DECARBONIZING THE EU INLAND WATERWAY CRUISE SECTOR

IMPLEMENTING THE ALTERNATIVE FUELS INFRASTRUCTURE REGULATION (AFIR)

APPLIED RESEARCH PROJECT REPORT

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Abstract

This project aims to evaluate the compliance of EU (European Union) inland waterway ports with the Alternative Fuels Infrastructure Regulation (AFIR) concerning the deployment of Onshore Power Supply (OPS) infrastructures for river cruise vessels at berth, by categorising them according to the development stages of these facilities (planned, funded or implemented). Through extensive online searches and direct contact with various European port authorities, the project tried to assess the progress of EU inland waterway ports in contributing to the achievement of climate neutrality by 2050. Indeed, the implementation of OPS represents a major accomplishment in terms of decarbonisation for river cruise vessels while mooring, as it consists of alternative fuel recharging points that promote the sustainability of the EU multimodal transport network. Consequently, the study provides critical insights into the readiness of the inland waterway ports in the EU to transition towards OPS, which is a low-emission technology, while also stressing where investments still need to be strategically targeted. Although our findings require constant updates to reflect the actual situations of these ports, the data has the potential to guide policy-makers and stakeholders in directing their investments to decarbonise the river cruise vessels at berths, thus aligning with the EU climate leadership aspirations and its policy instruments.

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Introduction

River cruise vessels are relatively green transportation means compared to cars, planes, and larger seagoing ships, as they are more compact and carry fewer passengers on board, which results in a reduction in their engine size[1]. Nevertheless, river cruise ships operate on smaller inland waterways and, therefore, they dramatically impact the environmental preservation of coastal areas and surrounding regions, as well as the health of local communities, due to their emissions of hazardous greenhouse gas (GHG)[2] and air pollutants[3]. The GHGs, including carbon dioxide (CO2) and methane (CH4), contribute to the dangerous issue of climate change, whereas the local pollutants such as nitrogen oxides (NOx) and particulate matter (PM) have direct toxic effects on both human health and air quality[4]. While inland waterway vessels, including river cruise ships, release relatively few GHG emissions into the atmosphere, they can emit high quantities of air pollutants compared to railways and trucks along inland waterways and nearby river ports[5]. Since these ports are located in or close to cities, the local pollutants emitted by inland waterway ships strongly affect the air quality of populated areas, thereby resulting in health issues[6]. For these reasons, it is crucial to significantly cut both the GHG and local pollutants emissions released by the river cruise vessels through the use of new low-emission innovations, so that cruises can become more environmentally friendly and align with the energy transition and sustainable development[7]. In this context, Onshore Power Supply (OPS) represents an increasingly widespread and clean technology that enables river cruise vessels to reduce GHG emissions and air pollution when berthed at inland waterway

Figure 1: OPS facility for river cruise ships. Photograph by project team members, 2024. Basel, Switzerland.

[1] Emma Smith, 'Eco-Friendly River Cruises | River Cruise Advice | River Voyages', *Stay up to Date with River Cruise News at RiverVoyages.Com* (blog), 14 January 2014, https://www.rivervoyages.com/news/eco-friendly-river-cruises/.
[2] Emma Smith.
[3] Emilia Kuciaba, 'EMISSION FROM INLAND WATERWAY TRANSPORT IN THE CONTEXT OF ENERGY, CLIMATE AND TRANSPORT POLICY OF THE EUROPEAN UNION' (Uniwersytet Szczeciński, 2018), DOI: 10.18276/ptl.2018.43-06.
[4] Kuciaba.
[5] Kuciaba.
[6] European Commission, 'CLINSH - CLean INland SHipping', 2023, https://webgate.ec.europa.eu/life/publicWebsite/project/LIFE15-ENV-NL-000217/clean-inland-shipping.
[7] Emma Smith, 'Eco-Friendly River Cruises | River Cruise Advice | River Voyages'.

ports (Figure 1)[8]. River cruise ships, instead of using diesel generators, connect to the local power grids through OPS facilities, whose electricity, if sourced from renewable energy sources, can significantly lower GHG emissions to zero, as well as drastically reduce air and noise pollution levels[9]. Consequently, these benefits positively impact the environment and the health of the people living in port areas and surrounding regions[10]. In other words, this low-emission shore side electricity technology results in more sustainable inland waterway transportation, and enhances the economic attractiveness of the area as well, especially in the urban and environmentally vulnerable localities[11].

This research project aims to map out the EU inland waterway ports, by assessing the development stage of OPS facilities for river cruise ships while at berth, as illustrated by Figure 2. It involves categorising these ports based on their planning, funding, or implementation stages of OPS infrastructures, and comparing them against key EU legislation requirements, particularly the Alternative Fuel Infrastructure Regulation (AFIR) and the Trans-European Transport Network (TEN-T) policies. This project also examines the local funding invested in this low-carbon technology for river cruise vessels by the top three OPS-implementing countries in the EU. Additionally, the study seeks to evaluate what investments are needed to advance OPS facilities for river cruise ships in the EU in the future, so that the inland waterways cruise sector can further reduce its GHG and air pollutants emissions released by the passenger ships while mooring. The project is significant as it aims to create a first comprehensive database on the OPS facilities' development status for river cruise vessels in the EU inland waterway ports, clearly indicating in which ports OPS facilities are lacking or where there might be insufficient power connection points for all the possible river cruise vessels that can dock at the port. The final result is an interactive map accompanied by some descriptive statistics employed to visualise the information gathered on OPS infrastructures within the EU inland waterway ports. Ideally, the dataset and the resulting interactive map will have to be continuously updated, so that policy-makers and stakeholders are provided with the real-time framework of the deployment of OPS technology within the EU inland waterway ports, which serve as a baseline for targeting their investments, by prioritising the ports with the greatest need.

In order to assess the state of development of OPS facilities in the EU inland waterway ports, it is necessary to analyse the context in which this low-carbon alternative fuel or technology to decarbonise river cruise vessels while berthing is implemented. The first part of the literature review will focus on the pressing issues of air pollution and global warming, which have prompted the EU to strive for a leadership role in combating climate change at the international

[8] European Commission, 'Ports and Infrastructure | European Alternative Fuels Observatory', n.d., https://alternative-fuels-observatory.ec.europa.eu/transport-mode/inland-waterways/ports-and-infrastructure.
[9] European Commission.
[10] European Commission.
[11] European Commission.

level. Subsequently, the climate policy tools adopted by the EU will be analysed in order to understand what their requirements are in terms of OPS implementation, as well as other local and national policies. Moreover, some key countries where OPS facilities are mandated under EU legislation will be specifically considered, and the benefits of OPS in terms of environment, climate and human health will also be explored. Afterwards, the research questions on which this applied research project is based will be formulated, and some pre-existing studies will be discussed. Lastly, the definitions of “inland waterways port” and “cruise ships” will be provided in order to precisely define the scope of this research project, as well as the difference between “EU investments” and “local fundings”. As for the methodology, it will be comprehensively explained, in order to understand the mixed research design, geographical scope, and the various steps and strategies of the data collection process. This section will also provide significant information on the variables of interest necessary to answer our research questions. Next, the analysis will focus on the presentation of the data that has been gathered on OPS infrastructures in the EU inland waterway ports, and it will also be interpreted by understanding its implications relative to our research questions. In addition, this paper will discuss the limitations or constraints of the information collected, highlighting opportunities for further research. Finally, the conclusion will recapitulate the main aspects of this study, along with the key steps taken and the major findings, aiming to provide comprehensive answers to the research questions initially formulated.

Figure 2: Shore-side eco-power for river cruise ships in Bamberg. Photograph, 2023. Bayernhafen, Barmberg, Germany.

Literature Review

Addressing Climate Change and Air Pollution: EU Leadership Aspiration

Human activities, including the burning of fossil fuels, land use changes, deforestation and industrial processes, have led to significant increases in the anthropogenic emissions of greenhouse gases (GHGs), precursors, and aerosols in the atmosphere, which are driven by the growing needs of evolving societies and have profound negative implications for our societies and planet[12]. The GHGs include carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), and ozone (O3), which are primarily responsible for trapping solar radiations and heat in the atmosphere, intensifying the greenhouse effect and exacerbating global warming[13]. The latter contributes to climate change, which refers to persistent shifts in the mean and/or variability of climate properties occurring over decades, which are also caused by external factors, including human-driven changes in the atmospheric composition[14]. Indeed, climate change results in severe consequences including extreme weather events, wildfires, scarcity of water resources, reduced food production[15], rising sea levels, melting polar ice, and declining biodiversity[16]. As for the precursors, they are atmospheric compounds like nitrogen dioxide (NO2) and sulphur dioxide (SO2)[17] that react in the air and influence the concentrations of GHGs and aerosols, which represent tiny particles that can stay in the atmosphere for several hours[18]. These particles can be either particulate matter (PM) or other gases created through chemical reactions involving precursors, such as sulphates and nitrates[19]. Both precursors and aerosols are responsible air pollution, which implies a degradation of air quality levels that negatively impact human health and ecosystem preservation[20]. Consequently, climate change and air pollution represent two hazardous environmental issues caused by human activities that dramatically impact our planet and human societies[21]. Moreover, they are closely interconnected, as most economic sectors, notably transportation, cause emissions of gaseous and particulate pollutants leading to both local air pollution and global GHG emissions[22]. Specifically, cruise vessels emit different air pollutants and GHGs because of the composition

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[12] Intergovernmental Panel on Climate Change (IPCC), ‘Glossary - Global Warming of 1.5°C’, 2018, https://www.ipcc.ch/sr15/chapter/glossary/.
[13] Intergovernmental Panel on Climate Change (IPCC).
[14] Intergovernmental Panel on Climate Change (IPCC).
[15] Sophie Berger et al., ‘FAQ Frequently Asked Questions - IPCC’, n.d.
[16] United Nations, ‘What Is Climate Change?’, United Nations (United Nations, n.d.), https://www.un.org/en/climatechange/what-is-climate-change.
[17] Global Climate Observing System (GCOS), ‘Precursors for Aerosols and Ozone’, n.d., https://gcos.wmo.int/en/essential-climate-variables/precursors.
[18] Intergovernmental Panel on Climate Change (IPCC), ‘Glossary - Global Warming of 1.5°C’.
[19] Intergovernmental Panel on Climate Change (IPCC).
[20] Intergovernmental Panel on Climate Change (IPCC).
[21] Berger et al., ‘FAQ Frequently Asked Questions - IPCC’.
[22] Berger et al.

of the fuel used and the combustion process of their engines[23]. The harmful pollutants released in the atmosphere include sulphur oxides (SOx), nitrogen oxides (NOx), and fine particulate matter (PM2.5) consisting of fine dust, soot and smoke, which can cause cardiovascular and respiratory diseases, premature deaths, ground-level ozone, as well as acidification of rains[24]. Additionally, GHGs like carbon dioxide (CO2) and methane (CH4) are emitted by cruise ships due to the combustion or leakage of fuel, which aggravate global warming[25]. Solutions such as the implementation of zero-emissions technological innovations for vehicles – like OPS – result in a win-win situation where air quality is enhanced and climate change is addressed at the same time[26].

According to the World Health Organisation (WHO), more than four million people die from outdoor air pollution each year around the world as of 2016, which underscores the urgent need to tackle the emissions of these harmful gaseous and particulate pollutants[27]. Furthermore, in accordance with the 2015 Paris Agreement, it is imperative to keep the increase in the global average temperature to well below 2°C above pre-industrial levels and strive as much as possible to stay below 1.5°C[28] in order to avoid the detrimental impacts and risks of climate change that would jeopardise a liveable future on the planet for our societies and ecosystems[29]. However, global warming due to GHGs emissions from human activities have already led to a global surface temperature increase equal to around 1.1°C above 1850-1900 levels in the period 2011-2020, with an overall increase since 1970 that is larger than any other 50-year period over the last 2000 years[30]. In addition, the full implementation of unconditional Nationally Determined Contributions (NDCs) by countries under the Paris Agreement are not sufficiently ambitious, as they would lead to a temperature increase of around 3°C above pre-industrial levels by 2100[31]. These figures, together with the current global surface temperature increase, clearly indicate that the world is not on track to meet the goals of the Paris Agreement. Consequently, countries must react quickly and in a more significant way, by implementing substantial reductions of their GHG emissions in the different polluting sectors, in order to

[23] Constance Dijkstra and Valentin Simon, 'The Return of the Cruise' (Transport & Environment, June 2023), https://www.transportenvironment.org/uploads/files/The-return-of-the-cruise-June-2023.pdf.
[24] Dijkstra and Simon.
[25] Dijkstra and Simon.
[26] Berger et al., 'FAQ Frequently Asked Questions - IPCC'.
[27] Berger et al.
[28] Intergovernmental Panel on Climate Change (IPCC), 'Glossary - Global Warming of 1.5°C'.
[29] United Nations, 'What Is Climate Change?'
[30] Katherine Calvin et al., 'IPCC, 2023: Climate Change 2023: Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, H. Lee and J. Romero (Eds.)]. IPCC, Geneva, Switzerland.', First (Intergovernmental Panel on Climate Change (IPCC), 25 July 2023), https://doi.org/10.59327/IPCC/AR6-9789291691647.
[31] U. N. Environment, 'Emissions Gap Report 2023', UNEP - UN Environment Programme, November 2023, http://www.unep.org/resources/emissions-gap-report-2023.

halve them by 2030 and achieve net-zero by 2050, which is the only way to meet the Paris Agreement targets[32].

Upon analysing the annual total GHG emissions by sector at the global level in 2020, it becomes evident that the transport industry represents the second-largest emitting sector after electricity and heat[33]. More specifically, if we focus on the maritime sector, global shipping emissions resulted in 1076 million tonnes of CO2 in 2018, accounting for nearly 3% of total global emissions[34]. At the European Union (EU) level, the maritime transport sector, which is an essential component of its economic sphere, was responsible for between 3% and 4% of its total CO2 emissions, corresponding to approximately 124 million tonnes in 2021[35] and roughly 135 million tonnes in 2022[36]. Breaking down the types of ships responsible for these emissions, cargo ships accounted for the majority of emissions, while seagoing cruise vessels released far fewer emissions, about 7 million tonnes of CO2, or about 5% of EU shipping emissions in 2022[37]. Furthermore, the EU inland waterway transport sector accounts for approximately 3.8 million tonnes of CO2 emissions yearly, including those of inland waterway cruise ships[38]. Despite its significant contributions to tourism and local economies[39], the cruise industry also contributes to air pollution and GHG emissions in port and coastal regions[40]. Committed to a robust climate strategy, the EU aims to mitigate emissions across all various polluting sectors. Although the river cruise sector is smaller, its decarbonization is essential, as every effort in this area is vital for climate change mitigation, potentially even serving as a blueprint for other industries. Highlighted at the 2023 United Nations Climate Change Conference (COP28), a landmark call to transition from fossil fuels[41] emphasises the importance of initiatives, even small ones, in shaping the global response to climate change.

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32 United Nations, 'Net Zero Coalition', United Nations (United Nations, n.d.), https://www.un.org/en/climatechange/net-zero-coalition.
33 Hannah Ritchie, Pablo Rosado, and Max Roser, 'Emissions by Sector', *Our World in Data*, 14 November 2023, https://ourworldindata.org/emissions-by-sector.
34 European Commission, 'Reducing Emissions from the Shipping Sector', European Commission, n.d., https://climate.ec.europa.eu/eu-action/transport/reducing-emissions-shipping-sector_en.
35 European Commission.
36 'Shipping Emissions: Latest Data', Transport & Environment, accessed 2 December 2023, https://www.transportenvironment.org/challenges/ships/european-shipping-emissions-2022/.
37 'Shipping Emissions'.
38 Waterborne, 'STRATEGIC RESEARCH AND INNOVATION AGENDA FOR THE PARTNERSHIP ON ZERO-EMISSION WATERBORNE TRANSPORT', 2021, https://www.waterborne.eu/images/210601_SRIA_Zero_Emission_Waterborne_Transport_1.2_final_web_low.pdf.
39 CLIA Europe, 'The Importance of Cruise to the Economy', CLIA Europe, n.d, https://europe.cruising.org/the-importance-of-cruise-to-the-economy/#:~:text=The%20cruise%20industry%20creates%20jobs,fell%20by%2059%25%20in%202020.
40 European Commission, 'Ports and Infrastructure | European Alternative Fuels Observatory'.
41 'COP28 Agreement Signals "Beginning of the End" of the Fossil Fuel Era | UNFCCC', 2023, https://unfccc.int/news/cop28-agreement-signals-beginning-of-the-end-of-the-fossil-fuel-era?gad_source=1&gclid=CjwKCAjw1K-zBhBIEiwAWeCOFwv16rNFqwYAjLHPqM6yAhFpP1mnxDhcOOnIvUjSF8Ve3EQHxF2b0RoCqwEQAvD_BwE.

The EU has reacted to the critical challenge of climate change and its hazardous consequences by striving to position itself as a global leader in the fight against this detrimental phenomenon[42]. To become the predominant international green actor, all three different types of leadership are needed: structural leadership focused on the ability to exercise power or actions that generate incentives, as well as costs and benefits for other actors; directional leadership, which involves making the first move by acting unilaterally and guiding other actors; and idea-based leadership, characterised by the promotion of specific policy tools to tackle collective problems such as climate change[43]. By examining the EU in detail, there is little doubt that it displays all these modes of leadership, as it has created economic, technological, and diplomatic incentives to encourage other international actors to participate in addressing climate change, served as an example for other countries by adopting binding regulations to reduce its GHG emissions, and proposed its own policy solutions to tackle climate change[44]. However, though it has set its agenda as a global leader in combating climate change, the performance issues of Member States, as well as internal conflicts among them concerning the EU's climate policy tools undermine its credibility and, consequently, its aspiration to establish itself as a global climate front-runner[45]. Therefore, the EU needs to enhance the poor compliance of its Member States with their climate obligations and encourage increased collaboration between them in order to really establish itself as a powerful global leader in the fight against climate change[46].

The EU Climate Policy Instruments

Within this framework of struggle to establish itself as a climate leader, the EU has adopted different policy instruments by which to curb its GHG emissions and also improve air quality in specific contexts. These efforts align with the Paris Agreement's objectives and address the urgent challenge of climate change, as well as its detrimental impacts on our societies and ecosystems.

First of all, the European Commission launched the EU Green Deal in 2019, which is a package of policy initiatives whose aim is to achieve climate neutrality by 2050 through the promotion of a green transition[47]. The EU strategy consists of a cross-sectoral approach embracing climate, environment, transport, energy, industry, sustainable finance, and agriculture[48].

[42] Charles F. Parker and Christer Karlsson, 'Climate Change and the European Union's Leadership Moment: An Inconvenient Truth?', *JCMS: Journal of Common Market Studies* 48, no. 4 (2010): 923–43, https://doi.org/10.1111/j.1468-5965.2010.02080.x.
[43] Parker and Karlsson.
[44] Parker and Karlsson.
[45] Parker and Karlsson.
[46] Parker and Karlsson.
[47] European Council, 'European Green Deal', 10 November 2023, https://www.consilium.europa.eu/en/policies/green-deal/.
[48] European Council.

Among the initiatives included within the EU Green Deal is the European climate law, which is a legally binding regulation through which EU member states commit to reducing their net GHG emissions by at least 55% compared to 1990 levels by 2030[49]. Moreover, the EU Green Deal encompasses the Fit for 55 initiative, another package of proposals initiated by the Commission in 2021 that aims to implement the Green Deal through the revision of EU legislation and the introduction of new legislative initiatives concerning the climate, energy and transport industries[50]. The Fit for 55 initiative serves as a policy instrument to put into practice concrete measures to help EU member states cut their GHG emissions by at least 55% by 2030 and achieve climate neutrality by 2050[51]. Within the Fit for 55 initiative, the EU emissions trading system (ETS) is one of the largest carbon markets in the world and represents the EU's strategy to significantly reduce its GHG emissions, whose reform was adopted by the Council in April 2023[52]. This policy tool consists of putting a price on carbon, which means that economic actors within the ETS have to buy allowances according to the amount of their emissions, which, however, decrease every year, thereby incentivising entities to reduce their emissions[53]. The EU renewable energy directive (RED) constitutes another measure within the Fit for 55 initiative, whose purpose is to boost the share of renewable energy by 2030[54]. In October 2023, the Council adopted the reform to increase the amount of energy from renewable sources from 32% to 42.5% by 2030[55]. Furthermore, the energy taxation directive (ETD), part of the Fit for 55 package, aims to tax the most polluting fuels more heavily in order to promote the transition to a cleaner energy sector and industry[56]. However, the revision of this directive on the taxation of energy products according to their environmental footprint is still under discussion in the Council since 2022[57]. Another proposal within the Fit for 55 package is the FuelEU maritime initiative (FEUM) adopted by the Council in July 2023[58]. This policy promotes the increased use of renewable or low-carbon fuels in maritime transport[59]. It forces seagoing vessels above 5000 gross tonnes to progressively decrease the GHG emissions from

49 European Council.
50 European Council.
51 European Council and Council of the European Union, 'Fit for 55: How the EU Will Turn Climate Goals into Law', 3 May 2023, https://www.consilium.europa.eu/en/infographics/fit-for-55-how-the-eu-will-turn-climate-goals-into-law/.
52 European Council and Council of the European Union, 'Fit for 55: Reform of the EU Emissions Trading System', 15 May 2023, https://www.consilium.europa.eu/en/infographics/fit-for-55-eu-emissions-trading-system/.
53 European Council and Council of the European Union.
54 European Council and Council of the European Union, 'Fit for 55: How the EU Plans to Boost Renewable Energy', 11 October 2023, https://www.consilium.europa.eu/en/infographics/fit-for-55-how-the-eu-plans-to-boost-renewable-energy/.
55 European Council and Council of the European Union.
56 European Council and Council of the European Union, 'Fit for 55: How the EU Plans to Revise Energy Taxation', 11 October 2023, https://www.consilium.europa.eu/en/infographics/fit-for-55-energy-taxation/.
57 European Council and Council of the European Union.
58 European Council and Council of the European Union, 'Fit for 55: Increasing the Uptake of Greener Fuels in the Aviation and Maritime Sectors', 27 January 2024, https://www.consilium.europa.eu/en/infographics/fit-for-55-refueleu-and-fueleu/.
59 European Council and Council of the European Union.

energy consumption on board by up to 80% by 2050 and to connect to OPS while berthing at the main EU seaports as of 2030[60]. Therefore, the FEUM doesn't cover the inland waterway vessels, namely the river passenger, cruise and cargo ships, berthed in EU riverports.

The policy initiative relevant to this research project within the Fit for 55 package is the alternative fuels infrastructure regulation (AFIR), adopted by the Council in July 2023[61]. This regulation aims to increase the deployment of alternative fuel (re)charging and (re)fuelling points for ships, cars, trucks, and planes across the EU in the years to come, so as to contribute to the achievement of climate neutrality by 2050[62]. The alternative fuel (re)charging points for vessels replacing fossil fuels include electricity, namely the OPS facilities, for both seagoing and inland waterway ships when moored at the quayside[63]. Indeed, shore-side electricity supply reduces the negative impacts of these ships on the environment, climate and human health, especially by improving air quality of city areas around ports[64]. As for seagoing passenger and container ships, they have to be given access to OPS in the busiest seaports for at least 90 % of the total number of port calls[65]. Article 9 of the AFIR calls for Member States to ensure that seagoing container and passenger ships, including cruises, get access to a minimum OPS in all TEN-T Core and TEN-T Comprehensive maritime ports by the end of 2029[66]. However, of more interest to this project, is that inland waterway passenger and container ships also have to be granted access to at least one installation providing OPS in the majority of the river ports[67]. Indeed, Article 10 requires Member States to install at least one OPS infrastructure for inland waterway vessels, i.e. passenger ships, including cruises, and container ships, at all TEN-T Core inland waterway ports by the end of 2024, as well as at all TEN-T Comprehensive inland waterway ports by the end of 2029 (Figure 3)[68]. To clarify, the TEN-T Comprehensive network, which has to be fully developed by 2050, represents an extensive European transport network that guarantees connectivity to the EU's remote, insular, and outermost regions, with

60 Council of the European Union, 'FuelEU Maritime Initiative: Council Adopts New Law to Decarbonise the Maritime Sector', 25 July 2023, https://www.consilium.europa.eu/en/press/press-releases/2023/07/25/fueleu-maritime-initiative-council-adopts-new-law-to-decarbonise-the-maritime-sector/.
61 European Council and Council of the European Union, 'Fit for 55: Towards More Sustainable Transport', 26 July 2023, https://www.consilium.europa.eu/en/infographics/fit-for-55-afir-alternative-fuels-infrastructure-regulation/.
62 European Council and Council of the European Union.
63 THE EUROPEAN PARLIAMENT and THE COUNCIL, *REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on the Deployment of Alternative Fuels Infrastructure, and Repealing Directive 2014/94/EU*, 2023, https://data.consilium.europa.eu/doc/document/PE-25-2023-INIT/en/pdf.
64 THE EUROPEAN PARLIAMENT and THE COUNCIL.
65 European Council and Council of the European Union, 'Fit for 55: Towards More Sustainable Transport'.
66 THE EUROPEAN PARLIAMENT and THE COUNCIL, *REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on the Deployment of Alternative Fuels Infrastructure, and Repealing Directive 2014/94/EU*.
67 'Fit for 55: Towards More Sustainable Transport'.
68 THE EUROPEAN PARLIAMENT and THE COUNCIL, *REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on the Deployment of Alternative Fuels Infrastructure, and Repealing Directive 2014/94/EU*.

the aim of enhancing economic and social links between them[69]. On the other hand, the TEN-T Core network is defined as the backbone of the European multimodal and sustainable transport network, since it includes the most critical nodes and connections with the highest European added value for the regional transports[70]. Moreover, the latter, which is targeted for completion by 2030, is instrumental in achieving the goal of reducing greenhouse gas (GHG) emissions caused by transport by 60% compared to 1990 levels by 2050[71].

Article 10

Targets for shore-side electricity supply in inland waterway ports

Member States shall ensure that:

(a) at least one installation providing shore-side electricity supply to inland waterway vessels is deployed at all TEN-T core inland waterway ports by 31 December 2024;

(b) at least one installation providing shore-side electricity supply to inland waterway vessels is deployed at all TEN-T comprehensive inland waterway ports by 31 December 2029.

Figure 3: Alternative Fuels Infrastructure Regulation (AFIR), article 10. Document excerpt, the European Parliament and the Council, 2023.

TENT-T, the EU's policy for the trans-European transport network, encompasses a system of railways, inland waterway, short sea shipping routes, and roads connecting maritime and inland ports, airports, and terminals[72]. The last framework for the TEN-T policy was established in 2013, under Regulation (EU) No 1315/2013[73]. The policy aimed to enhance efficient movement of people and goods, ensuring widespread access to services and facilitating the expansion of trade[74]. It sought to bolster the economic and territorial integration of the EU and to establish interconnected transport systems that are smooth and continuous across national boundaries, eliminating any physical gaps, bottlenecks, or missing links.[75] It was envisioned to function as Europe's main multimodal transport network and serves as a pivotal hub for commercial trade[76].

The TEN-T policy is currently being revised to make the network greener, more efficient and resilient, in line with the European Green Deal and the Sustainable and Smart Mobility

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69 European Parliament and the Council, 'Regulation (EU) No 1315/2013 of the European Parliament and of the Council of 11 December 2013', December 2013.
70 European Parliament and the Council.
71 European Parliament and the Council.
72 'Trans-European Transport Network (TEN-T) - European Commission', accessed 14 May 2024, https://transport.ec.europa.eu/transport-themes/infrastructure-and-investment/trans-european-transport-network-ten-t_en, n.d.
73 'Trans-European Transport Network (TEN-T) - European Commission'.
74 'Trans-European Transport Network (TEN-T) - European Commission'.
75 'Trans-European Transport Network (TEN-T) - European Commission'.
76 'Trans-European Transport Network (TEN-T) - European Commission'.

Strategy[77]. On December 14, 2021, the European Commission presented a proposal to amend the Union guidelines for the development of the TEN-T regulation[78]. This revision aims to prepare the network for the future, aligning it with the objectives of the EU Green Deal and the targets outlined in the EU Climate Law[79]. The proposed changes underscore the importance of comprehensive planning for the TEN-T network, encompassing specific requirements for infrastructure, equipment, and services, as well as those outlined in AFIR. Pertaining to Inland Waterway Transport (IWT), Article 21 stipulates that Member States must ensure that inland ports on the comprehensive network have environmental performance-enhancing facilities for vessels by December 31, 2050[80]. This includes measures to reduce air and water pollution[81]. Additionally, Member States are required to deploy alternative fuels infrastructure in inland ports in adherence to AFIR requirements[82]. Core ports must meet these same requirements by December 31, 2040[83].
As per the position of the European Parliament adopted in 2023, in line with decarbonization policy goals, by December 2024, the policy mandates that every Core inland waterway port on the TEN-T network should have at least one shoreside electricity supply point for vessels, expanding this requirement to all Comprehensive inland waterway ports by December 2029, which is in line with the AFIR policy[84].
Given its significance as the most utilised and essential network within the EU, decarbonizing TENT-T is crucial. As the EU aims to position itself as a global leader in the realm of climate change, this network is ideally positioned to establish benchmarks for decarbonization standards worldwide.

NAIADES III , introduced in 2021, is aimed at enhancing inland waterway transport across the EU[85]. Although this policy does not specifically cater to river cruise vessels, it is essential to mention it here to provide a comprehensive overview of the EU policy landscape. NAIADES III encompasses a broad action plan designed to increase cargo transport via Europe's rivers and canals, facilitate the shift to zero-emission vessels by 2050, and integrate inland waterways more deeply into a sustainable and intermodal transport system[86]. The plan is aligned with the European Green Deal and the EU's Sustainable and Smart Mobility Strategy, with goals to

[77] 'Trans-European Transport Network (TEN-T) - European Commission'.
[78] Salih Karaarslan et al., 'D4.2 Report on Findings, Perspectives and Recommendations on Clean Energy along Waterways and Ports', 23 December 2022, https://platina3.eu/download/clean-energy-infrastructure/.
[79] Salih Karaarslan et al.
[80] Salih Karaarslan et al.
[81] Salih Karaarslan et al.
[82] Salih Karaarslan et al.
[83] Salih Karaarslan et al.
[84] EUROPEAN PARLIAMENT, 'POSITION OF THE EUROPEAN PARLIAMENT', 11 July 2023.
[85] 'NAIADES III Action Plan - European Commission', accessed 14 May 2024, https://transport.ec.europa.eu/transport-modes/inland-waterways/promotion-inland-waterway-transport/naiades-iii-action-plan_en, n.d.
[86] 'NAIADES III Action Plan - European Commission'.

increase inland waterway and short sea shipping transport by 25% by 2030, and 50% by 2050[87]. It envisions transitioning to zero-emission inland waterway transport by promoting it as an efficient means of multimodal transport while also aiming at decarbonizing the sector.[88] It proposes assessing how to implement alternative technologies such as OPS to help with the greening inland waterway transport.[89]

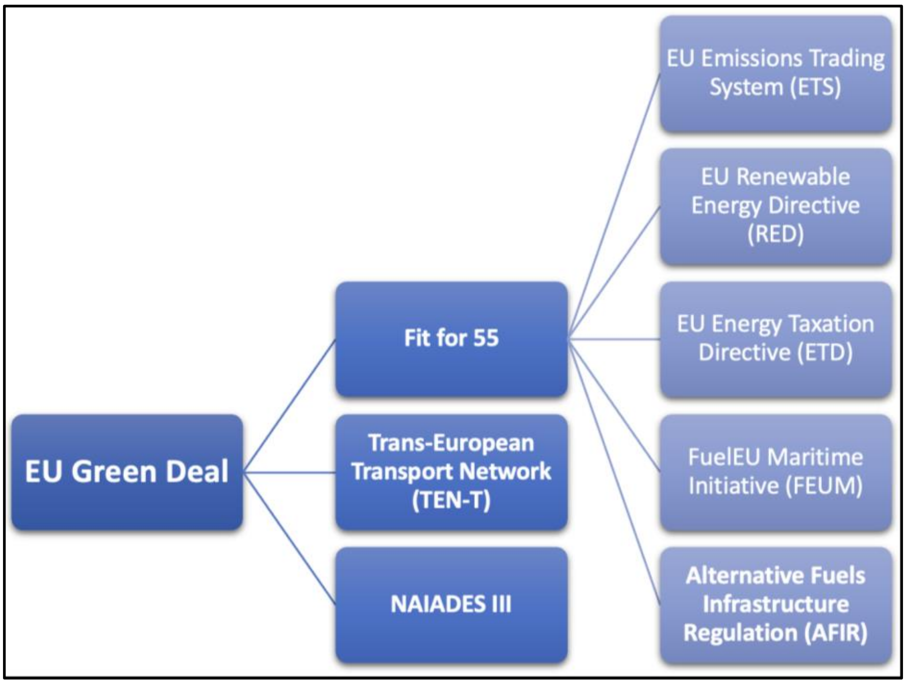

Figure 4 Overview of the key EU policy instruments to address climate change, as discussed in the literature review.

River Commissions Policies

Separately, the Central Commission for Navigation of the Rhine (CCNR), in line with the directives outlined in the Mannheim Ministerial Declaration of October 17, 2018, has independently developed a roadmap[90]. This strategic plan is geared towards significantly minimising greenhouse gas (GHG) emissions and air pollutants within the IWT sector by 2050, aligning with a shared long-term vision with the European Union[91]. Specifically, as mandated by the declaration, the CCNR is tasked with achieving a 35% reduction in GHG emissions and

87 'NAIADES III Action Plan - European Commission'.
88 European Commission, 'COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS NAIADES III: Boosting Future-Proof European Inland Waterway Transport', 2021, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52021DC0324.
89 European Commission.
90 Salih Karaarslan et al., 'D4.2 Report on Findings, Perspectives and Recommendations on Clean Energy along Waterways and Ports'.
91 Salih Karaarslan et al.

pollutant emissions by 2035 compared to 2015 levels[92]. Furthermore, the ultimate goal is to achieve a substantial elimination of both GHG and other pollutants from the IWT sector by the year 2050[93].

River commissions, including the Danube Commission (DC) and the CCNR, have collaborated on the EU-funded PLATINA3 project[94]. This initiative aims to conduct essential research and development activities, fostering the advancement of inland waterway transport in Europe in alignment with the key objectives of NAIADES III[95]. The PLATINA3 project has diligently undertaken comprehensive assessments, exemplified by reports like "Report on zero-emission strategy IWT, update of STEERER work"[96]. Based on these evaluations, the project puts forth priority action areas aimed at enhancing the environmental sustainability of Inland Waterway Transport (IWT). It emphasises certain OPS infrastructure-related studies and identifies key infrastructure areas as high-priority considerations in its recommendations.

Policy Landscape in EU Member States

Presently, European ports possess the autonomy to determine whether they will offer OPS services. Likewise, ship owners independently make decisions on whether to utilise OPS or operate their ships using the onboard engines[97]. In the European Union, the OPS landscape is as follows:

a. **Germany**

   Germany recognizes that onboard electricity generation is a cost-effective method for ships to meet their electricity needs[98]. According to the German Masterplan for Inland Shipping document published by the Federal Ministry of Transport and Digital Infrastructure in 2019, the BMVI is formulating a strategy to encourage environmentally friendly onboard and shore power supplies for sea and inland vessels[99].

b. **France**

   France’s Ministry of Transport, within its strategy for the ‘Engagement for the Green Growth of the River Sector’, promotes the adoption of shore power connections to replace onboard generators, to markedly decrease pollutant emissions and disturbances

92 Salih Karaarslan et al.
93 Salih Karaarslan et al.
94 Danube Commission, ‘Platina3 Reports’, accessed 18 December 2023, https://www.danubecommission.org/dc/en/publishing-activities/platina3-reports/, n.d.
95 Danube Commission.
96 Salih Karaarslan et al., ‘D4.2 Report on Findings, Perspectives and Recommendations on Clean Energy along Waterways and Ports’.
97 GSK, ‘On-Shore Power in Ports: Once Optional, Soon a Requirement’, 22 February 2023.
98 Deutscher Bundestag, ‘Unterrichtung Durch Die Bundesregierung Nationales Hafenkonzept Für Die See- Und Binnenhäfen 2015’, 22 January 2016, https://dserver.bundestag.de/btd/18/073/1807340.pdf.
99 Bundesministerium für Verkehr und digitale Infrastruktur, ‘Masterplan Binnenschifffahrt’, May 2019, https://bmdv.bund.de/SharedDocs/DE/Anlage/WS/masterplan-binnenschifffahrt-de.pdf?__blob=publicationFile.

associated with quay-side parking, especially in urban regions[100]. The engagement plan encompassed measures to adapt and double the number of boats capable of connecting to shore power by 2022[101]. Additionally, it is committed to ensuring the deployment of shore power supply infrastructures on each navigation basin by 2021[102].

c. Netherlands

The Human, Environment, and Transport Inspectorate of the Netherlands, operating under the Ministry of Infrastructure and Water Management, provided industry guidance, accumulating resources on its website as early as 2012[103]. More recently, safety standards, including interim guidelines to promote the secure operation of OPS services in ports and on ships, have been developed for the industry[104].

d. Belgium

In 2021, Belgium undertook an energy and shore power scan of 26 inland vessels as part of the European Clean Inland Shipping (CLINSH) research project[105]. Subsequently, the Belgian Department of Mobility and Public Works recommended that regular users transition to shore power as an alternative to traditional onboard diesel generators, drawing on the findings of the study[106]. Additionally, the department offers free OPS in certain locations and charges in others[107]. It also directs ships without OPS infrastructure to apply for grants so that they can convert. [108]

e. Austria

In 2023, a press release released by Austria's Federal Ministry for Climate Protection, Environment, Energy, Mobility, Innovation and Technology mentioned that the Ministry pioneered the launch project "Shore power for inland waterway vessels"[109].

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[100] Ministère des Transports, 'Engagements Pour La Croissance Verte Du Secteur Fluvial', n.d., https://www.ecologie.gouv.fr/sites/default/files/ECV%20-%20Secteur%20fluvial.pdf.

[101] Ministère des Transports.

[102] Ministère des Transports.

[103] Human Environment and Transport Inspectorate, '794 On-Shore Power Supply - Netherlands Regulatory Framework (NeRF) – Maritime', 24 November 2016, https://puc.overheid.nl/nsi/doc/PUC_1663_14/1/.

[104] International Maritime Organization, 'INTERIM GUIDELINES ON SAFE OPERATION OF ONSHORE POWER SUPPLY (OPS) SERVICE IN PORT FOR SHIPS ENGAGED ON INTERNATIONAL VOYAGES', *MSC.1/Circ.1675*, 27 June 2023, https://puc.overheid.nl/nsi/doc/PUC_746314_14/1/.

[105] Vlaanderen Department Mobiliteit en Openbare Werken, 'PERSBERICHT: ENERGIEBESPARENDE INVESTERINGEN BANEN DE WEG VOOR WALSTROOM', 16 September 2021, https://www.binnenvaartservices.be/nl/walstroom/nieuws.

[106] Vlaamse overheid, Departement Mobiliteit en Openbare Werken, 'WALSTROOM AANVRAGEN', 2023, https://www.binnenvaartservices.be/nl/walstroom/walstroom-aanvragen.

[107] Vlaamse overheid, Departement Mobiliteit en Openbare Werken.

[108] Vlaamse overheid, Departement Mobiliteit en Openbare Werken.

[109] Bundesministerium für Klimaschutz, Umwelt, Energie, Mobilität, Innovation und Technologie, 'Landseitige Stromversorgung Für Güterschiffe: Die Ersten Terminals Sind in Betrieb', 22 June 2023, https://www.bmk.gv.at/service/presse/gewessler/20230622_stromversorgung-gueterschiffe.html.

For the test period, the OPS was supplied free of cost so that all involved parties could mutually benefit from the know-how[110]. Additionally, as per Shipping Law Amendment Regulation 2023[111], the introduction of the mandatory use of OPS facilities at equipped public areas is intended to reduce the use of diesel generators otherwise necessary for generating the required ship power. It also mandates, that if functional and suitable shore power supply facilities are available, using onboard power generation systems is prohibited when the vessel is stationary for more than one-hour [112].

f. Romania

As per the Romanian Integrated National Energy and Climate Plan 2021-2030 Project (Update 2023), Romania is obligated to follow the Regulation 2023/1804 of the European Parliament and of the Council of 13 September 2023 on the deployment of alternative fuels infrastructure and repealing Directive 2014/94/EU[113]. As such, it is obligated to ensure a minimum shore-side electricity supply is provided in TEN-T maritime ports for maritime container ships and passenger ships by 2029.[114] Targets are also set for providing shore-side electricity to inland navigation vessels in ports.[115]

*For the purposes of this report, we have summarised policies for only major geographical territories within the scope of this project. This report does not go into details to assess policies for all European countries like Portugal, Poland, Czech Republic, Hungary, and Bulgaria.

Benefits and Drawback of OPS

Studies have consistently demonstrated the positive outcomes of OPS, establishing it as a cost-effective and environmentally friendly choice for ports, taking into account external savings[116]. Inland shipping activities result in air pollutants emissions, which often take place near highly populated areas such as berths, exposing many people to these emissions and associated noise, while also releasing GHGs into the atmosphere[117]. Furthermore, a specific CLINSH investigation highlighted that investing in OPS could result in significant societal benefits,

[110] Bundesministerium für Klimaschutz, Umwelt, Energie, Mobilität, Innovation und Technologie.
[111] Wirtschaftskammer Wien, 'Schifffahrtsrechtsnovelle-Verordnung 2023 (BGBl. II Nr. 204/2023)', 2023.
[112] Wirtschaftskammer Wien.
[113] Ministry of Energy, Govt. of Romania, 'The Integrated National Plan for Energy and Climate Change 2021-2030 Updated Project Version – 21.12.2023', 21 December 2023, https://energie.gov.ro/wp-content/uploads/2024/01/NECP_Romania_first-draft-version-21.12.2023_RO.pdf.
[114] Ministry of Energy, Govt. of Romania.
[115] Ministry of Energy, Govt. of Romania.
[116] Ketan Gore, Patrick Rigot-Müller, and Joseph Coughlan, 'Cost-Benefit Assessment of Shore Side Electricity: An Irish Perspective', *Journal of Environmental Management* 326 (15 January 2023): 116755, https://doi.org/10.1016/j.jenvman.2022.116755.
[117] Clinish, 'CLean INland SHipping', 2022.

including improvements in public health and biodiversity preservation, estimated at €4.9 billion[118]. This benefit outweighed the technical investment expenses (€1.3 billion) and additional costs for ship owners (€0.76 billion), making these investments economically viable from a socio-economic perspective[119].

However, the main challenge with OPS deployment is that the ports and shipowners investing in the necessary infrastructure may not directly benefit from the reduced emission levels. Additionally, OPS studies and cost-benefit analyses are contingent on fluctuating electricity and fuel prices, impacting the overall costs and benefits of OPS implementation. The evolving global geopolitical situation has heightened the relevance of these conditions, notably with electricity and fuel prices reaching record highs, especially within the EU, as observed in early 2022[120]. High investment levels pose a barrier, and since deployment responsibilities lie with ship owners and port authorities, governments have stepped in to provide tax breaks and subsidies for OPS. Seeking additional funding, cruise and shipping consortiums, like IGRC, are actively building a business case today to implement decarbonization in practical terms in the future.

Research Questions

Given all this information, this research project aims to answer the following research questions:

a. How does the current EU legislative framework for OPS for cruise vessels in EU inland waterway ports, as guided by the AFIR and TEN-T policies, compare with existing OPS infrastructures and investments in these ports?
b. What are the fundings of the three EU leading countries in OPS for their local OPS port installations?
c. What investments are needed in the future to advance zero-emission OPS infrastructures for the decarbonisation of cruise vessels along EU inland waterway ports?

Pre-existing Studies

Other studies to assess the distribution of OPS have been conducted. A study was conducted by a firm named Logistikum and the University of Applied Sciences of Upper Austria, to study Shore-side electric power supply in the Danube region and identify relevant stakeholders for the future implementation[121]. However, for the purpose of our study, this report was limited in

[118] Gore, Rigot-Müller, and Coughlan.
[119] Gore, Rigot-Müller, and Coughlan.
[120] Gore, Rigot-Müller, and Coughlan.
[121] Logistikum, 'Shore-Side Electric Power Supply in the Danube Region', October 2022.

scope as it was confined to the Danube River and only covered Bulgaria, Croatia, Hungary, Moldova, Romania, Serbia, Slovakia, and Ukraine[122]. Moreover, this study is not publicly available and was specifically provided to us by the Danube Commission only when we presented our project's objective.

Another study was conducted by the Ministry of Infrastructure and Waterways in the Netherlands to study the 'Preliminary Exploration of Shore Power at National Mooring Locations'. However, this study was also limited, focusing solely on the waterways within the Netherlands[123]. Moreover, it is not relevant to our project because the OPS power lock connections are insufficient for cruise vessels with passengers onboard. Additionally, the documents are in Dutch and are not publicly available; they were provided to us during our consultations with municipalities in the Netherlands to gather information on our identified ports.

In summary, there has not yet been a comprehensive study for TEN-T or other inland waterway ports within the EU, nor has such a study been found in the public domain. Multiple stakeholders we contacted have echoed this sentiment. As such, ours is the first comprehensive study of its kind on OPS infrastructure in the EU's inland waterways, specifically focusing on TEN-T ports.

Foundational Definitions

For the scope of this report, "cruise ships" are specifically identified as vessels accommodating overnight passengers, excluding yachts, and navigating within "EU inland waterway ports", meaning along rivers. This definition does not impose size or weight limitations. The "three leading countries" are defined as the top three EU countries with the most OPS projects implementation. To deepen the analysis, this study makes a clear distinction between "EU investment" and "local fundings", differentiating between investments made by the EU and those made at the national level by individual EU countries in OPS port facilities, which is crucial to address our third research question.

[122] Logistikum.
[123] Ministry of Infrastructure and Waterways, Netherlands, 'Preliminary Exploration of Shore Power at National Mooring Locations', 16 January 2024.

Methodology

Following the literature review and research questions, the primary objective of this study is to comprehensively assess the existing OPS infrastructures for cruise vessels along EU inland waterway ports. Specifically, the research aims to identify these ports, and the status of OPS technology. The scope of this project includes desk research and direct contact with port authorities as necessary.

Research Design

The research is exploratory and descriptive, blending quantitative and qualitative elements. Given the lack of comprehensive, up-to-date information on OPS status for EU river cruise sectors, it seeks to explore and gather the existing data and fill this gap. The study's descriptive nature is manifested in an interactive PowerBI map, consolidating gathered data. Specifically, the map displays all 574 inland waterway ports, each geotagged by its coordinates. In the dynamic version, hovering over any port reveals detailed information, including the development stage of OPS facilities for cruise ships. This creates an intuitive visual guide for the viewer/stakeholder.

Geographical Scope

The EU inland waterways frame the geographical scope, encompassing vital rivers. Specific inclusions and exclusions are established for clarity and relevance to the study's objectives.

1. French inland waterways are limited to the River Seine and River Rhone. The River Dordogne and Garonne should be counted as ports connected to Bordeaux, which serves ocean and river cruise vessels.
2. Portuguese inland waterways are limited to the River Douro.
3. The Rhine River stretch from Amsterdam (Rotterdam) to Basel is considered as one key River stretch connecting the Netherlands with Switzerland including the Belgium and Dutch River Delta.
4. The Rhine and Danube waterways are one selected area from Amsterdam to Bucharest. This should include itineraries connected to the Moselle and the Main.
5. The Elbe should be considered for the River cruising stretch, while Hamburg should be considered an ocean cruise-only port.
6. The Italian river Po and those around Venice are not included, neither are Saar (tributary of the Mosselle), Saône (tributary of the Rhône), Havel (tributary of the Elbe), Neckar

(tributary of the Rhine), Oder (Poland, Czech Republic, Germany), Tisza (Ukraine, Romania, Hungary, Slovakia, Serbia), and Vlatva (Czech Republic).

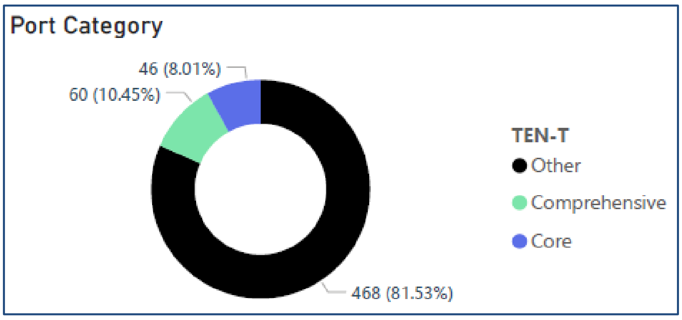
Thus, all ports located on the aforementioned rivers are part of our sampling population. In certain instances, a limited number of ports not situated along the previously mentioned rivers were included retrospectively. This inclusion followed additional information shared by the port operators we had contacted.

Figure 5: TENtec Interactive Map Viewer. Map by the European Commission, 2023. European Commission, Mobility and Transport.

Data Collection

The primary objective is to comprehensively assess the existing infrastructure of cruise vessel ports along the EU inland waterways. This involves identifying the current development status of OPS facilities across EU inland waterway ports (planned, funded, or implemented). The secondary aim was to acquire data concerning the financial contributions of the top three OPS implementing countries for the implementation of this technology in the EU. For the third research question, we will take the data we collected to make heuristic recommendations. The methodology encompasses both desk research and direct engagements with European port authorities.

Identifying Ports



The initial phase of data collection entailed identifying the relevant ports for analysis. Given the absence of a centralised database of EU inland waterway ports, it was necessary to compile an independent list. This list was created based on docking location data provided by three IGRC members (total of 856 ports), which was subsequently aggregated by the city and filtered to only include the ports within our geographical scope to form a comprehensive dataset of river cruise ports relevant to our study. The resultant list contained a total of 574 ports. Furthermore, we consolidated multiple docking sites within the same city into a single port entry with multiple berths to maintain clarity and avoid redundancy in data collection. These identified ports constitute the study's data population. We further categorised these ports into TEN-T Comprehensive (N=60), and TEN-T Core (N=46), as defined by the European Commission[124], and regular ports (N=468). Special attention was given to the collection of data from TEN-T designated ports due to their significant policy and geographical implications at the EU level.

OPS Data Collection Strategy

In the second step, we initiated the data collection on OPS availability and financing using various strategies. Initially, we conducted online searches through official port websites to gather the required information. However, it became clear that the information on OPS is not widely available or openly accessible, making this method inefficient for gathering comprehensive data for the number of ports.

Consequently, we adopted a new approach by identifying and contacting associations and organisations connected to the river cruising industry and European ports, such as the European Alternative Fuels Observatory Association[125]. Our objective was to assess if centralised information on the status of OPS for inland waterway cruising ports existed. It became evident that no regional, country, or river-specific entity systematically tracked OPS status for cruise ships across EU inland waterways.

[124] European Commission, 'ANNEX II LIST OF NODES OF THE TRANS-EUROPEAN TRANSPORT NETWORK', 19 December 2023, https://transport.ec.europa.eu/document/download/40f52207-d2d1-4cbf-9392-b61f37309ee8_en?filename=52022PC0384-ANNEX-2.pdf.
[125] European Commission, 'Ports and Infrastructure | European Alternative Fuels Observatory', n.d.

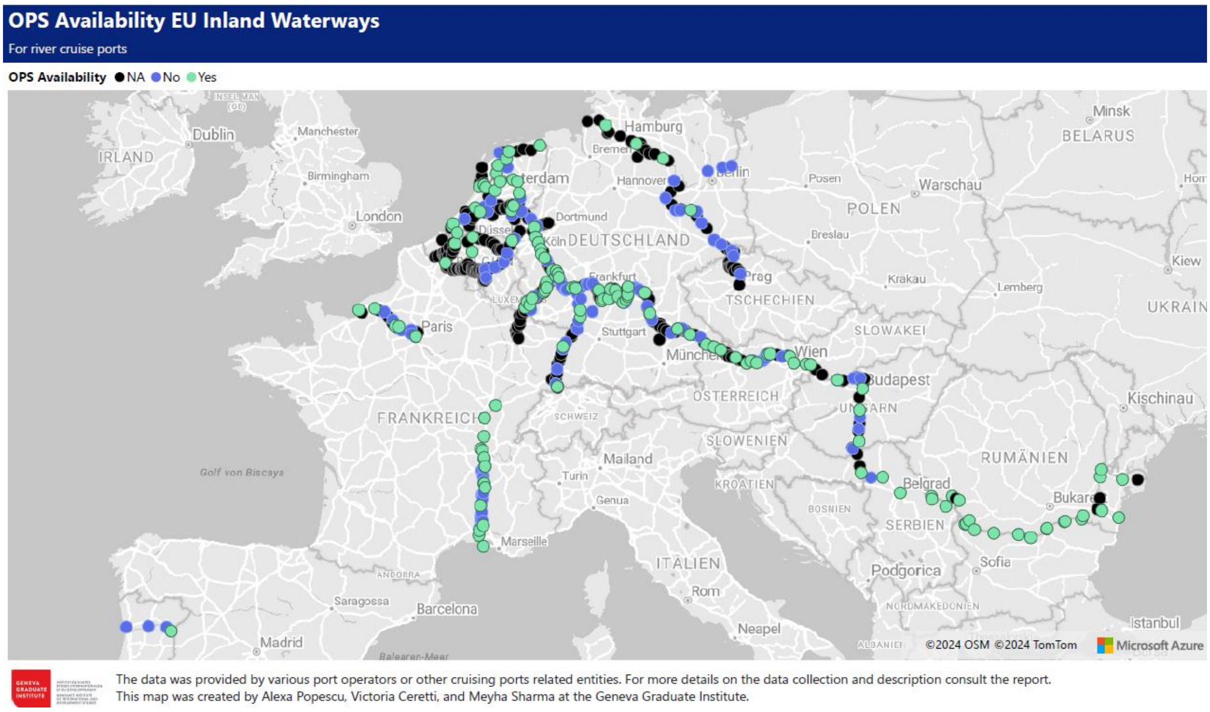


Figure 6: Interactive map of all EU inland waterway ports by OPS availability for river cruise ships. Map created by the project team members, 2024. PowerBI.

For the third strategy, we directly contacted port operators via email. We obtained contact information from IG River Cruise members and supplemented it with additional contacts found online. We were also helped with contacts provided by the European Inland Waterways Transport (IWT) and the European Federation of Inland Ports (EFIP)[126]. Approximately 600 emails were sent to port operators over two months (March and April 2024), with each contact being contacted at least twice. Despite this effort, the response rate was relatively low (approx. 30%). Additionally, we attempted to call the most significant TEN-T ports to obtain information.

Alongside this strategy, the databases received from three IGRC members indicating their docking location across EU inland waterway ports included data on whether these ports had OPS facilities or not. We used these 'Yes/No' values as evidence in our data collection. In some instances, after contacting port operators, we realised that the information we received was outdated. However, we were unable to cross-corroborate all the data for each port due to limitations relating to the response rate.

In total, we collected data on 253 ports out of 574 total inland waterway ports, representing 44.1% of the total ports within our study population. In some cases, we also received information on OPS facilities in ports outside our initial research scope (i.e., located on rivers

[126] 'EFIP - Organisation', n.d, https://www.inlandports.eu/organisation.

not explicitly included in our study), nevertheless, we added these data points to our list of ports ad hoc.

Data Processing

To answer the research questions we requested the following information from the port operators:

- Port name (city), country, river
- Maximum number of river cruise ships that can be docked at the same time in the port
- OPS availability (yes/no)
  If OPS is available:
    - Maximum number of OPS power lock connections that can be used by river cruises at the same time
    - OPS status (planned, funded, or implemented)
    - Active date of OPS (Month, Year)
    - OPS cost (Euros)
    - OPS funding source (Private, City, Country, EU funds, etc.)
    - Last update (Month, Year)

Other variables that we tracked are longitude, latitude, and TEN-T type.

Based on this data, we then compile descriptive statistics, which we discuss in the next section. The final research output, the interactive PowerBI map, showcases the availability of OPS across EU inland waterway ports for cruise vessels.

Analysis

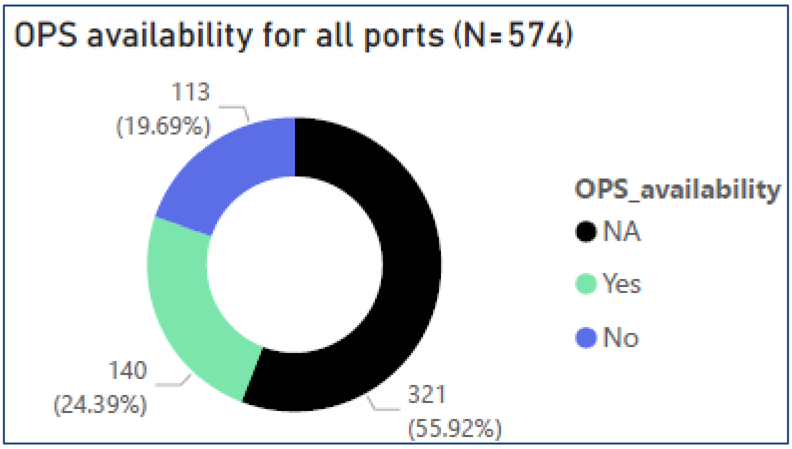
This section focuses on presenting the data we collected from multiple sources. We summarise this data by creating two tables specifying the availability of OPS infrastructure for TEN-T Core and Comprehensive inland waterway ports, and we employ descriptive statistics tools to better evaluate our findings. Subsequently, we interpret the results, by explaining their significance in relation to our research questions, with the final aim of assessing how they might guide strategic investments of policy makers and stakeholders. Finally, we discuss critical limitations of our research project, and how these might influence the conclusions we draw from our study.

Data Presentation

Overall, we collected data on 253 ports out of 574 total inland waterway ports of our list, which not only include Core and Comprehensive TEN-T ports, but also some regular river ports under the categorisation of 'other', as explained in the methodology. For some of these ports, we were able to gather information on most of the variables we were interested in, while for others, the information was limited, sometimes only confirming the presence or absence of OPS facilities.

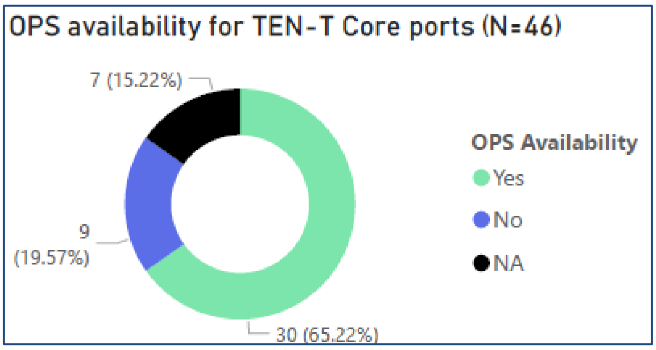
Tables A.1 and A.2 in the annexes summarise the data we collected on TEN-T Core and Comprehensive inland waterway ports, specifying whether or not each port provides river cruise vessels with OPS infrastructures, which represents the baseline information for all collected data. Both tables report information on the countries and cities where TEN-T ports are located, as well as the name of the river and the availability of OPS technology across these ports.

The pie chart illustrates the availability of OPS infrastructures across the 574 EU inland waterway ports within our scope. Approximately 24% of these ports have OPS facilities for river cruise ships, about 20% lack such facilities, and over 55% have no available information on their OPS status.

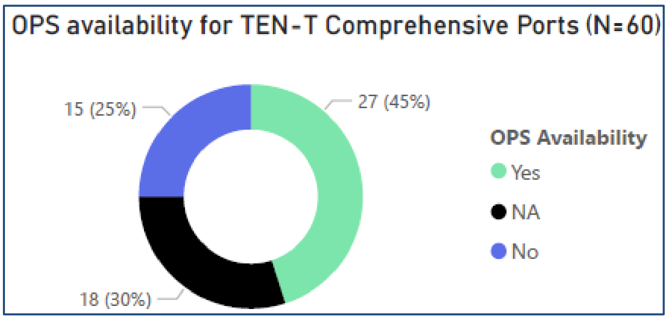


Data Interpretation and Implications

A. How does the current EU legislative framework for OPS for cruise vessels in EU inland waterway ports, as guided by the AFIR and TEN-T policies, compare with existing OPS infrastructures and investments in these ports?



Answering our first research question, as per Article 10 of the AFIR policy, EU Member States have to install at least one OPS infrastructure for inland waterway vessels, including cruise ships, at all TEN-T Core inland waterway ports by the end of 2024. According to the data we collected, of the 46 TEN-T Core inland waterway ports listed by the EU, 30 ports (65.2%) are equipped with at least one OPS infrastructure. Meanwhile, 9 ports (19.57%) lack any OPS infrastructure, and information is unavailable for 7 ports (15.22%) because of missing data.



Similarly, Article 10 also mandates that all TEN-T Comprehensive inland waterway ports install at least one OPS infrastructure for vessels, which include cruise ships, by the end of 2029. Our analysis of the 60 EU TEN-T Comprehensive inland waterway ports reveals that 27 ports (45%) currently have at least one OPS infrastructure in place. However, 15 ports (25%) do not have OPS facilities, and information on OPS status is unavailable for 18 ports (30%).

B. What are the fundings of the three European leading countries in OPS for their local OPS port installations?

Given the limitations of our data collection process, we are unable to definitively determine the top three OPS implementing countries in the EU, since we don't have comprehensive, up-to-date data available for all EU inland waterway ports. Therefore, this constraint prevents us from fully and comprehensively answering the second research question of our study.

However, based on the 253 data we gathered on OPS availability for inland waterway ports, we can propose the three or four leading countries in OPS implementation, though we acknowledge that our conclusions are potentially biased due to missing data because of the low response rate we experienced. These countries are Romania, with 68% of its inland waterway ports having OPS facilities, the Netherlands at 30%, France at 29%, and lastly Germany at 20%. When focusing only on TEN-T inland waterway ports, the ranking shifts to Romania leading at 100%, followed by France at 50%, the Netherlands at 48%, and Germany at 43%.

We do not have any data to comment about major lines of funding in any of these countries. Specifically, for Romania, there is no funding information available. Similarly, for France, we do not have active funding data available, but out of all the 74 ports within our scope, we received funding information for 6 ports. Of these, 4 projects received aid from ADEME (French government/ecological transition), FNADT (French government/transportation/Rhône-Saône Plan) and are eligible for European aid under the CEE scheme. For the Netherlands, we only have information for 6 out of 68 ports studied. Three to four of them have funding from the city or the municipality, while the other two received funding via the Economic Structure Reinforcement Fund (FES) and European subsidy (ERDF) and a blend of private and EU CEF funds. For Germany, out of the 233 ports in our scope we only have funding information from 10. Most of these ports received funding from the Federal Government or the state/city.

C. What investments are needed in the future to advance zero-emission OPS infrastructures for decarbonizing cruise vessels in EU inland waterway ports?

Focusing on our third and last research question, we cannot provide an exhaustive answer, since we were unable to collect complete data on OPS facilities for many EU inland waterway ports. Our analysis of the available collected information in our dataset (N = 253) reveals that 55% of the inland waterway ports have at least one OPS unit planned, funded, or implemented at their berths, whereas 44.6% lack such infrastructures. This indicates that nearly half of inland waterway ports in our dataset still need to invest in the development of OPS infrastructures for river cruise vessels in order to promote the decarbonisation of the cruise sector and align with sustainable development. However, this conclusion may be biased since all the OPS data we collected from IGRC members was not cross-corroborated independently for each case due to previously mentioned limitations.

Nevertheless, we can attempt to estimate the funding that would be required to meet the targets based on the data we collected. We received cost information from Voies Navigables de France (VNF) when we contacted them to gather information on OPS facilities for French ports. The organisation noted that for installing one OPS unit at an inland waterway port in the EU member states, the estimated cost ranges between approximately €350,000 to €600,000, including the purchase of the bollard, connection work, and a dedicated transformer station (as of 2023). Going by these estimates and the data we gathered, we can extrapolate an approximate range of minimum - maximum costs that would be required to reach the 2024 AFIR targets and have at least one OPS unit at all TEN-T Core ports. That would be:

Out of the 46 TEN-T Comprehensive ports in our scope, 30 have at least one OPS infrastructure, 9 don't, and for the remaining 7 we do not have data.

- In the best case scenario i.e. let's say the 7 ports for which we do not have data may already have OPS, leaving 9 ports without an OPS infrastructure. In that case:
  - Minimum cost for 2024 target = €350,000 * 9 ports = €3,150,000

- In the worst case scenario let's say the 7 ports for which we do not have data don't have OPS, that leaves 16 ports without an OPS infrastructure. In that case:
  - Maximum cost for 2024 target = €600,000 * 16 ports = €9,600,000

To reach the 2024 target, the funding required can be estimated to be somewhere between €3,150,000 and €9,600,000 for Core inland waterway ports. A similar extrapolation can be done for the 2029 AFIR target for TEN-T Comprehensive inland waterway ports:

Out of the 60 TEN-T Comprehensive ports in our scope, 27 have at least one OPS infrastructure, 15 don't, and for the remaining 18 we do not have data.

- Similarly, in the best-case scenario i.e. let's say the 18 ports for which we do not have data may already have OPS, leaving 15 ports without an OPS infrastructure. In that case:
  - Minimum cost for 2029 target = €350,000 * 15 ports = €5,250,000
- In the worst-case scenario let's say the 18 ports for which we do not have data don't already have OPS, that leaves 33 ports without an OPS infrastructure. In that case:
  - Maximum cost for 2029 target = €600,000 * 33 ports = €19,800,000

To reach the 2029 target, the funding required can be estimated to be somewhere between €5,250,000 and €19,800,000 for Comprehensive inland waterway ports.

For all ports contacted, we only received funding information on 33 ports. As per that data we received from port authorities, most of the OPS infrastructure installed was at least in part funded by the EU, then by the Municipality and Federal Government, and rarely by private entities. Majority of the EU funding was under the EU CEF scheme. The EU CEF i.e. the Connecting Europe Facility is a EU funding instrument to promote growth, through infrastructure investment at European level to implement the Trans-European Networks for Energy policy[127]. It aims at supporting investments in building new cross-border energy

[127] 'Connecting Europe Facility - European Commission', 13 May 2024, https://cinea.ec.europa.eu/programmes/connecting-europe-facility_en.

infrastructure in Europe or rehabilitating and upgrading the existing one[128]. Given the amount of investments needed, we hold the view that the EU would indeed have to step in to fill the funding gap.

Limitations and Future Steps

Throughout this project, we encountered several limitations, which we had anticipated. The primary issues were data accessibility and non-response bias, particularly concerning the general response rate to emails and phone calls. The response rate to our email requests was notably low (approx. 30%). Consequently, the final information on OPS availability (Yes/No) was derived from both verified sources – direct responses from port operators – and secondary sources, specifically the original list of ports provided by IGRC members, which we used to compile the list of all ports. The latter was assumed to have had a reliable source at some point. However, it lacked the verification from primary sources, making it less reliable but preferable to having no information at all. As already mentioned, much of this secondary data could not be cross verified for its current accuracy, indicating a need for future validation.

An additional challenge arose from the ambiguity in some responses received via email. The information provided was often unclear, particularly regarding specifications on maximum docking capacity and OPS availability. Some responses detailed the number of power locks available per docking spot without clarifying the total number of docking spots. Despite our efforts to follow up for clarification, some queries went unanswered, necessitating assumptions that compromised data reliability.

The data points collected on the level of investments in TEN-T ports were insufficient to make generalised statements (N=20). Thus, the section on investments in our analysis is based on assumptions derived from limited information. Moreover, the cost and financing structures for OPS varied significantly across different countries and regions, with no consistency in the financing sources (e.g., national, state, city, or private).

The current state of our research is still in progress and with the goal of acquiring comprehensive information on OPS status is gathered. Further tracking and research are necessary to achieve a complete picture. However, given the relevance of this study to the completion of the EU Fit for 55 and AFIR goals, we anticipate that progress will be made soon. The data we have collected thus far is valuable for future research and decision-making. The information presented in this report and the interactive map, have set a solid and unprecedented foundation to build upon.

[128] 'Connecting Europe Facility - European Commission'.

Conclusion

In conclusion, the primary objective of this applied research project is to provide a first assessment of the development status of OPS facilities for river cruise vessels while at berth in EU inland waterway ports, by comparing it against key EU legislative requirements, particularly the Alternative Fuel Infrastructure Regulation (AFIR) and the Trans-European Transport Network (TEN-T) policies. OPS infrastructures represent an increasingly widespread and low-emission technological improvement aimed at decarbonising cruise vessels during berthing, enabling them to turn off their diesel generators and connect to the local power grids, which results in reduced air pollution, GHG emissions, and noise levels at port and coastal areas. Based on the comprehensive analysis, the study quantifies and visualises the availability of OPS infrastructure for river cruise ships across TEN-T inland waterway ports, identifying the leading EU countries in OPS implementation and the regions that require targeted investments for future development.

Key Findings and Implications:

1. **Current OPS Infrastructure**:
   - TEN-T Core Ports: 65.2% of the TEN-T Core inland waterway ports are equipped with at least one OPS infrastructure, while 19.5% lack any OPS facilities, and information is unavailable for 15.2%.
   - TEN-T Comprehensive Ports: 45% of the TEN-T Comprehensive inland waterway ports currently have at least one OPS infrastructure, 25% do not have OPS facilities, and 30% have missing data on OPS status.

2. **Leading Countries in OPS Implementation:**
   - Our analysis indicates that Romania, the Netherlands, France, and Germany are the leading countries in OPS implementation based on the data available. However, due to the low response rate and incomplete data, these conclusions may be biased and should be verified with further research.
   - The majority of funding for these projects comes from various governmental sources, both at the national and local levels, with some projects also receiving substantial aid from EU funds.

3. **Future Investment Needs:**
   - Based on estimates, the cost required to meet the 2024 AFIR target for TEN-T Core ports could range between €3,150,000 and €9,600,000, assuming the installation of one OPS unit per port.

- The cost required to reach the 2029 AFIR target for TEN-T Comprehensive ports is estimated to be between €5,250,000 and €19,800,000, assuming the installation of one OPS unit per port.

Strategic Recommendations:

The data we have collected reveals that for all ports within our study, only about 24.4% have at least one OPS facility. Additionally, 19% of ports lack OPS infrastructure entirely. Alarmingly, for approximately 42% of the ports in our dataset, we lack even basic information regarding the presence or absence of OPS facilities. This highlights a critical need to complete this information, which is essential for assessing the progress and effective implementation of this policy.

As our team has recognized, addressing these gaps cannot be accomplished in isolation and will require proactive collaboration with EU port authorities. Moreover, our studies on funding requirements suggest that substantial investments, primarily from EU sources as well as national sources, as per precedent, will most likely be necessary to address these deficiencies. Based on these findings, we propose the following recommendations:

Targeted Investments: Policy-makers and stakeholders should prioritise funding for ports that lack any OPS infrastructure, and those not meeting the AFIR and TEN-T requirements. These might be prioritised on a national level based on internal criteria such as traffic, revenue, cost or other parameters. The EU and national governments should provide substantial financial support to bridge the investment gaps.

Continuous Updates: The interactive map and database created from this project should be continuously updated to reflect new developments in OPS infrastructures, ensuring that stakeholders have access to the most current information.

Stakeholder Collaboration: Stakeholders would need to proactively come forward to help with the study, such that the industry as a whole can build a case for collective funding.

While this is a pilot study to map out the OPS infrastructures for river cruise ships in the EU inland waterway ports, continued future research is also required to complete and update the missing data on OPS infrastructures. Only in this way can the study provide a comprehensive assessment of the OPS development status across EU inland waterways. This research has laid the groundwork for understanding the current landscape and future needs of OPS facilities for river cruise ships in EU inland waterway ports.

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Bibliography

Berger, Sophie, Sarah L Connors, Richard P Allan, Terje Berntsen, Lisa Bock, Ruth Cerezo-Mota, and Kim Cobb. 'FAQ Frequently Asked Questions - IPCC', n.d.

Bundesministerium für Klimaschutz, Umwelt, Energie, Mobilität, Innovation und Technologie. 'Landseitige Stromversorgung Für Güterschiffe: Die Ersten Terminals Sind in Betrieb', 22 June 2023. https://www.bmk.gv.at/service/presse/gewessler/20230622_stromversorgung-gueterschiffe.html.

Bundesministerium für Verkehr und digitale Infrastruktur. 'Masterplan Binnenschifffahrt', May 2019. https://bmdv.bund.de/SharedDocs/DE/Anlage/WS/masterplan-binnenschifffahrt-de.pdf?__blob=publicationFile.

Calvin, Katherine, Dipak Dasgupta, Gerhard Krinner, Aditi Mukherji, Peter W. Thorne, Christopher Trisos, José Romero, et al. 'IPCC, 2023: Climate Change 2023: Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, H. Lee and J. Romero (Eds.)]. IPCC, Geneva, Switzerland.' First. Intergovernmental Panel on Climate Change (IPCC), 25 July 2023. https://doi.org/10.59327/IPCC/AR6-9789291691647.

CLIA Europe. 'The Importance of Cruise to the Economy'. CLIA Europe, n.d. https://europe.cruising.org/the-importance-of-cruise-to-the-economy/#:~:text=The%20cruise%20industry%20creates%20jobs,fell%20by%2059%25%20in%202020.

Clinish. 'CLean INland SHipping', 2022.

'Connecting Europe Facility - European Commission', 13 May 2024. https://cinea.ec.europa.eu/programmes/connecting-europe-facility_en.

'COP28 Agreement Signals "Beginning of the End" of the Fossil Fuel Era | UNFCCC', 2023. https://unfccc.int/news/cop28-agreement-signals-beginning-of-the-end-of-the-fossil-fuel-era?gad_source=1&gclid=CjwKCAjw1K-zBhBIEiwAWeCOFwv16rNFqwYAjLHPqM6yAhFpP1mnxDhcOOnIvUjSF8Ve3EQHxF2b0RoCqwEQAvD_BwE.

Council of the European Union. 'FuelEU Maritime Initiative: Council Adopts New Law to Decarbonise the Maritime Sector', 25 July 2023. https://www.consilium.europa.eu/en/press/press-releases/2023/07/25/fueleu-maritime-initiative-council-adopts-new-law-to-decarbonise-the-maritime-sector/.

Danube Commission. 'Platina3 Reports'. Accessed 18 December 2023. https://www.danubecommission.org/dc/en/publishing-activities/platina3-reports/.

Deutscher Bundestag. 'Unterrichtung Durch Die Bundesregierung Nationales Hafenkonzept Für Die See- Und Binnenhäfen 2015', 22 January 2016. https://dserver.bundestag.de/btd/18/073/1807340.pdf.

Dijkstra, Constance, and Valentin Simon. 'The Return of the Cruise'. Transport & Environment, June 2023. https://www.transportenvironment.org/uploads/files/The-return-of-the-cruise-June-2023.pdf.

'EFIP - Organisation'. Accessed 19 May 2024. https://www.inlandports.eu/organisation.

Emma Smith. 'Eco-Friendly River Cruises | River Cruise Advice | River Voyages'. *Stay up to Date with*

River Cruise News at RiverVoyages.Com (blog), 14 January 2014. https://www.rivervoyages.com/news/eco-friendly-river-cruises/.

Environment, U. N. 'Emissions Gap Report 2023'. UNEP - UN Environment Programme, November 2023. http://www.unep.org/resources/emissions-gap-report-2023.

European Commission. 'ANNEX II LIST OF NODES OF THE TRANS-EUROPEAN TRANSPORT NETWORK', 19 December 2023. https://transport.ec.europa.eu/document/download/40f52207-d2d1-4cbf-9392-b61f37309ee8_en?filename=52022PC0384-ANNEX-2.pdf.

———. 'CLINSH - CLean INland SHipping', 2023. https://webgate.ec.europa.eu/life/publicWebsite/project/LIFE15-ENV-NL-000217/clean-inland-shipping.

———. 'COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS NAIADES III: Boosting Future-Proof European Inland Waterway Transport', 2021. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52021DC0324.

———. 'Ports and Infrastructure | European Alternative Fuels Observatory', n.d. https://alternative-fuels-observatory.ec.europa.eu/transport-mode/inland-waterways/ports-and-infrastructure.

———. 'Reducing Emissions from the Shipping Sector'. European Commission, n.d. https://climate.ec.europa.eu/eu-action/transport/reducing-emissions-shipping-sector_en.

European Council. 'European Green Deal', 10 November 2023. https://www.consilium.europa.eu/en/policies/green-deal/.

European Council and Council of the European Union. 'Fit for 55: How the EU Plans to Boost Renewable Energy', 11 October 2023. https://www.consilium.europa.eu/en/infographics/fit-for-55-how-the-eu-plans-to-boost-renewable-energy/.

———. 'Fit for 55: How the EU Plans to Revise Energy Taxation', 11 October 2023. https://www.consilium.europa.eu/en/infographics/fit-for-55-energy-taxation/.

———. 'Fit for 55: How the EU Will Turn Climate Goals into Law', 3 May 2023. https://www.consilium.europa.eu/en/infographics/fit-for-55-how-the-eu-will-turn-climate-goals-into-law/.

———. 'Fit for 55: Increasing the Uptake of Greener Fuels in the Aviation and Maritime Sectors', 27 January 2024. https://www.consilium.europa.eu/en/infographics/fit-for-55-refueleu-and-fueleu/.

———. 'Fit for 55: Reform of the EU Emissions Trading System', 15 May 2023. https://www.consilium.europa.eu/en/infographics/fit-for-55-eu-emissions-trading-system/.

———. 'Fit for 55: Towards More Sustainable Transport', 26 July 2023. https://www.consilium.europa.eu/en/infographics/fit-for-55-afir-alternative-fuels-infrastructure-regulation/.

EUROPEAN PARLIAMENT. 'POSITION OF THE EUROPEAN PARLIAMENT', 11 July 2023.

European Parliament and the Council. 'Regulation (EU) No 1315/2013 of the European Parliament and of the Council of 11 December 2013', December 2013.

Global Climate Observing System (GCOS). 'Precursors for Aerosols and Ozone', n.d. https://gcos.wmo.int/en/essential-climate-variables/precursors.

Gore, Ketan, Patrick Rigot-Müller, and Joseph Coughlan. 'Cost-Benefit Assessment of Shore Side Electricity: An Irish Perspective'. *Journal of Environmental Management* 326 (15 January

2023): 116755. https://doi.org/10.1016/j.jenvman.2022.116755.

GSK. 'On-Shore Power in Ports: Once Optional, Soon a Requirement', 22 February 2023.

Human Environment and Transport Inspectorate. '794 On-Shore Power Supply - Netherlands Regulatory Framework (NeRF) – Maritime', 24 November 2016. https://puc.overheid.nl/nsi/doc/PUC_1663_14/1/.

Intergovernmental Panel on Climate Change (IPCC). 'Glossary - Global Warming of 1.5°C', 2018. https://www.ipcc.ch/sr15/chapter/glossary/.

International Maritime Organization. 'INTERIM GUIDELINES ON SAFE OPERATION OF ONSHORE POWER SUPPLY (OPS) SERVICE IN PORT FOR SHIPS ENGAGED ON INTERNATIONAL VOYAGES'. *MSC.1/Circ.1675*, 27 June 2023. https://puc.overheid.nl/nsi/doc/PUC_746314_14/1/.

Kuciaba, Emilia. 'EMISSION FROM INLAND WATERWAY TRANSPORT IN THE CONTEXT OF ENERGY, CLIMATE AND TRANSPORT POLICY OF THE EUROPEAN UNION'. Uniwersytet Szczeciński, 2018. DOI: 10.18276/ptl.2018.43-06.

Logistikum. 'Shore-Side Electric Power Supply in the Danube Region', October 2022.

Ministère des Transports. 'Engagements Pour La Croissance Verte Du Secteur Fluvial', n.d. https://www.ecologie.gouv.fr/sites/default/files/ECV%20-%20Secteur%20fluvial.pdf.

Ministry of Energy, Govt. of Romania. 'The Integrated National Plan for Energy and Climate Change 2021-2030 Updated Project Version – 21.12.2023', 21 December 2023. https://energie.gov.ro/wp-content/uploads/2024/01/NECP_Romania_first-draft-version-21.12.2023_RO.pdf.

Ministry of Infrastructure and Waterways, Netherlands. 'Preliminary Exploration of Shore Power at National Mooring Locations', 16 January 2024.

'NAIADES III Action Plan - European Commission'. Accessed 14 May 2024. https://transport.ec.europa.eu/transport-modes/inland-waterways/promotion-inland-waterway-transport/naiades-iii-action-plan_en.

Parker, Charles F., and Christer Karlsson. 'Climate Change and the European Union's Leadership Moment: An Inconvenient Truth?' *JCMS: Journal of Common Market Studies* 48, no. 4 (2010): 923–43. https://doi.org/10.1111/j.1468-5965.2010.02080.x.

Ritchie, Hannah, Pablo Rosado, and Max Roser. 'Emissions by Sector'. *Our World in Data*, 14 November 2023. https://ourworldindata.org/emissions-by-sector.

Salih Karaarslan, Niels Kreukniet, Virginia Oganesian, Dejan Trifunovic, Kai Kempmann, Michelangelo De Lisi, Ruxandra Matzalik Florescu, Robert Rafael, Juha Schweighofer, and Mihai Barcanescu. 'D4.2 Report on Findings, Perspectives and Recommendations on Clean Energy along Waterways and Ports', 23 December 2022. https://platina3.eu/download/clean-energy-infrastructure/.

THE EUROPEAN PARLIAMENT and THE COUNCIL. *REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on the Deployment of Alternative Fuels Infrastructure, and Repealing Directive 2014/94/EU*, 2023. https://data.consilium.europa.eu/doc/document/PE-25-2023-INIT/en/pdf.

'Trans-European Transport Network (TEN-T) - European Commission'. Accessed 14 May 2024. https://transport.ec.europa.eu/transport-themes/infrastructure-and-investment/trans-european-transport-network-ten-t_en.

Transport & Environment. 'Shipping Emissions: Latest Data'. Accessed 2 December 2023. https://www.transportenvironment.org/challenges/ships/european-shipping-emissions-2022/.

United Nations. 'Net Zero Coalition'. United Nations. United Nations, n.d. https://www.un.org/en/climatechange/net-zero-coalition.

———. 'What Is Climate Change?' United Nations. United Nations, n.d. https://www.un.org/en/climatechange/what-is-climate-change.

Vlaamse overheid, Departement Mobiliteit en Openbare Werken. 'WALSTROOM AANVRAGEN', 2023. https://www.binnenvaartservices.be/nl/walstroom/walstroom-aanvragen.

Vlaanderen Department Mobiliteit en Openbare Werken. 'PERSBERICHT: ENERGIEBESPARENDE INVESTERINGEN BANEN DE WEG VOOR WALSTROOM', 16 September 2021. https://www.binnenvaartservices.be/nl/walstroom/nieuws.

Waterborne. 'STRATEGIC RESEARCH AND INNOVATION AGENDA FOR THE PARTNERSHIP ONZERO-EMISSION WATERBORNE TRANSPORT', 2021. https://www.waterborne.eu/images/210601_SRIA_Zero_Emission_Waterborne_Transport_1.2_final_web_low.pdf.

Wirtschaftskammer Wien. 'Schifffahrtsrechtsnovelle-Verordnung 2023 (BGBl. II Nr. 204/2023)', 2023.

Annex

A. Questionnaire

To whom it may concern,

We trust this message finds you well.

We are Alexa Popescu, Victoria Ceretti, and Meyha Sharma, Master students at the Geneva Graduate Institute (IHEID). We are currently engaged in a project in collaboration with IG River Cruise (IGRC) for the **European Cruise Investment Plan**. The objective is to evaluate the state of development of **OPS (Onshore Power Supply)** technology in **European Inland Waterways ports** for **river cruise vessels**. Additionally, the project seeks to assess the future investment needs necessary to promote OPS infrastructures across Europe.
We are writing to kindly ask for your invaluable assistance in gathering the necessary data for our project. Should you be able to provide any of the requested data listed below about European river cruise ports, we would be immensely grateful. Your collaboration is of great importance to us, and we sincerely thank you in advance for your support. Here is the list of information we need:

- Port name (city), country, river*:
- Maximum number of river cruise ships that can be docked at the same time in the port*:
- OPS availability* (yes/no):

If yes:

  - Maximum number of OPS power lock connections that can be used by river cruises at the same time*:
  - OPS status (planned, funded, or implemented)*:
  - Active date of OPS (Month, Year):
  - OPS cost (Euros):
  - OPS funding source (Private, City, Country, EU funds, etc.):
  - Last update (Month, Year):

The information we need most is marked with an asterisk. The rest would be nice to know.

We assure you that the data you are sharing with us will be treated with the highest level of confidentiality. Your support in providing this information would be invaluable to the success of this research project in collaboration with IGRC.
Should you have any questions or require further clarification, please do not hesitate to contact us at arp2023.decarbonize@graduateinstitute.ch.
We appreciate your willingness to contribute and look forward to your valuable input.

Best regards,
Alexa Popescu, Victoria Ceretti, and Meyha Sharma
MINT Master Students
Geneva Graduate Institute (IHEID)

B. OPS availability for TEN-T Core inland waterways ports

Table A.1: Information on the availability of OPS for TEN-T Core inland waterways ports in the EU.

	Country	City Port	River	OPS availability		Country	City Port	River	OPS availability
1	Austria	Linz	Danube	Yes	24	Germany	Karlsruhe	Rhine	No
2	Austria	Vienna	Danube	Yes	25	Germany	Koblenz	Rhine	Yes
3	Belgium	Antwerp City	Scheldt	Yes	26	Germany	Köln	Rhine	Yes
4	Belgium	Brussel	Rhine	Yes	27	Germany	Magdeburg	Elbe	No
5	Belgium	Gent	Lys	Yes	28	Germany	Mainz	Rhine	Yes
6	Belgium	Kortrijk	Leie	NA	29	Germany	Mannheim	Rhine	Yes
7	Belgium	Liège	Meuse	No	30	Germany	Nürnberg	Main-Danube Canal	Yes
8	Belgium	Namur	Meuse/Sambre	No	31	Germany	Regensburg	Danube	Yes
9	Bulgaria	Rousse (Ruse)	Danube	No	32	Germany	Regensburg	Danube	Yes
10	Bulgaria	Vidin	Danube	Yes	33	Hungary	Budapest	Danube	Yes
11	Czech Republic	Prague	Elbe	NA	34	Netherlands	Amsterdam	Amstel	Yes
12	France	Le Havre	Seine	NA	35	Netherlands	Bergen	Zoom River	NA
13	France	Lyon	Rhône	Yes	36	Netherlands	Deventer	IJssel River	Yes
14	France	Lyon QF	Rhône	Yes	37	Netherlands	Nijmegen	Waal River	Yes
15	France	Metz	Moselle	NA	38	Netherlands	Rotterdam	Meuse	No
16	France	Mulhouse	Rhine	NA	39	Netherlands	Utrecht	Amsterdam-Rhine Canal	No
17	France	Paris	Seine	Yes	40	Netherlands	Vlissingen	Western Scheldt	NA
18	France	Rouen	Seine	No	41	Portugal	Porto	Douro	No
19	France	Strasbourg	Rhine	No	42	Romania	Calafat	Danube	Yes
20	Germany	Duisburg	Rhine	Yes	43	Romania	Cernavoda	Danube	Yes
21	Germany	Neuss-Düssel	Rhine	Yes	44	Romania	Constanta	Danube	Yes
22	Germany	Frankfurt	Main	No	45	Romania	Giurgiu	Danube	Yes
23	Germany	Hamburg	Elbe	NA	46	Slovakia	Bratislava	Danube	Yes

C. OPS availability for TEN-T Comprehensive inland waterways ports

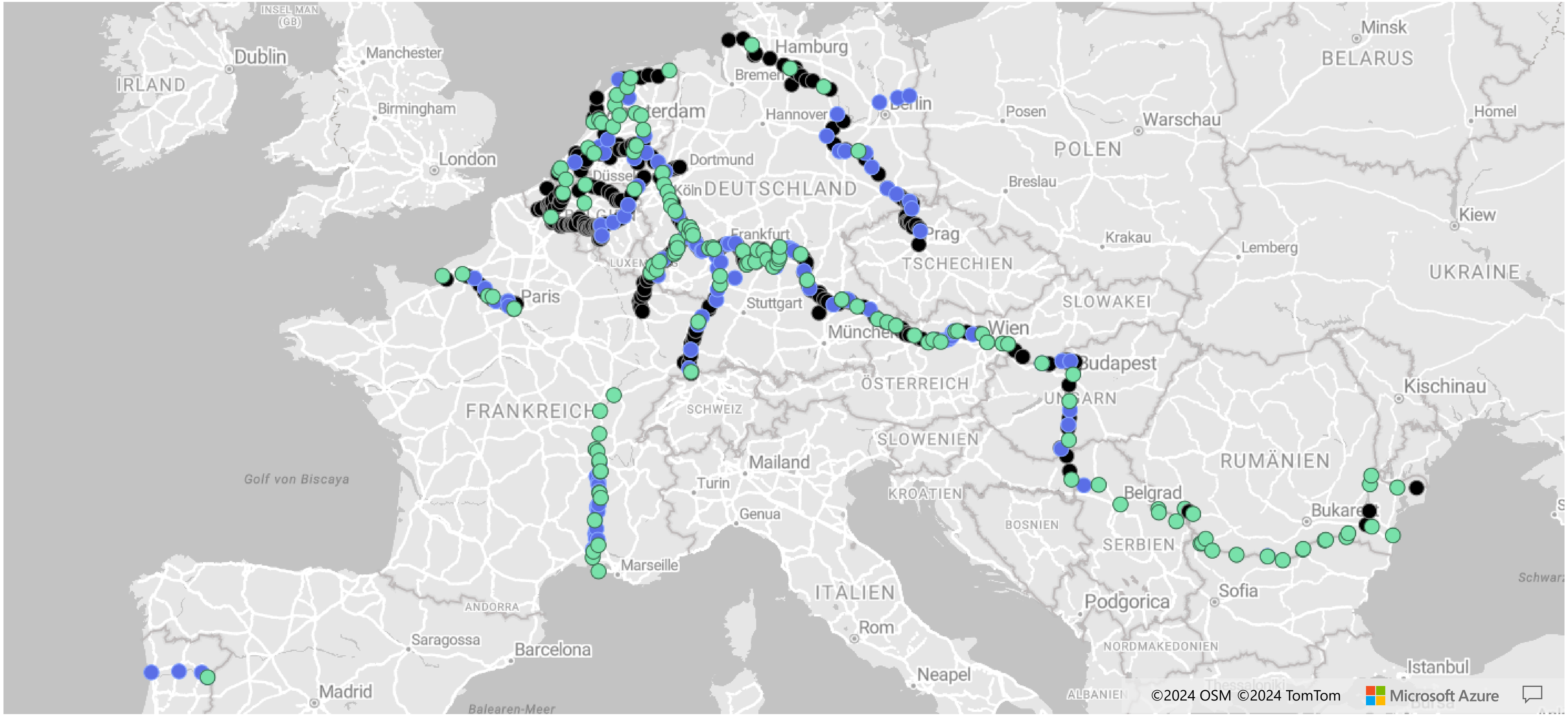
Table A.2: Information on the availability of OPS for TEN-T Comprehensive inland waterways ports in the EU.

	Country	City Port	River	OPS availability		Country	City Port	River	OPS availability
1	Austria	Krems	Danube	Yes	31	Germany	Straubing	Danube	No
2	Belgium	Mons	Haine	NA	32	Germany	Trier	Moselle	Yes
3	Belgium	Tournai	Scheldt River	Yes	33	Germany	Wesel	Rhine	No
4	Bulgaria	Lom	Danube	Yes	34	Germany	Wesseling	Rhine	NA
5	Bulgaria	Silistra	Danube	Yes	35	Germany	Wiesbaden	Rhine	No
6	Czech Republic	Lovosice	Elbe	NA	36	Germany	Worms	Rhine	No
7	France	Arles	Rhône	Yes	37	Hungary	Baja	Danube	Yes
8	France	Thionville	Moselle	NA	38	Netherlands	Alkmaar	Zaan River	NA
9	Germany	Andernach	Rhine	Yes	39	Netherlands	Arnhem	Rhine	Yes
10	Germany	Aschaffenburg	Main	Yes	40	Netherlands	Beverwijk	North Sea Canal	NA
11	Germany	Bonn	Rhine	No	41	Netherlands	Born	Julianakanaal	NA
12	Germany	Breisach	Rhine	No	42	Netherlands	Cuijk	Meuse	No
13	Germany	Brunsbüttel	Elbe	NA	43	Netherlands	Dordrecht	Meuse	Yes
14	Germany	Dormagen	Rhine	No	44	Netherlands	Gorinchem	Linge	No
15	Germany	Emmerich	Rhine	No	45	Netherlands	Groningen	Drentsche Aa	NA
16	Germany	Gelsenkirchen	Rhine	NA	46	Netherlands	Harlingen	Harinxma Canal	No
17	Germany	Germersheim	Rhine	No	47	Netherlands	Kampen	IJssel	Yes
18	Germany	Gernsheim	Rhine	No	48	Netherlands	Leeuwarden	Zwette	Yes
19	Germany	Hanau	Main	No	49	Netherlands	Lelystad	IJsselmeer Lake	NA
20	Germany	Herne	Rhine	NA	50	Netherlands	Maasbracht	Meuse	Yes
21	Germany	Iffezheim	Rhine	NA	51	Netherlands	Maastricht	Meuse	No
22	Germany	Kehl	Rhine	Yes	52	Netherlands	Roermond	Meuse	NA
23	Germany	Kelheim	Danube	No	53	Netherlands	Sneek	Sneekermeer Lake	Yes
24	Germany	Krefeld	Rhine	NA	54	Netherlands	Tiel	Waal River	NA
25	Germany	Ludwigshafen	Rhine	No	55	Netherlands	Venlo	Meuse	NA
26	Germany	Mülheim	Main	NA	56	Netherlands	Zaandam	Zaan	Yes
27	Germany	Raunheim	Main	NA	57	Netherlands	Zwolle	IJssel	Yes
28	Germany	Rees	Rhine	NA	58	Romania	Calarasi	Danube	Yes
29	Germany	Speyer	Rhine	Yes	59	Romania	Moldova Veche	Danube	Yes
30	Germany	Stade	Elbe	NA	60	Romania	Tulcea	Danube	Yes

OPS Availability EU Inland Waterways

For river cruise ports

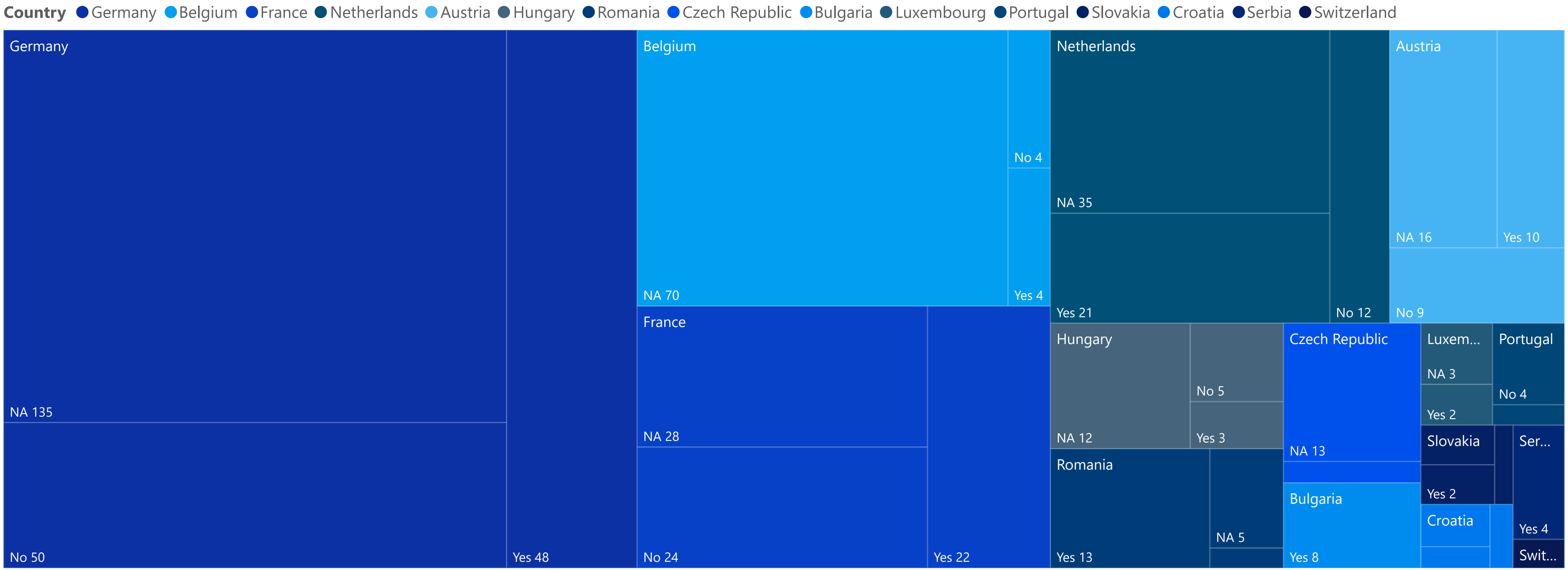
OPS Availability ● NA ● No ● Yes



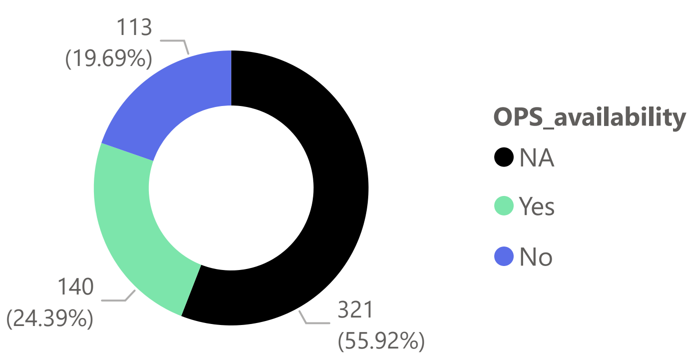
The data was provided by various port operators or other cruising ports related entities. For more details on the data collection and description consult the report.
This map was created by Alexa Popescu, Victoria Ceretti, and Meyha Sharma at the Geneva Graduate Institute.

Quickmeasure

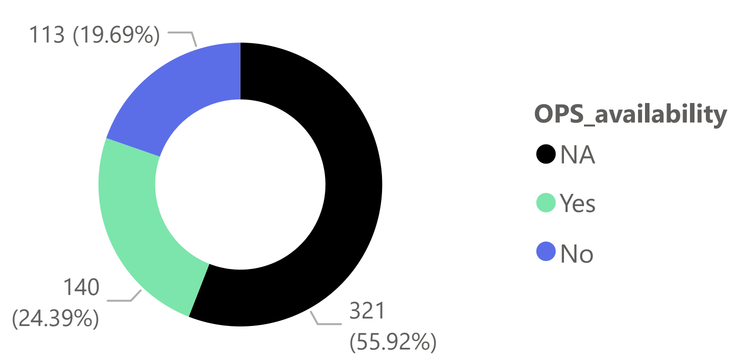
Cumulative OPS availability by Country



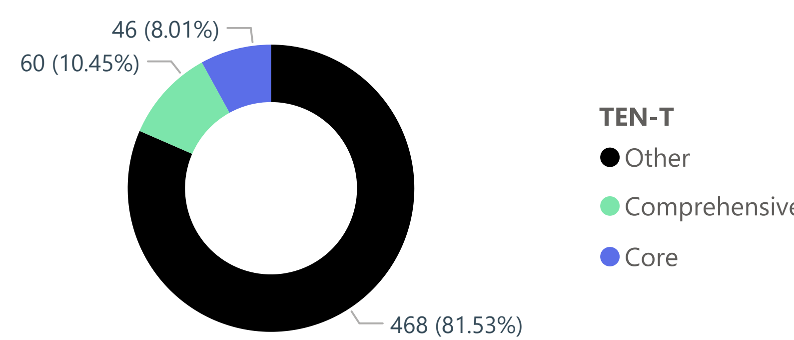
OPS availability for all ports (N=574)



OPS availability for TEN-T ports (N=106)

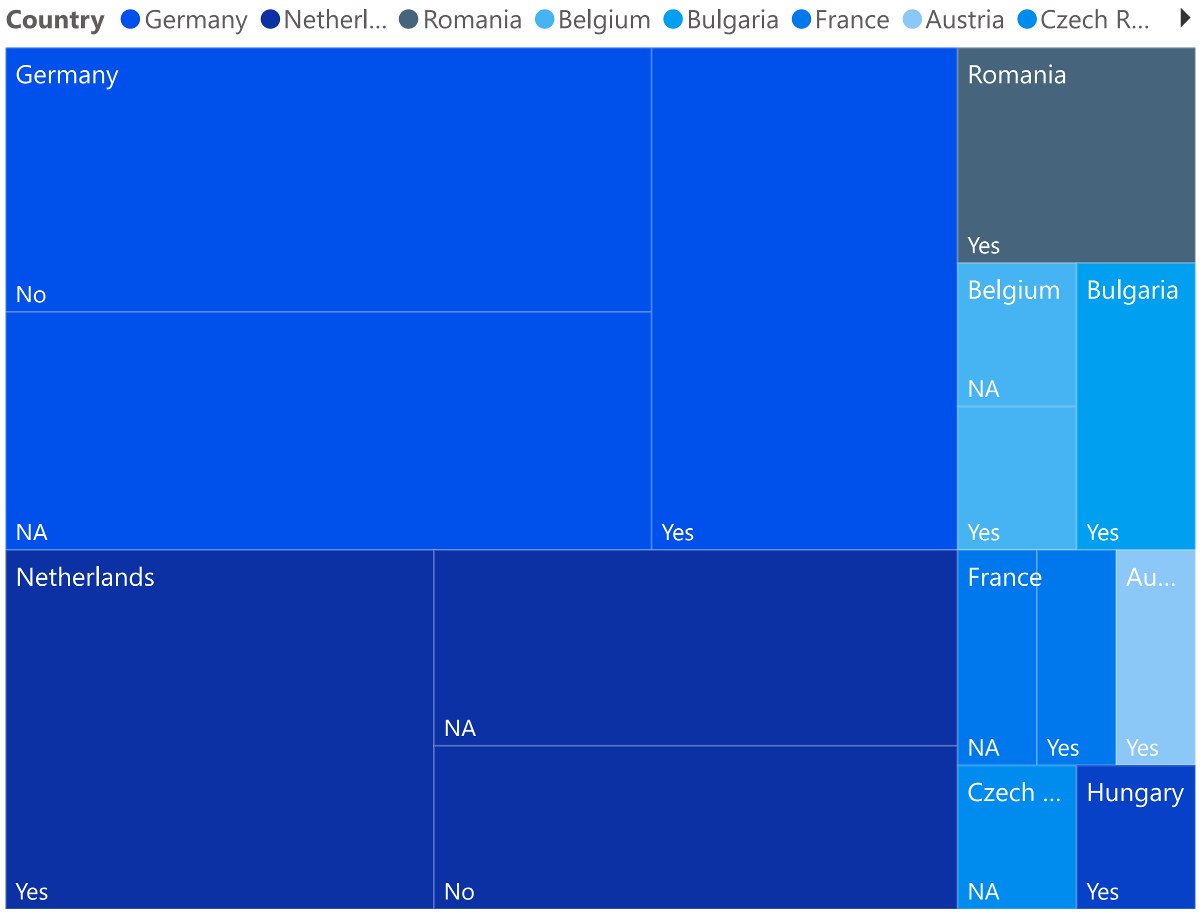


Port Category

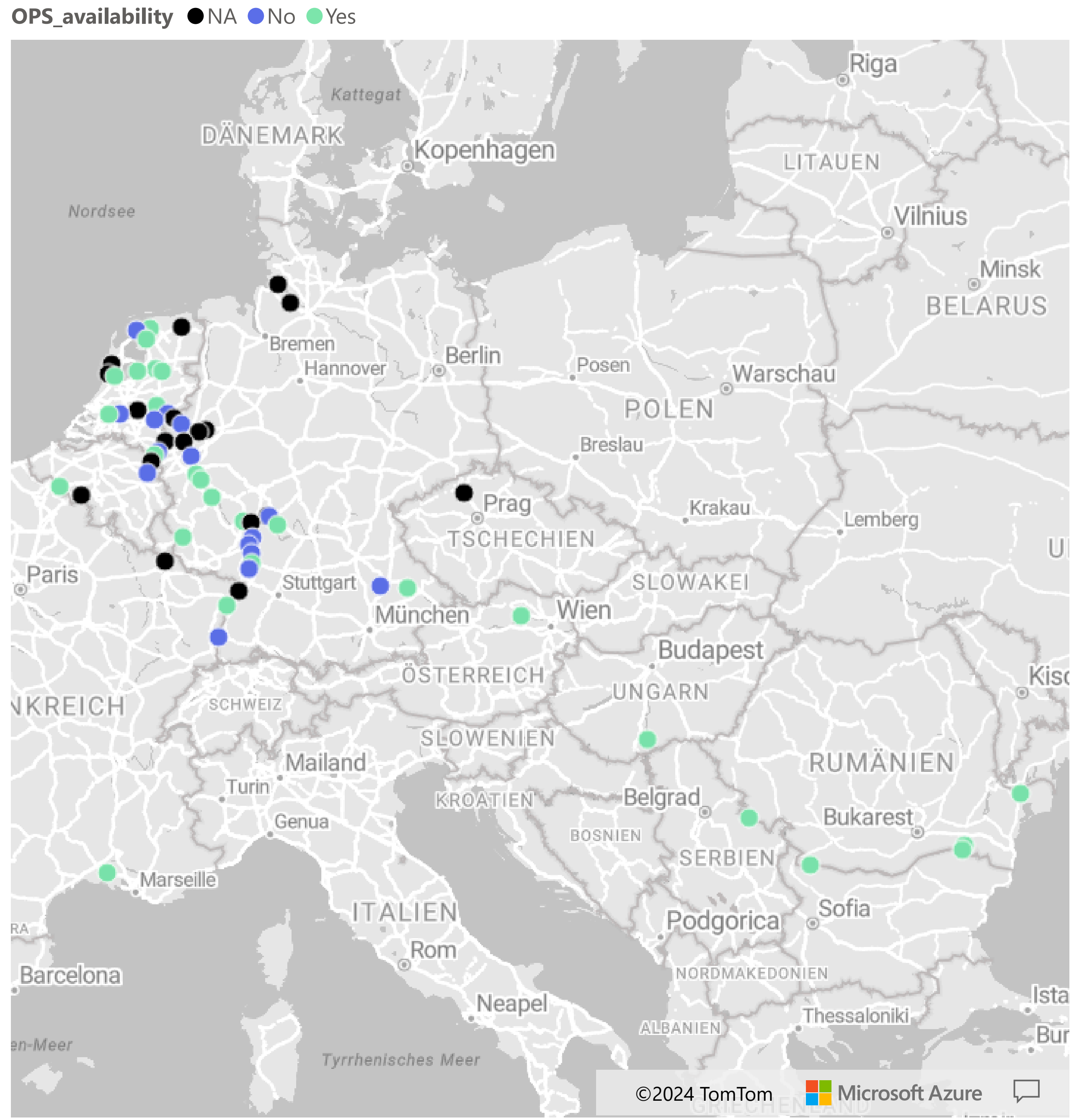


Quickmeasure

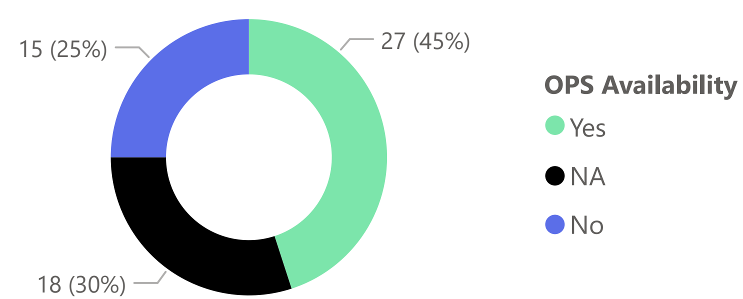
Cumulative OPS availability by Country for TEN-T Comprehensive ports



OPS availability for TEN-T Comprehensive ports

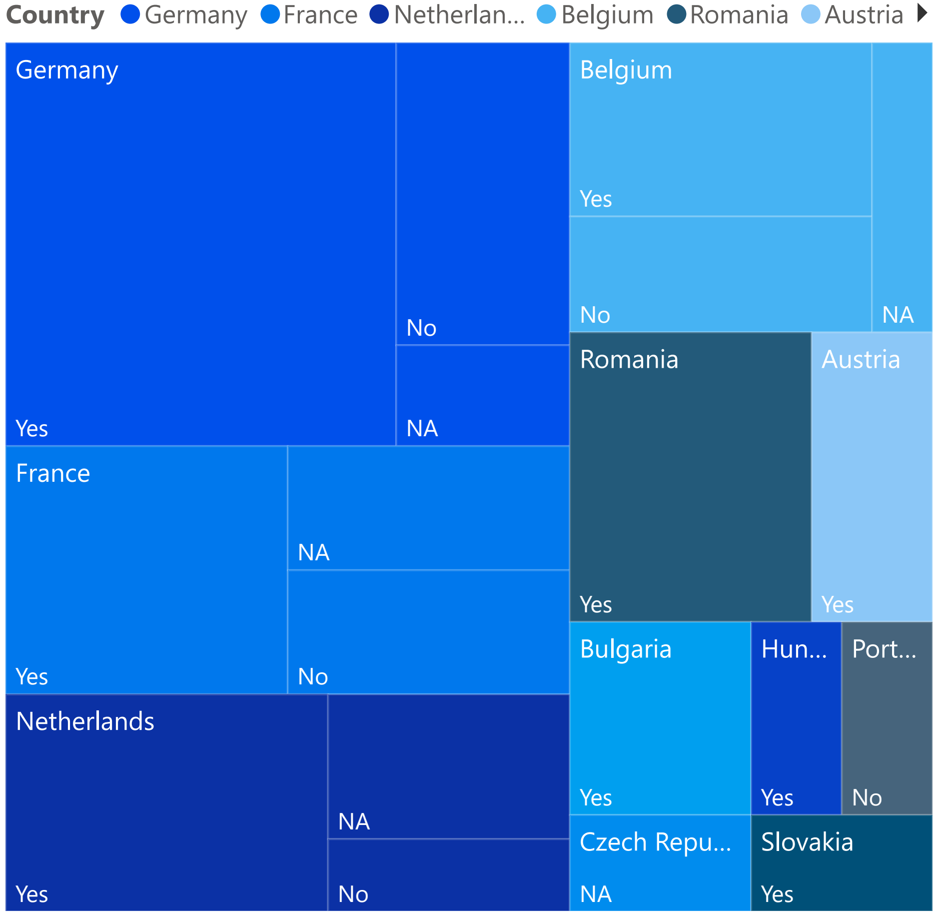


OPS availability for TEN-T Comprehensive Ports (N=60)

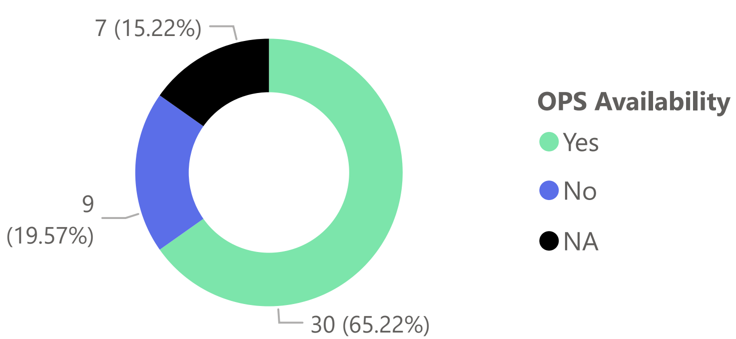


Quickmeasure

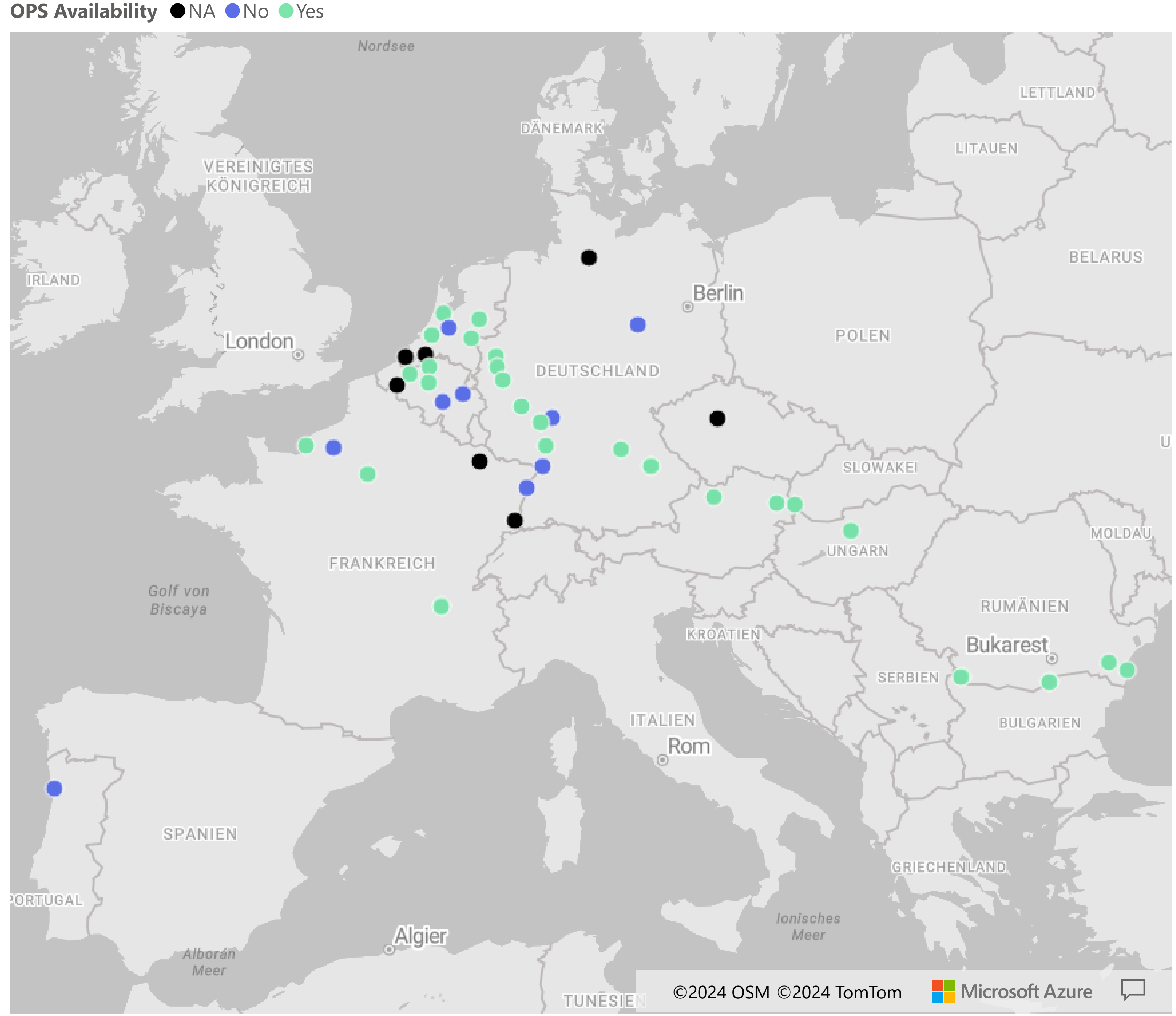
Cumulative OPS availability Country for TEN-T Core ports



OPS availability for TEN-T Core ports (N=46)



OPS availability for TEN-T Core Ports



Quickmeasure

OPS Information Complete Data Set

Country	City	River	TEN-T	OPS availability	Maximal cruises docking capacity	Total OPS powerlock connections	OPS progress status	Active Date OPS	OPS cost	OPS funding source
Switzerland	Basel	Rhine	Other	Yes	12	6	6x Implemented / Klybeckquai: funded	10.2024	St. Johann und Dreiländereck approx.. 1 MCHF each / Klybeckquai approx.. 0.5 MCHF	Funding by Port of Switze port authority)
Slovakia	Bratislava	Danube	Core	Yes	15	NA	NA	NA	NA	NA
Slovakia	Gabcikovo	Danube	Other	NA	1	NA	NA	NA	NA	NA
Slovakia	Komarno	Danube	Other	Yes	2	NA	NA	NA	NA	NA
Slovakia	Samorin-Cilistov	Danube	Other	NA	1	NA	NA	NA	NA	NA
Slovakia	Sturovo	Danube	Other	No	2	0	NA	NA	NA	NA
Serbia	Beograd	Danube	Other	Yes	NA	NA	Planned	NA	NA	NA
Serbia	Donji Milanovac	Danube	Other	Yes	NA	NA	Planned	NA	NA	NA
Serbia	Golubac	Danube	Other	Yes	NA	NA	Planned	NA	NA	NA
Serbia	Novi Sad	Danube	Other	Yes	NA	NA	Planned	NA	NA	NA
Romania	Braila	Danube	Other	Yes	1	NA	NA	NA	NA	NA
Romania	Calafat	Danube	Core	Yes	1	NA	NA	NA	NA	NA
Romania	Calarasi	Danube	Comprehensive	Yes	1	NA	NA	NA	NA	NA
Romania	Cernavoda	Danube	Core	Yes	1	NA	NA	NA	NA	NA
Romania	Cetate	Danube	Other	Yes	1	NA	NA	NA	NA	NA
Romania	Chiciu	Danube	Other	NA	1	NA	NA	NA	NA	NA
Romania	Constanta	Danube	Core	Yes	1	NA	NA	NA	NA	NA
Romania	Crisan	Danube	Other	NA	1	NA	NA	NA	NA	NA
Romania	Djerdap	Danube	Other	NA	2	NA	NA	NA	NA	NA
Romania	Fetesti	Danube	Other	NA	2	NA	NA	NA	NA	NA
Romania	Galati	Danube	Other	Yes	1	NA	NA	NA	NA	NA
Romania	Giurgiu	Danube	Core	Yes	3	NA	NA	NA	NA	NA

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