LIGHTHOUSE

SWEDISH MARITIME COMPETENCE CENTRE

LIGHTHOUSE REPORTS

Sustainable development of archipelagic port infrastructures

A prestudy carried out within the Swedish Transport Administration's industry program Sustainable Shipping, operated by Lighthouse, published in June 2025

www.lighthouse.nu

LIGHTHOUSE
SWEDISH MARITIME COMPETENCE CENTRE

HÅLLBAR SJÖFART

Sustainable development of archipelagic port infrastructures

Author
Henrik Ringsberg, Chalmers University of Technology

In cooperation with
Chalmers University of Technology

University of Gothenburg

Region Stockholm

Region Västra Götaland

Business region Västra Götaland

Tjörn Municipality

Katrineholm Municipality

Grums municipality

Öckerö municipality

Stockholms stad

A prestudy project carried out within the Swedish Transport Administration's industry program Sustainable Shipping, operated by Lighthouse

Summary

Society's increased demands for environmentally, socially and economically sustainable maritime transport in the archipelago have brought new challenges to the development of port infrastructure. Local and regional level public authorities with archipelagic ports face an increased pressure to develop port infrastructures to meet international- and national regulatory guidelines to reduce greenhouse gas emissions and increase accessibility.

This project explores regulatory policies and strategies as well as challenges at public authorities in planning of sustainable development of archipelagic port infrastructures. The project comprises a structured literature review of published scholarly papers and regulatory policies and strategies on sustainable development of archipelagic port infrastructures. It further includes a case study of two regions, four municipalities and six port authorities. Semi structured group interviews conducted in the case study comprise knowledge about regulatory policies and strategies and challenges in development of archipelagic port infrastructures.

Based on the conducted structured literature review the project present a conceptual model showing that port infrastructure development takes place based on the interaction between regulatory guidelines, and directives at the three levels: 1) first international level, 2) second international level, and 3) national level. The project further shows that relevant national regulations in development of archipelagic port infrastructures comprise statutory acts on port development as well as on societal planning. The case study showed however a challenge in a lack of stakeholder knowledge regarding international and national regulations on development of archipelagic port infrastructures.

Based on the case study results, the project further categorises challenges in sustainable development of archipelagic port infrastructures into the three categories: 1) collaboration, communication, governance, 2) funding, and 3) geographical and physical challenges (to meet accessibility requirements).

According to the results, presented challenges in the first category comprise lack in development of a structured and institutionalized collaboration and business forums, of communication between national, regional and local stakeholders, and operational capability, of competence, and political adaptability.

Similarly, the project shows that challenges in in the second category include insecurity in long term investments, uncertainty in ownership, maintenance and knowledge about green technology, the absence of a clear and stable demand of renewable energy, inconsistent funding, and a lack of funding for cooperation and collaboration between regional authorities.

Finally, the project shows that geographical challenges comprise logistical challenges due to long distance, and increased cost for construction and maintenance of energy nodes in remote archipelagic areas, and physical challenges in meeting accessibility requirements on renewable energy, service, and safety and people.

Sammanfattning

Samhällets ökade krav på miljömässigt, socialt och ekonomiskt hållbara sjötransporter i skärgården har medfört nya utmaningar för utvecklingen av hamninfrastruktur. Lokala och regionala myndigheter med skärgårdshamnar står inför ett ökat tryck att utveckla hamninfrastrukturer för att uppfylla internationella och nationella regulatoriska riktlinjer för att minska utsläppen av växthusgaser och öka tillgängligheten.

Detta projekt utforskar regulatoriska policyer och strategier samt utmaningar för myndigheter i planeringen av hållbar utveckling av skärgårdshamninfrastrukturer. Projektet omfattar en strukturerad litteraturgenomgång av publicerade vetenskapliga artiklar och regulatoriska policyer och strategier för hållbar utveckling av skärgårdshamninfrastrukturer. Det inkluderar vidare en fallstudie av två regioner, fyra kommuner och sex hamnmyndigheter. Semistrukturerade gruppintervjuer som genomförts i fallstudien omfattar kunskap om regulatoriska policyer och strategier samt utmaningar vid utveckling av skärgårdshamninfrastrukturer.

Baserat på den genomförda strukturerade litteraturgenomgången presenterar projektet en konceptuell modell som visar att utveckling av hamninfrastruktur sker baserat på samspelet mellan regulatoriska riktlinjer och direktiv på tre nivåer: 1) första internationella nivån, 2) andra internationella nivån och 3) nationell nivå. Projektet visar vidare att relevanta nationella regleringar för utveckling av arkipelagiska hamninfrastrukturer omfattar lagar om hamnutveckling såväl som om samhällsplanering. Fallstudien visade dock en utmaning i brist på intressenters kunskap om internationella och nationella regleringar för utveckling av arkipelagiska hamninfrastrukturer.

Baserat på fallstudiens resultat kategoriserar HISS-projektet vidare utmaningar inom hållbar utveckling av arkipelagiska hamninfrastrukturer i tre kategorier: 1) samarbete, kommunikation, styrning, 2) finansiering och 3) geografiska och fysiska utmaningar (för att uppfylla tillgänglighetskrav).

Enligt de presenterade resultaten omfattar utmaningarna i den första kategorin brist på utveckling av ett strukturerat och institutionaliserat samarbete och affärsforum, kommunikation mellan nationella, regionala och lokala intressenter, samt operativ förmåga, kompetens och politisk anpassningsförmåga.

På liknande sätt visar projektet att utmaningar i den andra kategorin inkluderar osäkerhet i långsiktiga investeringar, osäkerhet kring ägande, underhåll och kunskap om grön teknik, avsaknad av en tydlig och stabil efterfrågan på förnybar energi, inkonsekvent finansiering och brist på finansiering för samarbete och samverkan mellan regionala myndigheter.

Slutligen visar projektet att geografiska utmaningar omfattar logistiska utmaningar på grund av långa avstånd, och ökade kostnader för byggande och underhåll av energinoder i avlägsna skärgårdsområden, samt fysiska utmaningar med att uppfylla tillgänglighetskrav för förnybar energi, service, säkerhet och människor.

Contents

1 Introduction

Ports are critical in development of well-functioning economies, regional economies, and global supply chains (Verschuur et al., 2022). In a transport network, ports are physical nodes that connects original and hinterland transport of freight and people (Dekker, 2005; Kaliszewski, 2018). Because of this, ports integrate systems for provision of energy, information exchange and transport (Lind et al., 2021). During the last decade development of inland ports have received increased attention in policy (Witte et al., 2016) and in academia (Wiegmans et al., 2015). An inland port connects hinterland locations with a waterway transport corridor (Witte et al., 2016), being important in economic development of regions and municipalities (Wu et al., 2022). In this report an archipelagic port is defined as an inland port located within and serves a group of islands in a region through a waterway transport corridor.

Increased sustainability requirements (Roh et al., 2016; Haezendonck & Langenus, 2019) and demand for multi/intermodal transport (Kaliszewski, 2018; Abu-Aisha et al., 2024) have increased the attention on societal and environmental challenges in development of port infrastructures. For example, according to set climate and energy goals for 2030 in the European Union, 32% of all energy supply should come from renewable energy sources (Lu et al., 2020). In compliance with the stated climate and energy goals, the use of low-carbon fuels, such as electricity, hydrogen, or ethanol have been included in port development decisions (Platias & Spyrou, 2023). In addition to this, Renewable Energy Communities (RECs), comprising of citizens, social entrepreneurs, public authorities, and community organizations which collaborate on energy transition, provide benefits in economic development, job creation, reduced energy costs, enhanced self-sufficiency, strengthened community cohesion, and improved energy security (Cohen et al., 2016). Sustainable development of port infrastructures must comprise a balance between economic growth, environmental impact (Monios & Bergqvist 2019) and quality of life of communities (Gimenez et al., 2012). Investments in development of port infrastructures must be incorporated in planning decisions (Verschuur et al., 2022). Despite many published studies, there is still a lack in published reports on sustainable development of archipelagic port infrastructures. Published studies on sustainable development of inland port infrastructure are also adversely affected by a lack of data from municipalities and regions (Witte et al., 2019).

The purpose of the HISS project was to explore regulatory policy´s and strategies as well as challenges at public authorities in planning of sustainable development of archipelagic port infrastructures. Based on the stated purpose the two research questions (RQs) were used:

1. How do public regional and local authorities comply with regulatory requirements on sustainable development of archipelagic port infrastructures?
2. Which challenges exists in planning of sustainable development of archipelagic port infrastructures?

2 Methodology

A Systematic Literature Review (Tranfield et al., 2003) of scholarly papers was firstly conducted. The results from the SLR were used as references in the introduction, in the development of interview questions used for collection and in the analysis of empirical data. Empirical data were collected in a case study (Yin, 2009) of planning departments at local and regional public authorities in Sweden.

2.1 Systematic Literature Review (SLR)

The SLR was conducted in six-steps according to Sauer & Seuring,(2023) guidelines; Step 1 definition of the two research questions based on specification of research gap, theoretical constructs (see section 1); step 2 set of criteria for inclusion and exclusion of relevant papers; the start date for the SLR was set to October 22nd (2014) based on the release of the European Directive (EU) 2014/94 on the deployment of alternative fuels infrastructure (European Commission, 2014), and the end-date was set to February 2nd (2025) (end of the project). Further, to determine the relevance of an identified paper in the SLR, the following inclusion criteria were used:

- Scientific study/studies
- Peer-reviewed papers
- Abstract and keywords matches the purpose of this study
- Published in English

Step 3 comprised selection of journals in maritime transport, transport, ocean engineering, policy and development, and sustainability found in Web-of-Science (WoS) and Scopus databases. This was followed by development of search strings for retrieving potentially relevant papers to this study (Table 1). In step 4 retrieved potential papers were assessed based on the inclusion criteria (in step 2), and duplicates among identified papers were removed, which ended up in total of selected potential papers (Table 1).

Table 1 Search strings and databases used in the structured literature review

Search strings	**Search field**	**Web of Science**		**Scopus**		**Total amount of papers included**
		Number of identified papers	Number of selected potential papers	Number of identified papers	Number of selected potential papers	
"Port Infrastructure" AND "Sustainable Development"	Article Title, Abstract, keywords	36	4	72	6	9
"Port Infrastructure" AND "Regulations"	Article Title, Abstract, keywords	29	1	58	3	4
"Archipelago" AND "Port"	Article Title, Abstract, keywords	13	1	19	2	3
"Renewable energy" AND "Infrastructure" AND "PORT"	Article Title, Abstract, keywords	43	4	178	10	9

"Inland Waterways" AND "Ports"	Article Title, Abstract, keywords	31	1	106	0	1
"Sustainable Energy Development" AND "Infrastructure"	Article Title, Abstract, keywords	79	3	80	2	4
Total						**30**

In step 5, the potentially relevant papers (from step 4) were fully analysed based on direct content analysis (Hsieh & Shannon, 2005). This reduced the number of pertinent scholarly papers to totally 30 included as references in this report. In addition to the SLR on scholarly papers, relevant international, European and national policies on sustainable shipping, sustainable development of port infrastructures were identified in EUR-lex, IMO and Swedish parliament databases. In total, 16 relevant regulations (1 international, 6 European and 9 national) were identified and included as references.

2.2 Case study design and context area

Case studies are useful in policy analysis of a particular organisation or event (Trochim & Donelly, 2008). In addition, case studies should be used if the objective is to clarify a particular and complex situation by investigation of a contemporary phenomenon within its real-life context and when the boundaries between phenomenon and context are not clear (Yin, 2009). Daviter (2019) states that analysis of policies includes systemic complexity, due to competing problem boundaries, and unclear evaluative standards. Yin (2009) further emphasizes usage of case studies that include how or why research questions.

Published studies shows that stakeholders involved in development of archipelagic port infrastructures comprise policy makers at local level (Ringsberg, 2023; Bruzzone et al., 2021), regional level (Ringsberg, 2023), and public transport operators (Ringsberg, 2023; Bruzzone et al., 2021). Table 2 shows the statutory level of represented policymakers at public authorities included in the case study.

2.3 Case study data collection

Following the guidelines on collection of data based on combination of methods (Trochim & Donnelly, 2008) in case studies, empirical data were collected from interviews and review of internal documents (Yin, 2009)

Interviews

Interviews in the case study were conducted as mixed focus group interviews which include both open- and closed-ended questions posed by the researcher (Tashakori & Teddlie, 2003), and as semi-structured interviews since this allows the respondent to delve into topics related to the phenomenon under study (Blumberg et al., 2011). Mixed focus group interviews implies that the researcher allows a group of 2-12 respondents to delve into topics related to the phenomenon under study, but also keep the respondents focused by bringing them back to the studied phenomenon when needed. Moreover, mixed focus group interviews are especially relevant if the purpose is to explore a groups' thinking on a research topic (Tashakori & Teddlie, 2003).

In total seven mixed focus group interviews were conducted with respondents at Swedish public local and regional level authorities (Table 3) lasting 1-1,5 hours, and 12 semi-structured interviews with ports in Sweden, lasting between 30-45 mins, (Table 4). Open-ended questions, included in the mixed and semi-structured interviews, focused on knowledge in European and national regulatory guidelines on development of port infrastructure, and on strategic planning in sustainable development of archipelagic port infrastructures (in total 9). Similarly, closed-ended questions used during the interviews focused challenges on sustainable development archipelagic port infrastructures (in total 17). Closed-ended questions were asked at the end of each interview, in which the representative was asked to respond on Multiple- Choice Question (MCQ) about the importance in considering different published challenges in development of sustainable archipelagic port infrastructures. In addition to the mixed focus group interviews, internal documents were retrieved from public authorities included in the study (Table 2).

Table 2 Public authorities, internal documents and interviews included in the study

Statutory level	**Public authority**	**Internal document**	**Interviews**	
			Position of the respondent	No of years at the position
Regional level	Stockholm	• Report from the project "Replipunkter – the gateway to the archipelago" • Archipelago fact report • Report from the project "Kasta loss" • Guidelines on co-financing of bridges	System manager, Sea	2
			System manager, Sea & bus	2
	Region Västra Götaland	• Strategic plan for infrastructure development • Regional plan for transport infrastructure • PMs Infrastructure and Public Transport Committee • Status survey reports on social sustainability in regional transport planning • Transport-efficient society and regional infrastructure plans	Regional planner focus marine ports	3
Local level	Öckerö municipality	• Master plan • In-depth master plan • Traffic investigations	Department chef, social developer	3
	Tjörn municipality	• Master plan • Detail plan	Business development officer	9
			General planner	9,5
	Grums municipality	• Master plan	Regional planner	2
	Kristinehamn municipality	• Master plan	Urban planner	2

Table 3 Swedish port authorities included in the study

Port authority	Respondent position	Number of years in the position
A	Port Manager	3
	Infrastructure manager	5
B	Traffic and Goods Coordinator	4
C	Regional Industry and Developing Planner	9
D	Port Manager	12
E	Port Manager	8
F	Infrastructure Architect	5
	Project leader infrastructure	5

All respondents were selected by convenience sampling (Creswell, 2014). The interviews were transcribed verbatim (exactly as spoken) following Lavrakas (2008) guidelines. Transcribed interviews were thereafter sent back to the respondent for validation (Yin, 2009), without any requested changes and were finally anonymised in the analysis. In addition to the interview questions, respondents were asked three initial questions about their gender, position in the company and the number of years in the position. 11 of the respondents were men, seven of them were women, and the respondents had between 3-12 years of experience in their respective positions (Table 2 and 3).

2.4 Data analysis

Directed content analysis (Hsieh & Shannon, 2005) were used in the analysis of the papers identified in the SLR, of regulations and of internal documents retrieved from regional and local public authorities. Knowledge about integration of regulations into regional and municipal strategies, on collaboration (Lu et al., 2020; Puustinen et al., 2024), and consideration to sustainability requirements (mobility of passengers, access to sustainable energy and finance) (Lu et al., 2020) in development of archipelagic port infrastructures were identified in the SLR. These were used as units of analysis in the analysis of open-ended questions in the mixed focus group- and semi-structured interviews. NVivo 12 software was used to analyse the transcribed mixed focus group, and semi-structured interviews (Lumivero, 2024). To enhance external validity methodological triangulation was applied on the results from the SLR, the semi-structured interviews focus group interviews (Fusch et al., 2018).

3 Results

3.1 Literature review

3.1.1 Archipelagic ports and public authorities involved in development of their infrastructure

A port is a transport hub in the transport and logistic network, and a value-adding transit point due to its location. The importance of a port's location is affected by economic, technical, and political changes, and advantages of a port site characterized by physical features such as water depth, access channels, hinterland transport network, and available land. (Noteboom et al., 2022). Further, as a transport hub an inland port is characterized by the relationship between an inland port, inland waterway terminal, and a municipality, (Wiegmans et al., 2015; Wu et al., 2018). In addition to the above characteristics an archipelagic port, as an inland waterway port should characterized based on:

- **Scale**: refers to the assessment of the port size (i.e., its area, annual throughput of passengers or goods, the size of the connected hinterland, the number of shipping services, the number of customers) (Notteboom et al., 2022).
- **Geographical context**: Refers to physical characteristics of the port site and situation such as coastal and inland geography conditions (Notteboom et al., 2022).
- **Governance settings**: Refers to the terms of land ownership and the roles of institutional arrangements between the public and private sectors (Notteboom et al., 2022). Inland ports are also operated by public- or private stakeholders to indicate differences in responsibilities and ownership between the public and private sector, and to facilitate stakeholder business operations (Merkel & Sløk-Madsen, 2019).
- **Functions**: Refers to services offered by the port, such as cargo handling, logistics and distribution, and maritime services. Specializations, refers to handling of cargo and passengers (e.g., cruise ships and public transport ferries) (Notteboom et al., 2022). Another specialization concerns inclusion of marinas providing access and service for private sailing and motorboats (Martínez-Vázquez et al., 2021).

In addition, published research on sustainable integrated passenger and freight transport in archipelagic areas (Ringsberg, 2023; Makkonen et al., 2013; Wear, 2009), and published strategies on development of transport infrastructure reveals that public authorities involved in development of port infrastructures exist on the following levels:

- **Inter-state level:** Comprise the International Maritime Organization (IMO) under United Nations which is responsible for measures to prevent pollution from ships. Because of this IMO is a policy driver, a theoretical guide for energy efficiency and reduction in of air emissions in a port (Wan et al., 2025). As such, IMO sets guidelines on development of port infrastructure & energy infrastructure in ports (IMO, 2023). In addition, in the European Union, the interstate level also includes the European Commission responsible for development and setting of laws, policies and strategies on sustainable development of port infrastructures (European Commission, 2025)

- **State (or national) level:** Comprise government authorities which develop and grant permits for mooring, maritime traffic and has the main responsibility for the development and maintenance of archipelagic fairways. In addition to this, the Swedish Maritime Administration conducts nautical surveying and route optimizations in the archipelagic environment (Garberg, 2024). The governmental authority is funded by taxes under the governance of the Swedish government.
- **Regional level:** Comprise regional authorities which develop and establish regional strategic plans on development of social (Region Västra Götaland, 2019a; 2019b; 2024)- and environmentally sustainable (Region Västra Götaland, 2019a; 2023) transport. In addition, the regional authority develops and establishes strategies on efficient transport infrastructure (Region Västra Götaland, 2019b; 2022;2023; Trivector, 2023; Länsstyrelsen Stockholm, 2021) and traffic safety (Region Västra Götaland, 2019b; 2024) in compliance with national regulations on traffic safety, infrastructure development and on public transport (set by parliament policymakers). The regional public authority is funded by taxes under the governance of the state. In Sweden regional authorities comprise of regions i.e. self-governing and responsible for common tasks within a geographical area, and county administrative boards are state authorities that represent the state in each region. In addition, public transport operator, comprises a limited company owned by the regional public authority responsible for the procurement, planning and development of public transportation services by tram, bus, train and ferries in the region (Ringsberg, 2023)
- **Local level:** refers municipalities with the main responsibility for planning of local transport infrastructure public transport services, terminal operators with the main responsibility for cargo handling operations, and maintenance of terminal equipment and infrastructure (Ringsberg, 2023; Wear, 2009).

3.1.2 Regulatory framework on development of archipelagic port infrastructures

The review of regulatory policy´s and strategies reveal that the Swedish framework on sustainable development of port infrastructures consists of statutory and non-statutory guidelines across four different levels (two international levels and one national level) (Figure 1).

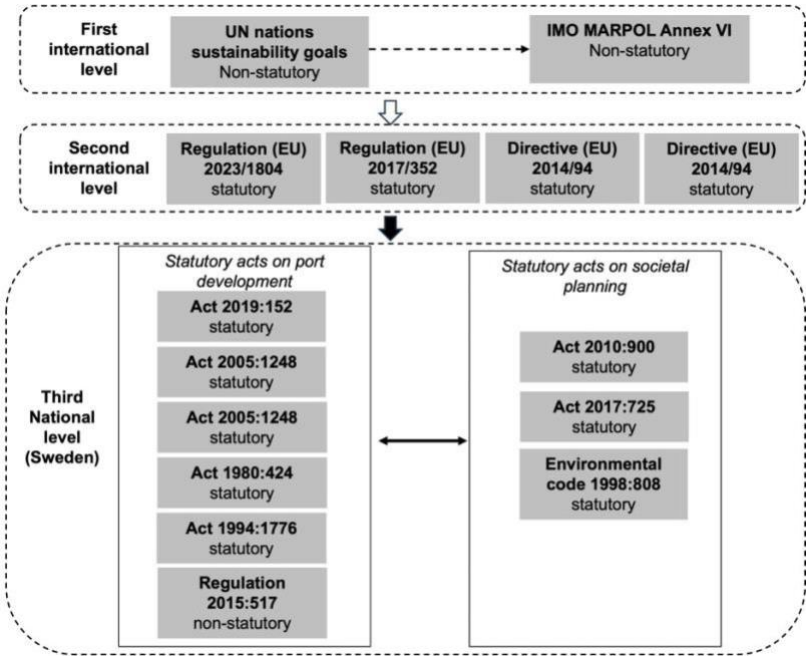

Figure 1 The Swedish framework on sustainable development of port infrastructures.

Notification: non-filled/ dotted arrows = non-statutory compliance, filled arrows= statutory compliance

The first international level

To provide guidance on reduction of air emissions in compliance with UN Sustainable Development Goal 13 Climate Action (Mollaoglu, et al., 2024) IMO has set non-statutory guidelines to phase out GHG emissions from the shipping industry (Nguyen et al., 2022). These guidelines include:

- A comprehensive policy framework of mid- and long-term targets (IMO, 2023).
- A plan for decarbonising international shipping and ports (IMO, 2023).
- Creation of the Maritime Environment Protection Committee (MEPC) to encourage voluntary cooperation between the port and shipping.

In addition to the set guidelines, IMO has included guidelines on the use of biofuels in MARPOL Annex VI. However, non-compliance with non-statutory guidelines on the first international level may lead to stakeholders being banned in the sector, and increased fines (Hopkin, 2018).

The second international level

The second international level exists to provide statutory guidance to national, regional and local public authorities in planning of sustainable development of archipelagic port

infrastructures. For the EU, this level comprises regulations and policies within the "Fit for 55" package which aims to ensure:

- minimum infrastructure to support the required uptake of alternative fuel vehicles across all transport modes and in all EU Member States to meet the EU's climate objectives.
- full interoperability of the infrastructure; and
- comprehensive user information and adequate payment options at alternative fuels infrastructure

The regulations included in the "Fit for 55" package ensures that certain range of alternative fuels are present in close to medium proximity to the Port and are publicly accessible (including hydrogen refuelling stations), electricity supply for ships ensuring the use of shore-side electricity for large seagoing ships and stationary aircraft and refuelling points for liquefied methane (European Commission, 2024). The level comprises the three statutory regulations Regulation (EU) 2023/1804, the Regulation (EU) 2017/352, and the two directives Directive (EU) 2014/94 and Directive (EC) 2009/28. Regulation (EU) 2023/1804 on the deployment of alternative fuels infrastructure includes statutory requirements on access to alternative fuels with low carbon emissions in ports (European Parliament, 2023) and the Regulation (EU) 2017/352 comprise statutory requirements on transparency in port services (European Parliament, 2017). Likewise, the Directive (EC) 2009/28 includes statutory requirements on promoting of renewable energy sources and state that minimum 20% of final energy consumption should be renewable (Lu et al., 2020), and the Directive (EU) 2014/94 statutory requirements on establishment of infrastructure for alternative fuels (European Commission, 2014).

Policies at the second statutory level includes the transport and accessibility (T&A) criteria of infrastructure, accessibility distance, and multimodality which can contribute to sustainable development (Sakib et al., 2018)

The third national level

To ensure compliance with statutory guidelines on the second international level, every nation has its own regulatory guidelines on the national level. The national level with regard to Sweden, as a member of the EU, includes statutory acts and ordinances. Moreover, Sweden has implemented a comprehensive framework on its national regulations and polices to promote the entry of alternative fuels especially in the maritime sector (Regeringskansliet, 2019). The framework complies with the Directive (EU) 2014/94. National statutory acts in sustainable development of archipelagic port infrastructures includes:

- Act (2019:152) on Implementation of the EU's Port Services Regulation (EU) 2017/352 into Swedish law. Establishes a framework for the provision of port services and ensure financial transparency, facilitating the development of energy supply infrastructure within ports (Swedish Government, 2019).
- Act (2005:1248) on provision of renewable fuels and larger refuelling nodes (Swedish Government, 2005).
- Act (2004:487) on Maritime Security incorporates the ISPS Code into Swedish legislation, improving the security framework for ships and port facilities. Secure port operations are essential for the safe handling and supply of alternative fuels

and energy (Swedish Government, 2004).

- Act (1980:424) on the Prevention of Pollution from Ships establishes environmental protection measures specific to Swedish waters, including regulations on waste reception and pollution prevention. They support the environmental sustainability of port operations and the integration of clean energy solutions (Swedish Government, 1980).
- Act (1994:1776) on tax reduction act for fossil fuels (Swedish Government, 1994).

To support local climate investments on alternative fuels, the Swedish government has published regulation 2015:517 (Swedish Government, 2015). This is also according to published research which shows that investments in port infrastructures must be incorporated in planning decisions (Verschuur et al., 2022).

In addition to the mentioned statutory acts and ordinances, sustainable development of archipelagic port infrastructures comprises statutory acts and codes in the planning of society i.e., development of Master plans and detail plans at local level.

- Act (2010:900) on planning and building which comprise land and water planning and construction. The act aims to, with due regard for individual freedom, promote social development with equal and good social living conditions and a good and long-term sustainable living environment for people in today's society and for future generations (Swedish Government, 2025)
- Act (2017:725) Municipal act on regulation of organization and responsibilities of municipalities and regions (Swedish Government, 2017)
- Environmental Code (1998:808) on protection of health, the environment affected by pollution, valuable natural and cultural environments, and long-term use of land, water and the physical environment from an ecological, social, cultural and socio-economic point of view (Swedish Government, 1998).

3.2 Interviews

3.2.1 Stakeholder knowledge about the Swedish regulatory framework development of archipelagic port infrastructures

The interviews with all stakeholders revealed a lack of knowledge about regulations at the first and second international level on sustainable development of archipelagic port infrastructures. During interviews with local level stakeholders, respondents addressed that they could not recall knowing anything about the European regulations and directives included in the Swedish Regulatory framework on development of archipelagic port infrastructures. The respondents also showed a lack of knowledge on European environmental obligations, provision of onshore power supply and reducing emissions at port facilities. According to interviews, stakeholders at the local level showed knowledge in statutory acts and codes used in society planning in archipelagic ports. These stakeholders expressed, however, a lack of clarity how to implement European regulations and directives even if they would know that they existed. The interview results also showed that all stakeholders on the local level addressed that European regulations and directives are useful in planning of sustainable archipelagic port infrastructures. Thus, the results from interviews with local level stakeholders suggest a need to improve the integration between statutory regulations on the second level international level and third national level regulations in sustainable development of archipelagic ports.

Interviews with all regional level stakeholders showed good knowledge in statutory guidelines on the second and third level. Two stakeholders on the regional level addressed, however, a lack in integration between statutory acts on the third national level and implementation of regional policies on sustainable development of archipelagic port infrastructures. For example, region A addressed a lack of national focus on regional maritime transport in national statutory acts. According to the interviews, this will be a challenge in development of archipelagic port infrastructures since it will limit the extent to which regions can align with national or EU environmental and infrastructural priorities. However, interviews with five of the local level stakeholders showed that their masterplans have not been updated for 10-25 years in compliance with the Swedish regulatory framework (see Section 3.2.1). This result was also confirmed in the results from the review of municipalities' master plans. Because of this, these masterplans act as a challenge in sustainable development of archipelagic ports.

3.2.2 Collaboration, communication and governance

The interviews with all local and regional level stakeholders showed a need for collaboration forums for planning of port infrastructure and alignment of investments between public and private sectors. Interviews with eight out of 11 stakeholders showed a lack in structured and institutionalized collaboration. Seven of the 11 stakeholders mentioned that the lack of collaboration as a challenge in sustainable development of archipelagic port infrastructures. Further, two of the local level stakeholders addressed that they collaborated with other municipalities in the development of the municipality's master plans including ports. This was also confirmed in the analysis of their retrieved masterplans. The analysed interviews also showed that collaboration on sustainable development of archipelagic port infrastructures is affected by international guidelines beyond the control of regional or local stakeholders. Two of the local level stakeholders also addressed the challenge of geographical distances and infrastructure limitations in the

collaboration with other regional and local level stakeholders. These two stakeholders addressed that they collaborate with the nearby neighbouring local level stakeholders which hamper the energy supply to the port since energy is produced in another municipality.

The interviews with local level stakeholders revealed positive impact on collaboration between local public authorities and industry stakeholders using "Business forums". According to interviews, these business forums were used to pool expertise and understand the different needs of other stakeholders. The majority (80%) of the local level stakeholders emphasized however that the use of such forums should be improved to enhance collaboration and to get valuable long-term insights in sustainable development of archipelagic port infrastructures.

Interviews with local level stakeholders showed the importance of good communication since sharing of information is critical in planning and development of infrastructure and energy. This was supported in the interviews with all archipelago ports, addressing the importance of good communication due to geographical limitations, financial capacity and a lack of policies which include collaboration between municipalities. Despite addressing the importance of good communication, the majority (5 out of 7) of interviews with local level stakeholders showed that the communication is insufficient and should be improved. All stakeholders also addressed a lack in clarity in the communication of what to invest in, and in the needs of infrastructure and renewable energy in archipelagic ports. This is according to interviews due to absence of structures, unclear responsibilities, and willingness to take the lead in sustainable development of archipelagic port infrastructures. Five of the interviews further addressed that the communication was mostly informal and driven by personal networks or in some cases by industry stakeholders. According to these interviews, insufficient communication leads to challenges such as delays, missed efforts, lack in understanding local needs, and cooperation opportunities in sustainable development of archipelagic port infrastructures. In addition, one of the local level stakeholders also mentioned that communication on sustainable development of port infrastructures is affected by the municipality's political governance in relation to European regulations.

The interviews with most stakeholders (10 out of 11) revealed challenges linked to decision-making on sustainable development of archipelagic port infrastructures. According to the interviews, the challenges comprised unclear mandates, lack of operational capability and competence, and political hesitation on long term investments. Four of the local level stakeholders also addressed the lack of authority of a municipality to act as a challenge to sustainable development of archipelagic port infrastructures. The interviews with all regional level stakeholders revealed development of long-term and general strategies to maintain a political consensus with some flexibility in most cases regarding port infrastructure. One of the regional level stakeholders' interviews addressed however that regional strategic plans may be intentionally vaguely formulated so that they can be adopted and interpreted by different political parties over a longer period, since political parties in Sweden have four-year terms of office. Thus, the results from conducted interviews indicate the challenge between political adaptability and operational clarity for the persons that will implement the policy on sustainable development of archipelagic port infrastructures.

3.2.3 Funding of sustainable development of archipelagic port infrastructures

According to interviews, a majority (7 out of 11) stakeholders addressed insecurity in long term investments of sustainable development of archipelagic port infrastructures as a challenge. The interviews show that the insecurity depends on that political priorities may change with new politicians who have other prioritisations and/or investment ideas. One of the stakeholders on the local level also addressed a lack in municipal planning of investments, despite knowledge on development of sustainable archipelagic port infrastructures. Moreover, the majority (7 out of 11) stakeholders also addressed that investments are affected by the uncertainty in ownership, maintenance and knowledge in using new green technology. Local level stakeholders especially addressed this as a challenge for rural municipalities, which also may lead to a migration of people to more technologically advanced municipalities.

All stakeholders addressed challenges in investment of renewable fuel, due to the absence of a clear and stable demand (i.e., the" chicken and egg" problem), as a challenge in sustainable development of archipelagic port infrastructures. The local and regional level stakeholders hesitate to invest due to low or uncertain demand from industrial stakeholders (e.g., logistics operators and shipping companies). On the contrary industrial stakeholders are waiting for public investments before they decide to start transition to alternative fuel. In addition to this, the interviews with all regional level stakeholders revealed that investment in sustainable development of archipelagic ports is separated from the state budget for development of transport infrastructure in Sweden. According to the interviews, this makes the budget of sustainable development of ports strictly limited, and that regional and local level stakeholders are referred to apply for funding (in competition with stakeholders) for sustainable development of archipelagic port infrastructures. For example, interviews with two regions and three municipalities addressed a lack in knowledge in European funding systems and resources which adversely affect their opportunity to receive funding for sustainable development of ports. During the interviews, these stakeholders also addressed a lack in consistent funding as a challenge in sustainable development of archipelagic port infrastructures. This is because funding for development of port infrastructures normally is granted for short development projects or test-bed project and not for development projects spanning over several years. For example, the interview with one of the local level stakeholders addressed that they were planning to dismantle a testbed for electric charging of trucks due to a lack of financial resources.

According to the interviews with two of regional, and four of the local level stakeholders funding of infrastructure for renewable energy is affected by the competition from fossil-based alternatives. These interviews revealed a stable and anchored demand for fossil-based fuels, high upfront costs and infrastructure cost for renewable energy, and slow development pace in production of renewable energy as barriers in competition with fossil-based fuel alternatives. The interviews showed that the majority (7 out of 11) of stakeholders emphasise the need for a combined funding i.e., between private, municipal, national and EU programmes, in sustainable development of archipelagic port infrastructures. However, interviews with four of the local level stakeholders addressed that combined funding may be too complex and does not reflect a municipality's financial situation. This because these municipalities, according to interviews, have low revenues from taxes which shows the challenge that they will be needing national funding support

in sustainable development of archipelagic port infrastructures. In addition, four of the local stakeholders addressed that larger companies with funding opportunities should take the main responsibility for investments in development of archipelagic ports infrastructures. This was also supported in an interview with one of the regional level stakeholders who pointed out that there is a high number of smaller archipelagic ports which have limited development opportunities due to their market segment, addressing this as a challenge in sustainable development of archipelagic port infrastructures.

According to interviews with all local level stakeholders funding exists for cooperation, collaboration and joint-venture activities between municipalities, as well as with regions. Similarly, interviews with two of the regional level stakeholders addressed a lack in funding for cooperation and collaboration, addressing this as a challenge in sustainable development of archipelagic port infrastructures.

3.2.4 Physical and geographical challenges in sustainable development of archipelagic port infrastructures

In addition to challenges linked to stakeholder knowledge in regulatory guidelines, collaboration, communication and governance, the semi structured group interviews showed geographical challenges and physical challenges in sustainable development of archipelagic port infrastructures.

Geographical challenges

According to conducted interviews with local and regional level stakeholders, geographical limitations emerged as significant challenges to infrastructure development, investment, energy transition, and logistics. These challenges comprise remote locations, rural areas, dispersed population, few accessibility points, seasonal tourism or limited seaside access with increasing ship size. Interviews with four (out of five) local level stakeholders showed that the geographical distance becomes a logistical challenge in remote rural areas. Likewise, establishment of energy access points would add a large cost for construction and maintenance in remote archipelagic areas. The interviews with local level stakeholders also revealed that establishment of a centralized renewable energy hub in a nearby urban area may lead to inequalities, segregation and economical differences between rural and urban areas. Because of this, access to renewable energy hubs also becomes a challenge in planning of archipelagic port infrastructures.

Physical challenges

Physical challenges comprise limitations in physical space for infrastructure (e.g., energy nodes, roads), depth limitations in ports and outdated infrastructure. The interviews with local level stakeholders revealed a challenging conflict between establishment of required technology to ensure accessibility of renewable energy, and fulfilment of requirements on service, and safety and accessibility of people.

The interview results also showed that standards and technical requirements of future ships and systems of renewable energy must be considered in planning of sustainable archipelagic ports. In addition, the interviews with all local and one of the regional level stakeholders showed that archipelagic ports should have access to at least two different types of renewable energy sources and that these should be physically accessible for ships. However, the interviews with local level stakeholders identified a need for policies and

regulatory measures against private stakeholders to manage the challenge of unnecessary construction in ports.

The interviews with regional and local stakeholders showed that trade-offs must be made between service requirements and accessibility requirements on renewable energy, in usage of physical space in development of port infrastructure. According to the interviews, for an archipelagic port comprising land and sea transport, the physical space needed for fulfilment of service and accessibility requirements on renewable energy will be significant.

4 Conclusions

The report explores how public regional and local level authorities comply with regulatory requirements on sustainable development of archipelagic port infrastructures. For the analysis of regulatory non-statutory and statutory guidelines on sustainable development of archipelagic port infrastructures the report presents a three-element conceptual framework. The report shows that public regional and local level authorities have limited knowledge about European and national statutory regulatory guidelines on sustainable development of archipelagic port infrastructures. The results presented in the report further shows that regional and local level stakeholders perceive challenges linked to 1) collaboration, communication, governance, 2) funding, and 3) physical and geographical in development of archipelagic port infrastructures. According to the presented results challenges linked to collaboration, communication and governance comprise:

- Development of a structured and institutionalized collaboration and business forums to enhance collaboration on sustainable development of archipelagic port infrastructures
- Improved communication between national, regional and local stakeholders
- Clarification of mandates,
- Improvement of operational capability, of competence, and political adaptability.

Moreover, the report shows that challenges in funding of sustainable archipelagic port infrastructures consist of:

- Insecurity in long term investments port infrastructures
- Uncertainty in ownership, maintenance and knowledge in using new green technology.
- Absence of a clear and stable demand (i.e., the" chicken and egg" problem) of renewable energy
- Inconsistent (fragmented) funding in sustainable development of archipelagic port infrastructures.
- Competition from unsustainable fossil fuels
- Lack of funding for cooperation and collaboration between regional authorities

Further, results presented in the report shows that geographical challenges comprise logistical challenges due to long distance, and increased cost for construction and maintenance of energy nodes in remote archipelagic areas. Finally, the presented results address physical challenges linked to fulfilment of requirements on accessibility to renewable energy, service, and safety and accessibility of people. Another significant challenge identified was the need for policies and regulatory measures against private stakeholders to manage unnecessary construction in ports.

5 References

Abu-Aisha, T., Audy, JF. & Ouhimmou, M. (2024).Toward an efficient sea-rail intermodal transportation system: a systematic literature review. *Journal of Shipping and trade.* **9** (23). https://doi.org/10.1186/s41072-024-00182-z*

Blumberg, B., Cooper, D. R., & Schindler, P. S. (2011). Business research methods (Third European edition). McGraw-Hill Education.

Bruzzone, F., Cavallaro, F., & Nocera, S. (2021). The integration of passenger and freight transport for first-last mile operations. *Transport Policy, 100*, 31-48. https://doi.org/10.1016/j.tranpol.2020.10.009*

Cohen, J. J., Moeltner, K., Reichl, J., & Schmidthaler, M. (2016). An empirical analysis of local opposition to new transmission lines across the EU-27. *The Energy Journal*, 37(3). https://doi.org/10.5547/01956574.37.3.jcoh*

Creswell, J.W., (2014). *Research Design: Qualitative, Quantitative and Mixed Methods Approaches*, Sage Publications.

Daviter, F. (2019). Policy analysis in the face of complexity: What kind of knowledge to tackle wicked problems? Public Policy and Administration, 34(1), 62-83. https://doi.org/10.1177/0952076717733325*

Dekker, S. (2005). Port investment: towards an integrated planning of port capacity. Dissertation, Delft University of Technology.*

European Commission. (2014). Directive 2014/94/EU of the European Parliament and of the Council of 22 October 2014 on the deployment of alternative fuels infrastructure. https://eur- lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32014L0094

European Commission. (2024). Alternative Fuels Infrastructure. https://transport.ec.europa.eu/transport-themes/clean-transport/alternative-fuels-sustainable- mobility-europe/alternative-fuels-infrastructure_en.

European Commission (2025) European Alternative Fuels Observatory: Ports and infrastructure – Maritime (sea). https://alternative-fuels-observatory.ec.europa.eu/transport- mode/maritime-sea/ports-and-infrastructure.

European Commission. (2014). Directive 2014/94/EU of the European Parliament and of the Council of 22 October 2014 on the deployment of alternative fuels infrastructure. https://eur- lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32014L0094

European Parliament .(2023). Regulation (EU) 2023/1804 of the European Parliament and of the Council of 13 September 2023 on the deployment of alternative fuels infrastructure. http://data.europa.eu/eli/reg/2023/1804/oj

European Parliament (2017) Regulation (EU) 2017/352 of the European Parliament and of the Council of 15 February 2017 establishing a framework for the provision of port services and common rules on the financial transparency of ports. http://data.europa.eu/eli/reg/2017/352/oj

Fusch, P., Fusch, G. E., & Ness, L. R. (2018). Denzin's Paradigm Shift: Revisiting triangulation in qualitative research. Journal of Social Change, 10(1). https://doi.org/10.5590/JOSC.2018.10.1.02.*

Garberg, B.(2024). Fem år av samordning Redovisning av regeringsuppdraget Nationell samordnare för inrikes sjöfart och närsjöfart, Trafikverket, Publikationsnummer: 2024:095.

Gimenez, C., Sierra, V., & Rodon, J. (2012). Sustainable operations: Their impact on the triple bottom line, International Journal of Production Economics, 140(1), 149-159. https://doi.org/10.1016/j.ijpe.2012.01.035.*

Haezendonck, E., & Langenus, M. (2018). Integrated ports clusters and competitive advantage in an extended resource pool for the Antwerp Seaport. Maritime Policy & Management, 46(1), 74–91. https://doi.org/10.1080/03088839.2018.1471535*

Hopkin, p. (2018). Fundamentals of Risk Management: Understanding, Evaluating and Implementing Effective Risk Management (5edn), Kogan Page Ltd.

Hsieh, H.F., & Shannon, S.E. (2005). Three approaches to qualitative content analysis.
Qualitative Health Research, 15(9), 1277-1288. 10.1177/1049732305276687

IMO. (2023). *IMO strategy on reduction of GHG emissions from ships*. https://www.imo.org/en/OurWork/Environment/Pages/2023-IMO-Strategy-on-Reduction-of-GHG-Emissions-from-Ships.aspx

Kaliszewski, A. (2018). Fifth and sixth generation ports (5GP, 6GP)–evolution of economic and social roles of ports. *

Lavrakas P.J. (2008). Verbatim Responses. In: Encyclopedia of Survey Research Methods. https://doi.org/10.4135/9781412963947.n622

Lind, M., Michaelides, M., Ward, R. & Watson, R.T. (2021). Maritime Informatics; additional Persectives on Applications, Springer.

Lu, J., Ren, L., Yao, S., Rong, D., Skare, M., & Streimikis, J. (2020). Renewable energy barriers and coping strategies: Evidence from the Baltic States. *Sustainable Development*, *28*(1), 352–
367. https://doi.org/10.1002/sd.2030*

Lumivero. (2024). NVivo 15 - The Most Trusted Qualitative Analysis Software (QDA) is Even Better. https://lumivero.com/products/nvivo/

Makkonen, T., Salonen, M., & Kajander, S. (2013). Island accessibility challenges: Rural transport in the Finnish archipelago. *European Journal of Transport and Infrastructure Research, 13(4)*, 274-290. https://doi.org/10.18757/ejtir.2013.13.4.3005*

Martínez-Vázquez, R.M., De Pablo Valenciano, J. & Caparrós Martínez, J.L. (2021). Marinas and sustainability: Directions for future research, Marine Pollution Bulletin,164, https://doi.org/10.1016/j.marpolbul.2021.112035.*

Merkel A, Sløk-Madsen S. (2019). Lessons from port sector regulatory reforms in Denmark: An analysis of port governance and institutional structure outcomes. *Transport Policy*, 78. https://doi.org/10.1016/j.tranpol.2019.03.010.*

Mollaoglu, M., Yazar Okur, I.G., Gurturk, M. *et al.* (2024) Review on Sustainable Development Goals in maritime transportation: current research trends, applications, and future research opportunities. Environmental Science and Pollution Research, 31, 8312–8329. https://doi.org/10.1007/s11356-023-31622-1*

Monios, J. & Bergqvist, R. (2019). Green ports : inland and seaside sustainable transportation strategies, Elsevier. *

Nguyen, H. P., Nguyen, P. Q. P., & Nguyen, T. P. (2022). Green port strategies in developed coastal countries as useful lessons for the path of sustainable development: A case study in Vietnam. *International Journal of Renewable Energy Development, 11*(4), 950– 962. https://doi.org/10.14710/ijred.2022.46735*

Notteboom, T., Pallis, A. & Rodrigue J-P. (2022) Port Economics, Management and Policy, New York: Routledge. doi.org/10.4324/9780429318184

Platias, C., & Spyrou, D. (2023). EU-funded energy-related projects for sustainable ports: Evidence from the Port of Piraeus. Sustainability, 15(5), 4363. https://doi.org/10.3390/su15054363*

Puustinen, T., Falkenbach, H., Ekroos, A. & Junnila, S. (2024). Integrating Climate policy objectives into municipal land policies: from conceptualization to empirical evidence from Finland, International Journal of Urban and Regional Research, 49(1), 69-93. https://doi.org/10.1111/1468-2427.13294*

Regeringskansliet. (2019). Sweden's 2019 report under the Directive on the deployment of alternative fuels infrastructure pursuant to Article 10(1) of Directive 2014/94/EU of the European Parliament and of the Council of 22 October 2014. https://alternative-fuels- observatory.ec.europa.eu/system/files/documents/2022-12/SE%20NPF%202019%20Report%20ENG.pdf

Region Västra Götaland, (2019a). *Förutsättningar Trafikförsörjningsprogram Västra Götaland 2021-2024*, Västra Götalandsregionen.

Region Västra Götaland, (2019b). Relationen mellan transportinfrastruktur och och sociala aspekter av hållbarhet, Västra Götalandsregionen.

Region västra Götaland (2022). Regional plan för transportinfrastrukturen i Västra Götaland 2022-2033, Västra Götalandsregionen.

Region västra Götaland. (2023). Hållbarhets konsekvensbeskrivning regional plan för transportinfrastrukturen i Västra Götaland 2022-2033, Västra Götalandsregionen.

Region västra Götaland. (2024). Strategisk inriktning för transportinfrastrukturen i Västra Götaland, Västra Götalandsregionen.

Roh, R., Thai, V.V. & Wong, Y.D. (2016). Towards Sustainable ASEAN Port Development: Challenges and Opportunities for Vietnamese Ports, The Asian Journal of Shipping and Logistics, 32(2), 107-118. https://doi.org/10.1016/j.ajsl.2016.05.004.*

Ringsberg, H. (2023). Sustainable FLM transport based on IPF transport by ferry in coastal rural areas: A case from Sweden, Transportation Research Part A: Policy and Practice, 178. https://doi.org/10.1016/j.tra.2023.103871.*

Sakib, N., Appiotti, F., Magni, F., Maragno, D, Innocentim A., Gissi, E., Musco, F. (2018). Addressing the passenger transport and accessibility enablers for sustainable development. *Sustainability,* 10 (4).1-20. https://doi.org/10.3390/su10040903*

Sauer, P.C., Seuring, S.(2023).How to conduct systematic literature reviews in management research: a guide in 6 steps and 14 decisions. Review of Managerial Science, **17**, 1899–1933. https://doi.org/10.1007/s11846-023-00668-3.*

Swedish Government.(2025). SFS 2025:71. Plan- och bygglag (2010:900).

Regeringskansliet Swedish Government.(2019).SFS 2019:152. Lag om

tillhandahållande av hamntjänster.

Swedish Government. (2017). SFS 2017:725 Kommunal lag

Swedish Government.(2015).SFS 2015:517. Förordning (2015:517) om stöd till lokala klimatinvesteringar.

Swedish Government.(2005).SFS 2005: 1248. Lag (2005:1248) om skyldighet att tillhandahålla förnybara drivmedel.

Swedish Government.(2004).SFS 2004:487. Lag om sjöfartsskydd.

Swedish Government, (1998). Miljöbalk (1998:808)

Swedish Government, (1994). SFS 1994:1776 Lag om skatt på energi

Swedish Government.(1980).SFS 1980:424. Lag om åtgärder mot förorening från fartyg.

Tashakkori, A. and Teddlie, C. (2002). Handbook of Mixed Methods in Social and behavioral research. Thousand Oaks, CA: Sage.

Tranfield, D., Denyer, D., & Smart, P. (2003). Towards a Methodology for Developing Evidence-Informed Management Knowledge by Means of Systematic Review. British Journal of Management, 14(3), 207–222. https://doi.org/10.1111/1467-8551.00375

Trochim, W.K., & Donnelly, J.P. (2008). The research methods knowledge base, 3rd Edn. Atomic Dog.

Trivector. (2023). Transporteffektivt samhälle och regional infrastrukturplan Ett kunskapsunderlag. Trivector Rapport 2023:47

Verschuur, J., Koks, E.E. & Hall, J.W. Ports' criticality in international trade and global supply- chains. *Nat Commun* **13**, 4351 (2022). https://doi.org/10.1038/s41467-022-32070-0. *

Wan, Z., Nie, A., Chen, J., Pang, C., & Zhou, Y. (2025). Transforming ports for a low-carbon future: Innovations, challenges, and opportunities. *Ocean & Coastal Management, 2025, 107636. https://doi.org/10.1016/j.ocecoaman.2025.107636**

Wear, A. (2009). *Improving local transport and accessibility in rural areas through partnerships*, In: *OECD LEED Forum on Partnerships and Local Governance Handbook no. 1.**

Wiegmans, B., Witte, P., Spit, T., (2015). Characteristics of European inland ports: a statistical analysis of inland waterway port development in Dutch municipalities. Transport Research Policy & Practice. 78, 566–577.*

Witte, P., Wiegmans, B., & Ng, A. K. (2019). A critical review on the evolution and development of inland port research. *Journal of Transport Geography*, *74*, 53-61.*

Witte, P., Wiegmans, B., Braun, C., & Spit, T.(2016). Weakest link or strongest node? Comparing governance strategies for inland ports in transnational European corridors, Research in Transportation Business & Management, 19, 97-105. https://doi.org/10.1016/j.rtbm.2016.03.003*

Wu, Z., Woo, S-H., Lai, P-L., & Chen,X. (2022). The economic impact of inland ports on regional development: Evidence from the Yangtze River region, Transport Policy,127. 80-91. https://doi.org/10.1016/j.tranpol.2022.08.012.*

Yin, R. (2009). *Case study research: Design and methods*. Sage Publications.