

Harbouring Change

The intermediary roles of ports in sustainable transitions

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Abstract

Climate change creates a backdrop of escalating concern to transition to low carbon solutions. This thesis delves into the central role of ports in this transition. With a specific focus on the emissions free Oslofjord project the thesis investigates what ports role as intermediaries in this transition is and how it may shift.

The research in this thesis examines the emerging field of intermediaries in sustainable transitions and looks at ports as central actors. The emerging view in transitions on how multiple sectors can be involved, which requires interactions between actors from multiple systems. The thesis proposes that the functions and activities of the intermediaries that have participated can be differentiated based on the level and phase of operation. The thesis illuminates the challenges faced by intermediaries in collaborations and regime actors in transitions.

The data collection consists of five semi-structured interviews. The research reveals that ports take on intermediary roles, and that the roles and activities mostly stay consistent through the different phases of transition. The insights contribute to the field of intermediaries in transitions and the role of ports as infrasytem intermediaries that must cater to diverse demands.

This thesis draws on concepts and ideas from innovation studies and transition studies, to understand and analyse the dynamics of innovation, and the role of intermediaries in transitions. And provides insights into intermediations strategies and procedures. And applies concepts from emerging field of research on intermediaries.

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1. Introduction

Today's discussions of climate change has a long history that has altered the 21st century. Science has warned about the effects of increasing amounts of CO₂ in the atmosphere since Swedish scientist, Svante Arrhenius asked the question of whether the ground could be altered by heat-absorbing gasses (Frilseth 2019). With time, knowledge of the impacts and obstacles caused by global warming has grown and matured (Damman and Steen 2021, 5). United Nations (UN) wrote a report "our common future" that tackled a number of the challenges climate change being one of those challenges. In the report the UN highlighted a concern over the time it would take to negotiate agreements that would lead to action against the effects of a warming globe (United Nations 1987). In Paris, the first global treaty came to fruition. Most countries made an agreement on keeping the average warming of the earth below two degrees Celsius and that every country must contribute, because if not, no one benefits.

The European Union deliberated the dangers of climate change and decided on a set of climate goals for the continent. And the Norwegian government committed in 2015 their efforts to meet the goals of the Paris agreement (Jakobsen, Kallbekken, and Lahn 2023; Klima- og miljødepartementet 2021b). Reaching national goals will require local solutions. Shipping and the port and harbour areas of Norway are moving towards their climate friendly solutions, and the transitions of the sectors is demanded.

The Oslofjord has the most traffic from freight ships and ferries in Norway (Thorsnæs 2023). The emissions caused by ocean shipping and that occurs at harbours can be varied. With the emissions free Oslofjord project the harbours have made the effort to discover and examine their emission reduction potential. The directorate for environment (Miljødirektoratet) wrote in collaboration with a number of other public organizations, that when it comes to shipping and port activity the main source of air pollution is emitted when ships are docked at a port with engines running. Nitrogen dioxide, sulphur dioxide and particular matter are of main concern from ships and in ports (Luftkvalitet i Norge n.d.).

The widespread diffusion of technological advancements and the development of new infrastructures has a crucial role in addressing climate change challenges (Markard, Geels, and Raven 2020). Sustainable transitions involve significant shifts in socio-technical systems like energy, food, or transport, aimed at tackling pressing environmental challenges. This thesis focuses on ports role as intermediary actors in sustainability transitions. As there are expectations for the ports to modify (Nærings-og fiskeridepartementet 2023). I explore where

there are links between actors, activities, resources, visions, and the networks with momentum for change. Aligning wider changes in a system allows for accelerating the implementation of innovations. There needs to be aligning complementary structures and technologies in place (Markard, Geels, and Raven 2020). The thesis employs Paula Kivimaa's categorizing of forms of intermediaries and intermediary roles in transitions (Kivimaa et al. 2019b).

In the instance of transitioning ports to more sustainable solutions, intermediaries are necessary to ensure interactions happen that can speed up an innovation process. Facilitating and cultivating infrastructure that can aid in ensuring interactions between actors can be useful (Kivimaa et al. 2020). There is a network and interaction between actors and institution that determine the direction of innovative activity. Emergence and accelerations of transitions are fields in intermediary studies. This approach indicate intermediaries as the actors that perform the function of translating information between the actors (Kivimaa et al. 2020). The collaboration and momentum might cause new configurations to disrupt the undesired socio-technical configurations and embed new configurations.

1.1 Aims and objectives

Intermediaries can act as accelerators and catalysts in transitions and are seen as having an influential role by connecting actors, create a foundation for collaboration and knowledge exchange (Kivimaa, Boon, et al. 2019, 1062). Actors in positions such as a port may translate information between shipping companies, charger companies and other stakeholders. Informed by the interest of the different actors the ports have a unique opportunity to communicate and advocate these accumulated interests. Which can lead to transitioning faster or more easily. More specifically the thesis will explore intermediaries in transitions.

Insight from institutional approaches and the geography of transitions can be combined to provide an understanding of spatial variety and the role of local actors in regime configuration (Damman and Steen 2021, 12). Theories on innovation systems tells us that innovation is a collective activity. This thesis research looks into how ports role as intermediaries has affected the collaborations, what the collaboration has entailed and the outcome of specific collaborations. A better understanding of ports in transitions and ports as intermediaries is necessary. It is vital to gain a deeper comprehension of ports in transitions and their role as intermediaries. With energy and transport systems growing in complexity, there's a transition from reliance on a few pivotal technologies to a diverse mix (Damman and Steen 2021). Damman and Steen call for more research on the role of ports as energy hubs and the key

infrasytem intermediaries as caterers of needs and demands. They also make an appeal to research how governance framework should be developed to facilitate interactions (Damman and Steen 2021, 12).

Gaining a better understanding of ports in transitions and their role intermediaries is necessary. Ports have a special role in transitions as they are at the intersection between land and sea transport. The ports interviewed in this research also have an interesting role as there are owned by the municipalities where they are. This thesis will examine port's role in in transitions as the port in the Oslofjord are moving towards zero-emission solutions in infrastructure for ships and in the intersection between land and sea. Transport of goods will be made more efficient by reloading on to zero-emission vehicles at transport hubs and the ships and there are challenges in aligning the needs of various shipping and cruising companies. Kivimaa et al. (2019b, 110) write that studies looking into intermediary action in different phases and levels of transition is important, because intermediary action can be regarded as an essential contributor to explaining transition processes.

What is the role of intermediaries in transitions? What is influencing the ports in the transition to zero emission? How/are ports attempting to shape and change the transition movement? To investigate and understand more of intermediary action, the thesis continues with the following research question:

What is the role of ports as intermediaries in transitions and how does their role change?

To answer this, I examine the *Emission free Oslofjord project*. A project where several ports are involved in collaborations and intermediations between different actors and sectors. The project is outlined in more detail below (see 2. Background.). The overall research project is built on a qualitative case study, comprised of semi-structured interviews and secondary data sources.

2. Background

The Storting requested the government to implement demands and regulations for emissions from cruise ships and other shipping in the Norwegian fjords as soon as 2026 (Meld. St. 41 (2016-2017), n.d.). The Storting asked the government to work towards an international standard and to establish a strategy for on-shore power supply by 2025. Currently, the only on-shore power supply station in Norway is at the harbour in Oslo. In the transport section the demand is for all transport of goods and services for the Oslo municipality to be emissions free within the first day of 2025 (Oslo kommune 2019). One of Oslo's means to lead the transition has been through procurements and demanding climate friendly solutions. The government in the Oslo municipality have put a time limited goal on reducing the cities emissions with 95 percent (Oslo Kommune 2015). And the goal is to accomplish this by 2030 (Miljødirektoratet 2023).

The city of Oslo located at the top of the Oslo-fjord harbours a rich plethora of marine activity. The harbour has over many years collected a rich history and the port has served as one of the foundations for the city's growth and expansion. This harbour in Oslo and the fjord has seen big shifts from rowing boats, to sailboats, to steamship and then to combustion engines. From here the access to Norway changed in many new ways. For tourist by cruises or delivery of goods from lands far away. Now the emerging emissions free transition is pushing the harbour into new ways.

Oslo will experience more extreme weather, less snow and extreme precipitation. Heatwaves will occur more often and are also associated with high air pollution. In 2021 there was a study on measures to improve air quality in Oslo and Bergen. The measures are expected to have big impacts on reducing emissions of nitrogen dioxide, sulphur dioxide and particular matter (Miljødivisjonen, Lützenkirchen, and Natur og forurensing 2021). Decreasing the concentrations of these pollutants are important because high concentrations of air pollution can lead to serious harmful effects on humans and the environment (Nestaas, Andersen, and Brinchmann 2023). Cities that take steps towards decarbonizing their ports and the shipping companies that use them, will contribute to driving the transition to clean shipping globally (C40 2023).

The government decided on an action plan that aimed at a clean and abundant fjord. In the plan they touch upon mitigation reduction measures and note that there are efforts to shift shipping towards zero emissions (Klima- og miljødepartementet 2021a; Klima-og miljødepartementet

2019). Ports are considered a critical actor in achieving a sustainable transition, at sea and by the port. They are a meeting point between sea and land transport and serves as location for energy infrastructure. The economic benefits and ports are both local and regional, but the negative impacts of air and water pollution and noise impact the port city.

The different ports in the Oslofjord have agreed on working towards removing the barriers related to on-shore power stations, they will examine the need for united environmental demands for the fjord and spreading awareness about the potential for emissions cuts in and around the ports and nearby cities. And have found sectors where there is potential for reducing climate emissions from the ports and from the transport through the fjord. The ‘Utslippsfri Oslofjord’ project is a collaborative effort among seven ports in the Oslofjord region with ambitious environmental goals. They aim to create a green corridor by 2025, with the goal of having ten container ships using shore power by 2025. The ports also plan to establish a shared environmental policy with hub ports like Hamburg, Rotterdam, and Antwerp by the end of 2023 (Oslo Havn 2022). This initiative is a significant step towards reducing emissions in the Oslofjord region. Currently, DFDS and Color Line ferries utilize the shore power facilities in Oslo, while Heidelberg cement boats in Sydhavna have recently connected to shore power.

The project's unique collaboration is key to achieving these goals, with a focus on finding the most ambitious customers who are willing to retrofit or build new ships for shore power. The aim is to inspire a shift towards emission-free maritime transport in the region, with the ports acting as catalysts for the green transition. The project also emphasizes spreading knowledge about potential emission reductions and more efficient logistics chains between sea and land, serving as an overarching framework for the other work packages. The ports have demonstrated their commitment by adopting various green practices, including electrifying cranes, boats, and vehicles, implementing local energy production, and using low-emission fuels like biogas and HVO100. Overall, the ports, along with the broader Norwegian port sector, are set to play a pivotal role in the green shift, not only by providing emission-free energy on land and sea but also by inspiring other stakeholders in the value chain to adopt green practices. This project has provided valuable insights into emissions from land-based activities in all seven Oslofjord ports, as well as a detailed understanding of emissions from ship traffic, paving the way for more informed and targeted efforts to reduce environmental impact.

3. Theory

In this chapter I will first present an overview of the theoretical background that is applied in the analysis. Initially I present a brief introduction to the innovation studies field. Next the thesis explores the field of sustainability transitions which is the theoretical background from which the theoretical framework I use, has raised from (Markard, Raven, and Truffer 2012). The research in the field aims at explaining “how radical changes come about in the way societal functions are fulfilled.” (Köhler et al. 2019, 2). Third I present the influential concept of the multi-level perspective. Fourthly I provide an insight into Paula Kivimaa’s theoretic approach to intermediaries. The concept discuss intermediaries as actors in transitions which form the foundation for the theoretical framework from which the research question is derived (Kivimaa, Boon, et al. 2019). The intermediaries concept considers the agency of intermediaries and their ability to create relations that aim at and affect sustainable transitions.

3.1 Innovation studies

This thesis has its roots in innovation studies. And the economist and sociologist Joseph Schumpeter has been seen as the root of innovation studies, as he was a significant contributor to the field (Fagerberg and Verspagen 2009). He found that there was an energy in the economic system that he sought to explain further and introduced the concept of innovations emerging from a process of creative destruction (Abernathy and Clark 1985). This principle explains how you can move from one, exciting solution to another solution and leave the first innovation in rubble. Schumpeter, the social scientist saw innovations as the driving force behind social and economic change (Fagerberg and Verspagen 2009).

There are the incentives and barriers for innovation and are the components of systems for the creation and commercialization of knowledge. “Innovations are not only determined by the elements of the system, but also by the relations between them” (Edquist and Hommen 1999, 67). An innovation system can be seen as the network of organisations in the economic system that are involved in the creation, diffusion, and use of the innovations. As well as the organisations responsible for the coordination and support of these processes. The innovation systems view recognizes that there might be feedback loops and interdependencies between the factors (Edquist and Hommen 1999, 65). Understanding the relations and collaborations related to an innovation process are relevant to answering the thesis question. And how they might be reconfigured (Geels and Turnheim 2022).

3.2 Sustainability transitions

Emerging from an interdisciplinary background, transition studies is a field which is based on systems thinking. Transitions are processes moving from one system to another. The field of sustainability transitions is concerned with the need for transformative change and emerged as a response to the grand societal challenges of our time (Köhler et al. 2019).

Sustainability transitions study the fundamental changes in the socio-technical systems we have become accustomed to, and research in the field has progressed rapidly the last twenty years (Geels and Turnheim 2022, 335). Transitions are authorised by firms and users and by social movements, wider publics, policy-makers, industry associations, and other special-interest groups (Geels, 2004). These groups have different interests and resources, and engage in activities like debates, investing in stocks, studying which make transitions a more complicated process that cannot be fully understood by one theory or discipline (Geels and Turnheim 2022).

The field aims to address grand challenges in ways that meet our present needs without compromising the needs of the future (Markard, Geels, and Raven 2020). “Transition Research investigates how radical innovations emerge, struggle with incumbent interest, and eventually lead to major system change (Markard, Geels, and Raven 2020, 1). Established technologies are deeply rooted in business models, organizational structures, regulations and have complementary technologies, and even political structures (Markard, Raven, and Truffer 2012, 955). Markard, Raven and Truffer (2012) deems sustainability transitions as *“long-term, multidimensional, and fundamental transformation processes through which established sociotechnical systems shift to more sustainable modes of production and consumption”* (Markard, Raven, and Truffer 2012, 957). Examples of socio-technical systems can be transport systems or food systems. Energy transitions is an interesting field in transitions as it is considered a hard to abate sector. Moving from one way of living or doing things to a new different way.

Long-term goals can inform the direction of the transition. In the case of the emissions free Oslofjord project the goal of reducing emissions with 85 percent by 2030, directs the transition process. Setting a goal is a guided governance strategy that one can tend to see in sustainability transitions. This according to Markard, Raven and Truffer means there are a broad range of actors expected to work together in a coordinated way (2012, 957). As well as political actors, regulatory and institutional support are influential here. The various special contexts of the ports

make for an unevenness in their ability to face this transition. Coenen specifies that sustainability transitions are geographical processes (Coenen and Truffer 2012). Both the abilities and local technological specialization contribute to development of innovations necessary for sustainability transitions.

A concept in transition research is the concept of destabilization of regimes. Entrenched technologies can decline or phased out. Regime-destabilization is processes that interrupt the processes that reinforce the system. Destabilization can be used as an active tool such as radical policy reforms or can be underlying processes that are less obvious, used to make space for the diffusion of niche-innovations (Köhler et al. 2019, 6). Policymakers can use destabilization as a tool to replace incumbent actors, introduce new actors, or remove important reinforcement structures. Typically, destabilization happens in the acceleration or embedment phase of transition, or in advance of exogenous shocks or radical innovations (Kivimaa et al. 2019b, 115).

When an innovation moves from being an emerging innovation and accelerates towards wide spread diffusion in the market, there are two main challenges according to Markard, Geels and Raven (2020). The researchers point to a barrier for innovations being *complementary innovations* and *changes in system architecture*. An example of complementary innovations are batteries that are necessary to for example store energy. Harvesting solar energy is one innovation that would have to be complemented by battery innovation to be able to accelerate in a market. And a system architecture change in the example of solar energy could enable people and communities to be self-sufficient of energy. The researcher point at policymakers for being responsible to stimulate developments in complementary innovations (ibid).

3.3 Multi-level perspective

A prominent framework in transition studies is the multi-level perspective. Innovations will struggle to be implemented if they don't manage to align with wider changes in the system (Markard, Geels, and Raven 2020, 1). There are established practices, systems, policies, and infrastructure that affect the speed and success of a transition. Multi-level perspective (MLP) is a framework that can be useful when understanding patterns and how transitions come about (Geels and Schot 2007). It is an approach to understanding and analysing largescale, socio-technical transitions. This framework contributes to analytical perspectives in socio-technical transitions studies. The multi-level perspective framework is suitable for investigating external events effects on actors, practices, and policies in a system.

There are three defined levels in the MLP. Niche, regime, and landscape. At the microlevel radical innovations happen. Niches in the multi-level perspective are innovations that can be the up-and-coming innovations. In this level you find the radical innovations and the actors developing the radical innovations. At the regime level there are dominant established actors, practices, policies, and structures in place in a system. And the landscape is the wider environment, which influence the regime and the niche dynamics. The landscape forms the external context or structure. This can be factors such as war, cultural norm, or environmental problems. Innovations in the regimes are interested in staying stable. There might be pressure built on the regime from the landscape, from acceleration of niches, weakening existing systems. These are mechanisms that can create a ‘windows of opportunity’ which allow niche innovations to enter the regime and become a stable part of the system (illustrated in figure 1). If more niches can align in new combinations and configurations this can strengthen the momentum of sociotechnical transitions (Geels et al. 2017, 1242).

An example used by Geels and Turnheim (2022) of an innovation moving from niche to regime and eventually affecting the landscape level is electric vehicles in Great Britain. Electric vehicles were considered niche innovation for many years. This transition required new infrastructure for charging, changed car bodies and battery technology. Electricity as an energy form for vehicles has become a more stable and reliable part of society (Geels and Turnheim 2022, 179). In Oslo, electric vehicles have become a bigger part of our transport system. The amount of vehicles and the increasing capacity for charging shows how society around the niche innovation has implemented infrastructure that allows the innovation to get stable footing (Klimaetaten, Oslo Kommune 2023). There were increasing sales and tightening climate regulations which seemed to convince the industry that the electric vehicle shift was both commercially and sustainability driven (Bohnsack et al., 2020 in Geels and Turnheim 2022). In Norway, policy makers were interested in the shift and sent out signals that they were willing to slow down the sale on fossil fuel vehicles (Richter 2023). And then as the shift had started, there were landscape influences that had the possibility to destabilizing the electric vehicle regime shift. Like for example the covid pandemic from 2020 to 2023 and the beginning of the war in Ukraine in 2022 and increasing prices for electricity that all challenged the shift.

Actors might be affected by the time, timing and location of their action and the resources available. Damman and Steen wrote in their article that ports efforts are strongly influenced by the extent and timing of the responses from other regime actors (2021, 11). “Emphasizing that

different kinds of alignments between developments at landscape, regime and niche level lead to different transition pathways” (Geels and Schot 2007; (Damman and Steen 2021, 11)

Policymakers and other powerful actors can contribute to facilitating acceleration and diffusion of transitions (Roberts and Geels 2019). Sustainability transitions require decisive interventions from state and non-state actors. By using the multilevel perspective one can understand the conditions for political acceleration. Sustainable transitions require decisive interventions from state and non-state actors. Leading socio-technical systems are characterized by lock in and apathy (Markard, Raven, and Truffer 2012, 964).

Influencing and affecting the amount of grants one might get in a municipality by presenting expert knowledge and bargaining with policy makers is lobbying activity. Compared to other interest groups, corporations and unions, the ports and municipalities might have both an advantage and a disadvantage. Many analyses of technological innovations systems were

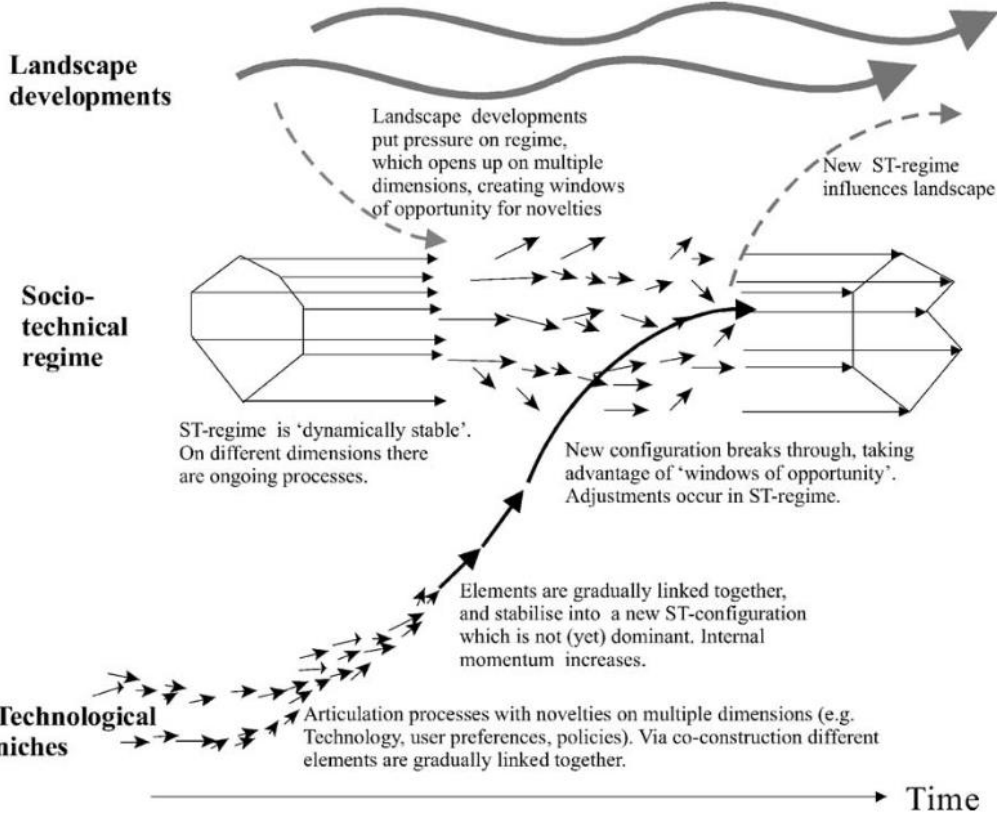


Figure 1: Representation of the dynamics in the multilevel perspective on system innovation.

(Geels 2004, 915)

intended to inform policy making, which is why identification of drivers and barriers to innovation is typical in technological innovation studies (Markard, Raven, and Truffer 2012, 959). Frequent changing policy can inhibit businesses willingness to invest. Geels and Turnheim remark that incumbent actors may be willing to make changes fast if they are incentivised, but that these established firms prefer to follow a path that protects their core business models (Geels and Turnheim 2022, 324).

Considering the dynamics and relationships between technologies, actors and governance can help recognizing opportunities that could be overlooked. “Science and technology thus are not outside politics, but bring new objects and issues into politics” (Translated by me; Asdal 2011). Shifts in public opinion can influence policy makers which can legitimize or delegitimize niches or discredit incumbent regimes (Roberts and Geels 2019, 222). Public debates about issues and concerns shape cultural meaning and legitimacy. And the long-term goals, using instruments set by policymakers can set the stage for stronger policy instruments later. And policy supporting new firms can lobby for further policy change (Geels and Turnheim 2022). Alternative ideas that are unfavourable to reproducing the regime but that experience major public support can create a looping effect where policymakers cannot ignore the idea. When policies align with public preferences, it can bolster trust in the government. Debates and discussions can also influence publics preferences and can create a sense of importance and can create stronger policy support (Geels and Turnheim 2022, 327).

By looking at the drivers, barriers, and strategies for development, one can find factors that support ports ability to contribute to transitioning the wider socio-technical system they are embedded in. (Damman and Steen 2021). Macro-level, regime change influence ports, and are dependent on how national, local and regimes align. Ports in Oslo are experiencing more pressure from national-measures and climate obligations because of the increased amount of ferry and cruise traffic compared to other ports (Damman and Steen 2021). Multi-level perspective is a useful framework for understanding system innovation. Introducing the concept of the MLP contributes to key analytical perspectives in socio-technical transitions studies. Insight from institutional approaches and the geography of transitions should be combined to provide a understanding of spatial variety and the role of local actors in regime configuration (Damman and Steen 2021, 12). Theories on innovation systems thinking indicate that innovation is a collective activity.

3.4 Intermediaries in transitions

In the sustainable transition literature, intermediaries have been identified as actors that can translate information between different actors, and aggregate and advocate for different interests (Kivimaa et al. 2020). The theory behind intermediaries in transitions has drawn from literature in socio-technical systems on technological regimes, technoeconomic networks and innovations view background from system of innovation and innovation intermediaries. The field of intermediaries in transitions is an emerging field but the terminology of intermediaries is increasingly being used (Kivimaa et al. 2019b). There are other terms such as system builders and knowledge brokers which are also being used to formulate similar meanings. The concept and terms are being used to describe how bridging actors in situations where direct interaction is difficult might come about. Relations matter in transitions (Kivimaa et al. 2020, 374).

Intermediary actors can be seen as organizations working between diverse interests to arrive at outcomes that would not be accomplished without their involvement (Hansen and Coenen 2015). This view aligns with the definition of intermediaries provided by the encyclopædia Britannica, which describes them as individuals who mediate between opposing sides to facilitate agreement, “a person who works with opposing sides in an argument or dispute in order to bring about an agreement» (Britannica Dictionary n.d.).

Intermediaries have been identified as taking a pivotal role as actors driving forward transitions towards more sustainable socio-technical systems (Kivimaa et al. 2019, 1063). The essence of intermediation lies in the creation of linkages across various actors, contributing to the development of shared expectations and visions, as well as facilitating collective learning processes. Intermediaries are not passive but are characterized by their proactive engagement and distinct identity, either as individuals or organisations.

Intermediary actors perform different tasks within innovations systems. It is through the dynamic functions that intermediary actors, whether individuals or organizations, become distinct and invaluable when transitioning towards sustainable socio-technical systems. The attention given to sustainability and system level change is what differs transition intermediaries from traditional innovation intermediaries. In the article ‘Towards a typology of intermediaries in sustainability transitions’ Kivimaa et al. propose this definition of transition intermediaries:

“Actors and platforms that positively influence sustainability transition processes by linking actors and activities, and their related skills and resources, or by connecting transition visions and demands of networks of actors with existing regimes in order to

create momentum for socio-technical system change, to create new collaborations within and across niche technologies, ideas and markets, and to disrupt dominant unsustainable socio-technical configurations.”

(Kivimaa et al. 2019, 1072)

Paula Kivimaa looks at intermediaries in transitions from an innovation studies background. And her research focuses on the idea of intermediaries in transitions drawing on literature on systems of innovation.

By looking into which actors or platforms are conducting collaborating efforts and activities one can determine who are performing intermediary functions in a transition process. In the editorial on intermediaries in accelerating transitions the authors highlight questions on the difficulties and challenges intermediaries face in the acceleration phase or what slows down transitions, which they believe could receive more attention (Kivimaa et al. 2020, 373).

Ports have a critical role in the infrastructure of transport and have a key role as intermediaries as they cater to the demands and needs of a plethora of stakeholders and they operate across multiple levels of jurisdiction and authority. They have access to a complex socio-technical system. That has a diverse geographical context. There are ongoing shifts from a few key technologies towards a mix of technologies at the ports which demand coordinating, implementation, and integration of an array of energy solutions (Damman and Steen 2021).

Kivimaa et al. (2019, 1068) suggested categorizing different roles that intermediaries can inherit in transition. The system for categorizing the roles of intermediaries, provides a valuable framework for understanding ports and their strategic importance. By identifying systemic intermediaries as key actors orchestrating interactions and shaping discourse, this system offers practical insights into how ports can actively influence and foster an environment that can encourage to sustainable transitions. The typology not only identifies strategic actors known as systemic intermediaries, who play a crucial role in shaping discourse and creating a conducive learning environment, but also sheds light on their pivotal function in orchestrating interactions among various stakeholders, ultimately advancing transitions towards sustainability in port operations. Within this framework, systemic intermediaries is a typology used to identify intermediaries that are considered to be strategic actors, orchestrating interactions among various actors, they shape discourse, and develop an environment that is better for learning (Kivimaa et al. 2019b).

The figures that I have adapted in figure 1 and 2, are presented in the article “Passing the baton” by Kivimaa et al. (2019b). The research paper delves into the critical role of transition intermediaries in the context of sustainability transitions. The study builds upon the early work of Van Lente et al. (2003) and Geels and Deuten (2006), who introduced the concept of 'systemic intermediaries' in complex, long-term processes, particularly transitions towards sustainability.

Figure 2 has as an overview of the different intermediary types based on their functions. These intermediary types are then put in the context of the phases of transitions and levels of operation.

Category	Context of action	Emergence	Goal of intermediation	Normative position	
				Position vis-à-vis niche	Neutrality/interest
Systemic intermediary	On the regime level they intermediate between many actors and interests.	Established for the purpose of intermediating	Seek or are ambitious to disrupt the unsustainable current system.	Outsider. And the ability to not be too tight to regime. This allows space for many, alternative niches	Seen as a neutral actor that facilitates interaction but does have an interest in making transitions happen
Regime-based transition intermediary	Regime level between multiple actors and are given mandate by dominant regime actors. Influenced by existing regime	Can be already existing actors taking on intermediary roles. Or established by dominant regime actors to intermediate for transition	Similar to systemic intermediaries. But typically pursues more incremental solutions or political aims	Outsider. Created space for multiple alternative niches	Regarded as a player in the existing regimes but are empowered for change
Niche intermediary	Operate in niche level, can be between local projects, or even global	Often emerges when a niche develops	Pursues goals and solutions from a perspective of a niche	Insider. Because of its goal and perspective from a niche. Biased to a niche	Regarded as player advancing a specific niche
Process intermediary	Within experimental projects or specific processes contributing to transitions	Intermediate and carry out important day to day actions	Employing context specific priorities	Outsider	A neutral unbiased networker. Does not have a specific agenda
User intermediary	Between technology and use and dominant configuration	Amidst users and consumers	Facilitator or can be a representative of end-use or -users	Insider or outsider to a specific niche	Takes user interest. What is the practical change this brings to users

Figure 2

Overview of transition intermediary types.
(Kivimaa, Boon, et al. 2019, 1069)

The levels in the figure are, niche level intermediaries, nice regime level intermediaries and regime level intermediaries. These levels are derived from the MLP concept. Firstly, I will explore the defining terminologies.

Systemic intermediaries as well as regime-based intermediaries operate on a regime level. System, regime-based and niche intermediaries all maintain a strong agency for change in the regime or niche level. Although the level of agency can vary between these types of intermediaries. Intermediaries appear as necessary and operate on many levels to advance transitions. Policymakers can to a degree influence the ecology of the intermediaries by giving funding or by setting up their own intermediaries (Kivimaa et al. 2020, 374). Systemic intermediaries are described as the intermediary that disrupt existing structures, while regime-based intermediaries translate new regulations and bridge gaps between producers and consumers. They focus on creating markets for alternative technologies, shaping future visions, and evaluating potential niches. Process intermediaries can operate on many levels, they can be part of concrete ground level projects or regime level. Process intermediaries do continue to support projects while adapting to changing regime priorities (Kivimaa et al. 2019b). Regime-based transition intermediaries are tied to the incumbent regime through institutional structures or interests. These intermediaries do although have a a mandate or desire to promote transition. Regime-based intermediaries tend to network with different niches or the regime system. Niche intermediaries focus on experimentation and advancing specific niches by employing methods such as directly interacting and influencing policymakers, for example in the form of lobbying. These actors do this to influence the direction of the regime transition preferable to the niche. Niche intermediaries and user-side intermediaries are between niche level and regime level. Process intermediaries don't have a definite agenda for a transition. Instead, they support contexts priorities set by other actors. User intermediaries act as a bridge between technology and users. They convey and translate users' preferences to innovators, developers, and actors. The user intermediaries share user's preferences to inventors, developers, and regime actors with the aim of assessing the value of technology that is available. User-side intermediaries are the ones that broker the relation to end-use or end-users.

In the pre-development phase, niche intermediaries are very active and play a crucial role in initiating experiments, connecting pilots and experiments on a broad scale and aggregate learning. Grassroots organizations, a specific subtype, engage in bottom-up innovation and coordination of local projects. Niche intermediaries have been important in the early stages,

while in the acceleration phase, systemic intermediaries have had a central role in aligning different perspectives and activities.

In the predevelopment phase, niche level intermediaries such as niche, user process and systemic intermediaries engage in activities such as forming networks, sharing ideas and best

Phase of transition	Destabilisation	Pre-development and exploration	Acceleration and embedding	Stabilisation
Niche level intermediation	<p>Systemic intermediaries decreasing public legitimacy for and endogenous commitment to an existing regime; destructing existing network, markets and institutions; translating new forms of regulation to practice.</p> <p>Niche intermediaries aiming for destabilisation (coupled with functions for vision articulation, new network formation, capacity building and institutional support).</p> <p>Regime-based transition intermediaries translating destabilising policies into practice or making sense of a complex and changing policy environment to niche innovations.</p>	<p>Niche, user, process, and systemic intermediaries promoting experimentation and coordinating projects. Niche intermediaries forming networks, sharing best practices and creating reliability for new technology. User intermediaries forming initial knowledge sharing networks; configuring systems and uses qualifying claims by producers and resellers; articulating demand for niche producers.</p>	<p><i>Niche intermediaries</i> aggregating knowledge, guiding local experiments, replicating projects and pooling resources. <i>Process intermediaries</i> facilitating embedding of niches (that they are outsiders to) to particular contexts of application <i>User intermediaries</i> fill in information missing in the emerging markets and in technology use and maintenance.</p>	<p><i>Niche, user, process and systemic</i> intermediaries promoting experimentation & coordinating projects.</p>
Niche regime intermediation		<p>Niche intermediaries articulating early expectations. Process intermediaries connecting context-specific regime priorities and local projects. Regime-based and systemic intermediaries finding and directing funding for niche R&D activities.</p>	<p><i>Niche intermediaries</i> supporting niche embedding (aiming to increase size and stability) and developing shared institutional infrastructure (e.g. standard bodies). <i>Regime-based transition intermediaries</i> supporting niche build up through practical action & forming networks with other transition intermediaries; engaging in market creation. <i>Systemic intermediaries</i> aligning different perspectives and preventing strategic games; engaging in market creation and identification / evaluation of promising niches. <i>User intermediaries</i> facilitating technology adoption and reconfiguration by users</p>	<p><i>Niche intermediaries</i> seizing to exist / changing roles. <i>Process intermediaries</i> connecting context-specific local priorities and local projects <i>Regime & systemic intermediaries</i> finding and directing funding for niche R&D activities.</p>
Regime level intermediation		<p>Systemic intermediaries articulating societal needs for change; making a variety of technological options more visible; creating political and institutional space.</p>	<p><i>Systemic intermediaries</i> maintaining/strengthening political and institutional space. <i>Regime intermediaries</i> raising public awareness and creating legitimacy for the new pathway. <i>Niche intermediaries</i> lobbying for visibility and resources in political strategy making</p>	<p>New <i>regime intermediaries</i> emerging to fill institutional gaps, in response to new governance modes or to market restructuring. <i>Niche intermediaries</i> transforming into new regime intermediaries. <i>Systemic intermediaries</i> looking out needs for change</p>

Figure 3

Table displaying the different levels where intermediation can take place.

(Kivimaa et al. 2019b, 115)

practice and create reliability for new technology. Process intermediaries work on facilitation of specific projects and translate the priorities from the regime. And there are some systemic intermediaries that engage with all levels and work for an explicit transition agenda. These intermediaries create institutional and social spaces (Kivimaa et al. 2019, 1069–70).

In the acceleration phase there are more intermediaries. Niche intermediaries take a slightly different role, they collect or combine a mass of knowledge and information. The niche intermediaries create shared infrastructures like for example standards and organisations and influence action, by lobbying. During acceleration, niche intermediaries aggregate local experiments, aiding in the formation of a niche on a larger scale. Process intermediaries adjust to new regime priorities facilitating projects. Regime-based transition intermediaries support multiple niches, but when a transition is accelerating the actors get a new mandate to support these transitions. Regime-based transition intermediaries do this by vision formation, learning and translating (Schot and Steinmueller 2018, 1564). Systemic intermediaries also take a more active role in this phase. They take roles in negotiating and market formation. And then there are these actors, user intermediaries that facilitate early user practices and configure their technical systems. Although user intermediaries may or may not have a strong agency (Kivimaa et al. 2019, 1069–70).

Acceleration of innovations might involve a broader set of stakeholders than in the earlier phases of the transition and might also then need new types of intermediary activities. Intermediation across the socio-technical system, between regimes and geographical locations is desired (Kivimaa et al. 2020, 375). As acceleration increases the actors in the transition increase, the boundaries between niche and regime become faint, which in turn makes it more difficult to tell the transition actors from others (Kivimaa et al. 2020, 375). According to the editorial by Kivimaa et al., this situation might cause confusion for the intermediary. But this confusion could be overcome by focusing on longer term goals, differentiation intermediary activities and networks in different contexts and re-positioning roles of the intermediary (2020, 376). And most likely less intermediation and actors performing intermediation roles will be required as a transition progresses. Some actors might also become redundant after a time (Kivimaa et al. 2019, 1073). Intermediaries in the diffusion phase might prioritise between different stakeholders' interests (Kivimaa et al. 2020, 733).

The phase where the new regime is stabilized is not as broadly discussed in Kivimaa's (2019) research as it's a segment of the transition that has been studied less. Even so, the research points out that niche intermediaries might cease to exist. And systemic intermediaries are seen as

moving to new activities as their activities in destabilizing the old regime is done. Regime destabilization processes are processes that may precede or follow niche development, stimulated by external shocks or radical innovations. Regime-destabilization is processes that interrupt reinforcement processes of regimes.

3.5 Analytical framework

I base the analytical framework on the concepts and theories I have discussed above. The scope of analysis is drawn to what the research question concerns. The framework integrates three concepts - sustainable transition, the Multi-Level Perspective (MLP), and intermediaries in transition. It utilises Kivimaa's (2019b) typology of intermediaries where intermediaries are put in the context of multi-level perspective. Most emphasis on Kivimaa's concepts and typologies of intermediaries in transitions.

Furthermore, the thesis grounds its analytical approach in Kivimaa's framework, leveraging terminology relating to types of intermediaries and phases of intermediary action. The thesis analyses intermediaries, as pivotal actors in transitions, recognised for their role in translating information, advocating for diverse interests, and shaping connection across stakeholders. Their dynamic functions are identified as central to advancing sustainable socio-technical systems.

4. Methodological approach

In this thesis I am conducting a qualitative case study. I conducted five in-depth interviews with people that had either been directly involved in the process or that are or have been central contributors to the process of the emissions free Oslofjord project. The interviews were conducted online in person, between August 2023 and October 2023, and were recorded, transcribed, and analysed. The questions were in large degree open-ended and exploratory in the sense that they did not proceed from a fixed set of questions but sought to map the participants' understanding of how the cooperation and emissions free concept developed and how cooperation became a central part of succeeding. The interviews allowed me to get a deeper understanding of how the different actors relate to each other and interact. It also provided insight to which issues their members are occupied with in terms of climate change and the transition. The material I rely on is primarily a large number of official and publicly available documents and a limited number of in-depth interviews, as well as secondary sources. Below, I present the more specific types of documents I analysed and the interviews I conducted for each site.

I believe case study method was best suited to research the thesis question. By restraining from using leading questions the research has a high degree of reliability (Kvale and Brinkmann 2017, 276). Although as the interview was semi-structured and I at some points deviated from the original questions some, this might affect the degree to which the research is reproducible.

4.1 Qualitative research

Qualitative research is trying to understand a social phenomenon, situations or practices (Tjora 2012). One can choose to do interviews, observations, document analysis to understand a phenomenon. Similar to quantitative methods, the research starts with defining the theme, a phenomenon, a question, formulated like a thesis question. In qualitative research you focus your research on a limited phenomenon you wish to understand and might conduct a limited set of interviews. With a more nuanced view on the research one can delve deeper into the experiences that a participant has had. As the researcher we can try and lead the participants to tell us about their experiences. And as researchers we can do a more theoretical influences interpretation of their answers. The interpretations will depend on the theories and the perspectives the researcher applies (Tjora 2012, 23).

Choosing the participants is a process based on their opportunity to talk about the subject, preferably familiar with the subject of conversation. Tjora then explains how after the initial interviews and contacts the selection might “snowball” and add to the pool of interesting informants (2012, 151). This method is widespread in research of relations and in areas that might be unknown when the research starts or when it might be difficult to recruit more participants (2012, 151).

Source code	Actor type	Time	Format
Oslo port representative	Port	1 hour	Video call
Moss port representative	Port	1 hour	Video call
Color line	Transport, shipping company	45 minutes	Video call
Samskip	Shipping company	45 minutes	Video call
Hafslund	Energy and infrastructure	45 minutes	Video call

Figure 4
Information on conducted interviews

4.2 Qualitative interviewing

Interviewing involves employing conversation for the purpose of knowledge producing. The in-depth interview situations success is dependent on a good dialogue between researcher and participant and Aksel Tjora defines this as a intersubjective situation. In a qualitative interview situation, it is possible to find out how the participants reason for their approaches and positions, and therefore what contributes to forming attitudes. Qualitative interview surveys can identify themes and attitudes that were not set up as questions or answers when the survey was designed. The participant can get into settings, such as various personal experiences and experiences that they relate to their attitudes, but which constitute person-dependent aspects that the researcher could not foresee in advance (2012, 24). Interviews can allow for a thorough understanding of

how the different actors relate to each other and interact within the harbour's networks and outside. Interviews might also provide unique insight into which issues the ports are occupied with in terms of transitioning into sustainable operations.

Aksel Tjora describes the in-depth interview as a situation where one can make a situation that builds up under a free conversation around a theme and create an environment where the participant gets to reflect and share opinions on the subject (2012, 104). Diverting from the questions and digressing into other subjects is a part of the semi structured interview process that is appreciated. As this might bring the researcher onto subjects they had not considered, but that can be of interest (Tjora 2012, 105).

The interviews in my thesis were conducted individually, with each informant virtually with camera and sound. The interviews took about 60 minutes to complete. The informants had a engaged manner and the conversation did not feel constrained. Each interview was started by me introducing myself, and the informants were asked to ask as many questions as they would like before the interview started. Before going through the interview guide and asking the questions I had prepared. Diverting if there were answers I wished to follow up on. I conducted four interviews, and those who wished, got the interview guide sent over before the interview. Although not losing the theme and talking too much about the things I am not researching, more about the themes and things I am exploring. The interview guide is helpful in this, binding together the themes and framework (Tjora 2012, 110).

In qualitative research the theories might set some parameters for how one formulates the questions in the interview guide or in what way (Tjora 2012, 29). The interview preparation was highly influenced by the topic of interest and initial research question. Throughout the process, the formulations of the questions were adapted, but without losing the central view on collaboration and interactions that were central from the beginning. The interview guide was formulated with three main topics of interest in mind: initiation, collaboration, and challenges. Even as some themes was set preliminary through the interview guide, the loose structure of the interviews opened for the conversation to go into other directions which created new categories not initially defined. And as more interviews were conducted the interview guide and questions would be adapted. Some questions were adapted to be more specific within various topics according to the relevance to the informants.

4.3 Transcribing interviews & analysis

According to Kvale and Brinkmann (2017) transcribing is preparing of the interview material for analysis and can be seen as a translation of verbal accounts to written text. After each interview, the recorded conversations were transcribed. To get the rough transcription I used Autotekst, which transcribes the audio into a long text document. I exported the file into a txt file format and listened to the interview as I read the Autotekst, text and corrected the faults. Kvale and Brinkmann point out that it is not possible to transcribe the interview without losing some of the essences from the oral discourse (Kvale and Brinkmann 2017, 205). And that the first step moving the interview further from the original is the voice recording, here you lose the body language, and then making the transcription into a written form you lose the tone of voice and breathing.

To avoid losing too much of the essence and to ensure a more accurate account I made sure to transcribe the interviews within a short time after conducting the interviews. Because of the short time between interview and transcription, I had a fresh memory of the conversation, and I could remember much of what had been said and I could recall the mood and nonverbal impressions. I choose to focus on what was said and less of a focus on how it was said because I was trying to get an understanding of the participants thoughts and experiences.

The transcription when made from oral to written form, gets structured in a way that is more suitable for analysis (Kvale and Brinkmann 2017, 206). Deciding where to put the commas and periods is a part of the interpretation process (Kvale and Brinkmann 2017, 212). The qualitative analysis is more influenced with the researcher's subjectivity than the mathematical analysis in quantitative methods. Qualitative analysis typically considers theoretical interpretations in the analysis (Tjora 2012, 25). Qualitative research is often based on one or more theoretical traditions, to determine the framework of what is interesting research questions in the field. In Steinar Kvale and Svend Brinkmann book "the qualitative research interview" (translated by me) they explain a method for analysing long, complex interviews that they call "meaning densification" (translated by me) (2017, 232). This is a process where you write down a sentence or a section from the interview and pull out the central theme or meaning, from the angle of the participant. The researcher tries to understand the meaning of the participant in an open-minded way, and give the statements, central themes (Kvale and Brinkmann 2017, 233). This was a useful way for me to navigate the long documents of text and organise the statements without losing the opinions as they were expressed by the participants.

4.4 Ethics in qualitative research

Aksel Tjora writes in his book “Qualitative research methods in practice” (Translated by me) about ethics in research as ethical considerations. And explains that this is because there should be assumed a certain ethical sense in all research despite the formal legal requirements. Trust, confidentiality, respect and mutuality are ethical aspects Tjora believes will affect the relationship with the participants (2012, 39). He also argues that the ethics of social research is important as the researcher is imposing them self onto others and because the results are to be released.

At the beginning of the interview, after the general conversation where we had discussed the research field and the thesis, I asked for permission to voice record the conversation. Before going through the interview guide. Diverting if there were answers I wished to follow up on. Every participant was sent the information letter with the consent declaration, confidentiality and anonymisation as well as stating their ability to withdraw from the project at any time. The point about withdrawal was reiterated at the beginning of the interview. Although Aksel Tjora highlights the fact that after the interview the participants might feel a certain refusal to withdraw, even if they would have wished to because they don't want to let anyone down or “fail” anyone (2012, 41).

As the themes of the research don't involve a high degree of confidential information, and the interviews have not addressed sensitive topics. But to ensure the rights of the participants, the transcription and voice recordings have not been shared and deleted when they are no longer useful (Kvale and Brinkmann 2017, 213). The ethical considerations are based on the National Committee for Research Ethics in the Social Sciences and the Humanities (NESH 2021) guidelines for ethical research in social sciences, humaniora, law and theology. All official documents and references have been provided links to in the appendixes (NESH 2021, 16). From the interview data there are limited personal details, if any, but rather of institutional details. The private interests of the data procured should be thoroughly documented, and as there is no agreement between me, and the organizations used as data. It is important to ensure quality and careful use of methods as the informants have not expressed nor had any opportunity to decline any indication of participation in my study (NESH 2021). Quality is maintained by thorough referencing, avoiding plagiarizing and scientific honesty (NESH 2021, 27–29). As some of the data is collected through a third party with confidentiality it is challenging to provide an open and shared data foundation, but through proper referencing I hope to contribute

by being responsible by referencing and protecting the information due to ethical concerns (NESH 2021, 29).

The number of interviews I was able to conduct was limited by the scope of the thesis, time restrictions and available resources. One could therefore argue that the sample size of informants is unsatisfactory as there are several actors involved in the project. However, the emphasis in qualitative research is more on the analysis of meanings in specific contexts, rather than pursuing representativeness.

5. Empirical findings

In this chapter I outline the empirical findings derived from in-depth interviews conducted with representatives from ports and other collaborating stakeholders. This chapter focuses on the roles of the participants as intermediaries and the roles in transitions.

I have based the structure of the chapter on the two figures (figure 2 and 3) from Kivimaa (2019b, 112 & 115). There are three main themes which are divided into *Oslo port*, *Moss port* and *Related actors*. Each of the sections concerning specific actors in the sustainable transition.

5.1 Oslo Port

Oslo port is a intermediary organisation owned by the municipality of Oslo. The port is Norway's biggest cargo and passenger port and is run by the municipal company called Oslo Havn KF (Oslo havn n.d.). The company has the overall responsibility for the exercise of authority over the sea areas and the operations of the port. Oslo Havn KF is also responsible for the port quay areas and making storage spaces available for businesses (Ødemark 2023a). In 2020 Oslo Municipality adopted an ambitious climate strategy towards 2030, which presented how the goals are to be achieved. This strategy put pressure on the port as the making the port virtually emissions free was one of the priority areas in the strategy (Oslo kommune 2020).

Oslo Ports identified the driving factor behind the initiative to work towards a zero emission port and harbour in some ways being the personal background of the interviewed representative. A individual can have major impacts as drivers for a project. The representative explained that the initiative for collaborations with the ports was with the aim of sharing knowledge and to jointly do research on technologies and solutions across the value chain.

“The initiative for collaboration came about because we saw that there were more of us that were sort of fumbling in the dark.” (Oslo Port representative)

For Oslo port the work started with getting an overview and defining the specific emissions the port was responsible for. In this instance the Oslo port representative informed that someone from the Norwegian institute for Air research (Nilu) came into contact with them.

“We started with knowledge in a collaboration where Oslo municipality asked for data from us. At the time, there was someone at Nilu who said that you don't need to get an

overview of just that. I can calculate all the emissions from the ships both when they enter the fjord and when they leave again for you.” (Oslo Port representative)

With a general idea of the emissions they had, the port could make a conscious effort to work towards cutting those emissions. For Oslo port the emissions on land and in the fjord, became equally important.

“As for our main source of emissions, container ships. Some of the cement ships utilizing the available on-shore power for some of the time that they are at dock.” (Oslo Port representative)

In Norway there are now 177 on-shore power stations. Norway has been leading in international standardization work. A study gave the port a overview of how many chargers would be needed and where it would be needed.

“Norway have a lot of on-shore power stations because of the support from subsidies and grants, many allocated by Enova. We now have sufficient knowledge and expertise to be able to now provide useful input on a international standardization process. Now that there is a international standard, so now we build after those guidelines.” (Oslo Port representative)

On-shore power was a solution to reducing noise and cutting emissions that one shipping company decided to move forward with. Because of that the company uttered a need for a on-shore power station at the port in Oslo where they dock.

The first company to say they want on-shore power have had a say in deciding how the charging solutions should look and how it should work. So then Color line has a solution that is perfect for their ships. While in the freight ports, we will build standard solutions that are more accessible for more customers. (Oslo Port representative)

The ports reputation has been damaging and inhibited some of the work. But also might have contributed to the sustainable shift that we have seen with on-shore power.

“A aim was to shift the reputation of the ports, among planners and in the municipalities, which at times may seem to think that the best thing would be to move ports further away. The reputation is often that the harbour is somewhat dirty, dusty, and noisy.” (Oslo Port representative)

On question of the interactions between the port and the shipping companies, the representative comments that there have been held meetings with the other ports along the way. And highlights the effect of a procurement strategy like the demands in the procurement of zero-emission construction sites in Oslo municipality. The procurement strategy states that if you are going to build something in relation to Oslo municipality, you must inquire about zero emissions and the municipality reward the businesses that can deliver the most climate neutral solutions (Oslo kommune 2020). Public procurement that weighs climate friendly solutions heavily can be an important driver for innovation. Such a procurement strategy provides the industries with incentives to develop climate friendly solutions, products and services (OECD n.d.).

“Usually, the shipping companies are delivering to a zero-emission construction site led by Oslo municipality. The requirements from Oslo municipality's procurement strategy has made its way down and is forcing these shipping companies to change their strategy. And by 2025 Oslo municipality is aiming at solely having zero-emission construction sites, and that includes everything that is transported in and out. Making these types of ships change to on-shore power has been a more rapid process.” (Oslo Port representative)

The representative further explained that they had struggled with connecting their customers together, and that they saw potential in making them more connected. By facilitating the initial conversations with the ports, Oslo port then saw there were common transitions happening and explain that they believed there was more potential for the ports transition if they were in alliance. This has been important to the representative as the shipping companies are the most important actor to get into motion.

“We couldn't get the customers connected. We saw great potential in sharing knowledge, sharing the experiences we have. And we saw potential in meeting the same customers in the same room, together. So that the customers realized that it is not just in Oslo, on-shore electricity is a topic of conversation at all ports in the fjord.” (Oslo Port representative)

The Oslo port representative point out that the time used to facilitate interactions has changed. The ports have later in the process moved from the planned systematic meeting structures to more informal connections. It is pointed out that the interactions and dialogues have changed, from more organized to more unplanned and spontaneous.

“A challenge is that the topic is very popular, so we are pulled in many directions. Having enough time to schedule meetings is difficult. There are not systematic meetings any longer. It's more like we ask each other. I spend more time coordinating and setting aside time for gatherings etc. We do although keep each other informed of where we are in different processes and what we have done. And there is a very low threshold for sharing knowledge and information with each other.” (Oslo port representative).

A important part of the Emissions free Oslofjord project has been the meetings and information sharing that Oslo port started when the project was evolving. And the representative from Oslo pointed out that the structures that emerged during the Covid pandemic from 2019 allowed for the ports to gather more often and with greater ease as the online meeting technology allowed for less traveling time.

“We spend our time on sharing information with each other and inviting each other in and making sure that we can share what is relevant and useful for the others. If I'm struggling with something I can call a colleague and ask them how they went about solving it” (Oslo port representative)

The Oslo port representative then note that there isn't as divisive a competition between the ports. Especially when it comes to making sustainability demands.

“So the competitions between the ports are not as prevalent, when it comes to the environmental challenges and making demands of our customers, we don't compete. There we are better of if we are more alike.” (Oslo Port representative)

5.2 Moss Port

Moss Port is a harbour in the middle of the Oslofjord. The port serves as a service providing municipal enterprise, a company that is partly owned by the municipality, similarly to Oslo port. Moss port is fully owned by the municipality of Moss. And the ferry connection between Moss and Holmestrand, close to Horten, is the most active harbour in Norway ('Moss Havn' n.d.). In Moss municipalities climate strategy, it is stated that the ferry connection between Moss and Horten account for the highest degree of emissions in the sea-transport sector (Moss Kommune 2020). Moss ports initiative began with the ambitious goals of the Oslo municipality.

For us at Moss port, the initiative from the Port of Oslo, which works with emission-free Oslofjord became a central motivator and push. The Port of Oslo and Oslo municipality

have very ambitious goals and demands, which they want to set, and that reach far out through the fjord. At the port of Moss, we have to reach zero emissions, but we can't set requirements for ships to be zero emissions from a certain point of the distance through the fjord, because they could just pass us. We are not big enough alone. (Moss port representative).

Having a bigger more influential port showing their initiative and paving the way for collaborative efforts might have given Moss Port the confidence to start their road to emissions free solutions.

“The emissions free initiative started in 2017 for us. We entered into a collaboration agreement with ‘Smart innovation Norway’ to look at solutions to building a smart port for the future. We established a program that we called “Smart Moss port”. Then we worked with businesses, scientific research, the municipality, and the ports together.” (Moss Port representative).

The program made by the Smart innovation Norway consulting firm encouraged and allowed for making connections to different companies. Working with consulting firms contributed to highlighting the way for supporting innovation for Moss Port. On-land harbour (Innlandshavn) is a project developed by Moss port in collaboration with the Norwegian railway directorate, and it functions as a on-land-harbour that aids in transporting goods from ships to other land transport. In explaining the advantage of the on-land harbour, the participant from Moss port highlighted that they could work with both technological solutions and electrical zero emissions transport, between the port and the on-land harbour.

“We had an ongoing project with the Norwegian railway directorate about construction here and established the on-land harbour” (Moss Port representative).

The on-land harbour proved to be an efficient option for the ASKO, as it saves time and money with not going around the fjord. The on-land harbour in Moss close to Moss port has been an added incentive that might have made the project more profitable. ASKO is a wholesale business that specialise in grocery trade and consumer goods. They are a significant supplier of groceries and consumer goods to NorgesGruppen. ASKO comprise of thirteen regional ASKO companies and operate a number of warehouses and loading terminals.

“We worked together to find solutions and got in touch with ASKO. I don't remember how. We had a plan to start the road towards zero emissions and for us it went through

electrification. Asko continued to work on their part. ASKO came up with the idea of a “sea drone”, and it was something that came up at a rather cool gathering. In a bubble bath, as they have said.” (Moss Port representative).

ASKO maritime AS initiated the work with establishing an autonomous transportation solution for goods that cross the Oslofjord between Moss and Holmestrand as an alternative to driving through the Oslofjord tunnel. This was going to be a part of the transition to a completely electric transport chain between two of their main warehouses in Vestby and Sande. They worked with Kongsberg Maritime for the automation and the electrical propulsion and Kalmar was the contributor for electric and autonomous terminal tractors. Flowchange AS have been involved in the ASKO seadrone project with developing the concept and with assessing the profitability.

“There must be technological development to achieve sustainable shift. The seadrones are electric, and zero emission. Then we killed the myth that transshipment is so expensive that you cannot use sea transport for short distances. To make it economically profitable for the businesses, it will require that the drones become autonomous. Which there is a plan to achieve.” (Moss Port representative).

Recently NOAH a company that handle, process and store inorganic waste, have entered in a contract with ASKO and the operating company Masterly (ASKO 2023). The companies have signed an agreement to use the electric vessels that will go between Moss and Langøya, so that they can reduce the amount of transport through the centrums of Holmestrand and Horten (NOAH 2023).

The combination of ASKO’s seadrone project and Moss ports On-land harbour possibly made for attractive business opportunities for other actors to cut their emissions. The Moss port representative also informed that they did not intend on intervening in the transitions and initiatives that are being taken by ASKO.

“We figured that if ASKO intend to bring electric trucks, then we wouldn’t try to motivate other companies to build electric trucks for the port. At the time of building the on-land harbour there were very few Electrical trucks at our port. So we slowed down and followed nicely behind them and moved the project in the same direction.” (Moss Port representative).

Although the transport between Moss port and Horten are the most emission intensive sea transport in municipality (Moss Kommune 2020). It is followed closely by the traffic that travels past Moss port. When asked about the direct interactions with shipping companies that frequently travel through the Oslofjord the representative explains that they mostly drive these conversations via the Emissions free Oslofjord project.

“As for the shipping companies, the picture is much more complex. And we don't have very much dialogue directly with the shipping companies about this. The biggest dialogue about this with the shipping companies in recent years has taken place through the Oslofjord project. And it's a really great channel for that type of dialogue.” (Moss Port representative).

The Moss port representative emphasizes the complexity of interactions with shipping companies, citing the Oslofjord project as a pivotal channel. Echoing this sentiment, the Oslo port representative underlined the collaborative approach among ports, stressing the importance of unity in making sustainability demands of customers for the collective benefit of all ports (see 5.1 Oslo port).

“Oslo Port has the main contact with the shipping companies, and we can convey what we need or want to the people in Oslo. But for the most part we have the same solutions that they have. I hope they feel they have support for us in this work here.” (Moss Port representative).

The Moss port representative emphasizes the crucial support they receive from Oslo port, particularly in areas like tender development and document specifics. Despite their smaller size and limited procurement capacity, the two ports maintain a strong cooperative relationship, benefiting from Oslo's resources and expertise. While they may not often collaborate directly, the exchange of documents and proactive sharing of information underpin their successful partnership.

“The solutions that they arrive at, at Oslo port, we are supportive of from here. There has been suggested and conveyed a desire for us to step in and help finance, for example, the necessary rebuilding of a ship. And to that we have said that if the other ports are involved, then we are also interested. But we want to finance a ship that would dock at our port. That is the only one condition we have set.” (Moss Port representative).

Oslo port in many aspects seem to lead the other ports and have a role where they actively assist in the development of crucial documents and tender specifics, a task they take the lead on and subsequently distribute among the ports. Given Oslo's substantial size many employees compared to Moss, it's evident that they bear a significant burden in terms of share of responsibilities and resources among the ports. In the transition the distribution of workloads seems to be distributed mostly to Oslo port.

“The Port of Oslo support us in for example developing the documents and specifics related to tenders. And Oslo port might share proactively, or we call them because we are working on something, and ask them “do you have anything in this area?” Then we would get the documents or support anyhow, it's rare that we do something together. We are a very small port, compared to the Port of Oslo. And in terms of procurement, we have very little. So it is in this area, like many other operation-related areas, we rely on and have good cooperation, and we are sharing culture.” (Moss Port representative).

While Moss Port is smaller in scale compared to its counterpart in Oslo, it benefits from a strong collaborative relationship with Oslo Port, which leads the way in developing crucial documents and tender specifics. This partnership allows Moss Port to leverage the resources and expertise of Oslo Port, enabling them to collectively work towards ambitious sustainability goals. Moss Port's strategic initiatives, such as the "Smart Moss Port" program and the establishment of the on-land harbour, showcase their commitment to innovative and sustainable solutions. These initiatives not only benefit the port itself but also provide attractive opportunities for businesses like ASKO to reduce their emissions.

5.3 Related actors

This section will cover the information derived from the interviews and research related to three related actors. The ports have in different ways had connection to the actors and the actors have interesting points of view of the roles of the ports in their transition efforts.

5.3.1 Color Line

Color Line is a Norwegian Ferry Company that led traffic all year between, Norway, Sweden, Denmark and Germany. The company joint a vision of zero emission of harmful substances and have invested in rebuilding their vessels for use of on-shore power, and to achieve this they

have collaborated with the port authorities. This led to the completion of Oslo's first on-shore powerplant in 2011 (Ødemark 2023b).

“The electricity prices were high enough at the time, so that the change was a zero-sum chance and perhaps a small financial initiative in that. It is very, very important in bringing about the green shift. It must be financially sustainable. And that's one of the big challenges we've got to the very end, as I see it in the green shift. That we have not made polluters pay enough, and that we will start the green shift.”

Color Line and Oslo port have been actively working on measures to mitigate the challenges posed by the government's restrictions on international passenger traffic. For instance, has one of Color Line's cruise ships been relocated to another port, that is further away from residential areas near the harbour, and another one of their vessels is now connected to on-shore power. This innovation replaces some of the engines and allows for electrical heating, making the ship nearly emissions-free and quieter.

“We see that we have ports very close to the city centre, and that if we are to manage to keep the ports close to the city centre in the future, we must improve and reduce the burden on the society around us. So when we don't have shore power, we tend to have noise as a main pollutant for those closest to us, but then there are also things like SOT and NOX, which are local pollutants and CO2 as a global pollutant” (Color Line representative)

From this, one can gather that there are certain considerations based of geographical context and place-specific factors in sustainability transitions. As public awareness of environmental issues intensifies, shipping companies situated near cities are confronted with mounting pressure to alleviate their impact on local communities. The change in public opinion reflects a broader global shift towards climate consciousness, underscoring the urgency for transformative action in port operations. And the publics depend on and require the policymakers to credit the niches and regimes that align with their opinions (Roberts and Geels 2019).

“We have had conversations and relations with Statnett, due to agreements such as reduced electricity charges. We got something called a disconnectable tariff (utkobbelbar tariff), which means that we don't have to pay high power grid fee. If there are problems on the power grid, there is no need for extra capacity for us. Therefore,

there was a lot of dialogue with Statnett and central authorities to get the deals in place.” (Color Line representative)

Like the representative from the port of Oslo commented, the reputation of ships and ports have been subject to a negative opinion. The Color line representative further commented on the culture change they have experienced.

“The environment around us have gotten used to it, so that when we don't use it, we receive a lot of negative attention. So we use on-shore power despite the prices making it not profitable for us” (Color Line representative)

The shipping company representative highlights the challenging dynamic surrounding on-shore power usage. Despite facing profitability concerns, the company recognizes the importance of adhering to environmentally conscious practices due to heightened public awareness. This commitment to sustainable operations has led them to implement on-shore power solutions at all their Norwegian ports, setting a precedent in the industry.

“We have now introduced on-shore power at all our Norwegian ports, and now recently in Kiel. As we were first out with on-shore power, I am unsure as to how much we were in contact with other shipping companies in this project. (Color Line representative)

The representative acknowledges being pioneers in this initiative and indicates a potential gap in collaboration with other shipping companies on this front. This proactive approach underscores their dedication to driving positive change in maritime practices, even in the face of economic considerations.

5.3.2 Hafslund

Hafslund Rådgivning has since 2019 worked on a number of projects related to the port in Oslo. Among those have been a significant, comprehensive study to map opportunities for making the industrial harbour in Oslo emission-free (*Hafslund Rådgivning* 2021). The impact of personal experience in creating connections can be seen in the journey of the representative from Hafslund, who spent a significant amount of time working at the climate agency in Oslo municipality. This job became not only an entrance into the climate sector but also an opportunity to initiate efforts in reducing emissions within the shipping industry in Oslo.

“Shipping was my sector responsibility. Ensuring that emissions from that sector were going to be cut. I was able to help create what was then called an action plan for green shipping. So I knew the subject matter well and had a genuine interest in working with

a subject matter that was familiar to me. From the political side and working with industry and with ownership and the conditions of the Port of Oslo. But also more specifically in dialogue with representatives at the port who worked closely with climate and environmental issues at harbour. When I moved to consulting at Hafslund, the Port of Oslo gradually became a natural partner. If we are wonder about something or the port wonders about something, they just call us. And we are very open to discussion and to sharing information.” (Hafslund representative).

Hafslund provide guidance when needed to navigate the installation of new infrastructure. This could include finding out specifics of available equipment, cable routes or the requirements for different vessels relevant to on-shore power. To help build relationships between ports and operators, as mentioned above, the guidance could also provide clarity on the payment mechanisms for electricity provided by on-shore power installations. To evaluate the role of government procurement in innovation processes, it is useful to know whether a firm participates in government procurement of innovative products and processes at regional, national or international levels.

“Hafslund wants to electrify society, both with technical solutions and with consultations and recommendations. We hope that we may eventually be able to take over and operate the on-shore power operations.” (Hafslund representative).

Identifying common challenges, where to implement on-shore power, easy solutions for ships, conversion costs, etc. One challenge highlighted by Color Line’s representative, has been ensuring the electricity network is capable to meet the demand and that the infrastructure of the network and grid capacity is sufficient. Mapping out the hurdles and benefits can contribute to a company making the commitment.

“Hafslund is a commercial company that is 100% owned by Oslo municipality. Mostly independent, but there is a wish from our owners, i.e. the municipality, that we contribute in making the municipality achieve their climate and environmental ambitions. We see that if we can help various businesses in the municipality with their challenges, then we have, in a way, met many of the expectations and wishes from our owners. Because of that we believe that the Port of Oslo is an exciting partner. We want to contribute to speeding up the climate and environmental change in the city” (Hafslund representative).

While largely independent, their owners aspiration for Hafslund to actively contribute to the realization of the city's ambitious climate and environmental objectives does influence their behaviour. Because of this they see helping local businesses reach climate goals as a way to meet the municipalities expectations. Port of Oslo is seen as an exciting partner in contributing to cutting emissions. Specifically, to help make the on-shore power stations a reality happen Hafslund talks with companies that provide supplies to the facilities. They have conversations with the electrical network company, which are important conversations as the network company figure out and decide whether there is sufficient capacity on the grid. And have conversations with the shipping companies that could use the facilities. This is important as Enova demand there to be a cooperation agreement in place with the shipping companies before the grants that will help build the constructions are paid.

“Because of that we have been eager to get the shipping companies into the conversations and agree to cooperation agreements. We want to work with the most important players who can contribute to a green Oslo. And Oslo port is one of them. And it is a sector that is undergoing substantial restructuring. It has been a very traditional sector and a traditional industry. And now they have tougher demands imposed on them.” (Hafslund representative).

To evaluate the role of government procurement in innovation processes, it is useful to know whether a firm participates in government procurement of innovative products and processes at regional, national or international levels (OECD and Eurostat 2005, 103). This perspective is relevant in the case of Color Line. The shipping company's early adoption to on-shore power solutions might have been earlier than others because of their business model.

«For a cruise ship that visits Oslo perhaps once a year, the economics of using or contributing to a on-shore power facility is more limited. It is a completely different starting point for using such a facility on a ship such as Color line's.» (Hafslund representative).

Their comprehensive guidance spans from infrastructure installation to navigating payment mechanisms, solidifying their role as a pivotal partner in the pursuit of emission reduction within the shipping industry. The shipping company “Samskip” have as we will see, other factors that play into their role as first movers in the sustainable transitions.

5.3.3 Samskip

As I highlighted in the theory chapter about innovations, the innovation system can be seen as a network of organisations. They are involved in creating, diffusing, and using the innovations as well as the organisations that are coordinating and supporting the processes. Samskip is a coordinating organisation.

“Rotterdam has one of the biggest ports in Europe and that has a big impact on the city. Samskip manage ships, trucks, trains, and we have smaller inland ships. And those all require different sustainability projects. And there are new laws and regulations that come our way. For instance, the European emission trading system where we have to be compliant with that next year. And we are operating almost exclusively in Europe. What's going to happen is EU will tax us. They're going to make they're going to create policies and systems that will benefit those companies who are green, and will penalize companies who are polluting.” (Samskip representative).

For ships to be able to use on-shore power they might be required to retrofit their vessels, which would make economic sense for a shipowner if enough of the ports they visit provide on-shore power. Which in turn could require investments and that would be profitable once a reliable amount of ships are adept to use the power stations.

“A very important stakeholder is ports. First ports are very important, because they are like the knots in the system. Everything comes together in the at the ports. And what we need is a fuel transition. If we're switching to other fuels, maybe some trucks will be electric, maybe some trucks will be fuel cell hydrogen. The ships might be ammonia or methanol or e-methanol or biofuels.” (Samskip representative).

Making sure there is an alignment between the ports and the shipping companies that are sailing to them emerges as a fundamental concern.

“What's most important to us, is that when we go to a port, and we have a new hydrogen ship, we need to be very sure that the port we're sailing to also has hydrogen available. There needs to be alignment between all these different groups. And this is something that we do just by talking to other groups in the industry. So, within the shipping sector; people are talking to each other, not a lot. Not enough, but people are talking to each other.” (Samskip representative)

In the dynamic landscape of the shipping industry, actively making their opinion known is a fundamental strategy for driving progress.

“We try to air our opinion, we, and especially our senior management, for instance, our CEOs, attend events, talking about what we want, what we need. And then hopefully the rest of the industry will pick it up.” (Samskip representative)

This proactive stance highlights the significance of vocalizing their perspectives, particularly through the influential voices of senior leadership, as a catalyst for broader industry-wide transformation. This reality of a growing urgency to act on climate change issues emphasizes the critical crossroad at which the shipping industry finds itself, where public perception has significant influence over the company’s future. In fact, as demonstrated by Samskip’s efforts in building a hydrogen vessel, proactively engaging with governmental bodies can yield tangible support in the form of subsidies. Such an approach can contribute to limit hesitation that might hinder progress in the transition.

“We have climate change becoming more becoming worse and worse, which will reflect in the way that the general public thinks about companies like some operating big polluting vessels. If the end consumer or if the general public starts to turn against you, you're done.” (Samskip representative)

Excessive perceived risks become barriers to all forms of innovation according to OECD. With subsidies and grants, a company can limit these risks and drive forward innovative activities. So to facilitate the interactions and supporting companies such as Samskip in applying for subsidies and grants, support them in realizing the innovations (OECD and Eurostat 2005, 113).

“If we are building this hydrogen vessel we can inquire the Norwegian government, explain that we are willing to invest in building a hydrogen ship and then they might give us a subsidy to build the vessels. And that's also what happened in real life. That ship breaks the cycle, the chicken and egg problem.” (Samskip representative).

Sharing knowledge or decisions between different shipping companies arises as a necessity for shipping companies to align on sustainable fuel sources. and this calls for a delicate balance between cooperation and strategy.

“I think the industry in the end has to choose one and move with that so then everybody can build ships with that fuel and the ports can start offering it. So we will have to talk to each other. But at the same time, we don't want to talk to our competition. Because

we're not going to share with them what we are going to choose. If it's hydrogen or methanol or you know, because that's a strategic business decision. And all the companies, of course, they think like that. They're not willing to share information with the market because it can be a competitive advantage.” (Samskip representative)

Being hesitant to engage with competitors in open discourse seems to stem from the notion of choice of fuel embodies a strategic business decision that can lead to potential competitive advantages. It is within this dynamic that the industry struggle between knowledge-sharing while safeguarding strategic interests. Then how does a company like Samskip make sure they are still moving forward and aren't stuck waiting for someone to take the leap?

“Do we know for sure that the whole industry is going to move towards hydrogen? No. Samskip wants to be a first mover when it comes to sustainability. The benefit is that you get a great story, having the first hydrogen ship in the world. And that's good marketing. You can charge your customers more to go on that hydrogen ship. The risk is that the whole industry might choose another fuel. Or hydrogen could become super expensive, or it might not even be available. You don't know.” (Samskip representative)

Samskip's eagerness to pioneer hydrogen-powered vessels stems from a desire to be a forerunner in sustainability transitions, reaping first mover benefits. This not only translates into a compelling marketing narrative but opens another market for this climate conscious service. However, the uncertainty surrounding the industry's ultimate choice of fuel calls for caution. There is also risk factors, hydrogen might face unforeseen challenges. Samskip analyses the value chain before embarking on construction, ensuring that all key stakeholders, from port authorities to hydrogen producers and infrastructure developers, are aligned in the ambitious mission.

“Before you go into buying or building a ship, you will be very careful that you have the whole value chain with that project. So if you're building a new vessel on hydrogen, you have to make sure that the ports that it's going to sail to, are also in that project group, the producer of hydrogen and the people building the infrastructure, is there. In this case, you want to know for sure when build something, that it can be operational.” (Samskip representative)

In navigating the uncharted waters of sustainable shipping, Samskip's forward-thinking approach can be seen as an example of progress.

6. Discussion

In the previous chapter I comprehensively detailed and identified intermediary activities initiated by different actors relevant to the emissions free Oslofjord project. In this chapter I will provide the conceptual analysis of the findings in accordance with the analytical framework presented in 3.5.

This chapter is divided into sections each concerning a specific actor involved in the transition. There are three main themes. First the thesis thoroughly discusses *Oslo port* as an intermediary and the three interviewed actors. In the second section the thesis likewise examines *Moss port*. Key findings will be highlighted and further examined in the third section. In the *The role of ports as intermediaries in transitions* section I consolidate both ports. The third section presents and analyses the ports in their roles as intermediary actors between the different ports. This section also examines the intermediary roles ports perform in relations to other system actors.

As this thesis question is ‘What is the role of ports as intermediaries in transitions and how does their role change?’ I will derive actions and situations that hint towards the intermediaries Oslo port and Moss ports roles and how it changes. As I am studying actors relevant to the Emissions free Oslofjord project, I will centre the discussion mostly around regime level intermediation as the ports are regime actors and the ports have mostly carried out activities of this type.

The intermediary transitions I have explored here are mostly still in the pre-development phase with a few exceptions. The other projects could be considered as in the acceleration or embedding phase. My analysis will therefore focus on the pre-development phase.

6.1 Oslo port

The work towards emission-free projects started with a broader perspective and existing extensive experience. For Oslo port, identifying opportunities to reduce climate emissions and environmental impact in the port, came first. “We started with knowledge in a collaboration where Oslo municipality asked for data from us” (Oslo port representative). From the date it seemed they had figured out that their “...main source of emissions, is container ships.” (Oslo port representative). And one of the solutions to cutting this emission was the procurement strategy that Oslo municipality had set in place. The procurement strategy states that there is a higher valuation than earlier, given to the supplier who can deliver the more climate friendly

service. Before this change, the municipality would value the supplier who had the lowest price for the service more. Ensuring climate friendly solutions thereby became an economic incentive for the suppliers, and they seem to have taken this pressure and now this destabilizes the system.

At this pre-development phase the port of Oslo emerges as a systemic intermediary. The expertise of Oslo port encompassed a spectrum of environmental work. Such as with Oslo Municipality's collaboration with Oslo port and Ruter. A transport company that introduced electrical public transport ferries between the mainland in Oslo and the islands and peninsulas in the fjord. The port of Oslo was responsible for upgrading the wharves and arrange for the charging facilities. The work with these facilities granted port of Oslo more knowledge going into the work with the on-shore power facilities.

The representative at Oslo port explained that there was an initial project period where there was more deliberate contact between the ports, «We had a project period, there was a formal project period from which we prepared a project report, and after that it has been more informal.» (Oslo port representative). The project is not at the stabilization phase yet. There is a significant speed and tension in the system. Hafslund for example are at this phase cross between a niche and a user intermediary as they wish to take over the work of maintaining and operating the on-shore power. As we saw with Color Line, one could draw from the comment on the on-shore power systems, that they might have wished there were more actors choosing their on-shore solution. Although one in many ways can argue that the on-shore power solution is reaching the equilibrium as there are standards being set.

The port of Oslo performed certain activities related to niche intermediary actors in the pre-development phase as an actor that formed networks, promoted experimentation, and creating early expectations through conferences and meeting where they would highlight the importance of having a port close to cities or the areas where the products are going closeness to infrastructure that can take the remaining products. “The ports are after all, at the interface between land and sea.” (Oslo Port representative). To be able to get the ships to sail emission free they are dependent on the other ports to also enforce such a demand. “*The Port of Oslo has the most resources and does most of the heavy lifting, and we try to keep up the best we can. But for our part, we have our work cut out with ensuing that our port is emission-free, and then there's working on the sea emissions, with making sure the ships are able to connect to our on-shore power.*” (Oslo Port representative, Moss port representative).

Oslo port in the acceleration phase can be seen as performing certain process intermediary activities. Process intermediaries facilitate embedding of niches in particular contexts of application. Their role shifts from supporting experimental projects to embedding niches in specific contexts through translation. Such as contributing to write grant applications for the other ports, or providing support through Hafslund Rådgivning. These intermediaries need to adapt to changing circumstances by managing innovation processes and facilitating communication between different parties.

Regime-based transition intermediaries, intermediate within the system. In the theory this actor has been granted a mandate to intermediate by dominant regime actors, which in this case would be the municipality of Oslo, and the Norwegian government. The port representatives recognized a common challenge, involving shipping companies and maintaining contact and having the time to share their knowledge as pointed out by the representative from the Oslo port “*ensuring sufficient time for collaboration given the popularity of the project.*” (Oslo port representative). These can be challenges given their role as intermediaries, which can be mediated by involving actors such as Hafslund Rådgivning. Which would make Hafslund a process intermediary in this situation.

Hafslund in the acceleration phase guided the on-shore power developments the port of Oslo and were involved in the conversations between the port of Oslo and the shipping companies to help source resources. But were not responsible for collecting knowledge. They play a role in constructing markets and related institutions, facilitating early user practices, and connecting user needs to manufacturers and resellers. In the acceleration phase Hafslund sought to understand specific context, such as the impact of on-shore power supply on different types of ships, and the potential reductions in emissions.

The shipping company Samskip can be seen as a niche as they emerged in the system with the development of their hydrogen ships. The company is advancing this technology as a solution for making the green corridor a feasible goal. To achieve the hydrogen solution, Samskip has had conversations with drivers of local projects and bigger international leaders. And in the interview point at the importance ports have in realizing their ambitions. Specifically, hydrogen refuelling stations at the ports.

Samskip has a role in niche regime transition linking niches to regime structures. The shipping company has an expectation that their bet on hydrogen technology will be worth their while

and that it will grant them a competitive advantage. They have started building ships with hydrogen propulsion technology that will ship goods between Oslo and Rotterdam.

Regime destabilization is processes that interrupt reinforcement processes of regimes such as Oslo ports portrayal of the need for alternative solutions and new technologies to meet the demands emerging from ambitious climate goals might further destabilize the existing regime. And help create a market for using on-shore power by enforcing penalties on shipping companies that emit pollutants. The penalty Color Line experienced with their emissions of NOX and SOT.

The ports may also work towards changing existing systems by advocating for societal needs and creating space for political and institutional shifts. Oslo Port moves from systemic intermediating to regime-based transition intermediating in the acceleration phase as they intermediate between multiple actors.

6.2 Moss port

In the predevelopment phase, Moss port have relied on Oslo port for forming knowledge sharing platforms. Although Moss port had their own platforms for sharing priorities and creating alternative system configurations. Moss port were forming networks, promoting experimentation, and creating early expectations through the need for solutions to the climate ambitions. The networks formed both with Oslo port and the intermediary activities performed by Moss port in relation to their “Smart port initiative” functioned as regime-based transition intermediary activities.

In the pre-development phase, the ports involved in the Emissions free Oslofjord project set their emission reduction goals. At the port of Moss, the on-land harbour project was a project that opened the gates for more innovation and more actors getting involved in finding new solutions at the port. When the niche development progressed from pre-development to acceleration, a new actor moved into the domain. The idea and solution of the Sea drone by ASKO became a supportive idea to the on-land harbour that was built by the Norwegian railway directorate. This harbour allowed the port to expand their reach and made the business more efficient.

ASKO had a challenge and were eager to find solutions for their long transport routes around the fjord. In relation to the “smart port initiative” by Moss port they encountered Moss port and worked out an idea of a transport system that would go between their two locations more

efficiently and climate friendly. The initiative of Moss port and the work on the on-land harbour formed ground for exploration of the ASKO sea-drone project. Moss port, when working on the seadrone and the on-land harbour project, supported the building up of the technologies involved. And in the interview explain that they didn't engage in other initiatives when the building of supporting structures for the ASKO sea-drone was advancing, specifically the chargers for heavy transport. The port supported the market creation between the port and the on-land harbour and the sea-drone. ASKO in this acceleration phase were working towards establishing reliable technology. As the project is stabilized, they may become new actors in the regime intermediary ecology, eventually shifting the role of Moss port.

The representative from Moss port explained that they “*slowed down and followed nicely behind them and moved the project in the same direction*” when talking about the on-land harbour and the initiatives to build infrastructure to support electrical trucks. This sentiment might hint to notions of the port leaning towards the user's interests, which is a characteristic typical for user intermediaries. Moss port seem to support both the initiatives with the on-land harbour, and the ASKO sea-drone project. Their position at this acceleration phase seems to still be one of regime-based transition intermediaries, as they are facilitating transitions between many actors.

Acceleration of the sea-drone project is at the embedding stage. Along with the on-land harbour project, one could state that the incumbent regime structures and systems are going through a process of destabilisation. The seadrone and the on-land harbour have contributed to destabilizing the infrastructure that has been dominant for Moss Port and transport system that previously had to drive around the fjord. Both the on-land harbour and sea-drone projects are functioning as part of the system. The full completion of the sea-drone project will be fulfilled once the ships are self-driving and autonomous. The sea-drone and the on-land harbour project are both commercialised and contributing to reducing risk and uncertainty between the actors involved. At this phase one could argue that Moss port has functioned as a systemic intermediary that has allowed disruption of the existing system and facilitated acceleration of new innovations.

6.1 The role of ports as intermediaries in transitions

Ports perform roles as intermediators as they are centrally placed actors in the process of establishing sustainability projects and engage stakeholders and actors in the field. The variety of actors, technologies and institutions involved in the transition at the ports and involved in

transitioning the shipping sectors and ports to sustainable solutions entails a high degree of uncertainty. Therefore there is a need for intermediary actors. To be able to get the ships to sail emission free we are dependent on the other ports to also enforce such a demand (Oslo Port representative, Moss port representative).

Because of the ports role as an organisation and business in the larger system, the ports mostly perform regime-based transition intermediary actions. Mainly focused on facilitating knowledge flow between the ports and stakeholders and they have a focused mandate (Klima- og miljødepartementet 2019). Regime-based transition intermediaries translate new regulations and bridge gaps between producers and consumers, and they disrupt existing structures. They may interact with a range of niches or the whole system (Kivimaa et al. 2019b). The ports are facilitated at the system level between multiple actors and there are goals, and a mandate to act (Kivimaa et al. 2019b).

The initial phases consisted of central intermediary activities led by the Port of Oslo. Oslo port and Moss port, mostly performing intermediation actions on the regime level, for example with explaining their priorities and connecting local projects. It is important for ports to collaborate because they are too small alone (Oslo port representative, Moss port representative). Niche regime intermediation typically involves intermediaries that have connections with the prevailing socio-technical regime but are inclined or mandated to work towards transformative change. The two ports are both intermediating with actors locally, and contextually to their mandate and the ports are intermediating between themselves. Such intermediary actors are highlighted as being crucial in the acceleration phase (Kivimaa et al. 2019b).

Moss port acted as regime-based transition intermediaries in the pre-development phase, collaborating closely with Oslo port, forming knowledge-sharing platforms, and setting emission reduction goals. The 'Smart port' initiative prompted the port to experiment and create expectations for climate solutions. The introduction of the on-land harbour opened doors for innovation and attracted new actors to the port, ultimately contributing to the acceleration of niche technologies. Moss ports role as intermediaries was continually one looking from the regime, but at the pre-development phase, one could see actions pointing at process intermediating, connecting the priorities of the port to the local projects. As the context might have been different that in the following acceleration phase (Kivimaa et al. 2019b, 115).

Destabilization processes are processes that may precede or follow niche development and is stimulated by external shocks or radical innovations. Regulation can exert pressure for change (Damman and Steen 2021, 2). The Samskip representative point out that this is something they have had in mind. The representative comment that not making this shift now might force them out of the market in a very short time and highlight that it's the consumer or user that is exerting this pressure. Regime destabilization may create a demand for new forms of intermediation that wasn't recognized before. There had to be intermediation actions played out by Oslo port to aid in realizing hydrogen shipping between Oslo port and Rotterdam port with the Samskip ships. This interaction seems to have involved actors such as Hafslund Rådgivning as well, to aid in grant application processes. And stakeholders that can aid in facilitating the infrastructure needed.

The innovation system can be seen as a network of organisations. Intermediators are involved in creating, diffusing, and using the innovations. Intermediaries arrange involvement of a broad set of stakeholders that might not previously have been active in the transitions. Emerging confusion and re-positioning of intermediary actors might occur as transitions accelerate and blur niche-regime boundaries. At the core of transitions is technological advancements or changes and tensions in the prevailing systems. For the ports, supporting different technology that drives the vessels and the technology and infrastructure needed to allow the ships to dock at the ports emissions free has been important. The diffusion process of on-shore power solutions at the ports are processes where development of users, user practices, institutions, production, and regulation became decisive.

At some instances the ports perform intermediary activities related to other actors than between the ports. Such as when the ports are intermediating within specific experimental niches, then they would be considered a process intermediary. For example when Oslo port facilitated embedding of the on-shore power station with Hafslund and Color Line. Or when Moss port performed intermediary activities with ASKO and the on-land harbour. In these instances, the ports are implementing context specific priorities informed by the broader goal. ASKO was prioritised to install electrical chargers and were allowed to advance the project without tensions with other actors. This demonstrates Moss port's support for the sea-drone project, in conjunction with the on-land harbour. As both projects near acceleration and embedding, Moss Port emerges as a systemic intermediary, - driving disruption within the established system and fostering the acceleration of new innovations for a more sustainable future.

Compared to other interest groups, ports and municipalities might have both an advantage and a disadvantage. In the acceleration phase, intermediaries like Oslo Port faced various challenges. Oslo port took on the crucial role of creating contacts and forming networks but found it challenging to manage innovation processes and facilitate communication as the project increased in dimension. They also had to adapt to changing circumstances, such as the shift in demanding emissions-free transport mandated by the municipality of Oslo, including the emissions through the fjord in the emission calculations and works on an international standardization.

As the transition accelerates, there is a blurring of boundaries between niches and regimes. This implies that successful transitions involve a dynamic interaction between existing systems and innovative approaches. “Intermediaries can translate information between different actors, and aggregate and advocate different interests” (Kivimaa et al. 2020, 372). By advocating for the adoption of land-based power supply and sharing the experiences, Oslo port and Moss port contribute to a shift in the broader regime towards sustainability. The multi-level perspective formulates a concept of how the transition from one socio-technical system to another happens in a specific way, as a regime shift.

Specific policy instruments and mandates, such as the goal of making Oslo municipality emissions-free by 2030, are driving factors in the transition (Oslo kommune 2020). And policies that are out of sync with public opinion may erode legitimacy (Roberts and Geels 2019). This underlines the importance of clear, long-term goals set by governing bodies.

In the interview with the representative from Oslo port, the importance of regime level intermediation in driving systemic change is highlighted. The port representative also emphasizes the significance of integrating shipping and land-based transportation systems to achieve substantial emissions reductions. Damman and Steen called for more research on the role of ports as key infrastructure intermediaries that must cater to the needs and demands of a plethora of stakeholders and operate within a complex multi-scalar governance framework.” (Damman and Steen 2021). The ports role as intermediaries as described here collectively addressed the challenge of connecting with customers and coordinating with energy suppliers, aligning their policies and approaches to different power supply options, creating a unified front. By presenting a consistent message, they communicated the inevitability for customers to adopt green technologies or face higher costs.

7. Conclusion

This thesis set out to investigate what the role of ports is as intermediaries in transitions and how their roles change through the transitions. The sustainable transition towards emission-free Oslofjord has been a complex and multifaceted process. At the heart of this transition lie the ports, which have emerged as pivotal intermediaries orchestrating interactions among various stakeholders.

This thesis draws upon a rich theoretical foundation encompassing various facets of sustainable transitions. The multilevel perspective is instrumental in comprehending the conditions for acceleration, here in the context of leading socio-technical systems. Drawing from the understandings of interactions between different system elements in sustainable transitions provided the contextual background to studying ports as intermediaries (Kivimaa et al. 2020). By studying the roles ports take as intermediaries within the system, this framework provided valuable insights into how ports, as essential intermediaries, can actively shape discourse and foster environments conducive to sustainable transitions.

The zero-emission transition in the Oslofjord might have been influenced and affected by the time and timing of the surroundings. The pressure of the landscape with the world demanding solutions to the climate crisis, or at least demanding an end to polluting. Intermediaries, as defined in the literature, play a crucial role in translating information, aggregating interests, and advocating for change. They bridge gaps between opposing sides, facilitating agreements and driving forward transitions that might otherwise stall. Intermediaries operate amongst other actors in transitions. And intermediation changes shape over the course of a transition. The composition of the intermediaries might change, and there might be battles for survival as need for new skills and knowledge grows. Ports, in this context, act as mostly regime-based intermediaries, forming networks, promoting experimentation, and creating early expectations. Although there are instances of the ports performing user intermediary actions.

Their proactive engagement and distinct identity, combined with their position at the interface between land and sea, make them uniquely positioned to influence the transition. Ports play a crucial role in sustainability projects, acting as intermediaries between various stakeholders and driving the transition towards emissions-free solutions (Damman & Steen 2021, 12). The ports perform intermediary action from a regime standpoint. Regime-Based Transition Intermediaries operate at the system level, collaborating with multiple actors and working towards specific goals set by governing bodies.

The Oslofjord project has seen a progression from pre-development to acceleration, with a diverse set of actors collaborating to advance emission-free solutions. Oslo Port, as an initiator, has worked closely with partners like Hafslund and shipping companies to forge networks and share knowledge. In the acceleration phase, their role shifted towards process intermediation, managing innovation processes, and facilitating communication. And Oslo port faced challenges in managing innovation processes and communication as the project grew.

Moss Port, through initiatives like the on-land harbour and support for the ASKO sea-drone project, has played a crucial role in accelerating niche technologies, ultimately contributing to the destabilization of the existing regime.

The dynamics of the transition have also highlighted the challenges intermediaries face, especially in the acceleration phase. The blurring of boundaries between niches and regimes calls for adaptability and a focus on longer-term goals. Policy instruments, such as the mandate to make all transport in Oslo municipality emissions-free by 2025, have provided a clear direction for the transition. Additionally, the influence of external factors, including consumer demands and regulatory pressures, have exerted significant influence on the transition.

Ports serve as key player in the sustainable transition in the Oslofjord. Their versatile roles as intermediaries, spanning from forming networks to advocating for change, have been instrumental in driving the transition forward. The Oslofjord project serves as a microcosm of the broader sustainability transition landscape, emphasizing the importance of clear policy goals, adaptive intermediaries, and collaborative efforts across multiple levels. As the transition progresses, the ports are needed to continue their role in shaping a more sustainable future.

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