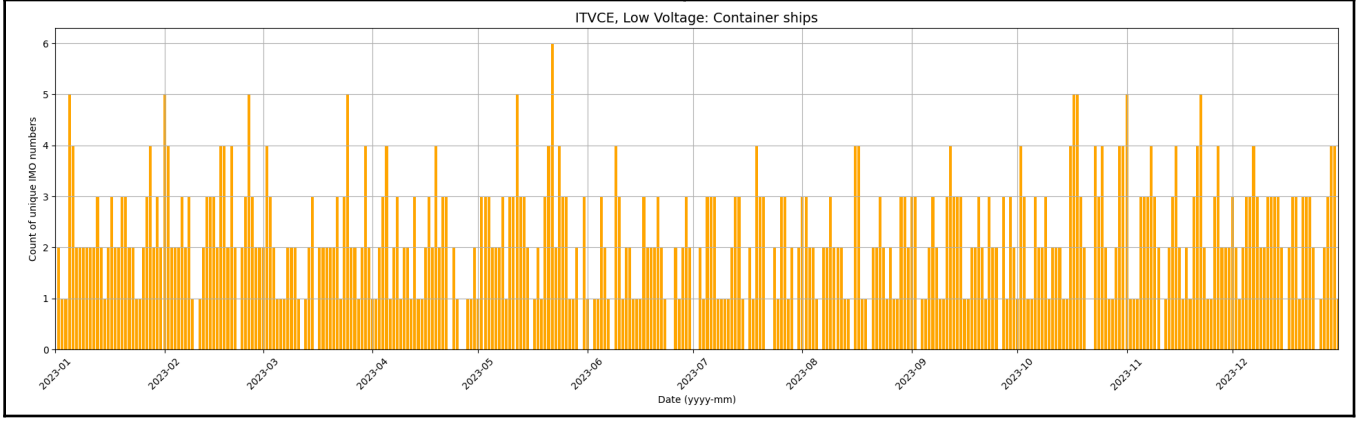
For **passenger ships**, 1 low voltage and one high voltage connection point are required for 90% coverage, although there were just a few hours in 2023 with passenger ships requiring low voltage connection points. Unless a significant increase in passenger traffic to the port is expected towards 2030, the port should not invest in such a connection point. In total, there is an estimated need for 7 connection points for container ships, 3 connection points for cruise ships, and 2 connection points for passenger ships.

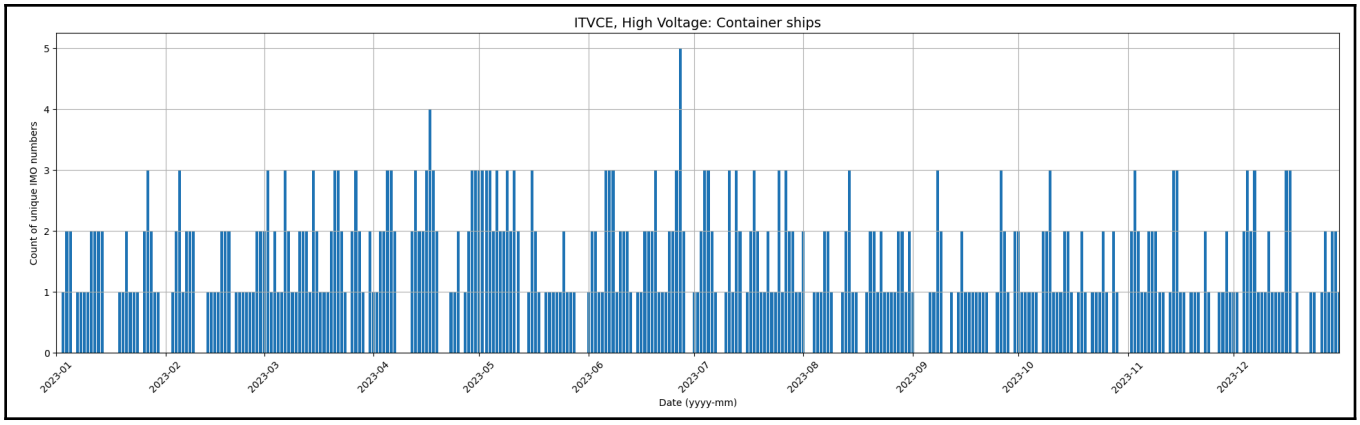
Table 6-102 Number of container and cruise ships at any day and passenger ships at any hour in 2023, and the estimated number of required connection points – split on low and high voltage.

Venice	Low Voltage	High Voltage
Container ships – req. connection points	4	3

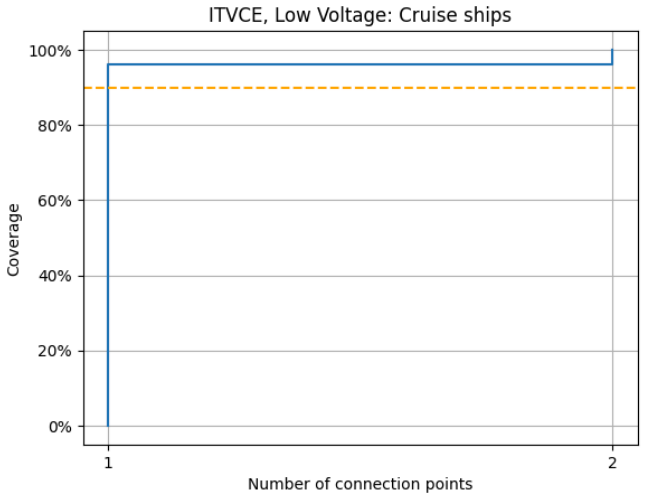


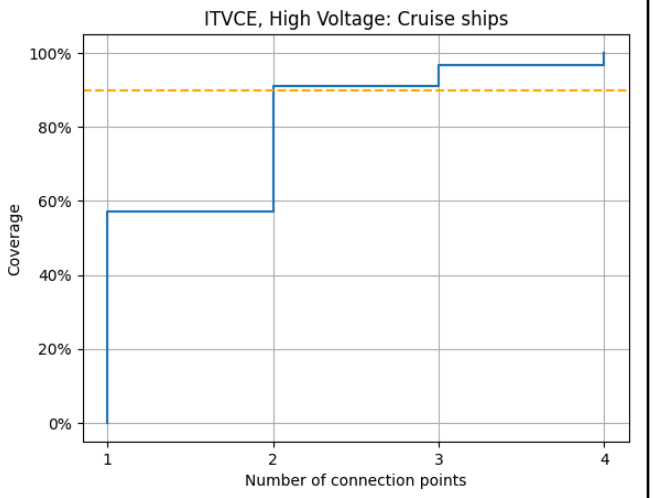


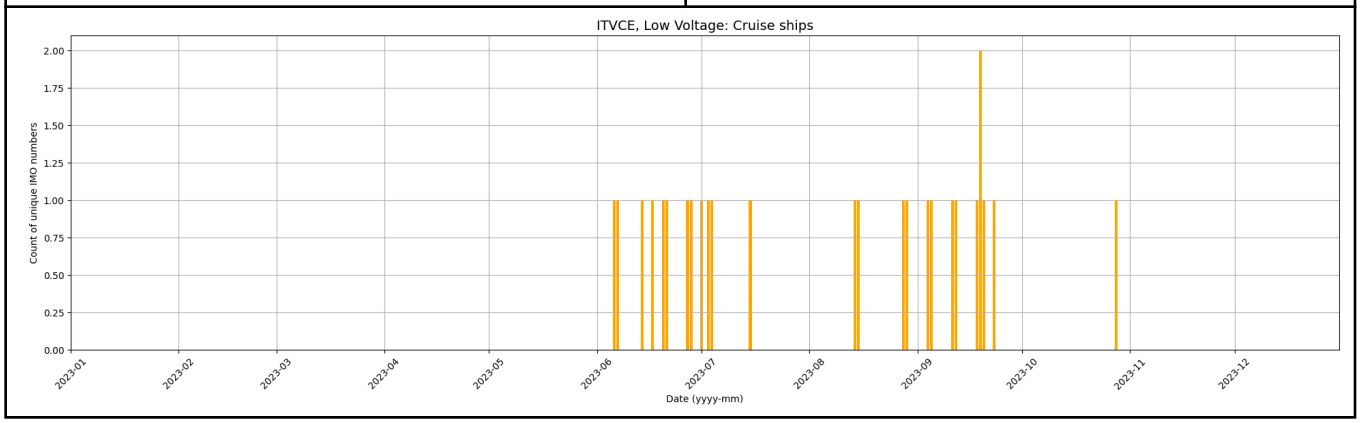


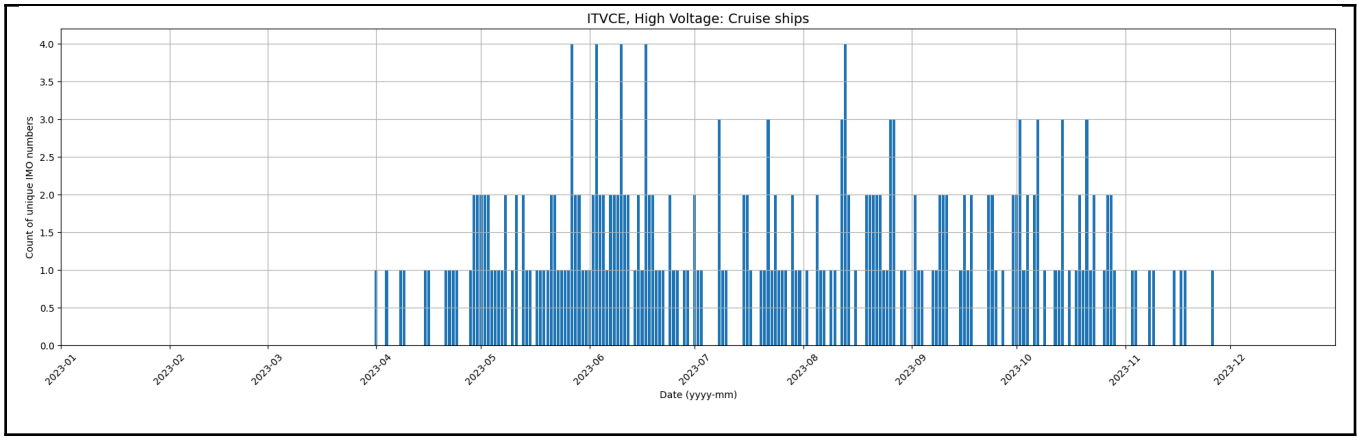


Venice	Low Voltage	High Voltage
Cruise ships – required connection points	1	2

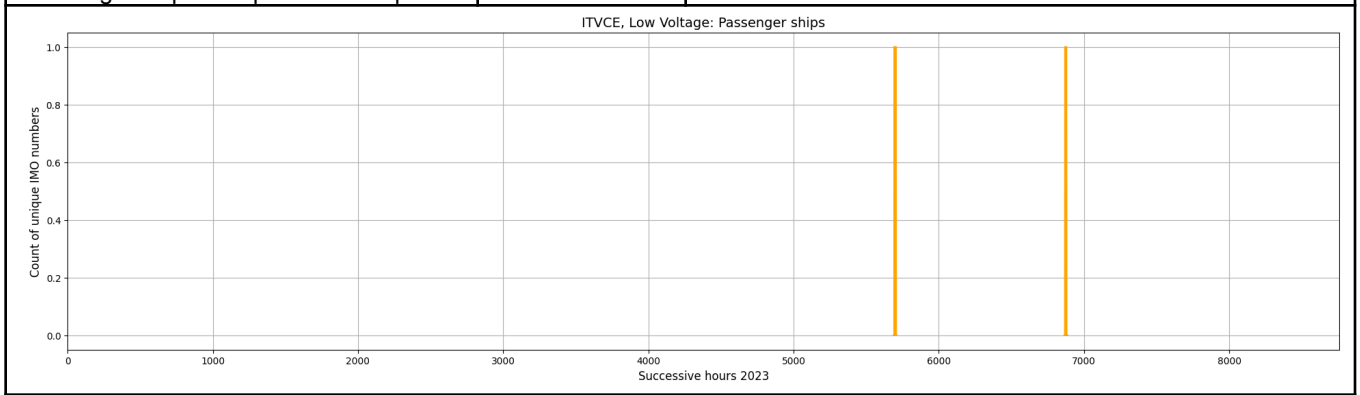


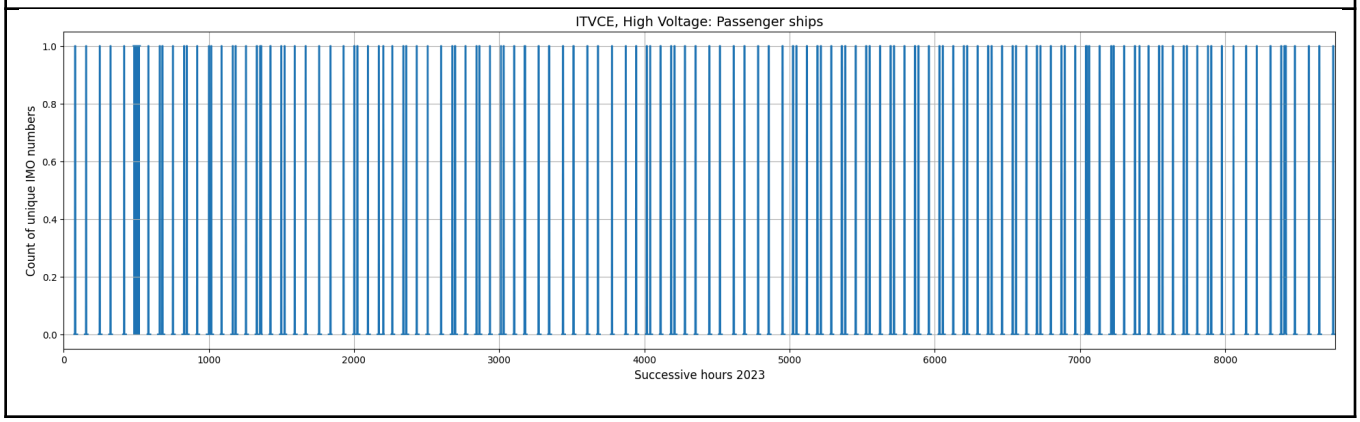






Venice	Low Voltage	High Voltage
Passenger ships – req. connection points	1	1





6.28.2 Current status and plans for onshore power supply

There are currently no OPS systems in operation in the port of Venice, but work is starting this year to install the OPS systems listed in Table 6-103.

Capacity in the local electricity grid

According to the port, sufficient power is available at the passenger terminals, but more power is needed at the cruise terminals. So far only two cruise ships can be connected at the same time. The port is in dialogue with the local grid company.

Table 6-103 Contracted OPS in the port of Venice.

Berth name	Max. no. of simultaneous ships	Types of ships	Max. system power capacity [kW]	System voltage	System freq. [Hz]	Standard	Availability	Operational from
Marittima	4	Cruise	24 000	6.6-11 kV	50 and 60	IEC 80005-1	Public	2026
Riva Santa Marta San Basilio	8	Passenger (ferry and mega yachts)	4 000	400-690 V	50 and 60	IEC 80005-1	Public	2025
Riva Sette Martiri	6	Passenger (mega yachts)	2 000	400-690 V	50 and 60	IEC 80005-1	Public	2025
Marghera	2	Cruise	30 000	6.6-11 kV	50 and 60	IEC 80005-1	Public	2026
Fusina	4	Passenger (RoPax)	14 000	-	-	-	Public	2026

6.29 Port of Ventspils, Latvia

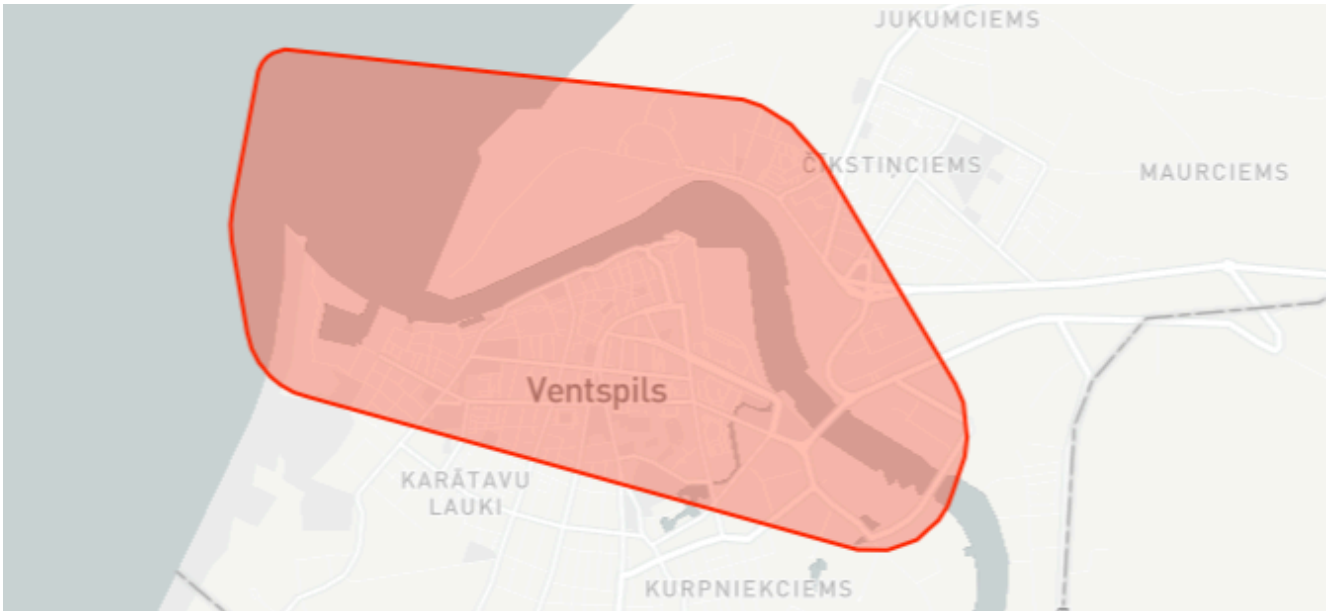


Figure 6-29 Port shape for Ventspils (LVVNT).

6.29.1 Current ship activity and energy requirements

Table 6-104 shows the effective hours in port per ship segment and size category for the port of Ventspils in 2023. There are no effective hours recorded in port for container ships and cruise ships larger than 5000 GT. For passenger ships larger than 5000 GT there are nearly 5000 effective hours in port.

Table 6-104 Effective hours in port per ship segment and size category.

Ventspils	400 - 999 GT	1000 - 4999 GT	5000 - 9999 GT	10000 - 24999 GT	25000 - 49999 GT	50000 - 99999 GT	100000 GT <	Total
Bulk carriers		22		1 248	7 313	69		8 652
Chemical tankers		853	1 350	2 121	3 598			7 922
Container ships								0
Crude oil tankers					230	370		600
Cruise ships								0
Fishing ships	4 024							4 024
Gas tankers								0
General cargo ships	71	9 231	1 772	768	71			11 913
Offshore supply ships	27							27
Oil product tankers		1 402	535	27	396			2 360
Other activities	5 744	3 519	123					9 386
Other service offshore ships								0
Passenger ships				704	4 085			4 789
Refrigerated cargo ships								0
Ro-Ro cargo ships		82						82
Total	9 866	15 109	3 780	4 868	15 693	439	0	49 755

Table 6-105 shows the estimated energy consumption per ship segment and power category for the port of Ventspils in 2023. All the estimated consumption for passenger ships is in the power category 1-5 MW, accounting for close to 50% of the total estimated energy consumption in the port. In addition, chemical tankers represent about 25% of the total estimated energy consumption.

Table 6-105 Estimated energy consumption in port (MWh) per ship segment and power category.

Ventspils	<100 kW	100-500 kW	500-1000 kW	1-5 MW	5-10 MW	>10 MW	Total
Bulk carriers	0	3 231	36	0	0	0	3 268
Chemical tankers	0	0	1 075	6 964	0	0	8 039
Container ships	0	0	0	0	0	0	0
Crude oil tankers	0	0	223	463	0	0	685
Cruise ships	0	0	0	0	0	0	0
Fishing vessels	258	0	0	0	0	0	258
Gas tankers	0	0	0	0	0	0	0
General cargo ships	915	695	44	0	0	0	1 654
Offshore supply ships	2	0	0	0	0	0	2
Oil product tankers	0	338	685	0	0	0	1 023
Other activities	241	915	63	0	0	0	1 220

Other service offshore vessels	0	0	0	0	0	0	0
Passenger ships	0	0	0	15 832	0	0	15 832
Refrigerated cargo ships	0	0	0	0	0	0	0
Ro-Ro cargo ships	0	12	0	0	0	0	12
Total	1 416	5 191	2 127	23 259	0	0	31 993

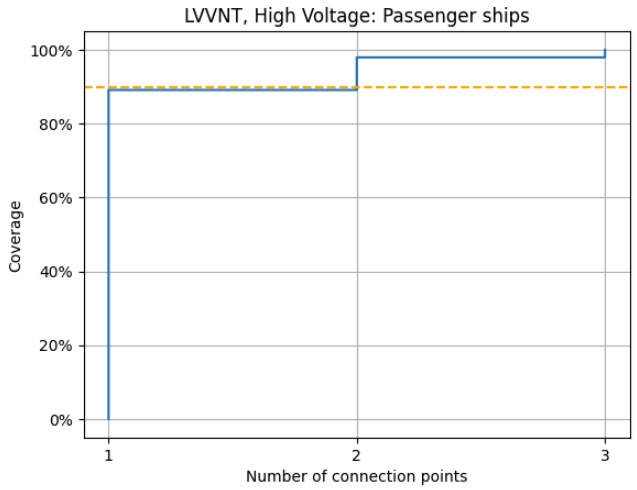
Table 6-106 presents simultaneous port calls for quantification of the need for low and high voltage connection points for container, cruise, and passenger ships above 5000 GT. For **container and cruise ships**, there was no traffic in the port in 2023, hence there is no estimated need for any connection points. For **passenger ships**, there were some hours with a need for 3 high voltage connection points, but 2 such connection points would be sufficient for 90% coverage.

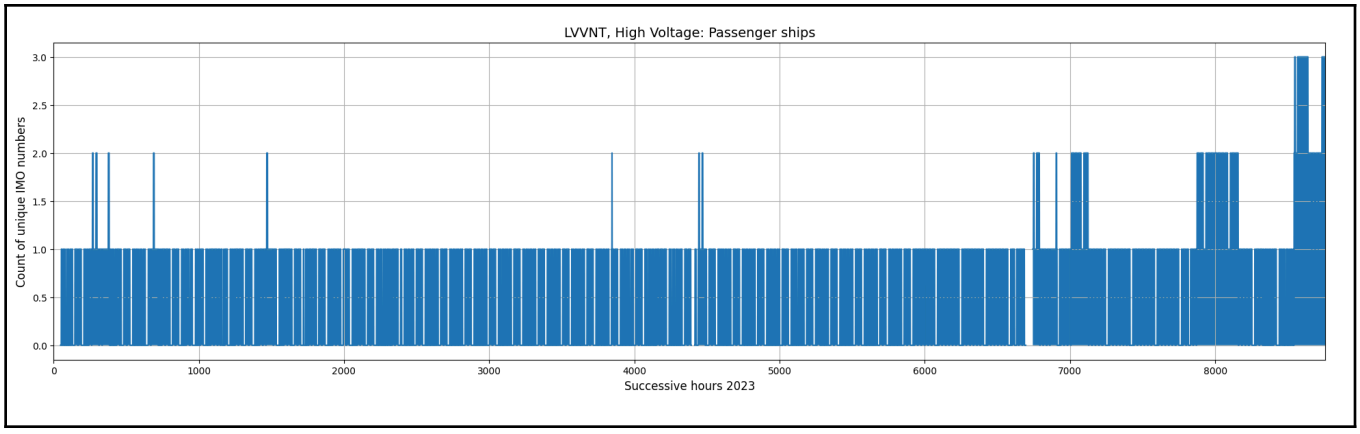
Table 6-106 Number of container and cruise ships at any day and passenger ships at any hour in 2023, and the estimated number of required connection points – split on low and high voltage.

Ventspils	**Low Voltage**	**High Voltage**
Container ships – req. connection points	0	0
No data		

Ventspils	**Low Voltage**	**High Voltage**
Cruise ships – required connection points	0	0
No data		

Ventspils	**Low Voltage**	**High Voltage**
Passenger ships – req. connection points	0	2





6.29.2 Current status and plans for onshore power supply

There is currently no implementation of OPS in the port of Ventspils, except for connection points serving the ports' own fleet of smaller ships, which are outside the scope of this study. There are no signed contracts for OPS, but the port expects to receive EU funding for OPS installations in 2024. Construction of 1 OPS for RoPax ships is expected to commence in the near future, with planned completion by 2026.

Capacity in the local electricity grid

The port is connected to the national grid through a 5 MW power line. This is expected to be sufficient for their current plans, but not necessarily for the 2030 requirements. In the future, a new substation will be installed.

6.30 Port of Vlissingen, Netherlands

Vlissingen is organized together with Terneuzen and Ghent as Northsea Port, but the results presented here relate to the port with UN/LOCODE NLVLI (Figure 6-30).

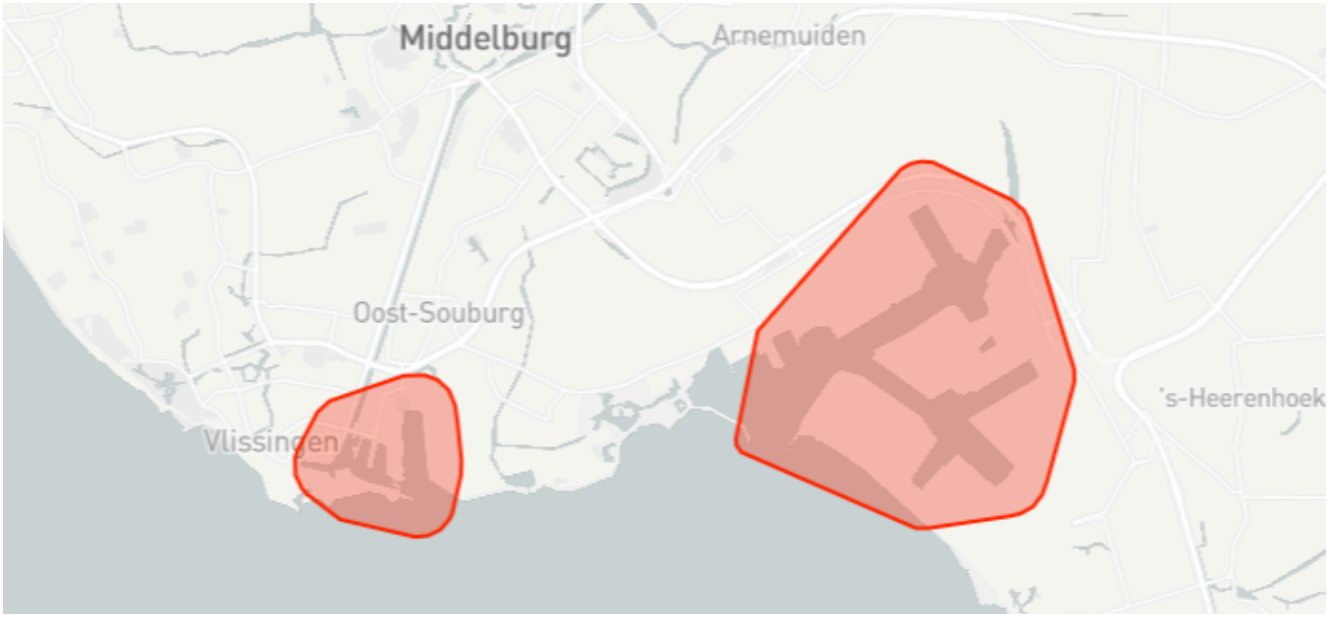


Figure 6-30 Port shape for Vlissingen (NLVLI).

6.30.1 Current ship activity and energy requirements

Table 6-107 shows the effective hours in port per ship segment and size category for the port of Vlissingen. There are nearly 6000 effective hours in port for container ships larger than 5000 GT. For cruise ships larger than 5000 GT there are around 650 effective hours in port, and for passenger ships larger than 5000 GT there are only 19 effective hours in port. Other segments with a high number of effective hours in the port are chemical tankers, fishing ships, general cargo ships and other activities.

Table 6-107 Effective hours in port per ship segment and size category.

Vlissingen	400 - 999 GT	1000 - 4999 GT	5000 - 9999 GT	10000 - 24999 GT	25000 - 49999 GT	50000 - 99999 GT	100000 GT <	Total
Bulk carriers		521	167	7 120	8 127	2 025		17 960
Chemical tankers	2 687	36 560	792	650	492			41 181
Container ships		6	423	349	4 849	186		5 813
Crude oil tankers					55	93		148
Cruise ships		731	663					1 394
Fishing ships	59 051		4 958					64 009
Gas tankers	697	13 523	4 596	3 141	1 165	204	124	23 450
General cargo ships	715	33 067	6 279	6 137	9 361	630		56 189
Offshore supply ships	28	2 102	39					2 169
Oil product tankers	636	6 557			24			7 217
Other activities	34 503	37 672	5 802	3 292		80		81 349
Other service offshore ships	15	2 487	977	4 168	797			8 444
Passenger ships	9 469	508			19			9 996
Refrigerated cargo ships		74	1 325	11 026				12 425
Ro-Ro cargo ships		673	126	9 751	1 079	1 792		13 421
Total	107 801	134 481	26 147	45 634	25 968	5 010	124	345 165

Table 6-108 shows the estimated energy consumption per ship segment and power category for the port of Vlissingen. For container ships, most of the estimated energy consumption is in the power category 1-5 MW. For cruise ships, the consumption is split between the power categorie 100-500 kW and 500-1000 kW. For passenger ships, most of the estimated energy consumption is in the lowest power category (<100 kW). Overall, the three most important contributors to the total estimated energy consumption are gas tankers, general cargo ships and other activities.

Table 6-108 Estimated energy consumption in port (MWh) per ship segment and power category.

Vlissingen	<100 kW	100-500 kW	500-1000 kW	1-5 MW	5-10 MW	>10 MW	Total
Bulk carriers	0	5 380	1 063	0	0	0	6 444
Chemical tankers	0	3	630	1 343	0	0	1 976
Container ships	0	211	247	6 708	0	0	7 167
Crude oil tankers	0	0	53	116	0	0	170
Cruise ships	0	299	619	0	0	0	918
Fishing vessels	3 779	2 117	0	0	0	0	5 896
Gas tankers	0	5 269	0	11 285	661	0	17 215
General cargo ships	3 287	3 788	6 388	0	0	0	13 463
Offshore supply ships	2	454	20	0	0	0	476

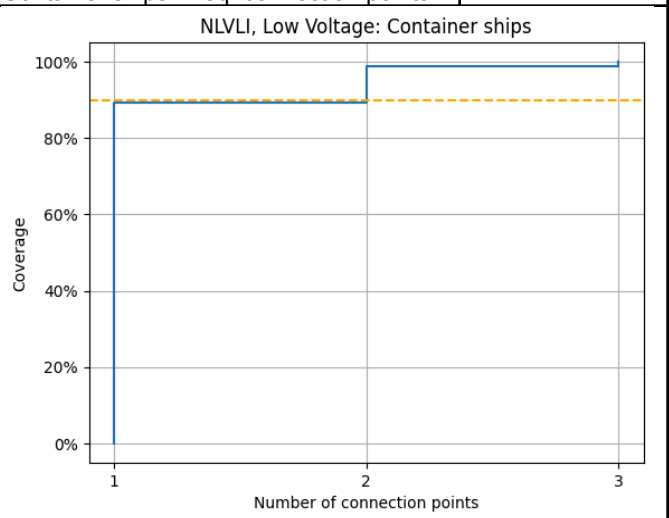
Oil product tankers	36	1 580	23	0	0	0	1 639
Other activities	1 449	9 795	5 805	154	0	0	17 203
Other service offshore vessels	1	923	3 296	0	0	0	4 220
Passenger ships	568	181	0	68	0	0	818
Refrigerated cargo ships	0	650	8 964	0	0	0	9 615
Ro-Ro cargo ships	0	135	6 922	1 796	0	0	8 853
Total	9 122	30 785	34 032	21 469	661	0	96 070

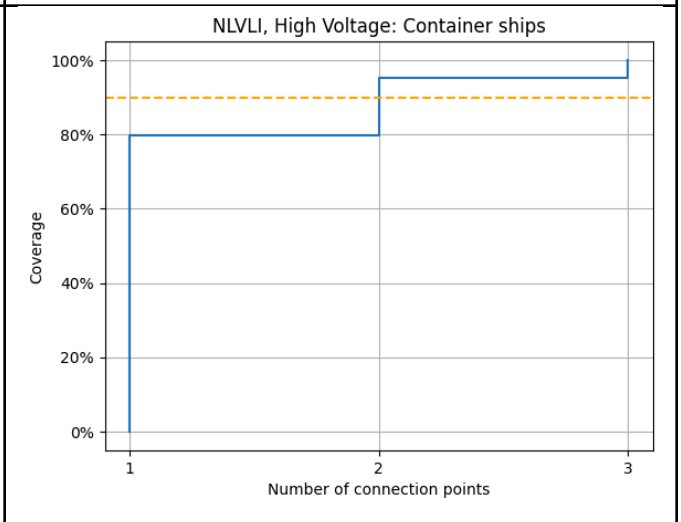
Table 6-109 presents simultaneous port calls for quantification of the need for low and high voltage connection points for container, cruise, and passenger ships above 5000 GT. There were some days in 2023 with 3 **container ships** requiring low and high voltage connection points in the port, but 2 connection points of each type would be sufficient for 90% coverage.

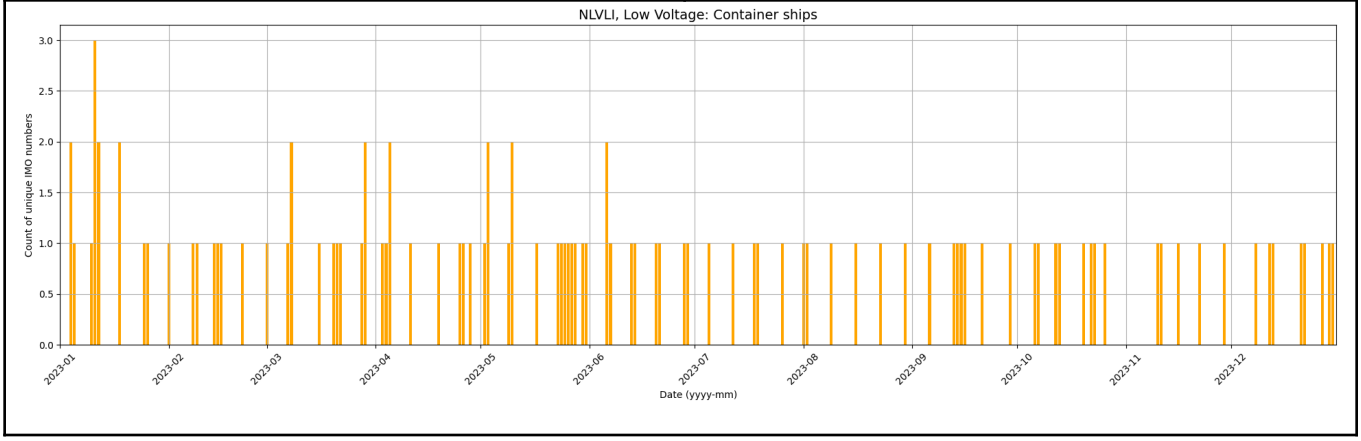
Since there were less than 25 port calls from **cruise ships** and less than 40 port calls from **passenger ships** in 2023, it is assumed that there is no need for connection points for these segments in the port of Vlissingen.

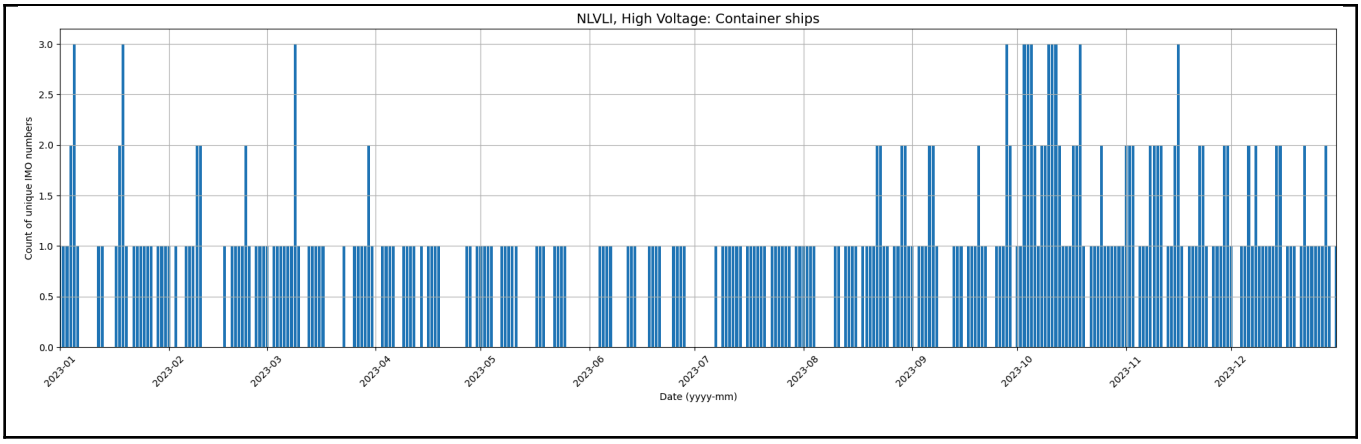
Table 6-109 Number of container and cruise ships at any day and passenger ships at any hour in 2023, and the estimated number of required connection points – split on low and high voltage.

Vlissingen	Low Voltage	High Voltage
Container ships – req. connection points	2	2

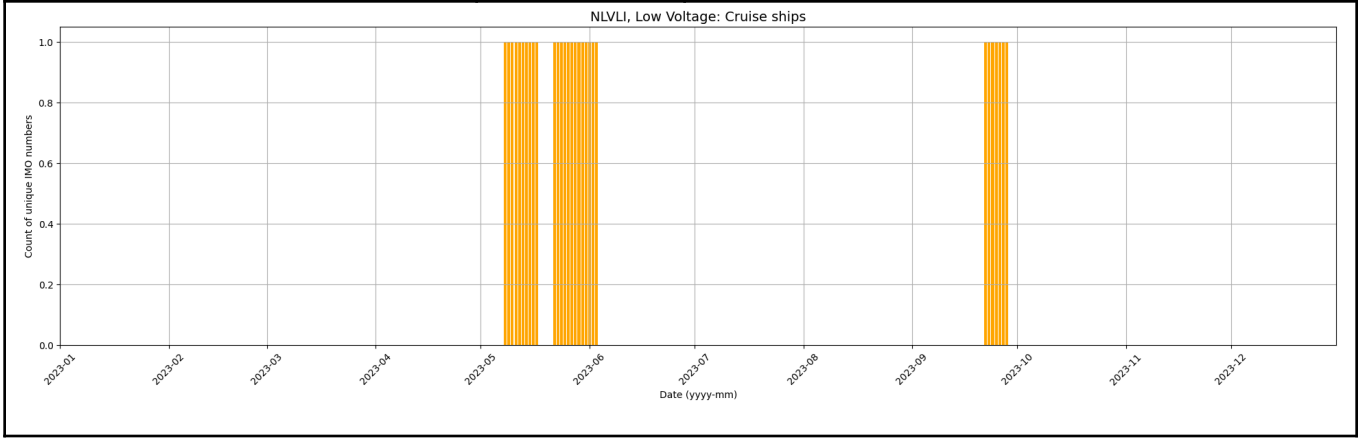




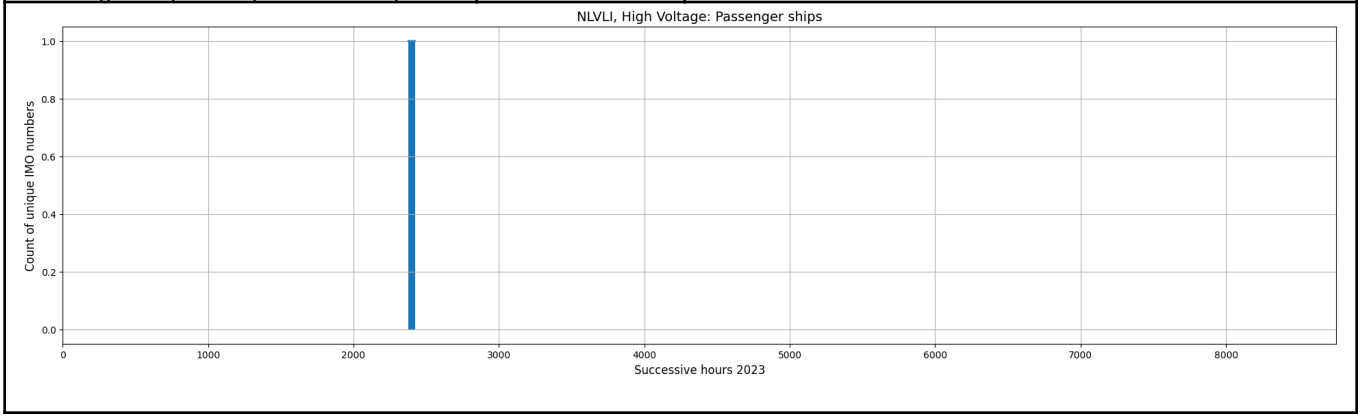




Vlissingen	Low Voltage	High Voltage
Cruise ships – required connection points	0	0



Vlissingen	Low Voltage	High Voltage
Passenger ships – req. connection points	0	0



6.30.2 Current status and plans for onshore power supply

In the port of Vlissingen, there is one OPS cabinet installed at the dry dock, which is not counted in this analysis, since it cannot be used by ships in normal operation. There are also three OPS cabinets with a capacity of 1.25 MW each installed at the offshore terminal (Table 6-110).

Capacity in the local electricity grid

According to the port, only 1.75 MW is available from the grid, while demand for OPS has been estimated to be in the range 8-14 MW. The port has ambitions to scale up the grid connection when possible.

Table 6-110 Installed OPS in the port of Vlissingen.

Max. power from grid [MW]	Max. no. of simultaneous ships	Types of ships	Max. system power capacity [kW]	System voltage	Standard
-	1	All types (dry dock)	1 600	400-690 V	IEC 80005-3
1.75	3	Other service offshore	3 750	400-690 V	IEC 80005-3

6.31 Port of Zeebrugge, Belgium

Zeebrugge is organized together with Antwerp as Port of Antwerp-Bruges, but the results presented here relate to the port with UN/LOCODE BEZEE (Figure 6-31).

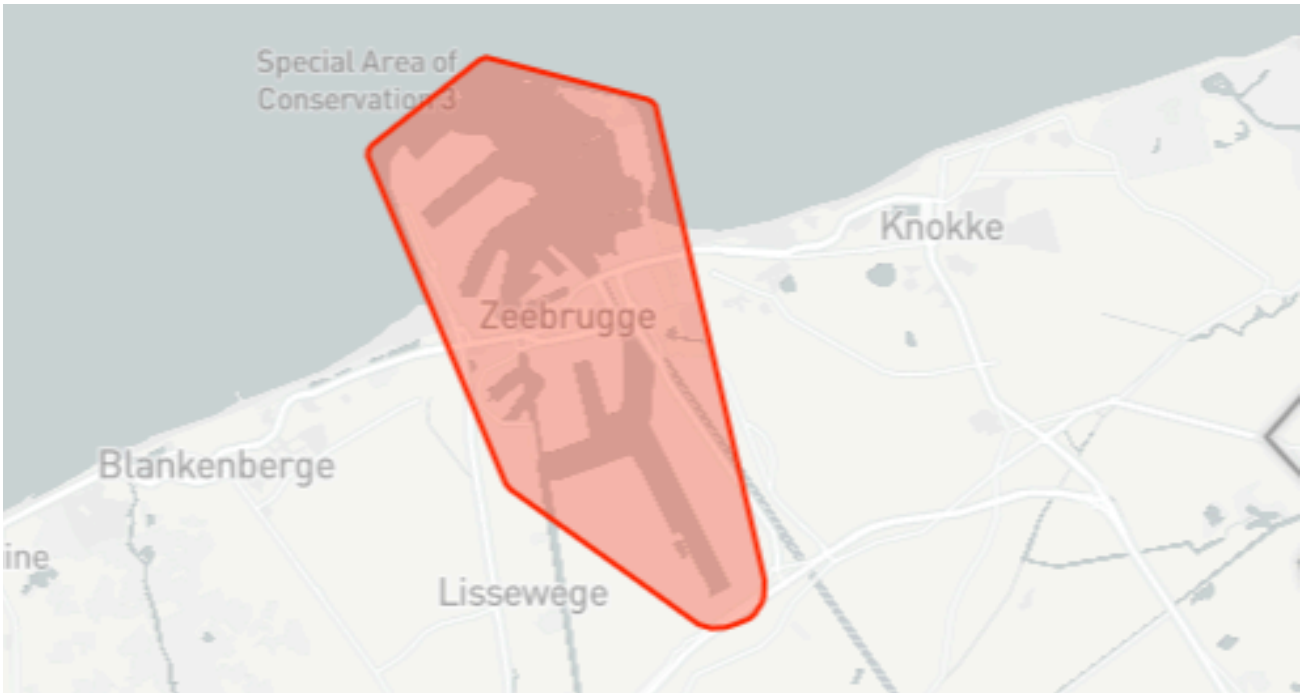


Figure 6-31 Port shape for Zeebrugge (BEZEE).

6.31.1 Current ship activity and energy requirements

Table 6-111 shows the effective hours in port per ship segment and size category for the port of Zeebrugge in 2023. There are nearly 7000 effective hours in port for container ships larger than 5000 GT. For cruise ships larger than 5000 GT there are around 1700 effective hours in port, and for passenger ships larger than 5000 GT there are only about 100 effective hours in port. Other segments with a high number of effective hours in the port are other activities and Ro-Ro cargo ships.

Table 6-111 Effective hours in port per ship segment and size category.

Zeebrugge	400-999 GT	1000 - 4999 GT	5000 - 9999 GT	10000 - 24999 GT	25000 - 49999 GT	50000 - 99999 GT	100000 GT <	Total
Bulk carriers			17		104	186		307
Chemical tankers	21	12 867	1 850	252	792			15 782
Container ships			2 405	1 514	869	60	2 108	6 956
Crude oil tankers								0
Cruise ships		5	53	37	255	312	1 048	1 710
Fishing ships	311							311
Gas tankers		949	5 174	962	1 161	578	4 563	13 387
General cargo ships	1	8 847	39	207	868			9 962
Offshore supply ships								0
Oil product tankers	3 665	6 310			14			9 989
Other activities	43 439	5 202	1 717	104				50 462
Other service offshore ships		440	2 273	795			22	3 530
Passenger ships		12		11	26	66		115
Refrigerated cargo ships			44	167				211
Ro-Ro cargo ships		3 718	2 467	17 246	24 117	39 572		87 120
Total	47 437	38 350	16 039	21 295	28 206	40 774	7 741	199 842

Table 6-112 shows the estimated energy consumption per ship segment and power category for the port of Zeebrugge in 2023. Most of the estimated energy consumption is in the power category 1-5 MW for container ships, > 10 MW for cruise ships, and 5-10 MW for passenger ships. However, the main contributors to the total estimated energy consumption are gas tankers and Ro-Ro cargo ships, with 75% of the total energy consumption in port.

Table 6-112 Estimated energy consumption in port (MWh) per ship segment and power category.

Zeebrugge	<100 kW	100-500 kW	500-1000 kW	1-5 MW	5-10 MW	>10 MW	Total
Bulk carriers	0	44	98	0	0	0	142
Chemical tankers	0	0	1 473	1 300	0	0	2 772
Container ships	0	1 195	1 073	8 521	0	0	10 790
Crude oil tankers	0	0	0	0	0	0	0
Cruise ships	0	2	49	1 119	2 252	10 490	13 913
Fishing vessels	20	0	0	0	0	0	20
Gas tankers	0	362	0	10 701	24 334	0	35 397
General cargo ships	876	89	542	0	0	0	1 507
Offshore supply ships	0	0	0	0	0	0	0
Oil product tankers	205	1 521	14	0	0	0	1 740
Other activities	1 824	1 353	975	0	0	0	4 152
Other service offshore vessels	0	955	498	23	0	0	1 475
Passenger ships	0	4	0	112	416	0	532

Refrigerated cargo ships	0	21	136	0	0	0	157
Ro-Ro cargo ships	0	1 311	29 876	39 651	0	0	70 838
Total	2 925	6 857	34 732	61 427	27 002	10 490	143 434

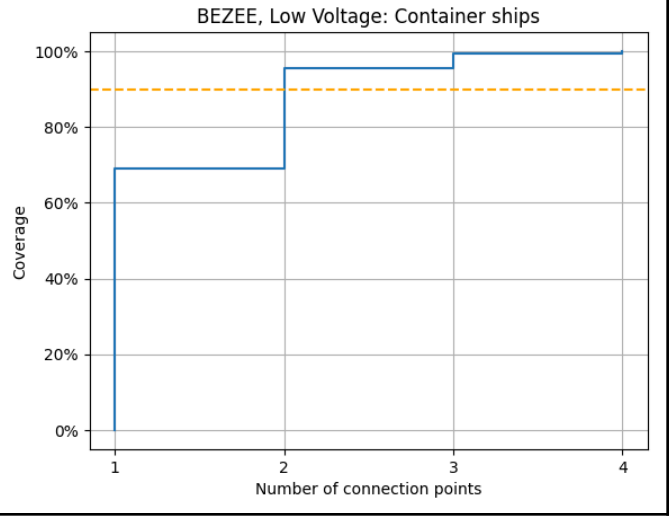
Table 6-113 presents simultaneous port calls for quantification of the need for low and high voltage connection points for container, cruise, and passenger ships above 5000 GT. There were some days in 2023 with 4 **container ships** requiring low or high voltage connection points in the port, but 2 connection points of each type would be sufficient for 90% coverage.

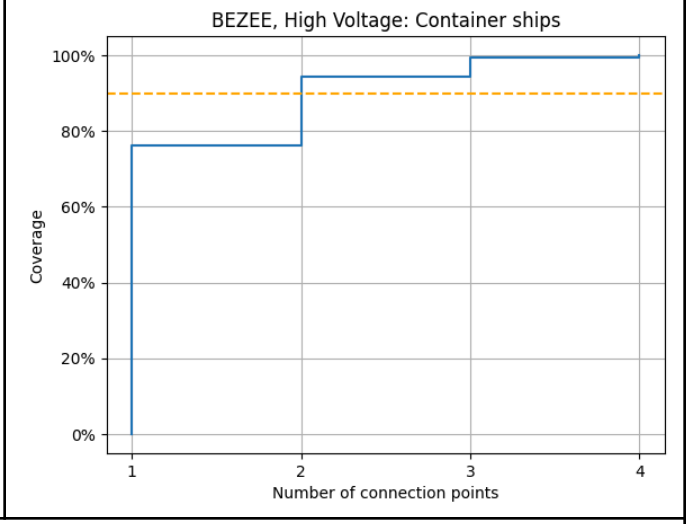
For 90% coverage, there is an estimated need for one low voltage connection point for **cruise ships**, although there were just a few days with such traffic in the port in 2023. There were some days with a need for 3 high voltage connection points for cruise ships, but 2 such connection points would be sufficient for 90% coverage.

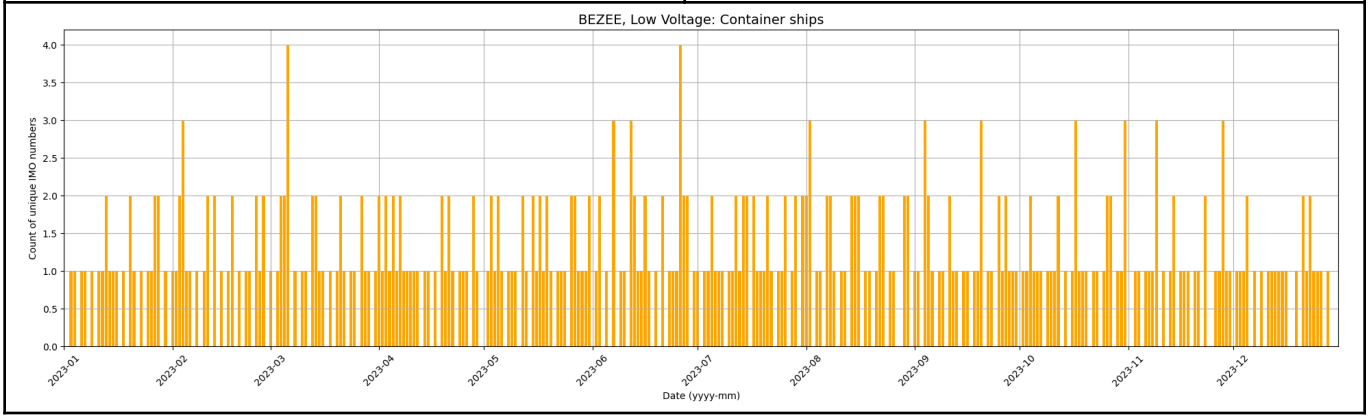
Since there were less than 40 port calls from **passenger ships** in 2023, it is assumed that there is no need for connection points for this segment in the port of Zeebrugge. In total, there is an estimated need for 4 connection points for container ships and 3 connection points for cruise ships.

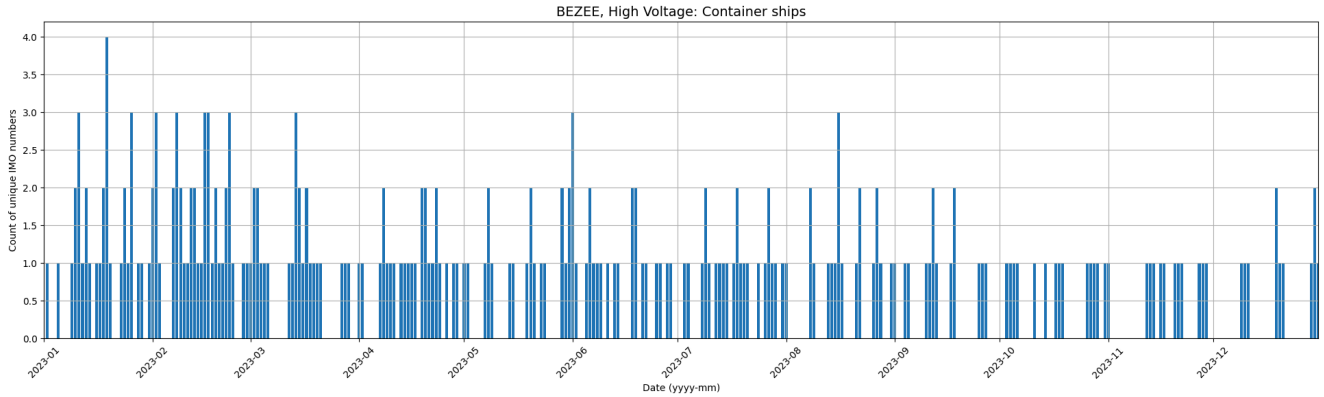
Table 6-113 Number of container and cruise ships at any day and passenger ships at any hour in 2023, and the estimated number of required connection points – split on low and high voltage.

Zeebrugge	Low Voltage	High Voltage
Container ships – req. connection points	2	2

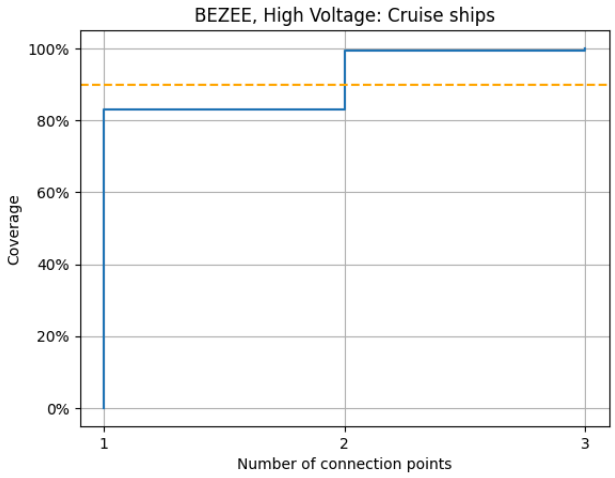


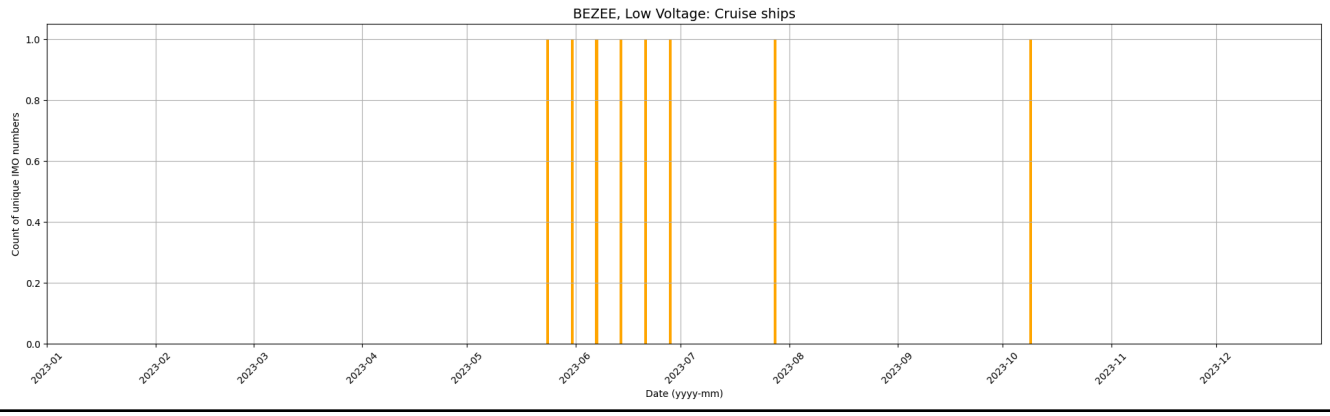


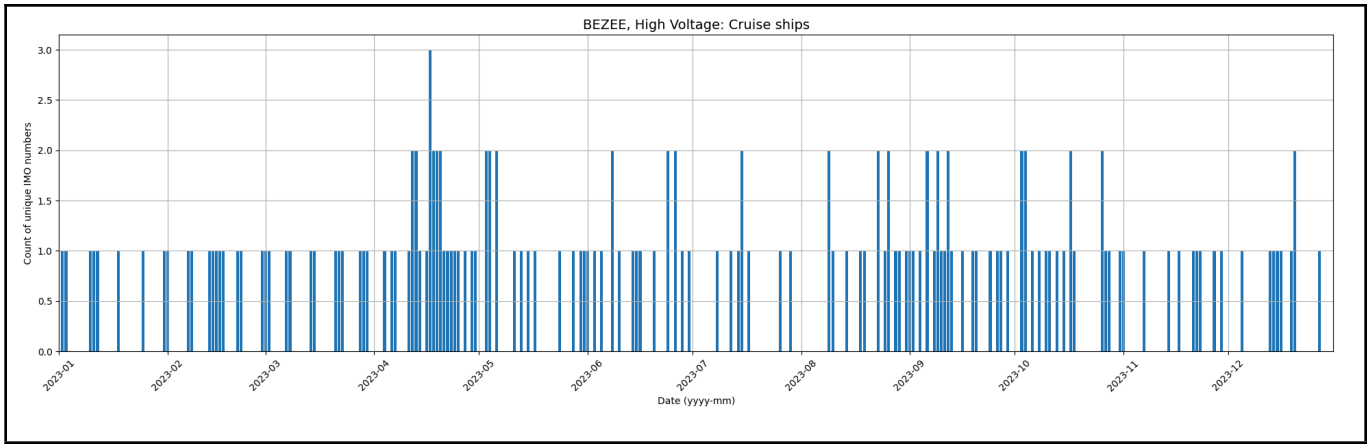




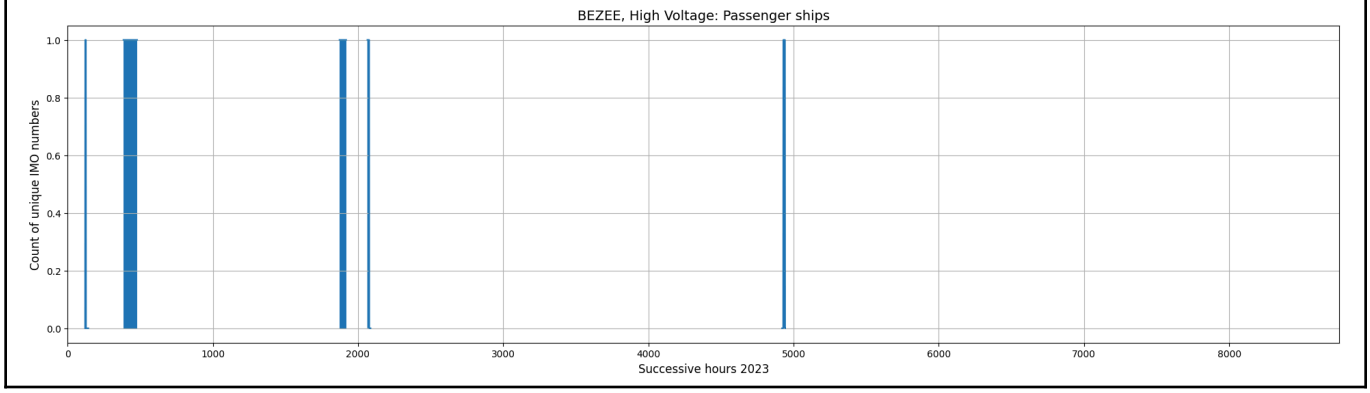
Zeebrugge	Low Voltage	High Voltage
Cruise ships – required connection points	1	2







Zeebrugge	Low Voltage	High Voltage
Passenger ships – req. connection points	0	0



6.31.2 Current status and plans for onshore power supply

In the port of Zeebrugge, there are currently no OPS systems in operation. There are no contracts signed for OPS either, but a tender is running for one connection point for cruise ships by 2026. The port is also planning one extra cable management system for a second cruise berth.

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transformations facing its customers and the world today and is a trusted voice for many of the world's most successful and forward-thinking companies.