Norwegian School of Economics
Bergen, Spring 2022

What does it take to unlock a Public-Private Partnership for Good?

Case study on the deployment of Carbon Capture and Storage in Norway

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Master thesis, Economics and Business Administration

Major: Strategy and Management; Energy, Natural Resources and Environment

NORWEGIAN SCHOOL OF ECONOMICS

Acknowledgements

This work would not have been possible without the support of Professor Christine Meyer. Thanks to your enthusiasm and intellectual interest, you have made our work feel relevant and exciting. We would also like to thank the many players of Longship who accepted to share their experience from within: the Ministry of Petroleum and Energy, Gassnova, Northern Lights, Norcem Brevik, Fortum Oslo Varme, Øygarden Kommune, and Aker Carbon Capture. You are doing something big, and the world is indeed *"looking at you now"*. We would like to express our gratitude to Professor Gunnar S. Eskeland and Professor Bram Timmermans for having first spoken of Longship and for having triggered our absolute interest in the project. We wish to salute the support of our respective partners, families, and friends who have probably read our thesis more than ourselves and who have dealt with our many ups and downs inherent to such a thesis-writing process. A special wink goes to Lucie's Grandfather, who has left us this year and who was not granted access to higher education. His legacy is a constant reminder that education and its empowerment should never be taken for granted. Last but not least, we thank the Norwegian School of Economics and Norway for having made us feel at home. May it be through education or infrastructure projects, you are showing that another way is possible for our planet. We are grateful for having been part of such an effort.

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Bergen, May 2022

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Abstract

In light of the world's social and environmental turmoils, cross-sectoral collaboration is often thought of as a potential solution to address sustainability challenges. We contribute to the nascent thread of research that delves into those public-private partnerships (PPPs) which focus on sustainability objectives. We do so by better understanding what are the mechanisms required to unlock a public-private partnership for good and how to best manage such a public-private partnership for good.

This thesis is based on the exploratory case study of Norway's Longship project, the world's first-ever full-blown value chain of carbon capture and storage (CCS). Primary and secondary data were gathered through seven semi-structured interviews, on-site observations, and an in-depth study of public publications and party agreements. In order to unlock the public-private partnership for good, our findings disclose the need for the government to adjust regulatory frameworks, give substantial financial support, bear significant risks, and supervise the project. Furthermore, we highlight successful management factors that govern PPPs for good. Such management concerns include the need to embed industry incentives notably through the agreement, the necessity of goal alignment, willingness to collaborate, project management mechanisms, trust and respect, human resources management, and stakeholder involvement.

Keywords – Public-private partnership for sustainability, carbon capture and storage

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1 Introduction

As over one billion inhabitants face hazards due to sea-level rise, scientists urge us to halve our greenhouse gas emissions by 2030 compared to 2019 levels (IPCC, 2022). Although such facts may at first appear overwhelming, there are reasons to remain positive. As the Secretary-General of the United Nations António Guterres confirms, we are at a *"defining moment"* to act and collectively draw down this phenomenon (United Nations Secretary-General, 2018).

Given the breadth of our era's challenges, actors - from public entities to firms and civil society - have a pivotal role to play in this necessary transition. This often entails different players from various sectors working together. A type of cross-sector collaboration that is bound to gain relevance in the years to come is public-private partnerships (PPPs). Described as a type of cooperative arrangements between public and private partners, PPPs have indeed triggered much interest in enabling partners to better *"share resources, risks, responsibilities to gain societal, economic or environmental objectives mutually"* (Kwak et al., 2009, p.52). Extensive literature has been directed toward understanding why PPPs are more efficient and provide better value for money than solely public or private provisions.

There indeed appears to be a consensus on PPPs' higher performance at delivering public goods (Savas, 2000; Osborne, 2000; Klijn & Teisman, 2003; Hodge & Greve, 2005; Steijn et al., 2011). Scholars have shed light on the potential resource complementarities and cost-minimization enabled by public-private collaboration. By working together, the public sector may import management expertise and proprietary know-how while the private counterparts can better share the risks with the public entities (Brinkerhoff & Brinkerhoff, 2011). Drawing on externality theory, Rangan et al. (2006) reveal that PPPs are usually established in activities with positive externalities. These positive ripple effects for the community are the reason that push for public intervention. At the same time, the private sector's lower resource costs incentivize the public sector to collaborate with its private counterparts. Overall, PPPs have sparked much academic interest as a reflection of their promising future for public good provision.

If societal, economic, and environmental gains are already included in the above-mentioned

definition of PPPs, a thread has emerged within PPP research that specifically focuses on public-private collaborations "for good". Coined as the *"new organizational zeitgeist in handling major societal issues"* (Vurro et al., 2010, p.40), PPPs indeed have sparked sizeable interest for their potential to address sustainability issues, characterized as a balance of economic, environmental, and social objectives (Brundland, 1987). This line of research notably looks into the potential contradictory agendas that may arise between the sustainability-oriented public sector and the profit-seeking private players (Koppenjan & Enserink, 2009; Utting & Zammit, 2009). As a result of these potential goal discrepancies, empirical evidence on PPPs for sustainability fail to provide clear evidence on the contribution of PPPs to sustainability (Pinz et al., 2018). Indeed, if some case studies reveal the contribution of PPPs to one dimension of sustainability (Bagchi & Paik, 2001; Teicher et al., 2006; Pérez-López et al., 2015), others show that this contribution may be at the expense of other dimensions (Lieberherr et al., 2012). Lastly, the research on PPPs for sustainability touches upon the key success factors to correctly manage PPPs for sustainability which shares much in common with the overall PPP research.

All in all, however, the potentialities of PPPs for sustainability are only surfacing. There remains much to do in this promising field that strives to facilitate public-private collaborations and successfully attain sustainability objectives with them. As a demonstration of this thread's immaturity, Pinz et al. (2018) aggregate only fourteen case studies on PPPs for good in their systemic literature review. Among these, partnerships for the environment were the least developed field, at the profit of economic or social-oriented partnerships. Furthermore, much attention is directed toward the management of PPPs and less towards implementing the necessary favorable conditions for the private sector's involvement in sustainability projects. Indeed, the literature does not dwell on identifying the prerequisite conditions to any private sector's engagement nor on the necessary governmental means to unlock the PPP for good.

In this thesis, we wish to fill this research gap by conducting a case study on Norway's Longship project; the world's first full-blown value chain of CO_2 carbon capture and storage (CCS). This topic is of high relevance because Longship is intrinsically aimed at achieving environmental objectives by capturing and storing CO_2, thereby precluding it from reaching our atmosphere. Longship is also a demonstration of extensive public-

private collaboration where unprecedented governmental efforts are made to attend to the industry players' preoccupations. We strive to contribute to the existing literature on PPPs for sustainability by addressing the following two research questions:

- What does it take to unlock a public-private partnership for good?
- How to best manage a public-private partnership for good?

To provide answers to these research questions, we leverage different types of data, both of primary and secondary nature. We conduct qualitative semi-structured interviews with multiple players involved in the Longship projects, from the Ministry of Petroleum and Energy to the Northern Lights, a joint venture between Equinor, TotalEnergies, and Shell that is responsible for the transport and storage links of the value chain. In addition, we made observations during the Open Day at the temporary storage site of Longship at Øygarden. We complement this primary data with the study of official public documents of the Longship project and agreements between different parties involved, thereby assuring the triangulation of our data.

In the following, we begin by reviewing the literature on PPPs and explore the thread of PPPs for sustainability. We finish this review by explaining global warming and carbon capture and storage technology which are both paramount to grasping the high stakes of Longship as a climate project. Once we have shed light on our research design, data collection and analysis, we present the Longship and the characteristics that make this case study relevant given the topic at hand. Lastly, we present our results and discuss our respective contributions to the literature as well as the limitations inherent to our work before concluding on this thesis's findings.

Referring to Guterres's words, we are at a pivotal time. The stakes in this project's success and the next to come have never been so high. Understanding what it takes to get private players to the table is a prerequisite to any public-private partnership. Similarly, grasping the management success factors of a PPPs for good is indispensable to achieving its sustainability desired outcomes. We hope that our work may facilitate and contribute to the trigger of further CCS projects and public-private collaborations for sustainability.

2 Literature Review

In the parts to come, we review the existing literature on public-private partnerships (PPPs) and on their recognized potential for sustainability. After investigating different forms of cross-sectoral collaboration, we deep-dive into PPPs and their theoretical value-creation mechanisms. We then link PPPs with the sustainability literature, understanding this organizational form's respective contribution to sustainability, its own set of challenges, performance, and key success factors. We finish by contextualizing Longship, introducing global warming and its effects, the impact of heavy industries, and the promises of carbon capture and storage as a game-changer.

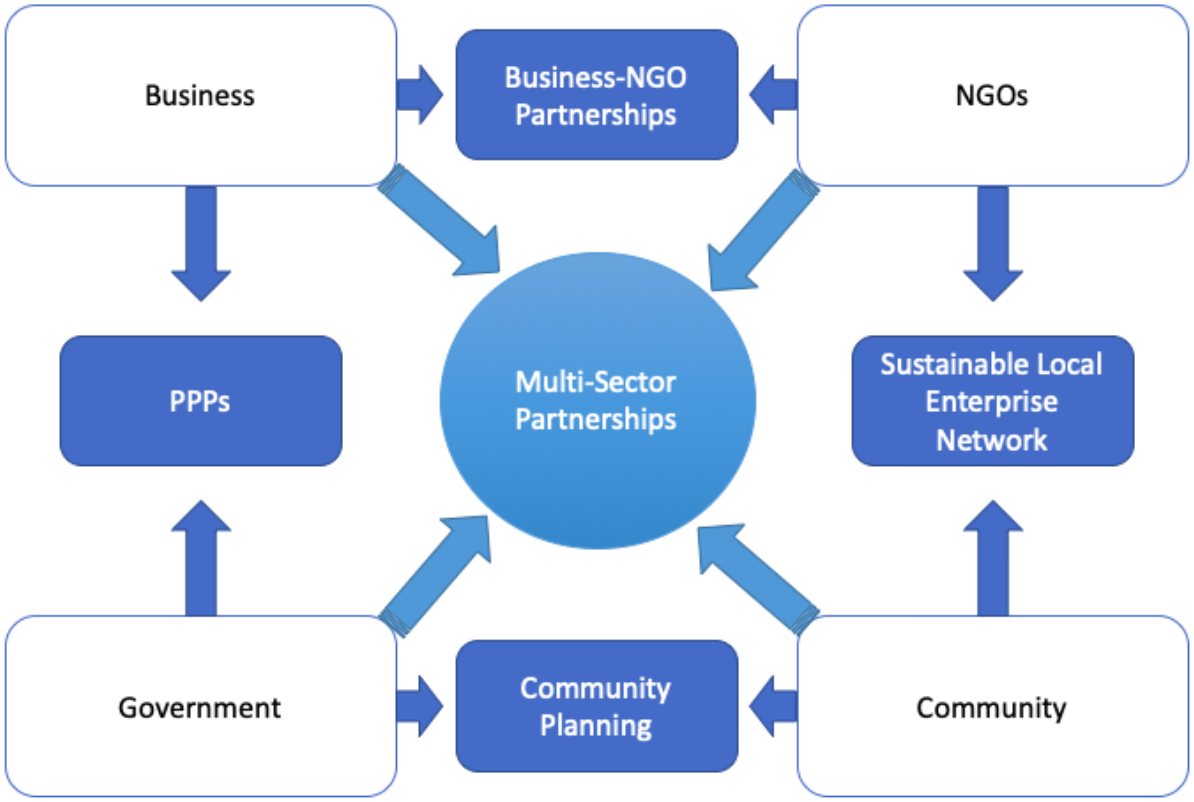
2.1 Cross-sectoral collaboration and public-private partnerships

2.1.1 The growing interest for cross-sectoral collaborations

Described as the collaboration paradigm of the 21st Century (Austin, 2000), multi-sector partnerships have grown exponentially in the last 15 years (Gray & Stites, 2013). This emerging phenomenon is generally defined as alliances in which different sector organizations work together to achieve a common purpose, pool core competencies, and share risks, responsibilities, resources, costs, and benefits (Utting & Zammit, 2009). Interest in such organizations has grown because they empower players by joining forces and allow players to overcome issues that they would not be able to solve individually (Gray & Stites, 2013).

These collaborations are cross-sectoral to the extent that they involve parties from different sectors: businesses, non-governmental organizations (NGOs), governments, or civil society. Such collaboration can hence come in many forms, ranging from alliances between businesses and NGOs to smaller networks between local communities and micro-financiers, for example. Cross-sector partnerships can be formed between any two of these sectors, with each type of cross-sectoral collaboration having its own term to reflect its unique cross-sectoral alliance.

Figure 2.1: Partnership by sector (inspired from Gray & Stites, 2013)



The present thesis focuses more specifically on one type of cross-sectoral collaboration: Public-Private Partnerships. In the following, we draw from the PPP literature and review the motivations underpinning such collaboration, the challenges associated, and the empirical evidence regarding PPPs' effective performance. Indeed, although they are praised in the literature for their capacity to overcome sustainability issues effectively, cross-sectoral collaborations do not always succeed. However necessary and desirable they may be, such collaborations are not easy to implement and manage. For this reason, we look at the literature's exploration of the key success factors that guide a PPP before contributing to the literature regarding this emerging research area.

2.1.2 Defining public-private partnerships

Public-private partnerships have been amply scrutinized over the past 50 years for their potential to satisfy the growing demands of society (van Ham & Koppenjan, 2001; Weihe, 2005; Rybnicek et al., 2020). Because they resulted in much academic attention, PPPs

have been defined differently across the years (Brinkerhoff & Brinkerhoff, 2011). There is, however, a consensus over PPPs' essence as a *"cross-sectoral cooperation between public and private partners"* (Rybnicek et al., 2020, p.1174). Researchers have specified the nature of this cross-sectoral relationship, arguing that the partnership must be based on a mutual commitment: it is not enough to have public and private actors working together, but it must be done to achieve some kind of joint outcome (Bovaird, 2004). PPPs are hence thought of as collaborations in which the private and public bring their skills and resources to the table with the aim of achieving better efficiency and synergies (Brinkerhoff & Brinkerhoff, 2011). Aligned with this goal-oriented approach, Kwak et al. (2009, p.52) define PPPs as *"cooperative arrangements between public and private partners to share resources, risks, responsibilities, and rewards to mutually gain societal, economic or environmental objectives"*.

With such an open-ended definition of a PPP, the literature on it has flourished, leveraging different understandings and theoretical lenses to grasp PPPs. However, to some researchers, this extended literature brought about theoretical confusion about what was concretely a PPP, arguing that *"if it means everything, then, in fact, it means nothing at all"* (Weihe, 2005, p.2). Indeed, many researchers argue that there are definitional issues attached to the concept, resulting in a general confusion on the topic (McQuaid, 2000; Hodge & Greve, 2005).

Since this realization, successful efforts have been made to categorize PPPs further. Beyond their application, PPPs have been distinguished based on the levels of risk-sharing, mutual coordination, and organizational arrangements. Added together, these indicators make up for the "degree of PPP" that determines the level of integration between the public and private sectors (Steijn et al., 2011). PPPs can indeed vary from tightly to loosely-coupled organizational forms or from a principle-agent relationship to an equal relationship between both sectors (Klijn et al., 2010). As an example of such categorization, PPPs dedicated to building infrastructure can be positioned anywhere between full public provision (where the public sector handles all aspects of delivering public services) to full private provision. Beyond the level of private involvement, PPPs also vary in terms of financial resources and ownership of property (Kwak et al., 2009).

Beyond classifying PPPs based on their organizational forms and level of integration,

attempts have also been made to distinguish PPP research based on the academic approach. In this vein, Weihe (2005) and Cheung (2009) identified at least four distinct approaches in the literature. Firstly, the "policy approach" aims to describe public-private cooperation and analyze how the production of goods and services may be divided between the public and private sectors. This approach leverages an open-ended definition of PPPs, treating PPPs synonymously with private-public cooperation (Weihe et al., 2005). Secondly, quite similar to the former approach, the "governance approach" delves into how PPPs are governed by both types of actors. It covers a great diversity of cooperative agreements between the private and public sectors and tends to focus on the softer issues of managing a PPP, including trust and interaction processes (Reeve & Hatter, 2004). A third thread specializes in the local economic development (the "local regeneration literature"), which can be compared to the "international development" literature that specializes in PPPs in developing countries. Lastly, there is the infrastructure approach which investigates those projects that involve private capital and focuses on the financial arrangements between both sectors (Weihe, 2005). Since our case study shows great similarities with infrastructure projects, we leverage this last approach by selecting literature on infrastructure PPPs in the parts to come.

In reflection of their popularity in the literature, PPPs are increasingly adopted in the field, with a growing interest in developing countries. As an illustration, the OECD reported a total value of 645 billion USD for such partnerships between 1985 and 2009 (OECD, 2012). In the European Union, over a thousand PPP projects have reached financial close from 2000 to 2015 (Tomasi, 2016). This type of partnership has gained prominence as the public and private involvement tended to gradually converge (Kivleniece & Quelin, 2012). Indeed, on the one hand, the government is increasingly involved in non-state sectors through entrepreneurial initiatives or regulatory insights (Ring et al., 2005; Klein et al., 2010), and on the other, a rising number of state functions are delegated to the private sector (Osborne & Gaebler, 1992). As a result of this gradual shift toward less government and more governance (Osborne & Gaebler, 1992), PPPs have emerged as a credible novel form of public-private interaction that durably shifted traditional views on the role of the private sector in the meeting of societal challenges (Kivleniece & Quelin, 2012).

2.1.3 Why public-private collaboration exists

Substantial efforts have been made to comprehend the reasons why cross-sectoral collaborations exist and why they are successful. This question can be answered by scrutinizing the value creation mechanisms in public-private ties in comparison to other organizational forms (Kivleniece & Quelin, 2012). Indeed, the quest for value creation has been the main driver for any kind of public-private tie, with the particularity that value within a public-private collaboration is thought of as the sum of benefits obtainable from the exchange, regardless of who appropriates the value (private actor, customer or any other party not directly involved in the transaction) (Mahoney et al., 2009).

Regardless of the form of PPPs one is referring to, the common assumption in academic literature is that PPPs lead to better value for money and thus to better outcomes (Osborne, 2000; Savas, 2000; Klijn & Teisman, 2003; Hodge & Greve 2005; Steijn et al., 2011). A developed thread of literature is attached to explaining such phenomenon, leveraging a variety of theoretical lenses. These perspectives are useful to grasp why PPPs are arguably more effective than other organizational forms, each theory shedding light on a particular advantage of a PPP. Wang et al. (2018) synthesize three main types of knowledge backgrounds: first, economic theories, including transaction cost theory, principal-agent theory, and property right theory; second public policy and public management theories such as the New Public Management (NPM) and lastly theories with a more organizational background involving stakeholder or institutional theory. Drawing on these theories, scholars have mentioned three main sources of value creation for PPPs (Rangan et al., 2006; Klein et al., 2010):

- Resolution of externalities;
- Resource complementarity;
- Differential cost advantage leading to efficiency gains.

Firstly, the presence of market inefficiencies such as externalities calls for various forms of collective action (Ostrom, 1990) or hybrid arrangement between the public and private sectors (Brinkerhoff & Brinkerhoff, 2011). Building on externality theory, Rangan et al. (2006) argue that the public sector will get involved in a joint collaboration when the public benefits significantly exceed private benefits and when the public actor's resource

costs largely outweigh that of the private actors. Public benefits here are represented by those that arise not only for the private actors involved but also for third parties who are not directly involved in the transaction. With the presence of strong positive externalities, the government is hence incentivized to join an activity but is not appealed to act alone. The lower resource costs of the private sector in comparison to that of the public sector necessitate the state to take advantage of the private sector's higher efficiency in performing tasks, resulting in cross-sectoral collaboration.

On the other hand, private actors are incentivized to join this collaboration to reap private benefits and to leverage the public sector's natural endowment in higher legitimacy and authority (Rangan et al., 2006). Indeed, if the private actor is more cost-effective in undertaking an activity, the public sector is more efficient at governing such collaboration and at bringing down the price of governance (contracting, coordinating, negotiating, and enforcing), thus reducing the overall uncertainty over value creation and appropriation for the private actor. Hence, public-private partnerships are necessary when an economic opportunity realization entails large positive externalities but is shrouded by high levels of uncertainty and leads to high governance costs for private actors.

Adding to the concept of positive externalities, scholars have further investigated the resource complementarities in the value creation process of public-private collaboration. Indeed, PPPs enable public partners to import management expertise and take advantage of the private sector's proprietary know-how (Brinkerhoff & Brinkerhoff, 2011). In turn, private partners can access public projects and share risks with their public counterparts. As a result, new types of knowledge and innovations can be formed (Kang et al., 2007). By harnessing each other's expertise, actors may enhance the overall value of a product or service, thereby creating added value (Steijn et al., 2011).

Lastly, a thread of literature from public management and economics focuses on the cost minimization and efficiency arguments of cross-sectoral collaboration (McQuaid, 2000; Savas, 2000). Indeed, taking infrastructure development projects as an example, the bundling of the investment between private and public players is argued to reduce the overall life-cycle costs of the project and enhance the social benefits altogether (Bennet & Iossa, 2006). Others shed light on the efficiency gains resulting from the introduction of market-like mechanisms and competition from the involvement of private players (Shleifer,

1998; Brinkerhoff & Brinkerhoff, 2011). Lastly, the reduction of fiscal pressures and public debt resulting from private financing is also considered a lever contributing to efficiency gains (Hodge & Greve, 2007; Engel et al., 2013).

2.2 Linking PPPs to sustainability

2.2.1 Sustainability as a concept and SDGs

Sustainability as a concept takes its origin from the Brundtland Report (1987), which focused heavily on both economic development and environmental protection. The report takes the name after Gro Harlem Brundtland who was the former Norwegian Prime Minister. Ever since 1987, UN members have been on a mission to improve sustainability in their respective countries and to contribute to sustainable development in general. The vision of the UN was and is to *"make development sustainable to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs"* (WCED, 1987, p.16). However, with time, sustainability as a concept has evolved from two dimensions into multiple dimensions, namely social, economic, and environmental.

Fiorino (2010) believed that sustainable development should indeed focus on multiple aspects, including environment protection, human well-being, generational interest balance, and the participation of the public in the decision-making process. For example, Kates et al. (2001) looked at sustainability from several angles, namely economy, society, human, and nature perspectives. The researchers also stated that sustainability was a dynamic, open, and evolving concept, sometimes based on the opposite goals (Kates et al., 2001).

In 2010, Kuhlman and Farrington argued that human well-being should be added to the traditional understanding of sustainability in order to incorporate the interrelationships of different factors from all the dimensions mentioned. Furthermore, Imran et al. (2014) pointed out that highlighting human well-being is not sufficient, and the focus should revolve around the environment and involve all creatures' well-being. Moreover, several scholars took a step further to consider the most crucial sustainability dimensions. The UNEP (United Nations Environmental Programme) report "Protecting our planet, securing our future" (Watson & Munasinghe, 1998) differentiated between environmental, financial

and social sustainability, addressing them as "people", "planet" and "profit". Overall, we understand from the development of the literature that sustainability is an ever-changing concept that incorporates many facets from social, environmental, and economic dimensions.

Sustainability can be understood through the many frameworks established by supranational authorities such as the United Nations. Indeed, after grasping the stakes and interrelationships of sustainability, the international community has developed frameworks to set a global direction toward reaching sustainability objectives (United Nations, 1992). During the UN Sustainable Development Summit in New York in 2015, for example, the Agenda 21 (non-binding action plan for sustainable development) was expanded by the new Agenda 2030, which established 17 sustainable development goals (SDGs) for all countries to follow (United Nations, 2015). These goals were created to serve as a blueprint in order to reach a more sustainable future by 2030 (see figure 2.2).

Among these goals, we observe that goal 17 revolves around "Partnerships". The UN indeed recognizes the necessity of cross-sectoral collaboration to accomplish these goals. In fact, the emergence of PPPs as a sustainability goal already began in 2002 during the Johannesburg World Summit on Sustainable Development (United Nations, 2002) which first put the spotlight on public-private collaboration as necessary to achieve sustainability objectives. It is perhaps the most crucial of all the UN SDGs, as it highlights the necessity of cross-sectorial collaboration for the achievement of the rest of the goals. Governments, the business sector, academia, and individuals must all combine effort and work together to achieve these goals according to the SDG 17.

2.2.2 PPP as a lever for sustainability

Categorized as the *"new organizational zeitgeist in dealing with societal issues"* (Vurro et al., 2010, p.40), cross-sector collaboration, and more precisely PPPs, are increasingly viewed as an efficient solution to address some of society's pressing issues (Gray & Stites, 2013). As the world grows ever more complex and interconnected, it becomes hard to imagine successfully addressing today's major public concerns without some sort of collaboration between the public and private sectors. There are indeed many motivations that guide the bonding of businesses and the public sector over sustainability issues.

Figure 2.2: 17 goals for a sustainable world (UNDP, 2022)

To start, the evolution of the role of private companies within society participated in the reconciliation of the private with the public sector. Traditionally, it is the state that is deemed to hold the responsibility for the country-wide development. However, this role has been challenged by several scholars. Indeed, in the past, the role of the private sector was seen as providing consumers with products and services that met their needs and wants and to operate at a competitive price while making profit. Nowadays, companies' role has become more complex. With the current level of innovation and being a strong source of employment opportunities, businesses are considered to be crucial contributors to improving poverty and living standards in general, while driving economic growth (Kolk & van den Buuse, 2012; UNSDSN, 2013).

In addition to businesses improving economic growth, there has also been a rising concern over the sector's negative environmental and social impact. Today, actors from the private sector are urged to enhance their reputation and reduce their environmental impact, under the name of Corporate Social Responsibility (CSR) (Gray & Stites, 2013). Hence, in regard to the world's focus on sustainable development, transparent operations and overall stakeholder pressure, businesses are expected not only to contribute to economic growth, but to include social and environmental responsibility into their core strategy (Brammer et al., 2012). The responsibility above encompasses such issues as infrastructure, health, education and pollution as an example (Newell & Frynas, 2007; Kolk & van den Buuse, 2012). On the other side of the spectrum, governments have increasingly recourse to

partnerships that represent the *"governance structure of the future"* (Gray & Stites, 2013, p.11). Therefore, the world's well-being is being influenced by both the state itself and by the private sector (Kolk & van de Buuse, 2012). With this in mind, the public sector might see the private sector as a tool to increase their public service delivery effectiveness and to promote economic, environmental and social stability.

Public-private partnerships are indeed found to be a possible solution for reaching sustainability objectives. For instance, creating a long-term contract can provide an opportunity for the private sector partners to take life-cycle costs into account, and invest in energy-saving and waste-minimizing options that will be more expensive initially but will prove more cost-effective in the future (Grimsey & Lewis, 2002).

Although private and public collaboration may prove to be auspicious for sustainability, there remains roadblocks that inhibit either the interest or performance of the private sector's involvement in sustainability. It is unclear whether private sector partners in the partnership are willing to address sustainability issues on a voluntary basis (Hueskes et al., 2017). The link between private sector involvement and long-term sustainability is complicated. Talking specifically about urban infrastructure, private sector involvement in the development and maintenance of such infrastructures might contribute to sustainability. However, market failures are inevitable because perfect market conditions are rarely present, and infrastructure-based public service delivery possesses the features of a natural monopoly. As a result, private sector involvement in public infrastructure may lead to opportunistic or rent-seeking behavior from both public and private parties. This means that they follow their own self-interest rather than the sustainability objectives that underpin the use of private sector involvement in sustainable urban infrastructures (Koppenjan & Enserink, 2009).

For this reason, even if the involvement of private parties in public infrastructure projects is a good leap towards achieving sustainability, it does not guarantee it. The reaching of sustainability objectives depends on the effectiveness of the governance structures in place that oversee these private contributions, as well as the extent to which regulatory concerns are identified and addressed. Economic regulation, such as price regulation and coverage goals, is required for private sector involvement in sustainable infrastructure. However, economic regulation alone is insufficient; it must be complemented by forms of governance

geared specifically for ensuring sustainability in the construction and management of urban infrastructures. Such forms of governance may include choosing parties committed to sustainability, ensuring project-specific contracts, openness to renegotiation during operations phase, including agreements on benefit sharing and involving stakeholders. (Koppenjan & Enserink, 2009)

2.2.3 Challenges of PPPs for sustainability

Starting broadly, as PPPs are primarily characterized as a cross-sectoral collaboration between the private and public sectors, it comes as no surprise that PPPs involve great challenges. Indeed, as ubiquitously proclaimed in the literature, the public and private sectors differ in terms of objectives. On the one hand, public actors strive to prioritize public benefits, which may be expressed in GDP per capita for example. On the other hand, private actors look to maximize private benefits realized at the firm level through economic profits and long-term survival (Eshun et al., 2020). However, private sector objectives such as profit and reputation are not always aligned with the ultimate social goal of PPPs (Brinkerhoff & Brinkerhoff, 2011). Whilst the private players are profit-driven, the government is "socially minded" and seeks cost-efficient ways of delivering public benefits (Suchman et al., 2018).

Hence, such heterogeneity in objectives from broadly social to narrowly private (Mahoney et al., 2009) can lead to potential "contradictory agendas" and tensions in the partnership (Utting & Zammit, 2009). Furthermore, the private players that function on the market principles of competition and efficiency may conflict with the norms and processes of public players that value legal and bureaucratic hierarchies and rules of operating procedures.

As a practical illustration of such incoherence, PPPs may increase costs and limit choice for consumers and restrict competition (Brinkerhoff & Brinkerhoff, 2011). Demirag and Khadaroo (2008) even expressed their doubts on the ultimate compatibility of public values, centered around transparency, equality, and openness, with the desire to achieve financial value for money in the private sector (Weihe, 2008). As a result, conflicts are already common practice in cross-sectoral collaboration. They tend to be exacerbated when partners vary in size, funding, or reputation, leading less powerful partners to worry that their interests are not taken into account.

As a consequence of this goal discrepancy, one major challenge within PPPs is to protect the public in the private-public equation (Wettenhall, 2003). Indeed, there exist risks that the public goal may be absorbed by the commercialization and privatization approach of the private sector. These potential challenges bring to light the absolute necessity to reach the right balance of interest and incentives to align private and public players.

The above-mentioned challenges inherent to PPPs appear particularly relevant in the PPPs for sustainability literature. Indeed, in this research area that emphasizes the role of delivering economic, social, and environmental benefits under the holistic umbrella notion of "sustainability", the threat of goal discrepancy seems exacerbated. As many academics pointed out concerning PPPs for sustainability, the focus on short-term cost reductions of private players may be at odds with the long-term sustainability outcomes of the government (Koppenjan & Enserink, 2009).

According to Koppenjan and Enserink (2009), there are four potential challenges that hinder the private sector participation in the projects with sustainability-related outcomes related to urban infrastructure, and to a large extent, the following preoccupations are also shared by non-sustainability-oriented PPPs. As this thesis is focused on a PPP within the infrastructure sector, these challenges are the most relevant for our research.

The first challenge is creating prospects for return on investments. Private sector participation's (PSP) first task is to produce initiatives that generate positive cash flow. This necessitates users' willingness and ability to pay for services. Underpriced public services result in excess demand, increased levels of pollution, and misallocation of public finances, hence charging consumers may be motivated by sustainability goals (OECD, 2003). In addition to charging customers for public services, establishing positive cash flows requires the ability to think outside the box to identify projects with the potential to be lucrative.

The second challenge is managing the scope of the project and externalities. If public infrastructure projects are not profitable, private participation may still be conceivable if integrated with profitable activity. Decisions over contract scope have a big impact on whether cross-subsidization between unprofitable and profitable elements of the infrastructure plan is possible. Furthermore, selecting the appropriate scope may avoid private cherry-picking, which means private stakeholders are limiting their contributions

to the project's most profitable elements.

The third challenge is managing risks perceived by private parties. To persuade private actors to invest in public infrastructure in a way that promotes long-term urbanization, the government must have a good understanding of the factors that influence private investment decisions. Private parties are persuaded to invest by governments who go to considerable pains to encourage them. When commercial risks are moved to taxpayers, local governments, or users, attempts to make projects appealing to private investors degenerate into unethical practices. Offering subsidies in order to achieve full cost recovery, providing financial guarantees in regard to operation and currency risks, giving tax exemptions, supplying soft loans, and formulating helpful regulations that grant the private provider a local monopoly are some of the methods used to entice private parties to invest. (Koppenjan & Enserink, 2009).

The fourth challenge is reducing political uncertainty. Because investment in urban infrastructure may only be recouped over a long period of time, private investors are particularly susceptible to political risks meaning political or regulatory changes that jeopardize cost recovery throughout concession periods. Another cause of political uncertainty is a large number of government bodies engaged and their lack of policy coordination. When the environmental agency, for example, establishes performance targets independently of the economic regulator, the contract's targets may become unworkable. (Koppenjan & Enserink, 2009).

2.2.4 Performance of PPPs for sustainability

To get the full picture of how the PPPs contribute to sustainability if at all, we have reviewed PPPs' performance on a larger scale first. A substantial part of scholarly interest indeed has been directed towards empirically understanding whether PPPs can lead to win-win situations (Wang et al., 2018). However, stemming from the very different nature of the players involved, evaluating the performance of PPPs is complex as each party may have a diverging view on success. Despite this inherent difficulty, PPP performance has been extensively investigated, using two distinctive definitions of performance: the "narrow" and the "broad" concept of performance (Jeffares et al., 2013; Gestel et al., 2014; Wang et al., 2018).

Firstly, the performance of a PPP can be determined by looking at the achievement of specific targets or outcomes established in the PPP contract. This narrow definition entails scrutinizing the level of return on the investment made (Wang et al., 2018). In contrast to this narrow definition, the broad perspective on performance involves looking at a wider set of characteristics. This evaluation success is anchored around the achievements of benefits for the wider population such as citizens, partner organizations, and service users, for example. This broad definition builds on the notion of "Value for Money" (VfM) which has evolved as a fundamental prerequisite for establishing PPPs (Santandrea et al., 2016).

Previous work on infrastructure PPPs shows that evidence of PPPs' performance is ambiguous (Hodge & Greve, 2007; Petersen, 2019). Indeed, if some papers suggest superior VfM, quality, and lower costs of PPPs (Raisbeck et al., 2010; Zhang et al., 2013), others come up with opposite conclusions (Reeves & Ryan, 2007; Shaoul et al., 2010; Daito & Gifford, 2014). Indeed, as a result of the many pitfalls of cross-sectoral collaboration, many PPPs fail to achieve their intended public benefits (Brinkerhoff & Brinkerhoff, 2011; Song et al., 2016). From the review of past PPPs case studies, Grimshaw et al. (2002) show that there is, in fact, little proof that both parties benefit from the PPP because of the imbalance of power or because the gains are not equitably distributed. Shrybman and Sinclair (2015), for example, demonstrated that most PPPs are privately skewed in order to attract private funding. Walwyn and Nkolele (2018) complemented this by showing that the majority of PPPs are impregnated with asymmetry contracting. According to Li et al. (2020), the conflicting interest coupled with information asymmetry that exists between both the private and public sectors can ultimately result in opportunistic behaviors, primarily from the private players (Wang et al., 2018). Additionally, recent research suggests that PPPs are, in fact, riskier than other types of projects (Rybnicek et al., 2020).

For some authors, such a lack of consensus over the performance of PPPs may be due to the unstructured and blurry academic treatment of PPPs (Weihe, 2005). Indeed, because PPPs vary so much in nature, Weihe (2005) argued that one general statement about one PPP might not apply to another, thus inviting researchers to clearly define their assumptions on PPPs in order to avoid making misleading statements about them.

Narrowing down the performance of PPPs and focusing only on PPPs for sustainability,

it becomes even more unclear how effectively PPPs contribute to the three different dimensions as a result of the potential tension between sustainability and commercial interests (Koppenjan & Enserink, 2009). One way of analyzing the performance of a PPP for sustainability is to measure its contribution to one specific sustainability dimension (Pinz et al., 2018). This approach is criticized to some extent on the basis that it disregards the interrelations between different dimensions and confirms that public-private partnerships are a useful tool as long as they influence at least one of the dimensions positively (Patil et al., 2016).

Pinz et al. (2018) analyzed fourteen studies on how public-private partnerships contribute to sustainability objectives. All of these studies leveraged this more concise approach to sustainability, evaluating the PPPs based on their social, environmental, or economic contributions. The social dimension was of interest in twelve studies and the economic and the financial dimensions were mentioned in most of the studies (Pinz et al., 2018). The ecological dimension, on the other hand, received the least amount of attention, with only four studies focusing on it.

Overall, all the studies together provided a mixed impression on whether or not PPPs contribute to sustainability-related outcomes. In support, often, it is the case that the focus on short-term reduction of costs in many public-private partnerships could conflict with the long-term sustainability objectives (Koppenjan & Enserink, 2009). Several studies describe positive outcomes, such as improving cost-efficiency of public service delivery and its accountability, developing infrastructure, positively impacting human resource development, contributing to the ecology, and improving the risk allocation among partners (Bagchi & Paik, 2001; Teicher et al., 2006; Pérez-López et al., 2015). However, the same positive outcomes have been reported to have mixed results, improving one sustainability dimension while failing to address others. For example, Lieberherr, Klinke, and Finger (2012) recognize a trade-off between the financial sustainability dimension (the profit-making) and the social sustainability (the public good) in the sanitation and water supply sectors in Berlin.

In addition, multiple studies state that PPPs have failed in their mission to improve the sustainable development objectives. For instance, research done in the UK shows that either financial objectives or both social and financial ones have not been reached (Shaoul

et al., 2008; Hellowell & Pollock, 2010). Moreover, Andrews and Entwistle (2010) discover that PPPs can have a negative impact on the social sustainability outcomes, especially in regard to the public service delivery and its effectiveness.

2.2.5 Key success factors of PPPs for sustainability

As many unsuccessful PPPs exemplify (Kwak et al. 2009; Chen et al. 2013), sustainability outcomes can only be attained when the partners reach the *"right balance between the investor's willingness to invest and the long-term sustainability objectives"* (Koppenjan & Enserink, 2009, p.293). Indeed, it takes great management precautions to overcome the challenges intrinsic to PPP for sustainability. In this vein, we give an overview of the key success factors for PPPs in general.

In light of the challenges mentioned in the previous sub-chapter, we understand that PPPs do not suffice as an organizational form to achieve better outcomes. Rather, management measures are required to fully exploit PPPs' full potential. Indeed, similarly to the business administration literature on strategic alliances, the PPP research highlights the relevance of managerial efforts (Borys & Jemison, 1989; Niederkofler, 1991). A thread of literature has deep-dived into the governance and management of such PPPs by unfolding the Success Factors of PPPs (Grunert & Ellegaard, 1992). Ranging from "key" to "critical", success factors are those *"limited number of areas, the result of which, if satisfactory, will ensure the successful performance of the organization"* (Rockart et al., 1980, p.4). In other words, these factors outline the few areas where that must be done right for the partnership to flourish.

Building upon Bryson's et al. (2006) cross-sectoral work, these management concerns are often categorized as either "structural" or being part of a "process", although this distinction is blurry in certain instances.

Regarding the structure, firstly topics such as the risk allocation, definition of responsibilities and the choice of the governance and financing structure established in the contract are analyzed (Pinz et al., 2018). More specifically, a majority of research has been directed toward the governance of PPPs (van Gestel et al., 2012; Xiong et al., 2019) as a mechanism to steer the decision and action processes of the collaboration (O'Leary et al., 2006, Koppenjan et al., 2009). The literature has analyzed three types of

governance: the self-governance type, in which decision-making occurs through regular meetings and other informal occasions; the second type includes a lead organization that represents the main coordinating and decision-making body and lastly a network type of governance in which one network organization which is separate from the rest oversees the network's operations. Regardless of the type of governance chosen, such formal and informal processes are likely to play a role in the effectiveness of the collaboration.

On the other hand, elements that go beyond the legal and contractual obligations fall under the process branch, although researchers have sometimes used various elements as interchangeable between structure and process (Bovaird, 2004; Teicher et al., 2006; Emerson et al., 2012). In this line of research, it has been revealed that "soft" elements such as trust, leadership, and shared understanding are crucial to the development of a PPP (Bovaird, 2004; Teicher et al., 2006). The key success factor literature elucidates that leadership can be either formal (steering committee, project director or coordinator, etc) or informal, but it is important to be most effective that the people have both types of leadership . Two key leadership roles are "champions" and "sponsors," and to be successful, PPPs need to have both informal and formal power. The latter refers to an individual who holds considerable prestige, authority, and access to resources, although they are not involved in the project on a daily basis and monitors from afar. The champions, on the other hand, are people who are more directly involved to intently keep the collaboration going and accomplish its goals.

Regarding trust, if many collaborations begin with a varying degree of trust, researchers emphasize the importance of fostering continuous trust. Such trust can be built by sharing information and knowledge, good intentions, and follow-through. On the other hand, PPPs also need to put mechanisms in place for conflict management and should set conflict-resolution mechanisms as well as tactics to equalize power between the partners.

In addition, regarding planning, two types of approaches are mentioned by the literature for the success of PPPs: the formulation of clear goals, roles and responsibilities, phases, and steps of implementation can either be "deliberate" and stated from the beginning, or they can be "emergent" and defined over time. The former form of planning is prescribed for mandated collaboration, whilst the emergent is said to be more relevant in the case of non-mandated PPPs.

Lastly, agreements are also included in this process by Bryson et al. (2006). Agreements can either be formal or informal, although some research demonstrated that formal agreements have the advantage of supporting accountability (Bryson et al., 2006). Elements included in such formal agreement may include the definition of a broadly shared purpose, description of members, a commitment of resources, designation of formal leadership, decision-making structure, and built-in flexibility to deal with unexpected events. Studies of collaboration emphasize the importance of drawing a process that is participatory and directly inclusive of stakeholders.

Applying this research endeavor to infrastructure PPPs, Kwak et al. (2009) outline four categories of critical success factors (CSF) based on a systematic literature review. Although key success factors can vary between case studies, it appears that most PPPs depend on the following classification:

- Government's role and responsibilities;
- PPP finance;
- PPP risks;
- Concession selection.

To begin with, the literature sheds light on the necessity for governments to establish favorable investment environments with stable economic, social, and legal conditions, as well as create adequate legal/regulatory frameworks without being too over-regulated (Pongsiri, 2002). Governments should also set up a supportive and coordinating authority while ensuring that the highest political authorities give their full support to pushing the program further (Durchslag et al., 1994). Koch and Buser (2006) suggest that governments subsidize feasibility studies and continuously investigate potential sectors for cross-sectoral collaboration. Lastly, the government should also be actively involved throughout the project's life cycle (Kwak et al., 2009).

Regarding PPP finance, a sound financial plan is critical to the success of a PPP. Applied to infrastructure projects, Zhang (2004) reveals that a concessionaire's financial capability requires advantageous finance sources with low service costs and an adapted capital structure (between the level of equity and debt), as well as strong risk management capabilities. A key component within the finance structure is also the government's

support. The government indeed needs to step in to ensure the financial viability of PPPs, and it can guarantee its support (Kwak et al., 2009):

- Securing a minimum guaranteed revenue for the private parties;
- Providing financial support to increase the financial return of a project;
- Ensuring force majeure protection by either extending concession periods or by offering compensation for force majeure events to protect from the potential loss caused.

Thirdly, PPPs are commonly characterized by their high level of risk, either due to their extended concession time period or by the diversity of players involved in such partnerships. According to the literature, correct risk identification, classification, and allocation strategies are important to determine either the success or failure of a PPP. Merna and Smith (1996) suggest classifying risks by function of their "global" and "elemental" nature. Global risks are those that are outside the control of the project's participants (political, legal, commercial, and environmental factors), whereas elemental risks encompass project-level risks (related to construction, design, operation, finance, and revenue risks, for example). In general, it is recommended that operational risks should be allocated to the private sector while letting the government manage the legal, political and financial uncertainties (Charoenpornpattana et al., 1999).

Lastly, the successful outcome of PPPs relies largely on the good selection of private concessionaires, which requires a well-organized tendering process with an adapted concessionaire evaluation method (Zhang, 2004).

As we have just examined, empirical evidence on PPPs' success determinants is vast. However, these management tools are rarely examined in a sustainability context (Pinz et al., 2018). Although academics argue that it is difficult to draw a coherent picture of the overall appropriateness of PPPs (Roehrich et al., 2014), many agree that making PPPs successful often depends on various management elements (Ysa, 2007; Bryson et al., 2015).

Regarding the structural elements that generally aim at reducing information asymmetry in the principal-agent relationships (Jensen & Meckling, 1976), contracts are of particular relevance in the scope of PPPs for sustainability. Indeed, contracts are of utmost

importance to fix economic, ecological, and social concerns in a legally binding manner (Spraul & Thaler, 2020). Koppenjan and Enserink (2009) highlight the significance of setting appropriate incentives as a good practice for sustainability PPPs. A majority of the literature focuses on the role of governance as some would argue that it *"is a prerequisite for (...) steps towards sustainability"* (Kemp et al., 2005, p.18; Walker & Hills, 2012). Indeed, according to Kemp et al. (2005), openness and participation, accountability, efficiency, and increased sensitivity to the present situation are all characteristics of effective governance. Other needs for sustainability include ways to internalize external costs and ensure the integration of policy concerns, options appraisal, and trade-off management. Building on that, Amovic et al. (2020) suggest that another crucial success factor in constructing sustainable PPPs is the formulation of national PPP policies and strategies, which is just as vital as establishing an appropriate regulatory framework.

Regarding the process elements that go beyond pure contractual agreements, the importance of stakeholder engagement, trust and leadership is emphasized. With respect to the latter characteristic, both the public and private sectors may show leadership in the attainment of sustainability outcomes. Moreover, PPPs' process standardization and openness are critical for establishing defined procedures, duties, and capabilities (Amovic et al., 2020), and for developing common goals, trade-off rules, and metrics (Kemp et al., 2005) which are paramount for the success of PPPs for sustainability. Lastly, the role of willingness to collaborate is stressed throughout for the achievement of sustainability-related objectives (Liu et al., 2010, Walker & Hills, 2012). We summarize the above key management concerns for PPPs in figure 2.3.

Figure 2.3: Summary of key management concerns for PPPs

2.3 Climate change and the promises of carbon capture and storage

To fully grasp the stakes of environmental initiatives like Longship, it is necessary to reiterate the global context of the climate emergency in which Longship emerges. We do this by firstly explaining global warming and the human-induced activities that accelerate it. We then further deep-dive into hard-to-abate industries, a sector from which both planned and potential capture plants of Longship emanate. We introduce carbon capture and storage as a potentially game-changing technology, notably for hard-to-abate industries. We conclude by shedding light on this technology's current state of development as well as its barriers as a prelude to the investigation of our case study, Longship.

2.3.1 Global warming and its impacts

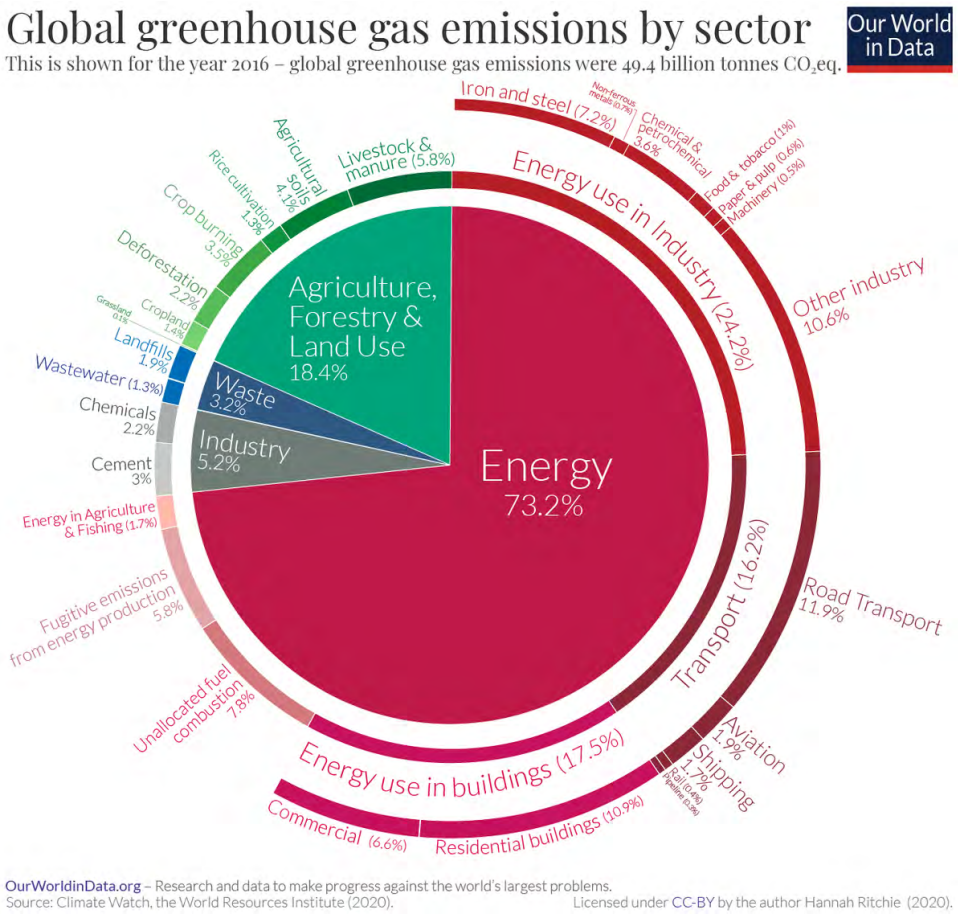
Global warming has largely become one of the biggest concerns of the 21st century. Characterized by the long-term heating of Earth's climate system, global warming is primarily due to fossil-fuel exploitation that augments the heat-trapping greenhouse gas (GHG) levels of the atmosphere (NASA, 2020).

In terms of end uses, the industrial sector is responsible for 24 percent of global emissions, followed by buildings, transport, and agriculture that make respectively for 18 percent, 16 percent, and 11 percent of global greenhouse gasses (OWiD, 2020). Today, it is estimated that the above-mentioned human activities have raised the Earth's global average temperature by around 1.2 degrees Celsius since the pre-industrial period, a number that is increasing by 0.2 degrees every decade (NASA, 2020).

Today, there is a scientific consensus that this warming is due to human activities, as over two-thirds of the worldwide greenhouse gas emissions result from how we produce our energy which is today largely based on fossil fuels (oil, coal, and gas). According to the Intergovernmental Panel on Climate Change (IPCC), global warming is already having dramatic effects on ecosystems and human societies (IPCC, 2021). According to the IPCC's latest scientific review of global warming's impacts, 3.3 to 3.6 billion people are estimated to live in highly vulnerable contexts (IPCC, 2022). Adding to the effects on ecosystems, global warming directly affects human systems by reducing water and

food availability, damaging infrastructure, and forcing displacements due to the rise of water levels and the demultiplication of natural disasters (IPCC, 2022). If the severity of these above-mentioned effects varies depending on the temperature increase scenario (Representative Concentration Pathway RCP) ranging from 1.5 to 5 degrees, scientists call for the necessity to reach net-zero emissions by mid-century (IPCC, 2018). Hence, the economic, social, and environmental impact of global warming cannot be overemphasized, urging the immediate and dramatic decarbonization of our economy.

Figure 2.4: Global greenhouse gas emissions by sector (OWiD, 2020)



2.3.2 A focus on hard-to-abate industries

Figure 2.4 shows that many different activities and processes emit GHG, implying that there is no easy fix to decarbonize our economy. However, some activities are particularly complex to decarbonize. Heavy industry, including the fabrication of cement, steel, and chemicals, as well as the long-distance transport modes, are included within these hard-

to-abate industries. According to the International Energy Agency (IEA), this is in large part because the lion's share of their decarbonization relies on technologies that are at very early stages of development (IEA, 2020).

Focusing on heavy industry, the cement, steel, and chemical industry play a critical role in the energy transition in two ways. Firstly, because the making of these three materials is highly GHG-emissive: combined, these three activities - chemicals, steel, and cement - are directly responsible for a number of emissions similar to that produced from all road transport (IEA, 2020), and they account for around 70 percent of direct CO_2 emissions from industry (IEA, 2020). Secondly, although it is such a substantial contributor to global warming, heavy industry is to this day irreplaceable, and projected demands are still spiking. Since 2000, global demand for steel and cement has more than doubled, and plastic, which is a key final product of chemicals, has jumped by 90 percent (IEA, 2020). Also, heavy industry is expected to play a critical role in the energy transition by providing key inputs required for clean energy technologies. As an illustration, in the International Energy Agency's (IEA) "Sustainable Development Scenario", steel demand for renewable energy generation technologies such as wind turbines is almost three times higher in 2070 than the baseline projection (IEA, 2020). If the heavy industry is to contribute to a sustainable pathway, its emissions must fall by 90 percent by 2070.

However, heavy industry is especially complex to decarbonize for four reasons. Firstly, because of its long-lived assets: industrial plants require expensive and long-lived plants of around 30-40 years; retrieving them earlier at the profit of less emission-intensive technologies would result in large losses. In the absence of retrofitting alternatives, emissions from these large investments are hence "locked-in" at least until their end-of-life, slowing down the overall deployment of less carbon-intensive technologies. Secondly, the cement, steel, and chemical industries all require high-temperature heat for their processes, which today is almost fully provided by fossil fuels. Such high temperature and thus energy requirements complicate the adoption of alternative fuels that may be less performing. Thirdly, beyond the emissions resulting from the energy use in industry, GHG is also produced as a result of a chemical reaction. For example, cement process emission represents 3 percent of total GHG emissions due to the carbon dioxide emitted as a byproduct from the chemical conversion process to produce clinker, a key component of

cement (OWiD, 2020). Lastly, because they operate in a globally competitive market where competition is stringent, industrial products are highly price-sensitive. Such a competitive environment refrains producers from opting for currently more expensive low-carbon alternatives or making large upfront investments for near-zero emission technologies.

Today, technologies and strategies to abate the heavy industry's emissions by a more or less sizable impact are commercially available. Such innovations include technology performance improvements, including the adoption of the best available technologies (BAT), material efficiency (for example, eco-conception), fuel switching to bioenergy for example and the electrification of the low or medium temperature heat. However, because of their hard-to-abate characteristics, these technologies are not sufficient to reach sustainable development objectives. Taking cement as an example, a decarbonization strategy to use less clinker-to-cement ratio is already common practice today. This alternative does not negate the need for clinker entirely, failing to reach near zero-emission targets on its own. Thus, such initiatives should be complemented by other technologies in order to fully achieve climate objectives set in the IEA's sustainable development scenario.

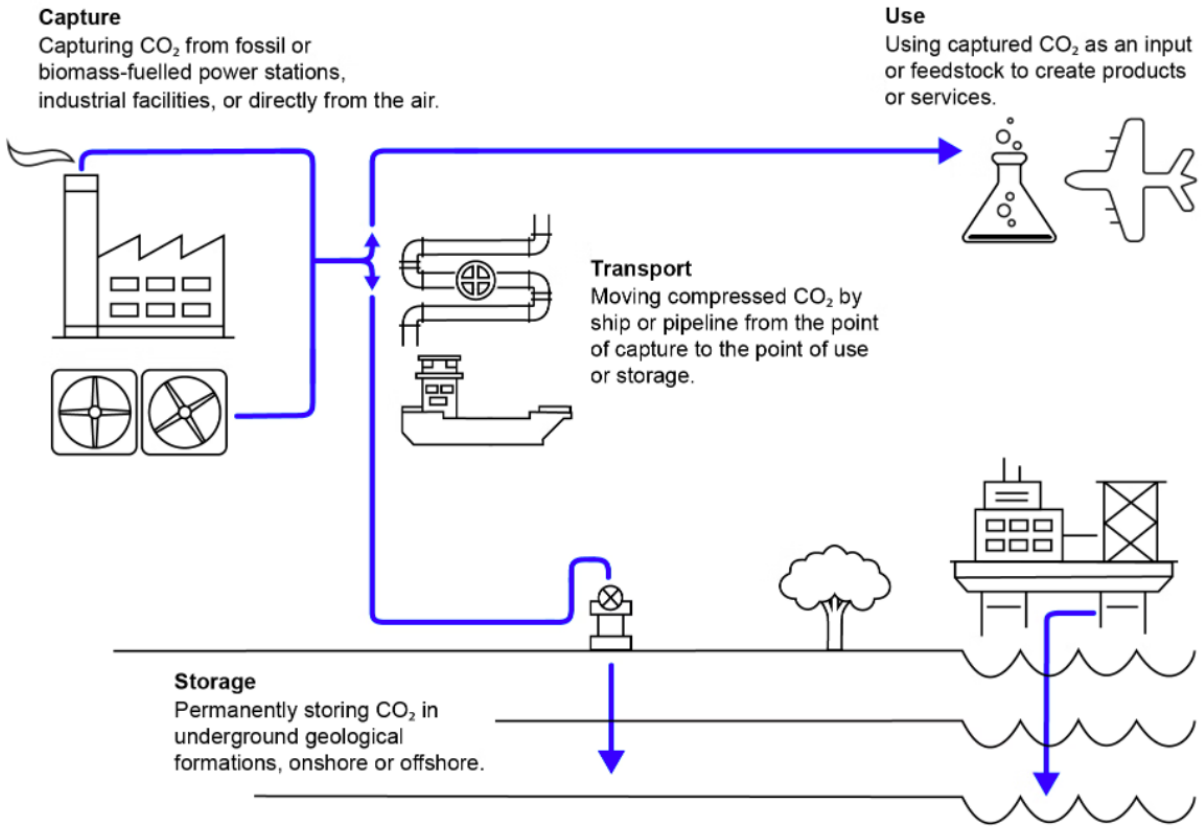
2.3.3 Introducing carbon capture, utilization, and storage

Carbon Capture, Utilization, and Storage (CCUS) technologies are gaining ground among the technologies solutions to abate emissions. CCUS represents a suite of technologies that capture CO_2 from large point sources (power generation that burns hydrocarbons, industrial and bioenergy plants) or from the ambient air (Direct Air Capture) to prevent its release into the atmosphere (see figure 2.5). In the case of CCUS from large point sources, the objective is to capture the negative externalities (CO_2 emissions) resulting from industrial activity and either reuse this carbon for other applications (Carbon Capture and Utilization, CCU), or store it permanently in deep geological formations or oil and gas fields (Carbon Capture and Storage, CCS). In the case of Direct Air Capture (DAC) or biomass-based fuel production (BioEnergy with Carbon Capture and Storage, BECCS), the capture and storage of CO_2 will result in a net decrease of CO_2 in the atmosphere and lead to the so-called "negative emissions" (Mckinsey, 2020).

There exist three techniques to capture CO_2. As its name indicates, post-combustion carbon capture removes the CO_2 from coal-fired power generation or natural gasses after

combustion: the CO_2 is separated from the flue gas (mainly constituted of nitrogen) using a liquid solvent. Unlike the former, pre-combustion occurs when fuel is pretreated and converted into a mix of CO_2 and hydrogen. After being separated from the CO_2, hydrogen can be burned to produce electricity. Lastly, in the oxyfuel combustion process, fuel is burned using oxygen which creates CO_2 and water vapor. Because there is no presence of nitrogen, the CO_2 is easily removed (IPCC, 2005). The rates of carbon capture can reach 85 percent to 95 percent in both techniques used, pre and post-combustion systems (Durmaz, 2018).

Figure 2.5: Explaining CCS (IEA, 2021)



Once captured and if it is not used on-site, the CO_2 is compressed and then transported either on ships, pipelines, or on trucks and trains for shorter distances. Usually being the cheapest means of transport, pipeline CO_2 transport has been practiced for many years, notably in North America, where an extensive onshore CO_2 pipeline network of more than 8,000km is exploited (IEA, 2021). In terms of application, CO_2 can either be used directly as such without conversion (as a fertilizer or solvent, for example) or can be

chemically altered and turned into other useful products (fuel, chemicals, and building material) (IEA, 2021). Today, the biggest consumer of CO_2 worldwide is the fertilizer and ammonia industry, which consumes around 100 MTpa for urea manufacturing, for example (Gassnova, 2019). The fertilizer industry is followed by enhanced oil recovery (EOR), a technique that is largely led by the United States (Mckinsey, 2020). Typical oil extraction processes leave from 40 percent to 80 percent of oil uncovered. Through the injection of CO_2 in an oil reservoir that is used as a solvent, EOR enables the recovery from 5 percent to 15 percent of the oil. However, no more than 220 Mtpa of CO_2 is used for various purposes, which represents a negligible percentage of global emissions (IEA, 2019).

In the fight against global warming, CCS is often projected as a game-changer. Today many scientific reports include CCS technologies in their pathways to reach net-zero by mid-century. As an illustration, the IPCC Special Report on "Global warming of 1.5 degrees Celsius" predicts three model scenarios to reach climate neutrality by mid-century out of four to use a type of CCS technology to drive negative emissions (IPCC, 2018). Altogether, the IEA's Sustainable Development Scenario predicts CCUS to account for almost 15 percent of the cumulative reduction in emissions compared to the Stated Policies Scenario. Having their potential thus recognized by international organizations, CCS are also increasingly taken into account by countries, as 80 percent of them have included CCS features in their long-term Low Emission and Development Strategies (LEDS) (Global CCS Institute, 2021).

At the sectoral level, CCS could contribute to the net-zero transition in four ways. Firstly, CCUS is presented as particularly relevant for hard-to-abate industries. Taking the example of cement, CCS is estimated by the IEA as indispensable in providing a solution for current asset lock-ins. Indeed, in the "sustainable development" decarbonization scenario for the heavy industry, CCS technologies account for over half of the annual emission reductions in 2070 (IEA, 2020). Secondly, CCS could also help decarbonize the energy sector by capturing the power generation's emissions. Thirdly, CCS could enable the transition to low-carbon hydrogen at scale. Indeed, global hydrogen production needs to grow from 70 million tonnes today to 425 - 650 million tonnes per year by mid-century. Coal or natural gas CCS is currently the most cost-effective way to produce such energy

and is likely to remain so, especially in developing countries (Global CCS Institute, 2020). Lastly, CCS is especially scrutinized for its capacity to deliver negative emissions through BECCS and DAC, which essentially results in taking surplus CO_2 out of the atmosphere. In this thesis, we will more precisely focus on Carbon Capture and Storage and its impact on the heavy industry.

The first commercial CO_2 storage project was commissioned by the Sleipner offshore gas facility in 1996 in Norway. The natural gas produced by this facility contains up to 9 percent of CO_2, which is separated offshore and injected into saline formation 800m below the seabed. Around 1 Million tonnes of CO_2 is injected per year, reaching over 17 million tonnes of CO_2 stored below water in 2017 (IEA, 2021).

2.3.4 CCS today, its barriers and future outlooks

Today, the current 26 operational CCS facilities around the world have the potential to capture more than 40 million tonnes per year (Global CCS Institute, 2020). Thanks to a growing momentum against global warming, the pipeline of planned projects have been growing since 2017 (see figure 2.6). A recent trend worth mentioning includes the creation of "hubs" which capture CO_2 from a range of facilities with common CO_2 transport and infrastructure. Such hubs aggregate, compress, and transport streams of CO_2 from clusters of facilities, reducing the capital costs of compression plants by leveraging economies of scale. In terms of sector, the lion's share of the CCS facilities is operating in the energy sector (natural gas processing), with a few big facilities in development in the power generation sector (coal and natural gas).

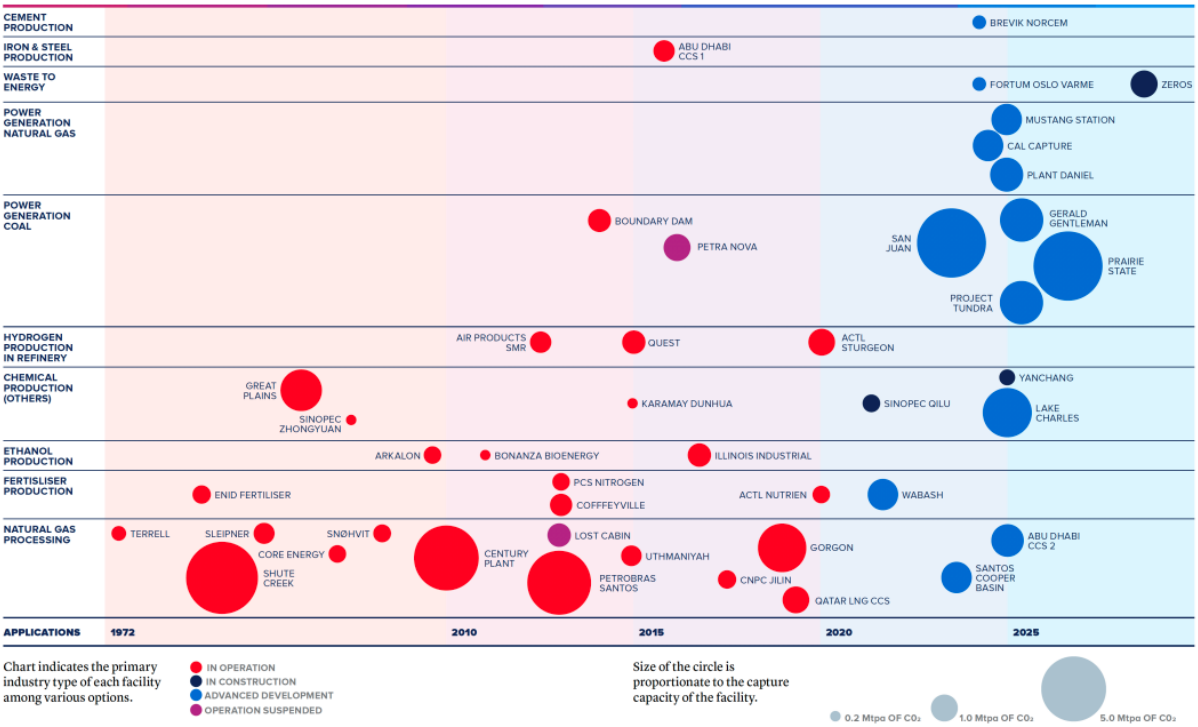
If the current storing of 40 million tonnes of CO_2 per annum may appear substantial, this number must increase a hundredfold to 3.6 Gigatonnes per year by 2050 if we want to meet the net-zero goals (IPCC, 2018). Indeed, even though CCS is recognized as a key way to mitigate emissions, CCS has not reached the scale required for substantial impact (IEA, 2020). This lagging behind can be mainly explained by the unstable business case of CCS projects. Indeed, in most countries, the cost of capture, transportation, and storage is superior to the value placed on CO_2, deterring private players from making profits. One can understand better how the economics of CCS may be off entailed by looking more specifically at the revenues and cost side of the equation.

Firstly, the revenues generated from CCS largely depend on environmental climate policy. Policies such as a carbon tax, pollution permits with price, or Enhanced Oil Recovery (EOR) schemes can provide offsetting revenues necessary to make a CCS economically viable (Durmaz, 2018). Looking at the drivers of past CCS projects today in operation, CCS projects in the United States of America (US) and Canada have been largely driven by enhanced oil recovery (EOR). Conversely, looking at Norway, we see that the carbon tax and provisions by the government have played a key role in the rolling out of the CCS projects (IEA, 2020).

Regarding costs, it is paramount that CCS unit costs are sufficiently low to prevent companies from preferring to pollute and paying the price of emitting CO_2 instead. Already in 2005, it was estimated by the IPCC that the application of CCS to electricity production would increase electricity generation costs by about 00.01–0.05 US dollars per kilowatt-hour (US dollars/kWh). This estimation, however, can vary in function of site-specific characteristics, including the fuel, the specific technology, the location, etc. (IPCC, 2005). The costs of CCS projects, which today are largely dominated by that of capture, are a function of technological change: technology can help lower the price of carbon capture, transport, and storage (Dumaz, 2018). CCS cost is also driven by the availability of geological carbon sinks. Indeed, the limited availability of carbon sinks can lead to scarcity in carbon rents and thus, increase the unit cost of CCS (Dumaz, 2018).

Such inauspicious economic dynamics demonstrate that CCS systems are unlikely to be further deployed in the absence of clear climate policies. Indeed, as demonstrated in the literature, CCS technology is implemented as long as a well-suited environmental policy is in place and the cost mark-up of CCS is sufficiently low to satisfy the profit-seeking private operators. Without these initiatives, CCS will continue to represent niche opportunities, failing to reach the industrial scale needed to attain climate targets (IPCC, 2005). For these reasons, it is necessary that the governments in place set the right incentives to mitigate the risks and ensure that the CCS project is viable for the private businesses involved. Public and private players are both fundamental to CCS projects, each holding their specific responsibility. For the success of such projects, it is paramount that the parties meet their own objectives.

Figure 2.6: Global portfolio of commercial CCS facilities (Global CCS Institute, 2020)



2.4 Literature gap

As we have seen, cross-sectoral collaboration and public-private partnerships have sparked a substantial academic interest. There exists vast and mature literature on the challenges, levels of performance, and governance required for such specific collaboration between the private and public sectors.

However, as the 2002 COP Johannesburg World Summit on sustainable development epitomized, the interest in PPPs has recently shifted as the world is confronted with urgent social and environmental challenges. Acclaimed for their ability to achieve the "best of both worlds" and to solve some of today's most pressing issues, PPPs have gained the front scene. As a result, a new thread of literature has emerged that links PPPs to the achievement of various sustainability objectives.

We see that the literature on sustainability PPPs is only emerging. It is only beginning to apply well-established research topics such as management and success factors to cross-sectoral collaboration for sustainability (Pinz et al., 2018). However, academic loopholes remain: if academic interest is emerging within the management branch, less

attention is paid to the upstream of the collaboration. In other words, inquiries such as how to get private players on board remain largely unaddressed. This field appears particularly relevant in pioneer sustainability projects which are being run for the first time.

In this thesis, we wish to contribute to this surfacing literature that places environmental or social objectives at the core of the cross-sectoral collaboration. We do so by addressing topics that until now have been either overlooked or little researched by the literature. In this thesis, we attempt to answer the following two research questions:

- What does it take to unlock a public-private partnership for good?
- How to best manage a public-private partnership for good?

Additionally, within the emerging thread of public-private collaboration, the ecological dimension has received the least attention, at the profit of social concerns that have raised more academic scrutiny. We wish to complement such a gap by exploring the success factors to the realization of such cross-sectoral collaboration over carbon capture and storage projects, a theme that, by its immature nature, has never been studied before.

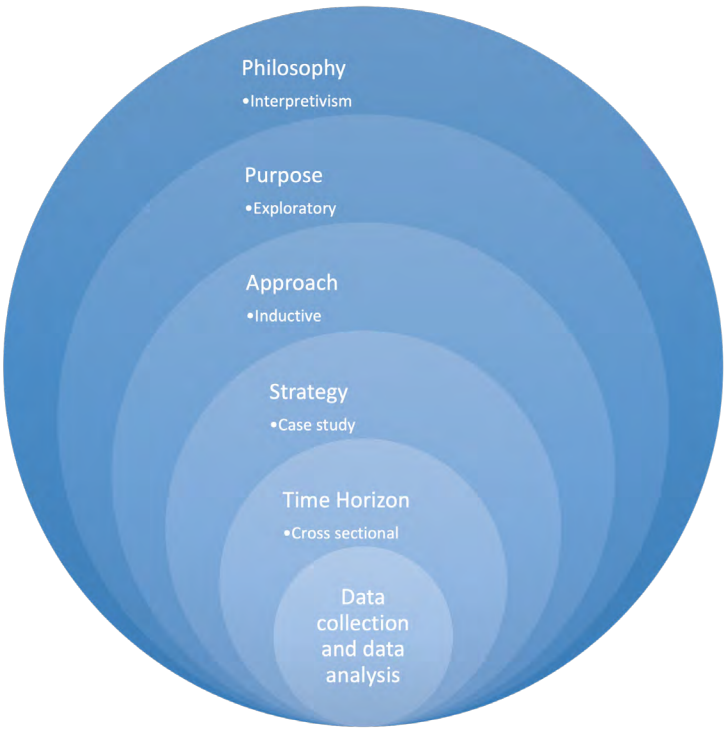
3 Methodology

In the parts to come, we detail the methodological decisions we have taken as researchers in order to answer our research questions. We first begin by describing our research design and elaborate on our choice of data sources in our data collection part. Lastly, we explain how we have analyzed our data in order to drive pertinent findings for our research endeavor.

3.1 Research design

Clearly, defining a research design for our thesis is essential in order to guide our research from theory to empirical examination. Such design addresses a list of choices we have to make as researchers in order to best tackle our research objective. We strive to provide coherence within our design so that our research philosophy is aligned with our thesis's purpose and the type of data we use. As every research strategy has its own limitations, we integrate these weaknesses into our design and state the ways we attempt to overcome these limitations.

Figure 3.1: Research onion (adapted from Saunders et al., 2009)



3.1.1 Philosophy, approach, and type of data

Building upon the idea that knowledge is dependent on the observer and is inherently subjective in nature, this thesis is anchored to the interpretative epistemology tradition. In contrast to positivism, the latter perspective on what constitutes acceptable knowledge stipulates that our complex world cannot be summed by a series of objective law-like generalizations. It rather puts an emphasis on how people create meaning and largely considers the effect and role of the observant as part of the knowledge-creation process (Burrell & Morgan, 2017).

As a logical continuation of this epistemology position, we opt for an inductive approach. We are looking to create knowledge out of an in-depth case study and hence follow a bottom-up approach, going from the specific to the general. Because we do not believe in the objective nature of knowledge, our aim is not to test and verify a theory. Our aim is rather to generate and build a theory that could apply to a variety of cases, but we do not strive for a generalization in the statistical sense that is more appropriate to the deductive approach. Hence, out of the in-depth study of a particular context, we wish to build theory (Saunders et al. 2009). This is especially pertinent for the topic of PPPs for sustainability, as we know this thread is only surfacing.

In line with our interpretive philosophy, we decide to use qualitative data in this thesis. This type of data is most pertinent for our research question since we want to understand how the public-private collaboration is lived by its main parties and hence go deeper into individuals' perceived sensations. We are looking to deep dive into their contextual barriers and scrutinize management elements that affect such a public-private partnership. It appears to us that these elements may only be made visible through in-depth qualitative data rather than hard quantitative data.

3.1.2 Purpose

As previously announced, the topic of cross-sectoral collaboration for sustainability is still emerging. We would like to contribute to this surfacing research through an exploratory thesis. Our aim is to develop a nuanced theory on a topic that has until now gathered little academic interest: upstream incentivizing mechanisms to get the private sector on board,

as well as successful management mechanisms inherent to a cross-sectoral collaboration for sustainability. Additionally, the nascent nature of CCS projects within the spectrum of PPPs for sustainability supports the need for an exploratory case study in order to explore this phenomenon before elaborating on theory or testing a hypothesis. Lastly, the qualitative nature and flexible research design employed in our thesis are well-suited to empirically explore cross-sectoral collaboration through our case study on Longship.

3.1.3 Research strategy

We chose to run a case study on the Longship project to answer our research question. Such a case study will provide us the opportunity to drive an in-depth empirical analysis of the Longship project in its real-life setting (Yin, 2009).

Our thesis is based on a single case study. We decided to focus exclusively on the Longship project because of its uniqueness. Indeed, Longship is unique in many stances. Firstly, on the technical side, it is the first-ever full value chain connecting capture facilities to the storage of CO_2 below water. It will be the first time that a cement and waste-to-energy plant will be used as capture sites.

Secondly, Longship demonstrates an unprecedented level of governmental engagement. Indeed, the level of uncertainty associated with such a CCS project, combined with the first-of-its-kind nature of Longship, calls for the unrivaled level of engagement of the public sector, and in this case, of the Norwegian government. The commitment of the private sector on the other side of the spectrum is, however, not to be forgotten. At the crossroads of the energy and climate transition, businesses are increasingly confronted with the need to adapt and either abate their emissions or develop new markets that are aligned with the low carbon transition. Hence, the high expected level of engagement from both sides made the case all the more interesting.

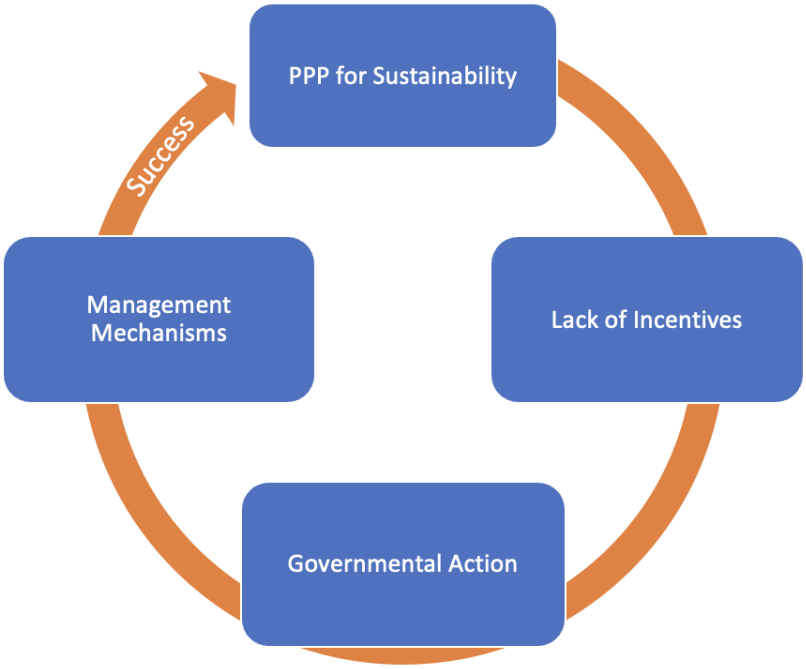
Another specificity of Longship is that it is designed to be a showcase for other CCS projects and further enable its technical and commercial deployment. Extremely high hopes are put on Longship, and meeting the private sector's expectations as well as correctly managing the collaboration is critical to the project's success. The level of commitment of both the private and public sectors combined with the high stakes associated with Longship are hence two factors that altogether convinced us of the uniqueness and relevance of

Longship for our research topic.

3.1.4 Model

After having conducted an extensive academic literature and secondary data literature review, we have established a model to assist us with the research. First of all, we wish to understand the obstacles halting investment in PPPs for sustainability. We then would like to look into the governmental means to overcome these hurdles. Lastly, once the partnership is established, we wish to comprehend the appropriate management mechanisms needed to sustain the public-private partnership. We illustrate our research endeavor in figure 3.2.

Figure 3.2: Model



3.1.5 Time horizon

Regarding time scope, we decide to conduct this case study at one point in time. This is because our current resources at hand, notably time, limit us from examining cross-sectoral collaboration, specifically during the construction phase. The very nature of the project,

which is still in construction, does not allow us to make a longitudinal study before and after the project is constructed.

It may be argued that this period is a critical phase in the long-term development plan of such a vast project. Indeed, it consists of the first phase among the long chain of development phases in which players are put to the test, with many risks lurking, including overrun or technical uncertainties. Because the construction phase is the first major milestone of a long series of developments, there are hence extremely high stakes to succeed and get the rest of the plan rolling out as planned. This is why we believe that studying at this point in time is not a disadvantage but is rather an asset to our research.

3.1.6 Ethics and access

Similar to other qualitative studies, the topic of ethics is paramount to our study. Indeed, because of our research question, we are dealing with potentially sensitive topics through our interviews. Also, the fact that we run interviews with a series of players within Longship and that these insights will be shared with them urges us to prioritize questions of ethics. It is essential that we treat our interviewees with care and respect.

Firstly, to get first access to Longship, we have leveraged the contacts of an academic teacher of NHH, which facilitated our work and worked as a stamp of credibility. From this initial contact, we have asked other participants if they knew someone whose insights could be relevant to our thesis topic. With such a snowball effect, we have come to interview nine participants.

We have sought to maintain an atmosphere of trust and respect toward our interviewees throughout the interview process (organization, conduct, and post-interview). Since our research initiative involves the process of, to some extent, personal data, we have notified the Norwegian Center for Research Data (NSD) of our research project. To ensure time availability and to limit distractions during the interviews, all informants were initially contacted by email and asked to pick a time for the interview. Moreover, after the respondents' requests, they were provided with sample interview questions in order to set their expectations and to allow for the best time-management and quality of response. At the start of the interview, the respondents were asked permission to record, and then all the conversations were recorded.

Lastly, to ensure consent, all the informants were provided with a fully written transcription of the interview and given an option to delete parts that were not approved. Moreover, the final draft of the results section was provided to them as well in order to ensure their consent to publish. We hope that this possibility enabled a more open and trust-laden environment in which interviewees were freer in their speech.

Regarding the secondary sources of data, all of them except one were open to the public. The one document that we have acquired via the Ministry of Petroleum and Energy was the Agreement on Support for Capture of CO_2 between the Government and Norcem Brevik.

Lastly, concerning the observation, we took part in it as "participants-as-observers" and hence revealed our identity as Norwegian School of Economics students. Our access was granted by Northern Lights, a key player in Longship and co-organizer of the event, which invited us and comforted us in the idea that our presence was welcomed.

3.1.7 Quality of research design

There are intrinsic limitations to the methods used in our research design. The quality of the research design is traditionally established by defining its reliability/ consistency (how it was measured) and validity/ relevance (what was measured) (Saunders et al., 2009). It is paramount to clearly distinguish the limitations of each research method and to delineate strategies to reduce their intrinsic weaknesses.

Regarding our primary source of data which is qualitative (interviews and observations), the reliability of our data collected may be weakened by participant/ observer biases and errors. Indeed, the context in which the participants answered may have had an impact on their discourse or reciprocally; when running an observation or interview, we as researchers may have misunderstood the interviewees or let our subjective views corrupt the data. In order to overcome these potential biases, we decide to use different sources of data in order to inform our research question. By leveraging qualitative interviews as well as using secondary data and observations, we hope that each data may complement the other and will help us minimize the limitations of each data source. In addition to the triangulation of data, we aim to establish a chain of evidence through our coding and different sources of data that may act as a supplementary endorsement of our findings

and oust remaining outliers. Lastly, in order to overcome misunderstandings, we repeat the key messages at the end of each interview and send a draft of our result's part as a report of the main takeaways.

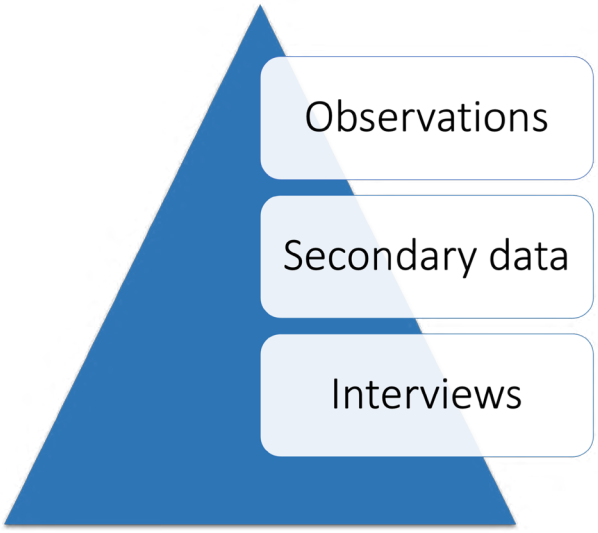
In addition to reliability concerns, it is essential to ensure that we measure what we intended to: barriers to investment and management factors within a PPP for the climate. Such concerns relate to the internal validity or credibility of a research design. We have taken measures to ensure the internal validity of our research when running data analysis. We have indeed identified themes through the coding that directly refer to categories and meta themes identified in the literature. Additionally, working in pairs and being able to confront one's own understanding of someone else involved in the project has proved to be an asset throughout the data analysis phase.

Lastly, the question of transferability is also paramount to case study research. The generalization of case studies is usually inherently difficult because case studies are often picked for their specificities. This is the case for Longship, which we chose precisely for its specificities and uniqueness, which hence makes our findings harder to generalize. One of the pitfalls of the case studies as a research strategy is that the boundaries between the phenomenon are scrutinized, and the context is blurred. It is indeed difficult to separate the context from the element studied, which is, in our case, cross-sectoral collaboration. For this reason, we pay particular attention to accurately describing the context prior to our result's part to help the reader better distinguish between what is context-specific and what can be generated into theory. Lastly, it may be important to emphasize once more that we do not intend to generalize our findings to all public-private collaborations. Instead, we wish that our findings may contribute to the emerging literature and be transferred to a theory possibly applicable to other climate-related public collaborations.

3.2 Data collection

In this case study, we leverage three different types of data (see figure 3.3). We do this to reinforce the reliability of our work through triangulation, but also because each data contributes to the research question differently. As an example, the secondary data informs us on the terms of the partnerships, governance, and financing structure, whilst the interviews enable us to get inside the partnership and understand how the different

Figure 3.3: Data collection



players live such collaboration. The primary data enabled us to raise issues such as trust, leadership, and other managerial considerations that could not have been possible if solely leveraging secondary data. The following chapter presents detailed information about both the primary and secondary data, the sampling techniques, and the structure and process of the interviews.

3.2.1 Primary data

The primary data, in this case, was collected by two different methods. First, the authors conducted seven semi-structured interviews with both public and private actors of the Longship project. In the second place, we were able to collect primary data through observation as participants. Both methods are described thoroughly below.

3.2.1.1 Interview method

For this particular case study, it was possible to use the census method due to the relatively small number of relevant actors in the Longship project. The census method means that all the participants of the Longship project were interviewed; therefore, the scope of the study was not limited by sampling. The census method allowed the creation of a clear picture of the case study (Saunders et al., 2009).

Thus, the participants for the interviews were chosen from all relevant parties of the Longship project, including the Ministry of Petroleum and Energy, Gassnova, Norcem,

Fortum Oslo Varme, Aker Carbon Capture, Northern Lights, and the Øygarden Kommune. Interviews were conducted over zoom, every interview lasting between 40 to 60 minutes. All the representatives from relevant parties provided valuable insights, both the public and the private sectors, which in turn allowed for the research questions to be answered. Conclusions were drawn from the responses that were repeated by multiple respondents. We provide an exhaustive overview of the profiles of our respondents in the table 3.1.

Table 3.1: Overview of conducted interviews

Date	Respondent	Organization	Position
28.03.22	1	Fortum/ Fortum Oslo Varme	Public Affairs Mgr.
28.03.22	2	Fortum Oslo Varme	Local Project Mgr.
28.03.22	3	Gassnova	Head of Market Intelligence
30.03.22	4	HeidelbergCement	Sustainability Dir.
01.04.22	5	Aker Carbon Capture	Head of Sustainability
01.04.22	6	Aker Carbon Capture	Business Mgr.
06.04.22	7	Øygarden Municipality	Business Development Dir.
08.04.22	8	Ministry of Petroleum and Energy	Senior Advisor
08.04.22	9	Northern Lights	Com. & Gvmt. relations Dir.

Qualitative non-standardized semi-structured interviews were chosen as an interview method because of the exploratory nature of the research question and the necessity for flexibility during the data gathering process. To emphasize, we assumed the knowledge would progress during the research process, which served as an additional catalyst for choosing a semi-structured method. The semi-structured interviews were created by developing an interview guide with predetermined themes and key questions, which provided some structure to the interviews (see Appendix). We were able to compare and observe patterns in the obtained data because all of the interviews covered the same given themes and questions. Furthermore, the interview guide was adaptable and changed according to the interviewed organization and in response to new insights. This, in turn, allowed for a better flow of the conversation. (Saunders et al., 2009).

Before each interview, preliminary research about the company was conducted in order to

make any necessary changes to the interview guide. One informant at a time was interviewed most of the time, with the exception of two organizations, where two respondents joined at the same time. The duration of the conversation was within 30-50 minutes each interview to allow for flexibility in terms of follow-up questions. Seven interviews in total were conducted.

The interviews all followed the same flow, starting with introductions from both sides and a short description of their role in the organization and in the project. We clearly stated their background, the choice of the research topic, and the purpose of the conversation. The respondents were asked open-ended questions during the interviews in order to enable them to share thorough and insightful explanations of their perspectives, attitudes, ideas, and opinions about the project. Follow-up questions were asked where additional information was required.

3.2.1.2 Participant observation

To ensure good triangulation, we attended the Open Day at the Northern Lights' storage site in Øygarden Kommune on the 24th of April.

The type of participant observation that was chosen was observer-as-participant since we openly revealed our identity as university students. We did this because we wanted to ensure our ethical posture and because hiding our identity would not have served us in any way. Participant observation can be explained by the researchers entering the world of the observed, becoming a part of their community, and participating in their activities. When attending the open day, we have indeed participated in workshops, attended presentations directed to the public, and have opened dialogue with engineers working on the temporary storage site as well as the public itself visiting the site for the first time. Such observations enabled us to take clues from the social situation, get a concrete grasp and visualization of the project as well as build upon more informal discussions with the staff or the public. In addition, these informal conversations enabled us to get insights different from those they would obtain in official and recorded interviews. These observations were particularly useful to better understand how stakeholder engagement was led and how the project was received by the local community.

3.2.2 Secondary data

The secondary data was used in order to complement the primary data collected through the interviews. The sources of the secondary data included both documents that can be easily accessed by the general public, namely websites and online articles and documents that the researchers were able to acquire through the Ministry of Petroleum and Energy, namely the agreements between relevant parties (see table 3.2).

The secondary data was used during the development of the interview guide and was a crucial element in understanding the structure and progress of the Longship project.

Table 3.2: Overview of secondary data sources

Document	Description
Report to the Storting	White paper on Longship
Agreement on support for capture of CO_2	Agreement btw the Gvmt. & Norcem Brevik
Northern Lights' annual report	Progress and financial reports
Company websites and think tanks	Northern Lights, Gassnova, Bellona, etc.

3.3 Data analysis

3.3.1 Preparing qualitative data

In order to prepare the collected primary data for future analysis, the recordings of the interviews were run through the speech-to-text transcribing online tool "Otter.ai." Even though the data was transcribed well, several transcription errors needed to be corrected. Using the free online tool allowed us to save time and focus on the data analysis. After correcting the errors, the transcripts were sent to all the interview participants for the final checking and verification of the information. They were also given an option to delete any pieces of data that they deemed not necessary to use.

Furthermore, additional contextual information was added to the transcripts, namely the tone and gestures of the respondent and any other non-verbal clues, in order to ensure important incidents during the interview process were included (Saunders et al., 2009).

Each interview transcript was saved as a separate word file, and the name of the file ensured the anonymity of the respondent.

3.3.2 Template analysis

Template analysis was chosen as a data analysis method due to the nature of the research. This approach starts by developing the coding template from the first interview conducted and establishing themes and sub-themes (Saunders et al., 2009). Therefore, this method allows saving time by coding specific information pieces instead of coding the whole transcript. Since it is of exploratory nature, knowledge and understanding of the research topic have been developed throughout the process, the new relevant theory was included in the literature review, the research question was modified, and the data analysis method had to reflect it.

This approach offers a flexible, adaptable, and systematic approach to qualitative data analysis. Furthermore, template analysis serves as a more holistic tool when it comes to all the stages of data analysis by having the flexibility to develop a coding template at the beginning of the analysis and revise it along the way (Saunders et al., 2009).

The data analysis was undertaken by us in stages. First, we became familiar with the collected data by reviewing and identifying patterns throughout our data. This stage is important as it not only creates a sense of familiarity and a deeper understanding but enables us to engage in the analytical processes of data analysis. Secondly, coding was introduced. Coded data allowed us to condense large amounts of data in a more manageable manner. Moreover, the template analysis allowed us to develop an initial coding template, which evolved in the process of data analysis until a satisfactory template is found that captures the data's main themes and relationships (Saunders et al., 2009).

Lastly, the coded data units were grouped into appropriate themes and subcategories in an Airtable spreadsheet. For example, if a corresponding piece of information was describing political influence within the project, it was assigned a "political influence" theme and marked as a "Governmental action" category. If a respondent was elaborating on trust and respect among project players, the data piece was labeled "trust and respect" and assigned as an "PPP management" category. The last category was "Unfavorable conditions" and quotes related to the missing regulation or market failures were directed

there. In addition, remarks were added concerning which source the quote came from and in which context it was made. This allowed the researchers to extract data units for analysis from different topics without sacrificing context. We provide a visualization of our coding spreadsheet in the figure 3.4.

Figure 3.4: Coding used for primary data

Citation	Theme	Notes	Tags	Coded	Meta category
You must not forget EU E...	Regulation	Need higher EU ET...	EU ETS	✔	Unfavorable conditions
But the Norwegian politi...	Political influence			✔	Governmental action
We competed as as capt...	Competition	Competition for fun...		✔	Governmental action
that was another discuss...	Governnace structure Resp	Uncertainties regar...		✔	Unfavorable conditions
We can it's easy for us t...	Responsibility	Role of the state in ...		✔	PPP management
the authorities funded th...	Political influence	Role of state for fin...		✔	Governmental action
But I think and one of my...	Goal alignment	Goal for Norcem is t...		✔	PPP management
But as I said, there are s...	Responsibility	Need to clearly defi...		✔	PPP management
It's public money. A lot o...	Trust and respect	Respect for public ...		✔	PPP management
It's good when it functio...	Risk management Governn	Contract needs to i...		✔	Governmental action
I worked in the ministry a...	HR manangement	Hire people who ha...		✔	PPP management
The only way to receive t...	Trust and respect	You gain trust by be...		✔	PPP management

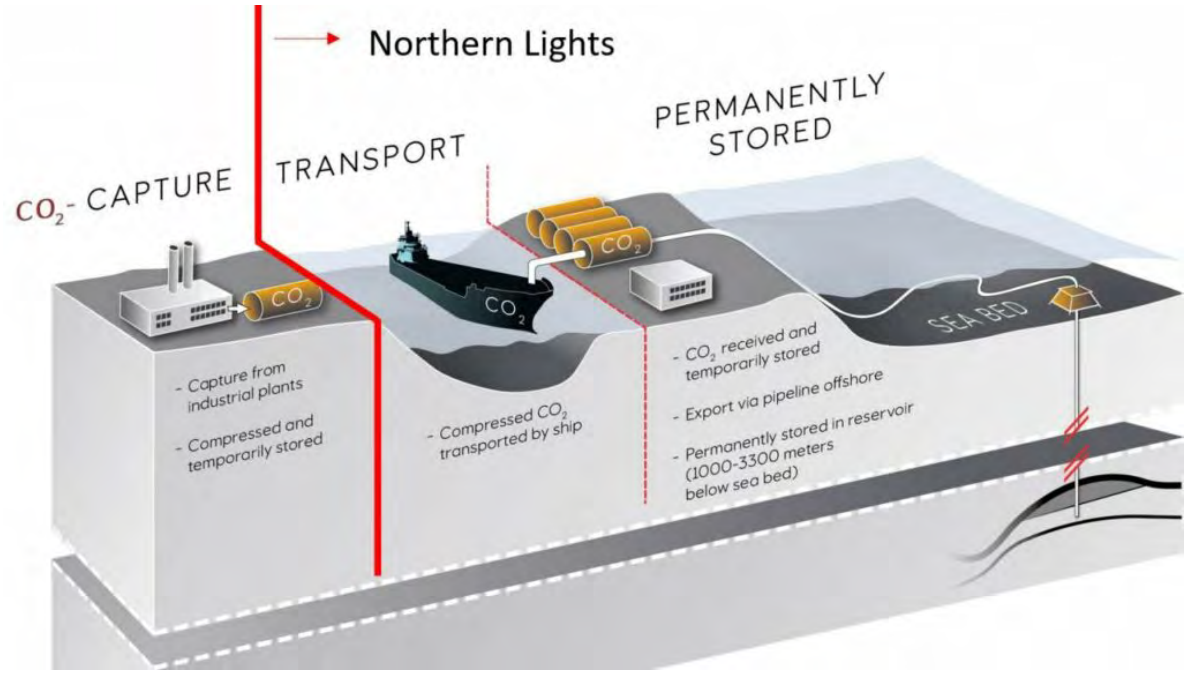
4 Introducing the case

In the following, we describe Longship as a climate technological project, present its key milestones and main players involved. After contextualizing it, we give further detail on how Longship represents a great case study as a PPP for sustainability.

4.1 The Longship project

The Longship project represents one of the world's biggest ambitions to reduce the environmental footprint of hard-to-abate industries and make a durable dent in the world's greenhouse gas emissions. Making mention of the symbol of the Vikings' technological advancement, Longship is the Norwegian government's first full-scale carbon capture and storage project. It will be the world's first cross-border, open-source CO_2 transport and storage infrastructure network, allowing firms all throughout Europe to securely and permanently store CO_2. Its aim is to capture CO_2 emissions from various point sources and permanently store them underground in safe geological sites. In the longer run, Longship aims to store emissions of other industries across Europe that will transport their CO_2 via ships to the storing site.

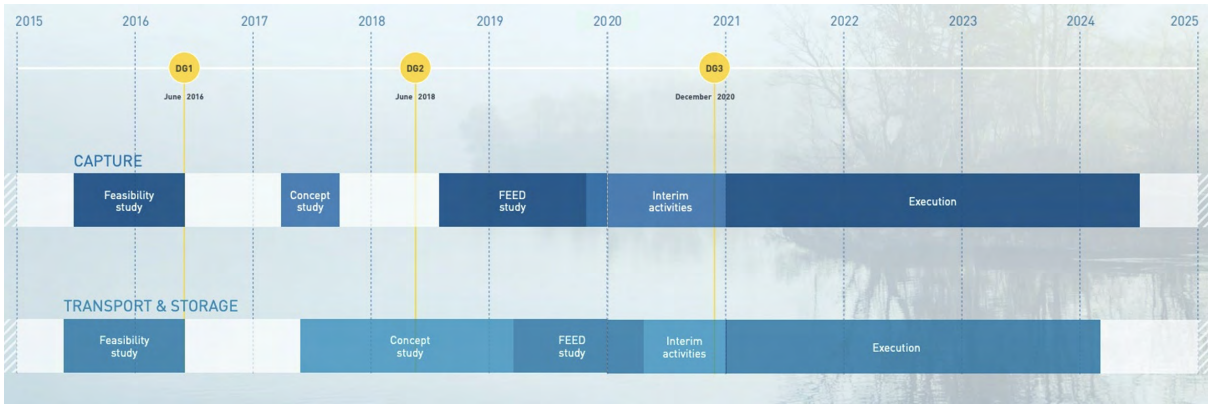
Figure 4.1: Architecture of the Longship project (Bellona, 2020)



In its current first phase of development, Longship is planned to capture CO_2 emissions from two hard-to-abate heavy industries sites in the Oslo-fjord region: a cement factory (Norcem's cement factory in Brevik) and possibly a waste-to-energy plant (Fortum Oslo Varme, FOV). After the CO_2 is captured, compressed, and liquefied, it will be transported by ship to a reception facility in Øygarden municipality before it is transported by pipeline to permanent geological storage 3000 meters below sea level in the North Sea in the "Aurora" formation. Three energy companies, including Equinor, Shell, and TotalEnergies, are responsible for the transport and storage part of the project through their joint-venture, Northern Lights. Cement and waste-to-energy plants are both first-of-a-kind capture projects which, combined with the scale and nature of Longship, make the latter one of the world's most ambitious CCS projects.

Because Longship is a long-term infrastructure plan, it has been forged throughout an extended period of time. The main milestones and decision gates that provided all the partners with an option to leave the project at the end of each stage are shown in the figure 4.2.

Figure 4.2: Longship timeline (Gassnova, 2020)



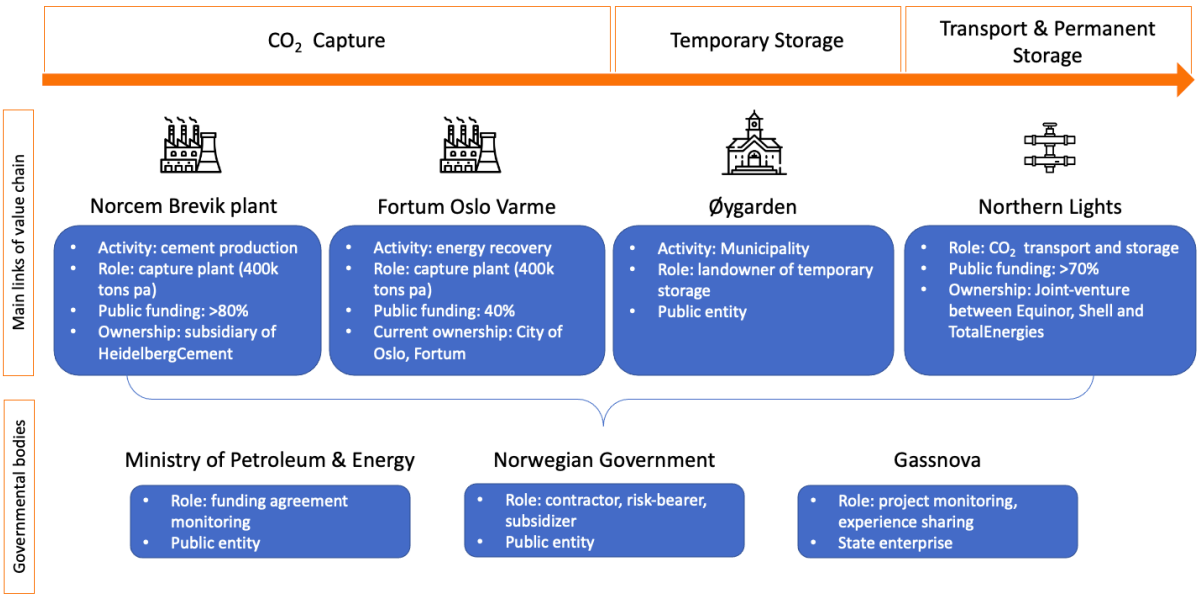
Norway is well-positioned to demonstrate CCS at scale. Pioneer country to launch a CCS project, Norway benefits from over 20 years of expertise with CO_2 storage and other CCS-related experience such as offshore engineering and geology (Meld. St. 33 (2019–2020), p.19). Also, it secures a substantial natural geological CO_2 storage capacity area under the North Sea, which makes this country a credible and auspicious host of further CCS projects.

Beyond its unforeseen technological deployment, Longship represents an unprecedented collaboration of the public and private for sustainability. Its environmental and economic benefits, as well as the extent to which the state is involved, are unparalleled and provide an ongoing illustration of an extended collaboration between the state and private players.

4.2 Main players within Longship

As understood from the literature, there can arise many challenges from the collaboration of the public and private sectors. Longship is not an outlier which, through its organization, joins public and private players who vary in size and level of experience and whom each have different roles and responsibilities in the Longship value chain as outlined in figure 4.3.

Figure 4.3: Value chain of Longship and its main players



It is important to mention that Forum Oslo Varme has gone through an acquisition that was completed in May 2022 and therefore changed its name to Hafslund Oslo Celsio on 20th May 2022 (Celsio, 2022). Nevertheless, as all the secondary data we reviewed refers to it as "Oslo Fortum Varme", as well as all the interviewees, we decided to keep the old name in this thesis.

Each player has a distinct role and responsibility within the CCS value chain and, as a result, may prioritize different elements. For example, beyond successfully rolling out

the capture and storage of CO_2, private players like Norcem Brevik and Northern Lights must reach profitability to ensure the project's sustainability. Conversely, public entities like the Municipality of Øygarden focus on creating jobs as well as building a dynamic business network of companies that leverage this new local CO_2 storage capacity. More largely, public entities, such as the Ministry of Energy and Petroleum, have the goal of developing CCS for industrial plants, not only for Norway but for Europe. Lastly, the state-arm Gassnova has the role of ensuring that Longship is successfully rolled out in due forms, limiting time and budget overruns.

Overall, the interdependence of all these players has been challenging and sometimes resulted in frustrations regarding diverging expectations: *"Different expectations concerning work processes, level of detail in deliverables, resource use, etc. have created frustration for all parties"* (Gassnova, 2020, p.17). The Lonsghip collaboration hence required the *"fine balance between widely differing company cultures and practices"* (Gassnova, 2020, p.17). As a matter of fact, at the heart of this thesis's aim lies, among other things, the investigation of the means to achieve this *fine balance*.

4.3 Longship for sustainability

It is clear that Longship's primary objectives are environmental. Indeed, the whole project is designed to create the appropriate infrastructure to enable CO_2 capture and storing in safe reservoirs, preventing its leakage into the atmosphere and thus mitigating global warming. Longship aspires to contribute to the development of a solution that will allow the world to meet its climate goals at the lowest cost possible. Without CCS adoption in many locations, the European Union's long-term goal of carbon neutrality by 2050 will be extremely difficult to fulfill. Furthermore, CCS must also play a role in reducing large-scale negative CO_2 emissions (Geden et al., 2019).

The most direct climate benefits of Longship can be measured by tonnes of CO_2 captured: Norcem Brevik is expected to capture 400,000 tons of CO_2 annually. To verify that these climate advantages are not offset by the CCS infrastructure emissions (energy use, construction, etc), studies have been conducted on the overall environmental impact of the infrastructure. Notably, the study commissioned by Gassnova and performed by DNV GL and Carbon Limits confirms that Longship stores more than it emits, implying that the

climate advantages are way above the environmental footprint of the project (Helgesen et al., 2021). Indeed, overall, Longship's carbon footprint in CO_2-equivalent across its lifecycle is low, and this is notably due to three reasons. Firstly, internal steam or waste heat is used in the capture processes, utilizing excess energy generated from the plants. The second reason for Longship's limited footprint has to do with Norway's electricity mix, which leverages renewable energies and hence has a very low CO_2 footprint. Last but not least, the project has had, throughout its development, a large focus on using fuel alternatives and low-footprint energy whenever possible (Helgesen et al., 2021).

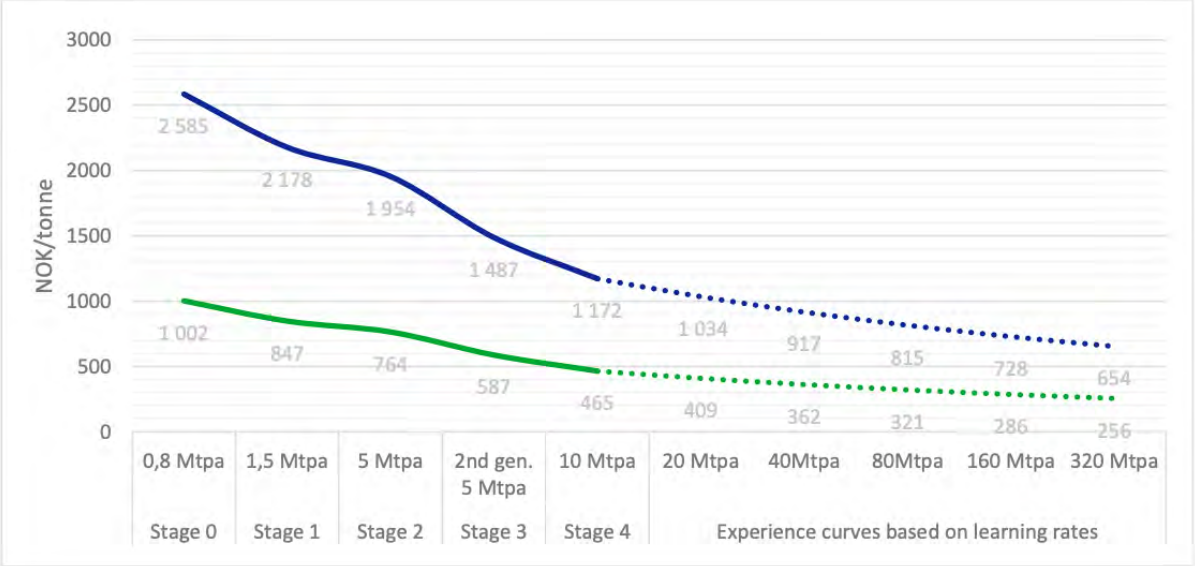
Phase one of the project, with a capacity of up to 1.5 million tons of CO_2 per year will be finished in mid-2024. A potential second phase will have the capacity of 5 million tons of CO_2 per year (Meld. St. 33 (2019–2020), p.76). Longship's dimension of common purpose is epitomized by the classification of Northern Lights as a "Project of Common Interest" (PCI) under the EU's Trans-European Networks for Energy (TENE) programme (Bellona, 2020).

A more indirect goal of Longship is to provide a showcase for further CCS projects. Indeed, more than proving that the technology works, Longship is about demonstrating carbon capture and storage at an industrial scale and making the infrastructure accessible to third-party volumes. The focus hence is not so much on building Longship with the lowest cost per tonne but rather on building it in an international perspective as the world's pioneer full value-chain CCS. As an example, the flexibility required to import third parties' carbon through ships and excess storage capacity is responsible for the high specific cost per metric tonne. In the long run, however, Longship is expected to unravel cost reductions for further CCS projects and large cost cuts in the future due to the use of new technologies and optimization of the value chain (see figure 4.4). More importantly, Longship will contribute to a better understanding of risks, the establishment of a facilitating regulatory framework, evolving business model and learning/ scale effects after demonstration levels are proven (Bellona, 2020).

Longship may also have a good impact on Norwegian business development (Størset et al. 2019), in addition to the environmental benefits discussed above. Economic benefits such as the creation of high-value jobs and business development are also paramount to the Norwegian government. According to the Report to Storting (2019-2020, p.54), Longship

is estimated to employ around 1,500–3,000 full-time positions during the construction phase and around 170 positions during the operational phase. It is difficult to quantify how such effects improve value creation in Norway; it will rely, among many other things, on whether the globe and Europe execute policies and actions that are consistent with the Paris Agreement's global climate goals. Hence, driven by its environmental and economic benefits, the Longship project provides a great showcase of sustainability-related cross-sectoral collaboration.

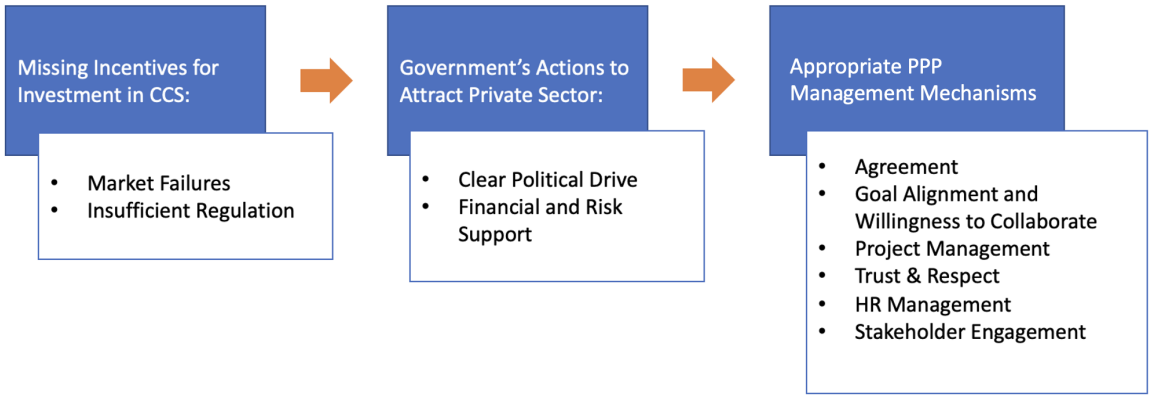
Figure 4.4: Cost reductions estimates from capacity utilization increase, optimization and learning for increased CCS capacity. Investors' perspective (high curve) and Norwegian Environment Agency method (low curve)(Gassnova, 2020)



5 Results

Our research on the Longship brought us to identify the reasons why private investment is today nonexistent or, at best, lagging behind. After pinpointing these unfavorable conditions for CCS investment, we highlight how the government has intended to curb these failures through unprecedented intervention. Lastly, we bring insights into how to successfully manage such a public-private partnership by outlining the success factors of its good management. We summarize our findings for each of these three categories in figure 5.1.

Figure 5.1: Unlocking a public-private partnership



5.1 Incentives are missing for private investment in CCS

If it is clear that CCS has great potential for climate mitigation, it is also observable that investments have been lagging behind. CCS technology is imbued with inherent qualities that deter private involvement in CCS. The hurdles to CCS investment are represented by market failures and insufficient regulations that together do not secure economic attractiveness for private players.

5.1.1 Sustainability's unfavorable economics: market failures

The lack of commercialization is primarily driven by several market failures specific to CCS. Indeed, two market failures act as roadblocks to CCS investment, necessitating both subsidies and government-industry collaboration to execute a demonstration project as big as Longship. The first and most serious market failure is that the cost of producing greenhouse gasses is less than the socioeconomic costs of doing so. As a result, these socioeconomic costs of emissions are not borne by the actors who produce them. This makes it more advantageous from the standpoint of commercial economics to emit higher amounts of greenhouse gasses than is reasonable from a socioeconomic standpoint (Meld. St. 33 (2019–2020), p.22).

The development and the extent of new technology are the subject of the second market failure. Technology advancement may have the qualities of a public good which implies that the technology is beneficial to people other than the person who created it. As a result, the expenses will be borne by the actors who develop the technology, while the benefits will be shared by many (Meld. St. 33 (2019–2020), p.22). That is a second market failure, explained by R8: *"There's another market failure which is a first-mover disadvantage in this type of technology. Because you expect that over time, as you develop more projects, you develop learning. So the following projects will be less expensive to develop. The game for everyone would be to wait for someone else to do it".*

Combined, these two market failures create a cumulative effect. This entails that putting a price on emissions equivalent to the socioeconomic price of emissions will not be enough to drive innovation and new technology. Therefore, emissions price combined with financing for new technology development is the most effective strategy (Meld. St. 33 (2019–2020), p.23).

Adding to these market failures, there are other intrinsic qualities to CCS projects that hinder private players' investment. To illustrate, economies of scale, notably in the storage part of the value chain, are a significant obstacle. While the costs of developing the storage facility are considerable, the costs of new consumers using the facility are comparatively modest (Meld. St. 33 (2019–2020), p.23). Moreover, the inter-dependencies inherent to CCS infrastructure projects may deter private investment. Indeed, because

they often involve one source, one sink, and one pipeline, CCS projects involve high levels of dependencies that lead to a high cross-chain risk that only a few private investors are willing to take. Lastly, if the risk of CO_2 leakage is relatively small, it is not null. If no limit on liability is fixed, it is the private operator that has to assume this responsibility. Such unlimited and colossal liability is hard to assume for private players, especially in emerging industries where experience is limited.

These market failures combined with the intrinsic qualities of CCS explain in part why no or few players have until now resorted to CCS. This is why governmental action is indispensable. R5 indeed sees the necessity of the state stepping up: *"State funding or collaboration is important for the first movers in this area".* Similarly, respondents highlighted the importance of the state's support in addressing the two market failures specific to CCS: *"For these reasons, the government identified a need for a correction of those market failures and also being the middleman between the projects"* (R8). Furthermore, it was highlighted that it is the state and only the state that has *"the competency"* (R8) to overcome both the investment barriers and the market failures.

5.1.2 Current regulations are one step towards involving industry players

As an effort to curb these above-mentioned market failures, new environmental regulations have emerged. This regulatory framework composed of such environmental policies has been instrumental in gradually bringing the cost of pollution to the cost of abating and hence driving progressive business interest for CCS projects.

Although it does not reach the desired prices that would align it with the cost of capture, the European Union's Emission Trading Scheme (EU ETS) framework provides a good basis for the business case of CCS. More precisely, the increase in the EU ETS carbon price over the years has had a positive influence on the economic projections for private players taking part in such projects. Indeed, when the parties began the negotiations over the contract, the prices of the emission allowances were much lower than what they are now: *"When we finalized the agreements, the ETS price was at 26 euros per tonne. The price was even lower when we started negotiating"* (R8). The price assigned to EU allowances represents the potential avoidance of costs associated with purchasing emission

allowances, now that they emit less than expected thanks to the emission-abatement technology. Taking this into account, we understand how the rising trend in the EU ETS has represented a *"huge commercial driver to develop CCS"* (R8).

In parallel and perhaps as a result of these environmental policies, climate change has gradually gained momentum: *"I think the investor climate has changed significantly the last five years after the Paris agreement, the IPCC's "1,5 C" special report, after Van der Leyen's European Green Deal, etc"* (R3). One respondent highlights the fact that various terms such as *"net-zero"*, ubiquitous today, were completely absent from the discussions when the project began: *"There was no discussion about net-zero emission when they started in 2011. That has changed dramatically"* (R3). As a testimony of the more auspicious economic dynamics for climate action, we observe more profit-seeking actors taking part in green projects. As an illustration, one can cite the new ownership structure of the Fortum Oslo Varme plant, where two private investment funds are planning on acquiring a relevant chair in the company; the transaction is still to be made (Oslo Kommune, 2022). According to some respondents, this shows that *"also private investors start to believe that investing in CCS is a viable way to get payback on their investment"* (R2). A rising number of companies today have committed to net-zero targets and *"have set these 2030 targets to reduce their emissions"* (R7). In parallel, we see the growing frameworks to organize such transitions, including the Science-Based Targets Initiative (SBTi): *"We think about SBTi"* (R7).

Beyond the EU ETS and the carbon tax, the Norwegian government has also played a part in developing regulations specific to CCS. Examples include Norway's support for amending the London Protocol that prohibited *"the intentional dumping or storage of wastes on the seabed or in sub-seabed geological formations"* (Meld. St. 33 (2019–2020), p.42). Thanks to the 2019 amendment by a Norwegian-Dutch coalition, it is now possible for countries to enter into cross-border cooperation on transport and storage of CO_2, provided they have a bilateral agreement.

All the above-mentioned regulations and emerging climate momentum have provided auspicious conditions for the partnership to emerge. These have more specifically played the role of making a step towards securing the economic profitability of such projects, paramount to private actors.

5.1.3 Nevertheless existing regulations are insufficient, and loopholes remain

CCS technology is contingent on a well-suited environmental policy and a sufficiently low-cost mark-up to satisfy the profit-seeking private operators. Until this day, however, these regulatory mechanisms to align economic interests with the development of CCS are largely missing. Indeed, if *"a lot has already happened"* on the regulatory front, there remains much to do (R7). Although they represent a step forwards in terms of setting the correct incentives for businesses, these measures are largely insufficient today. The above-mentioned regulations either do not go far enough or are simply nonexistent. Indeed, we gather from our interviews that there are still largely missing regulations to fully attend to all the players' preoccupations and address remaining uncertainties. As respondent 1 confirms, *"Now we really see that new business models are emerging, but it's still very immature"*. Our interviews revealed a persistent feeling of uncertainty regarding either the emergence of new regulatory frameworks or the business case for such a project.

Firstly, if the increase in the EU ETS emission price is a good sign, it is not enough to fully secure the profitability preoccupation of the capture plants: *"The income side of this investment is very uncertain at the moment"* (R1). Many players have indeed referred to the necessity of the two cost curves to meet: between the cost of emitting (represented by the EU ETS emission price) and the cost of capture: *"I think one important question will be that the cost of emitting (the* CO_2 *price) will match or even be higher than the cost of capturing"* (R4). However, there remains much uncertainty regarding when this time will come: *"I don't think we can pinpoint the exact date"* (R7). For the sake of illustration, today, the net cost per tonne for capture, transport, and storage is high, and for 800,000 tonnes per year, the cost is around NOK 1,280. However, this cost is expected to decrease with full utilization of the transport and storage facilities (Gassnova, 2020).

On a more national scope, another concern is the lagging of public investment in these green projects: *"We need more and quicker funding"* (R7). Providing bigger loans or seed investment in start-ups would enable to curb the risk and uncertainties inherent to such an initiative and hence help align economic motivators: *"We also need incentives for the business community to go green"* (R7).

In addition to the unpredictability associated with the existing regulatory mechanisms, there still appear to be missing regulatory frameworks. To this day, one of the main incentives to capture plants is to save money from the sale of EU ETS allowances (Operators can subtract CO_2 that has been captured and stored from activities subject to the EU ETS from their emissions accounting, implying that they do not need to surrender allowances for this volume (Meld. St. 33 (2019–2020), p.44). However, up to this day, the waste-to-energy sector and CO_2 emissions from biomass (biogenic CO_2) are not included in the EU ETS. Quoting the Report to the Storting (Meld. St. 33 (2019–2020), p.44), the EU ETS regulations do not provide incentives to capture biogenic CO_2 (2020). However, this current uncharged right to pollute may change, and such doubts over this new imposition largely predominate in the discourses of our respondents. Other interviewees expressed their speculations on how the carbon tax and EU ETS prices were to increase and would hence represent additional incentives for companies to abate their emissions: *"Both the national* CO_2 *tax and also the EU ETS will be determinant"* (R1); *"There are expectations on the EU ETS to continue to go up towards 2030 as we are taking out allowances from the market"* (R7). As another example, there have been recent consultations regarding the proposal of implementing a carbon tax on waste incineration in order to compensate for the EU ETS loopholes. If adopted, the carbon tax will improve the business case for capture by representing potential saved costs for the FOV capture plant (Meld. St. 33 (2019–2020), p.44).

As a consequence of its none-inclusion in the EU ETS, Fortum Oslo Varme's economic interest to capture CO_2 is hence limited to the sale of *"negative emission carbon credits"* since half of its incinerated products are of biogenic source (R1). This type of credit can indeed be exchanged under the condition that the seller (Fortum Oslo Varme, in this case) is a net-subtractor of CO_2 from the atmosphere: it absorbs more CO_2 than it emits. The combustion of biogenic elements is considered a negative emission under the current emissions accounting (the capture of biogenic matters, considered naturally carbon-neutral by the current accounting system, leads to a net subtraction of CO_2). If today there exists the trading of such emissions, this market is, until now, rather unregulated. An EU classification of such negative emissions would give the necessary stamp of credibility required for this market to take off: *"All of these things are necessary to build the market that people trust in the future"* (R2). Lastly, international policies such as the Carbon

Border Adjustment Mechanisms (CBAM), still not applied today but in construction by the EU, are indispensable to avoid carbon leakage and gradually align the prices of non-regulated cement with the less CO_2 - intensive cement.

5.2 What it takes to get private players involved

We understand that market failures, investment barriers, and insufficient regulations deter private investment in CCS. However, it is clearly stated that the private sector's engagement in CCS is indispensable. Indeed, firstly emanating from the public side, there is a clear acknowledgment of what private players can bring to the table. Quoting the Norwegian Ministry of Petroleum and Energy, the private sector's expertise appears crucial: *"The petroleum industry's experience and expertise have been important to realize dedicated business models for CCS"* (Meld. St. 33 (2019–2020), p.20). Conversely, throughout our interviews, private players acknowledge the necessity of the state intervention to help them surpass these investment failures: *"That is why we need to state in this transition period"* (R1). This mutual dependency to achieve CCS sustainability objectives call for the unprecedented involvement of the state. Throughout Longship, the government indeed makes great strides to get private players on board. Beyond a clear political consensus that stands as a pre-condition to governmental action, such engagement takes the form of extensive finance and risk-taking capacity.

5.2.1 Clear political drive towards CCS

In consideration of these market failures and investment barriers inherent to CCS projects, it becomes clear why the government is needed. However, this governmental entry into the field of CCS should not be taken for granted. Rather, it must be remarked that it results from a long-term, planned, and integral commitment to CCS from the Norwegian government. In other words, great political determination and consensus are required prior to any financial or risk-taking commitment.

Longship is the culmination of years of collaboration between different Norwegian governments. Indeed, CCS has been part of the Norwegian long-term climate plan, *"regardless of the color of government in place"* (R4). They all have long financed technological research, testing, and pilot projects, emphasizing CCS as a key climate

mitigation option in international climate conversations. In 2014, the government unveiled its carbon capture and storage program. The strategy included a wide range of initiatives in research and development, a full-scale demonstration facility construction, and international collaboration (Meld. St. 33 (2019–2020), p.25). The previous Norwegian government, led by Erna Solberg, started the work on the development of the Longship project. Longship is developed on the back of the Stoltenberg government's "moon landing" project on Mongstad. The current government's political framework led by Jonas Gahr Støre *"has built on this strategy and has proposed financing for the Fortum Oslo Varme project to Parliament"* (R8).

This engagement toward carbon capture technology is embodied through several governmental initiatives. For example, CCS is a key research topic of both the Norwegian CCS Research Centre (NCCS) in Trondheim, and the Technology Centre Mongstad (TCM), which has established itself as a prominent international competence center for the demonstration of capture technology. In addition, the CLIMIT program, which is Norway's national plan for research, development, and demonstration of CO_2 capture and storage technology, is an important source of funding for both national and international projects. Established in 2005 by the Ministry of Petroleum and Energy, this program aims to support the development of CCS technology and place Norway as a leader in this emerging industry. As proof of the national dimension embedded in Longship, the terms used to name key parts of the project make direct reference to Norway's avant-garde expertise in technologies and landscape attributes. From "Longship" to "Aurora formation" and "Northern Lights", these terms altogether emphasize the nationalist perspective of this project, reflecting Norway's national commitment toward CCS and its ambition to become a leader in this field (Bellona, 2020). Now, similarly to those who built Viking longships, *"We (the Norwegian government) also aim to take our technology out into the world"* (Meld. St. 33 (2019–2020), p.5).

Moreover, the significance of this project on the European scale is emphasized throughout as one interviewee enlightens: *"We believe it's necessary to get the CCS off the ground for industrial emissions in Europe. We think Norway needs to play a leading and active role in this. It is for the benefit of Europe really"* (R8). Indeed, the Europe dimension of Longship is stressed throughout our interviews and in the formal documents, an example, the Report

to the Storting (Meld. St. 33 (2019–2020), p.37) that clarifies that Longship is a key step toward reaching European climate goals: *"Through the demonstration of full-scale* CO_2 *management, the CCS project will contribute to the necessary development of* CO_2 *management, so that Norway's and the EU's long-term climate goals can be achieved at the lowest possible cost"* (Agreement on support for capture of CO_2, 2021). Longship indeed represents a major milestone in the reaching of EU climate goals: *"Now that we have the ball rolling, it will be possible to achieve what the European Commission says is necessary, namely to store between 300 and 600 million tonnes of* CO_2 *per year by 2050"* (R9). Moreover, international cooperation is needed in order to commercialize the solutions developed in Norway's initiative (Meld. St. 33 (2019–2020), p.8). Emphasizing this, R7 has said that the stakes are very high in the Longship project: *"Norway and the world are dependent on that Northern Lights is going to be a success and also our local community, we're trying to get them into the picture and as I said (...) The world is looking to us now".*

Stepping out of the global picture, the engagement of more local entities is also worth noting. Indeed, other key stakeholders of Longship are local governments, such as the city of Oslo, that has been a driving force for the capture of the emissions: *"This project has been very politically important for the city of Oslo who has set the goal of reducing their emissions by 95% by 2030 (...) They put a lot of capital and also political capital into this"* (R1). Indeed, the City of Oslo who has stakes in Fortum Oslo Varme was *"instrumental"* (R1) for FOV to push the capture project forwards, notably because the city's climate plan would be virtually impossible without abating the city's waste-to-energy high emissions. Hence, the government's long-term strategy on CCS, combined with the engagement of local governments, both build the solid foundation that is underpinning Longship's cross-sectoral collaboration.

5.2.2 Extensive governmental financial support

Finance is one of the key levers of action for the state to align economic incentives. Indeed, in the current context where *"to develop CCS, you need money"* as put blatantly by one of our interviewees (R7), the role of finance and extensive governmental financial support is not to be undermined in Longship's success.

Firstly, what sets aside Longship is the unrivaled financial commitment of the state in both the investment and operations of Longship. Perhaps one of the most necessary measures from the government is the model for the investment and operational funding (Meld. St. 33 (2019–2020), p.40). Indeed, in an attempt to fix the market failures, the Norwegian state covers a large part of the Longship project's costs. Out of the total 25.1 billion NOK expected costs, state aid equals 16.8 billion NOK. This means that the government is expected to cover around two-thirds of the project's expenses (Meld. St. 33 (2019–2020), p.7).

The state has different investment models for both capture and storage sites. For example, when it comes to the storage site, a cost split was agreed upon, with the state covering 80% of the investment expenditures and the businesses covering 20%. During the operating phase, the state will fund 95% for the first year, 90% for the following year, 85% for the 3rd year, and then 80% for the 4th year and the rest of the funding period, which is 10 years from the start of operations. If an additional well and/or additional ship are required, the government will finance half of the expenditures, with a maximum funding amount of NOK 830 million (Meld. St. 33 (2019–2020), p.40).

Figure 5.2 illustrates the expected costs and the amount of state aid.

Figure 5.2: Estimated expected costs and Parliament's cost frame for Northern Lights, Norcem and Fortum Oslo Varme (Meld. St. 33 (2019–2020), p.56)

Bill. 2021 NOK with exchange rates per 2 June 2020	Expected costs (P50)			Parliament's cost frame (P85)
	Total QA2[2]	Industry/ other sources	State aid	State aid
Northern Lights	14.2	3.8	10.4	
Norcem	4.5	0.7	3.8	
Fortum Oslo Varme	6.4	3.8[3]	2.6[4]	
Total	25.1	8.3	16.8	Investments: 13.1 Operation: 6.1

[1] Expected costs do not include additional funding for captured CO_2 that is not subject to the European Emissions Trading System, equivalent to the allowance price per tonne CO_2 excluding a potential Carbon tax per tonne CO_2.
[2] Construction and ten years' operation.
[3] Based on the external quality assurers' estimate excluding the Government's recommendation
[4] Based on the external quality assurers' estimate excluding the Government's recommendation

When it comes to the capture sites, additional financing was agreed upon during the

discussions for CO_2 that is not covered by the EU ETS, with the funding recipient receiving funding equivalent to the allowed price for every tonne of CO_2 captured. If the polluters are subject to a tax, the value of the tax will be deducted from the EU ETS allowance price, leaving the difference between the CO_2 tax and allowance price as the supplementary funding amount. CO_2 originating from biogenic sources is also eligible for further financing (Meld. St. 33 (2019–2020), p.40).

This extensive financial investment on behalf of the state is also largely recognized by those parties benefiting from it: *"Definitely, it is no secret, but actually 80% of our project is funded by the authorities"* (R4). Such initial investment was judged absolutely necessary: *"Having the state kind of incentivizing and picking up part of that bill is crucial"* (R6). The state's financing plays an indispensable role, without which nothing would have been possible: *"Our firm belief is that we wouldn't have seen those projects moving forward this quickly without the huge investment Norwegian public has made in Longship"* (R6).

The choice of the financing structure is influenced by political orientations. As an example, the investment in both Northern Lights and Norcem Brevik is higher than the investment in Fortum Oslo Varme. This was, to some extent, to reflect the political objectives: *"That was a political decision. In order to have the Longship project flying, they (the government) needed one capture facility fully funded"* (R2).

Similarly, the Ministry has also looked at other co-funding options for the project in addition to the parts covered by the private sector under the signed agreements. As the project aims to help businesses and other stakeholders in the EU reduce emissions at a cheaper cost, special efforts have been made to acquire EU co-funding (Meld. St. 33 (2019–2020), p.20). As supported by one respondent: *"They wanted to see if there is a possibility to also get funding from the EU, through the Innovation Fund, and asked Fortum to go that route"* (R2). The Innovation Fund is the largest potential source of funding from the EU and is supported by the selling of EU ETS allowances (Meld. St. 33 (2019–2020), p.20). This decision reflects the Norwegian government's ambition to not make Longship a Norwegian standalone project but a *"European-oriented, first of many projects"* (R2). Moreover, such a financing option on the EU Innovation fund enables not only to leverage international institutions' support but also to *"share the political risk with the EU"* (R2) and signals that it is not only Norway developing CCS but rather *"Europe*

as a whole" (R2).

5.2.3 Considerable risk-bearing

Alongside its large financial investment, the state takes large stances in its risk-bearing capacity. Indeed, to make Longship work, *"The state has gone in with various sort of project-specific support for this and it has taken on a lot of risk"* (R8). This is understandable given that CCS and Longship incorporate such risk, may it be relating to technical, regulatory, or economic uncertainties.

As per the agreement, the government is responsible for a large part of the costs and risks associated with CO_2 transportation and storage. Cost-sharing is the primary risk-sharing mechanism used in the establishment and management of a capture facility. Moreover, the state highlights the necessity of collaboration: *"In case of delays, the parties shall jointly seek practical solutions to minimize negative impacts for other parts of the CCS project and the* CO_2 *chain"* (Agreement on support for capture of CO_2, 2021).

The Norwegian state absorbs many of the financial risks of the project. The details are complex, and the description here is simplified, seeking to capture the main principles (Bellona, 2020):

- The state takes the interface risk. Due to the state being an intermediary between Norcem and Northern Lights, and possibly Fortum Oslo Varme and Northern Lights, there are risks of delays from both sides. In such a case, the state has agreed to cover the costs of the waiting party. Similarly, there are also risks during the operations phase. If the capture actors do not deliver the captured amount, or if the amount cannot be stored, the state will cover the costs related to that (Meld. St. 33 (2019–2020), p.58).
- The state also takes a large proportion of the risk of cost overrun. In broad terms, the state only takes overrun risk up to an agreed maximum; for capital costs, it takes 80% of overrun costs for Northern Lights, and 83% for the Norcem capture plant. For operating costs over the first 10 years, it takes 75% of the costs of any overrun at Northern Lights and also 75% for the capture plants. These payments are limited to the level at which there is estimated to be an 85% probability that the costs will be below.

- The state also absorbs most of the risk of leakage from storage, but this is considered a very low chance risk. However small the chance is, if such an incident should occur, the state has agreed to cover 80% of the costs for corrective and preventive measures in the first phase of the project. During the operations period, the state will cover 80% of the costs related to the CO_2 volume. Therefore, the amount of the leaked CO_2 will determine the cost. For the other 20%, the government has agreed to take on the part of the risk of rising allowance prices by paying the cost of allowances above EUR 40 per tonne of CO_2 (Meld. St. 33 (2019–2020), p.58).
- Lastly, in the event, that a storage facility is closed, all monitoring and corrective action obligations are handed over to the state under the CO_2 Storage Regulations (Meld. St. 33 (2019–2020), p.45).

By committing to bear such financial risk, the state has allowed the private players to have the freedom and safety to operate and focus on the development of CCS itself, which would not have happened otherwise. As R3 emphasizes: *"The cost and the risk and the uncertainty about the future, how the future will evolve, and if you're able to get payback on investment is so large that you need some type of guarantees for the time being to make CCS happen".*

Moreover, the sharing of profits is clearly indicated in the agreements in order to avoid miscommunication in the future. If Northern Lights is profitable after future expansion, then the state will take a share of the profits, from 50% rising to 75% at defined thresholds, and sees reduced costs for volumes above 1.5 million tonnes per annum. Similar types of arrangement apply to the capture projects, with a reduction in operating cost grant over a certain rate of return. If the rate of return is above a higher threshold, the state gets a 75% share of further net cash flow. (Meld. St. 33 (2019–2020), p.60).

All in all, the state's clear push in favor of CCS, and its financial and risk-taking commitments are all elements that were absolutely necessary to get private players on board. As a result, participants recognize the state's role in correcting market failures: *"It has opened up for large-scale use of CCS and broke the chicken and egg situation that we have been battling for many years"* (R9). The state also helped to get the *"ball rolling"* thanks to unprecedented governmental intervention (R9).

As a result of the acknowledgment of such mutual dependency, both sectors set a favorable and stable foundation for their future collaboration. Combined together, both parties must work together to achieve their common objective: *"In much the same way, we must also continue to work together to implement the project in the best way possible"* (Meld. St. 33 (2019–2020), p.5). Similarly, the agreement between the Norwegian government and the capture plant Norcem AS emphasizes that parties must *"jointly seek to resolve any unforeseen challenges that may arise"* (Agreement on support for capture of CO_2, 2021). Lastly, making reference to the latter cited document, the fact that terms such as "agreements" prevail over commercial contracts is indicative of this desire to work together. Hence, the recognition of each other's utility is a key element that contributed to building solid foundations for this public-private partnership.

5.3 How to manage a public-private collaboration

It is one thing to get industry players' interest in CCS, it is another to manage collaboration with them. As we have seen in the literature, successfully leading a PPP is hardly easy. There remain many management issues that should be addressed in order to correctly lead this challenging unprecedented partnership with the state. It takes well-suited management tools to secure the sustainability objectives of the partnership and ensure that state money is being well used. Similarly, preoccupations such as information asymmetry that is predominant in the negotiations, power distribution, and the potential frustration of players being monitored are all challenges that need to be addressed. In the part to come, we analyze these management preoccupations by leveraging the terms of success factors. In light of the present case study on Longship, we reveal various elements within reach of management that contribute to the good running of such a partnership. We do so by leveraging past literature when identifying themes and adding on to it by recognizing management factors overlooked in the literature.

5.3.1 Agreement

5.3.1.1 Separate contracts with built-in flexibility

One lesson learned from attempting to construct European CCS initiatives is that developing commercial models that span beyond one industrial sector might be difficult

(Gassnova, 2020). The state has also spotted this eventual difficulty early on: *"The owners of the best emission sources are generally not set up to develop a storage site and vice versa. So developing these two projects independently wouldn't work. Someone needs to combine this value chain"* (R8). In order to accomplish that, *"Someone needs to go in and be the middleman, taking the risk for the complete value chain and linking it together"* (R8). This is the state's role. Indeed, the Norwegian state acts as a middleman by dividing the CCS chain and establishing individual agreements for each component: *"The agreements are structured so that a state has one agreement with Norcem and another one with Northern Lights"* (R8). There are no direct commercial contracts between Northern Lights and the capture projects (Bellona, 2020).

Separating each contract has the virtue of avoiding cross-chain risk. Hedging against such cumbersome dependence contributes to reducing the overall risk linked to the operations (Gassnova, 2020). The reason that they are only those contracts in place is to ease the complicated logistics of having negotiations with multiple stakeholders at the same time: *"It would be very complicated if, in addition to those negotiations, the capture sites would have to have a direct negotiation with the transportation and storage site"* (R8).

In addition, the various components of Longship, from the capture to the storage, have different ownership and commercial structures. Among other things, this gives a degree of flexibility for future developments. This is of particular relevance for Northern Lights, whose aim is eventually to make further contracts with additional capture sites to transport and store their CO_2 (Bellona, 2020).

5.3.1.2 Embedded industry incentives

Beyond defining the finance and risk-taking capacity of the state, the agreement also integrates incentives for private players to perform well and efficiently, thereby using state money correctly. Indeed, the way the agreement is built and its different clauses act as economic incentives to succeed in the PPP. We outline three such incentives.

Firstly, the agreement is structured in a way to incentivize private players to keep costs at a minimum and complete the project on schedule. This is enabled through the finance and risk structure defined by the agreement. Indeed, if the government takes on a large part of the financial and risk burden, it does not, however, take on everything. There is a clear

divide in risk. In fact, this latter fact appears to be a cardinal point regarding Longship: *"A key principle is that costs and risks shall be distributed between the government and the recipient"* (Meld. St. 33 (2019–2020), p.40). The government is hence to cover a significant portion of the costs, while the recipient carries the risk of any savings and revenues. The fact that the companies own and develop the carbon capture, transport and storage projects, and that they cover a share of the actual costs when they accrue a powerful incentivizing mechanism to ensure good management of time and money. Similarly, the state has committed to cover all costs up to a certain threshold and beyond such point of impact, the state will "only" cover 75% of the costs, leaving the other 25% to be paid by the companies. Such a model used to determine the operating and investment costs gives good cost control incentives. As argued by the Ministry: *"25% of all costs above the threshold will provide sufficient incentives in the range where the company has the possibility to influence costs"* (Meld. St. 33 (2019–2020), p.40).

Secondly, the finance structure is also used as a powerful incentivizing mechanism to further develop an excess capacity to store more CO_2 from plants across Europe. As designed in the state aid agreement for the transport and storage part of the project, Northern Lights will get no profits from storing CO_2 within phase one (from Norcem Brevik). As highlighted by one respondent, this is to ensure that the key objectives of Longship to project CCS in Europe are guaranteed: *"And how do you achieve that? Well, you require through the contracts that the only way that Northern Lights can break even or even achieve a positive return on investment is by developing a market for* CO_2 *storage"* (R8). Indeed, as clarified in the Report to the Storting, the state aid agreement has been *"designed to give Northern Lights the incentive to incorporate new projects"* (Meld. St. 33 (2019–2020), p.8). With their revenues only stemming from future CO_2 storage of new projects, Northern Lights is largely motivated to roll out into phase 2 and further develop storing capacity for commercial use. Hence, the way the current finances of Longship are structured help align private operators' economic incentives with the overall political goals that the government has set for Longship.

Lastly, the fact that Norcem and FOV generate savings by reducing their need to buy emission allowances or tax obligations per tonne of captured CO_2 represents in itself an incentive to operate the carbon storage facilities efficiently. In other words: to save more

money, the plants need to capture more tonnes of CO_2.

All in all, these three incentives tied to the agreement constitute powerful securing mechanisms to ensure that state money is efficiently spent and that the project is well run by the involved parties.

5.3.2 Goal alignment and willingness to collaborate

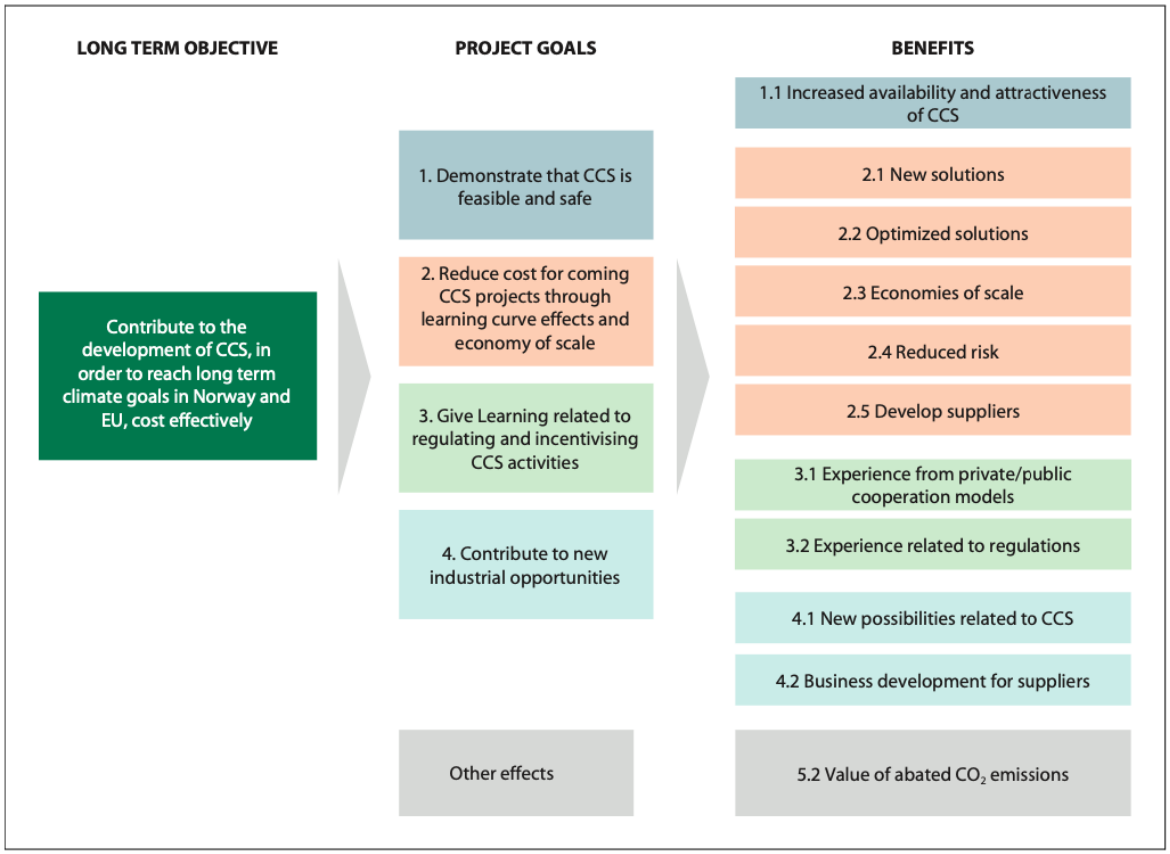
5.3.2.1 Mechanisms to secure public goals

As understood from the literature, securing the public goals of a public-private partnership represents a predominant issue. Concerning Longship, the societal goals have been largely formalized thanks to a *"benefit realization plan"* piloted by Gassnova. Such study was destined to *"identify the benefits and increase the probability of achieving the impact goals and thereby also the societal goals"* (Meld. St. 33 (2019–2020), p.36). The document formalizes the overriding objective of contributing to the development of CCS to achieve long-term climate goals in Norway and EU effectively. It then outlines four project goals and derives benefits emanating from each of these project goals (see figure 5.3).

The benefit realization concept has been essential to developing a *"common understanding of what the state wants to achieve (...) and helped all project parties (both industrial and public sector) to identify and carry out value-adding activities"* (Gassnova, 2020, p.27).

It is one thing to determine the public aims of such public-private collaboration, but it is another to ensure their upholding and achievement. In other words, creating a benefit realization plan does not suffice in itself; mechanisms need to be implemented to ensure these goals are correctly addressed. In this vein, the benefit realization plan was largely used as a tool to coordinate and collate the plans of every actor involved and the state. Firstly, industry players were required to clearly outline their contribution to benefit realization throughout their FEED studies. As a result, the benefit realization has been updated a number of times, thus resulting in a collaborative effort between the industry actors, Gassnova and the Ministry of Petroleum and Energy, to co-construct such an essential document. Thus, the efforts made by the industrial partners to align their business development to the benefits realization lead to *"strong results"* as it resulted in an *"impressive plan for developing the market and the infrastructure"* (Gassnova, 2020, p.27).

Figure 5.3: Benefit realization plan (Gassnova, 2020)



Secondly, the societal goals included in the benefit realization were largely included in the tendering process for choosing industry partners. Indeed, the Report to the Storting (Meld. St. 33 (2019–2020), p.37) outlines that the selection of industry partners resembled a formal tendering process where contribution to societal goals was evaluated and compared. Among other things, the tendering process was structured to guarantee a clear framework for assessing subsequent projects as well as avoiding allocating more state aid than necessary. The selection of the partners was conducted by Gassnova, which rated contenders based on three main criteria:

1. Technical evaluation
2. Assessment of the quality of the actors' cost estimates
3. Evaluation of contribution to benefit realization

Must also be added to this formal selection process the role of industry players' self-interest. This concept was referred to during our interview as an indirect element that played a role in the selection of the state's partners: it is essential to ensure that a potential private

partner holds an intrinsic self-interest to realize a common project beyond the financial benefits attached. Such a criterion played an indirect role in determining the receivers of public money, as the government was making sure that partners were taking part in the project, not because *"the city asked for it but because they needed it for themselves"* (R3). For example, private players' self-interest can revolve around questions of companies' license to operate that have increasingly been challenged in the context of climate action. Such dependence on the common goal of realizing such a climate project consisted of a *"good starting point for discussing a contract with the state for demonstrating CCS"* (R3).

Hence, the fact that the contribution to benefit realization as well as industry players' self-interests are included in the tendering process stands as a safeguard to achieve the partnership's public goals.

5.3.2.2 Sustainability as a key enabler

Beyond the realization that each party needs the other, sustainability also plays a large part in driving the participants' willingness to collaborate. Indeed, as a leitmotif guiding our interviews, every player announced one way or another that sustainability is the common thread that unites each player: *"We are all in for climate, for the sake of climate"* (R3); *"Of course, it is a job but it's good that it's an interesting job that makes life more sustainable and makes a difference"* (R1). The fact that everyone is working towards a common goal facilitates the collaboration: *"Right now that everyone's working towards the same goal, dialogue is very constructive and operationally geared" (R8)* ; *"All of these three companies have their own strategies which are not necessarily directly aligned, but they are aligned around the purpose and objectives of Northern Lights. That is what is important for us in this context"* (R9).

Juxtaposed to the sustainability drive is the idea that Longship is desired to be the first of many other CCS climate projects: *"You will see this in 20 years, when there will be a lot of CCS plants on waste-to-energy in Europe, and then you know that we built the first one, right? So of course, we are motivated"* (R1); *"The world is looking to us now"* (R7). Sustainability hence appears to be a key motivational drive, emphasizing players' willingness to cooperate.

Furthermore, this drive to achieve something for the greater good appears to be very

anchored to the project and to the respondents' mindsets. As one respondent remarked, had this Longship been devoid of such a sustainability goal, the overall project would be a different thing with possibly less cohesion between the players: *"So if you take another type of contract, a private-public partnership that is not linked to climate but only a discussion about how can we as a company earn money, I think that would be very different"* (R3). Hence, the sustainability dimension, linked to the fact that this is a first-of-a-kind project, appears to be a clear motivational driver that facilitates the collaboration and goal alignment of the different players.

It may be suggested that such cohesion over sustainability goals has also been enabled through the previously outlined coherent tendering process that included societal goal contribution as a decisive criteria. Regardless of its origin, the sustainability element specific to Longship does play in favor of the players' willingness to collaborate.

As symptomatic of this goal alignment and commitment, some of the Longship's players unite and co-animate mutual events at the profit of the shining of CCS: *"We create these joint-CCS safaris (...) when politicians or businesses come from other countries to look at our different plants. Then they get more interested in realizing their own CCS projects"* (R1). Such events provide a great occasion to physically meet: *"I saw them just last week, because we were together opening an exhibit at the University of Bergen on the carbon storage simulator that opens now"* (R7). Overall, beyond putting the spotlight on the newly CCS-equipped plants, such events are perfectly aligned with the government's strategy to make CCS shine internationally: *"And that fits well with the strategy of the State, that these projects are not the first and only but the first of many"* (R1).

Similarly, the way players interact and share information is also an illustration of the players' willingness to collaborate. As an example, communication between Gassnova and the capture plants or Northern Lights is ensured by both formal and informal discussions on a very regular basis: *"We have a lot of formal meetings"* (R4). In addition, the creation of committees with actors from Gassnova and industrial partners enabled *"free discussions on topics of common interest"* and has led to *"more efficient and predictable interaction between the partners"* (Gassnova, 2020, p.17). Because everyone recognized the importance of Gassnova's role as a piloting and monitoring body, all the players seem to rank as a priority the relation with Gassnova and are fully available for them: *"If there is anything*

that needs to be discussed along the way, we pick up the phone. Same with the Ministry" (R9). This level of commitment and acknowledgment of Gassnova's and the state's role was striking throughout our interviewees, the fact that we understand as a key success factor to such a public-private collaboration.

5.3.3 Project management

5.3.3.1 Follow-up by a central governmental body and state enterprise

Due to Longship's complexity, quality project management needs to be established. Compliance with the agreement is crucial because it is this very document that fixes the level of engagement of the state and guarantees that industry players contribute to the desired outcomes of Longship. The high state's cost and risk exposure associated with this project entails that Longship's project management goes beyond usual payment and funding requirements. Indeed, as one respondent enlightens: *"With so much politically at stake, it requires a lot of follow up"* (R8). Longship's project management hence calls for a good follow-up by the state, and particular attention must be paid to any changes in the sub-projects.

The Report to the Storting (Meld. St. 33 (2019–2020), p.66) clearly delineates the parties responsible for the project management. In this case, it is the Ministry of Petroleum and Energy that is responsible for following up on the funding agreements. Regarding the more operational follow-up, it is Gassnova that acts on behalf of the state to run the daily project management by requiring the reporting on *"a large spectrum of areas: from money to progress, of course, risk assessment, benefit realization, quality, etc"* (R4). The fact that Gassnova is state-owned has been essential so that, through Gassnova, *"the government retains the project integrator role"* (Gassnova, 2020, p.17). This clear organizational divide between the strategic overview of the project that is done by the Ministry and the operational issues monitored by Gassnova enables more efficient treatment of information and of time.

5.3.3.2 Clear role and objectives definition

If it is easy to define responsibilities on paper, in reality, there may still lie ambiguities. There is hence an embedded necessity to go beyond the contract and collectively agree on

each party's responsibilities. As one respondent highlighted: *"There are some differences in our roles. The understanding of these roles is always important. And I think maybe that's a good point when you're talking about a public-private corporation: you have different jobs"* (R4). R3 supports the importance of having clearly defined roles in his response: *"This is something in between: this is public, private. So you have to be more specific on the roles between what is the public responsibility and so forth".* When describing where these responsibilities should be clearly notified, one respondent highlights the limits of contracts: *"It is partly in the contract but it is not all over the contract"* (R3). These testimonials hence shed light on the necessity to go beyond the contract and agree on the interpretation of each other's responsibilities to avoid potential tensions.

Similarly, the same preoccupation applies to the project's goals. Outlined in the benefit realization plan, Longship's goals, however, mostly describe the *desired* effects of Longship. This has left much space for the interpretation of the respective parties regarding Longship's aims. If this enabled players to build plans so that objectives better fit their business rationale, it has also resulted in *"challenging discussions between Gassnova and the industrial partners regarding design performance"* (Gassnova, 2020, p.15). Indeed, due to the benefit realization's relative newness and, to some extent, vagueness, this document has sometimes *"been misunderstood as a set of activities to advertise the project or CCS in general"* (Gassnova, 2020, p.27). Hence, along with the benefit realization plan, the definition of goals based on the SMART principle (Specific, Measurable, Achievable, Relevant, and Time-Bound) is recommended from the early phases of the project onward.

5.3.3.3 Conflict-management mechanism

Similar to many projects, cross-sectoral collaboration can also result in conflicts. Our research has shown that within a public-private partnership, measures need to be taken to include conflict-resolution mechanisms. As one respondent enlightens, the discussions and negotiations between the state and industry players started years ago, however, *"There will be and are elements that need to be discussed with regard to the interface"* (R9). This is where the need to have a straightforward agreement that also details the procedures in the eventualities of a conflict is essential: *"It is good when it (the agreement) functions as a guideline when you have the practical problems, so you are prepared to solve practical issues"* (R4). As an illustration, the Report to the Storting outlines that *"It is nonetheless*

likely that cases will arise where the state and industry disagree about specific technical assessments, and this must be resolved by dialogue with the companies" (Meld. St. 33 (2019–2020), p.66)

5.3.4 Trust & Respect

5.3.4.1 Embark genuine, accountable and optimistic individuals

Trust appears to be a fundamental precondition to any collaboration. This trust can take the form of either confidence in the project or trust in the people involved. Firstly, the uncertainties linked to Longship are ubiquitous, even in the preamble of the Report to the Storting: *"Now that our own Longship is ready for construction, we are also entering uncharted waters"* (Meld. St. 33 (2019–2020), p.5). In situations of such unparalleled risks, belief in the project appears crucial. As the same document outlines, despite these uncertainties, one can *"have great faith that the project will contribute to technological development and learning"* so as to decrease the costs for future carbon capture facilities.

Adding to the necessary faith in the project, trust in the partners also appears critical. In fact, it is so important to the well functioning of the partnership that it is made explicit in the agreement between the state and Norcem AS: the parties involved *"shall cooperate loyally with each other and with other players involved in the CCS project"*. Similarly, one respondent points out that mutual trust appears to be a precondition to all collaboration: *"If there wasn't already a feeling of trust between the different actors, such an agreement would never have been signed"* (R9). Trust appears all the more relevant given that this type of cross-sectoral collaboration is imbued by information asymmetry between the parties. In such a context of knowledge disparity, it is all the more important to trust its partners: *"There are leaps of faith, on both sides. You have faith that everyone is working towards achieving a goal"* (R8). Similarly, in this project that unites very different players together, trust and respect may be the two safeguards against power imbalances.

Such trust appears to be built gradually over time by players demonstrating they are able to deliver consistent work in due time: *"The only way to receive trust is to show the proof of the pudding in the way you are working"* (R4). Such accountability must be driven over a long period of time for it to lead to trust: *"So I think where we are at now is a reflection of the trust and confidence that has been built around the ability to deliver over many*

years" (R9). In this vein, negotiations are a perfect opportunity to instill trust between the parties because it is a defining phase during which parties come together for the first time to agree on the terms of their common project. As respondent 4 argues: *"I think in a way you can build up the trust, for instance, is through the negotiations. Through the negotiation, we have built up a good relationship with the authorities".* Negotiations are also paramount to such a long-term undertaking because they set the general direction and mood of the rest of the collaboration. If conducted in a genuine manner, the rest of the collaboration may be facilitated: *"We do it in the same way, but it is easier and easier now because we know each other. We have worked together for a long time, also before we came into this realization phase"* (R4).

Time is also helpful because it enables the different players to get to know each other personally and build solid personal relations with others who are equally committed: *"And we know the people quite well, we know what they stand for"* (R1). Time does not suffice to itself, trust also calls for respect: it is not sufficient to follow the contract and to abide by your role, but it is also about how you embody your role and treat other parties: *"It's not all over the contract. It's partly in the contract. But I think it is a way to play the role"* (R3). Similarly to trust, respect seems a sine qua nons condition to a successful PPP which prevents conflicts from power imbalances: *"I think part of the reason why you have trust in people is because you treat them as your equal"* (R4). In this line, the use of public money by private players appears to be a critical issue that crystallizes these questions of respect and trust in a public-private collaboration. Indeed, there exists the pre-established idea that because grants are "free money", private players will use it irresponsibly. It is therefore paramount that the private players, capture plants, in this case, demonstrate their respect for public money. Only then, can trust be solidly anchored between the public and private parties: *"A lot of this is public money, and we have a responsibility that it is spent the right way. I always say that public money is exactly the same kind of money as private money (...) Once you show that, then I think there will be respect between the parties"* (R4). In addition to embarking genuine individuals who value public money, *"the competition between the capture projects, the reasonable technical requirements from the state, and the strong desire with all parties to keep the cost down"* have also been important in this respect (Gassnova, 2020, p.24).

Thus, trust in both the project and the people stands as a fundamental precondition to a public-private partnership. For this reason, we suggest embarking on trustworthy and accountable individuals capable of riding the waves of uncertainty inherent to such an extensive technological project.

5.3.4.2 Open and inclusive management style

Lastly, trust and respect can be facilitated and must be reflected in the management of the partnership. As one respondent emphasized, it is *"extremely important to have a management style and the corporation style that invites openness"* (R3). It is indeed indispensable to instill trust at the core of the interactions between the players. This is all the more relevant given that the role of some players, such as Gassnova, may naturally provoke more apprehension than others.

5.3.5 HR Management

5.3.5.1 Appoint individuals with dual-sector experience

Issues of human resources management should not be forgotten in the scope of such a collaboration. Our interviewees revealed the benefits of appointing individuals with prior cross-sector collaboration, as one respondent pointed out: *"Having an understanding of both sides (private and public) is important. I think that that was one of the better sides of my work: that I had an understanding of both sectors before I came"* (R4). Because there is a *"difference in the way they (both sectors) are acting and working"* (R4), appointing individuals with dual experience may facilitate the partnership. Such individuals could be more inclined to recognize what is critical to the public sector and better fulfill its expectations.

5.3.6 Stakeholder engagement

As recognized among the objectives of the Longship, the need to share experience on CCS technology for its further development is key to the project. In this sense, the state and its representatives have engaged considerable efforts to instill knowledge on CCS to relevant stakeholders. In this line, Gassnova is specifically entitled to *"facilitating the sharing of relevant experience with other projects and stakeholders"* along coordinating

Longship (Meld. St. 33 (2019–2020), p.66). As an example of relevant parties, Gassnova has shared experience with previous succeeding projects, academia, and the authorities in other European countries. In addition, seminars, a European CCS conference with the European Commission, and study visits from the authorities of other countries and industry actors have been organized (Meld. St. 33 (2019–2020), p.36). A website has been specifically designed to efficiently share reports and experiences with stakeholders.

As another key stakeholder lies in the Norwegian population. Indeed, since Longship is such a vast project of a pioneer nature, there are large stakes to explaining to the local population what the project is about, what its objectives are, and the stakes behind such endeavor. In this aim, there exists today a large amount of publicly-available information, such as the Report to the Storting, destined, among others, to the public.

Similarly to the state's transparency towards its stakeholders, Northern Lights declares that *"It is a priority to involve and initiate early dialogue with stakeholders on many levels to ensure regular distribution of information and communication about our activities"* (Northern Lights, 2022). The first stakeholders concerned are, for example, the local community of Øygarden, where the temporary storage facility is currently being built. In order to showcase their activity, Northern Lights organized an Open Day as soon as the road of the storage site was paved. This day was the opportunity to pedagogically explain the Longship project through indoor presentations and to let the community discover the site through the eyes of the many engineers and workers that were positioned along the walkway (see figure 5.4). This day was also marked by the presence of local figures, such as the mayor of the Øygarden Municipality, to once more demonstrate the clear ties with the local administration and the national scope of such a project. In line with this willingness to pedagogically approach Longship and CCS more generally, a visiting center is currently being constructed (see figure 5.5). Such building will be used to sensibilize a diverse public, including schools, individuals, or corporates on CCS.

As another key stakeholder come the local authorities and relevant civil society associations. To address these stakeholders' doubts or expectations, Northern Lights has stayed in consistent dialogue with local organizations. According to its annual report (2022), Northern Lights has conducted several meetings with key authorities in Øygarden and Fedje municipalities (both political and administrative level), with the Vestland County

Figure 5.4: Project manager presenting Longship on open day, Øygarden

Figure 5.5: Administration building and visiting center, Øygarden

and with relevant Norwegian government ministries and authorities. Northern Lights also engaged with the Øygarden Fire and Rescue, the Directorate of Fisheries and the Norwegian Fishermen's Association. All in all, these local engagements with the locality, either administrative or civil society, may be pointed out as a key factor that triggered the acceptance and positive reception of Longship by its main stakeholders.

6 Discussion

Having detailed our findings from the study of the Longship project, we must now clearly delineate our contribution to the existing literature as well as the limits inherent to our research endeavor. Our findings unveil the need for the government to align economic incentives for private players. We also shed light on the four main governmental levers necessary to unlock a favorable environment for private investment in sustainability. We enrich the literature by sharing managerial considerations that are key to the deployment of PPPs for CCS. We reveal the actors to whom the conclusions are most relevant and include limitations to our work in order to fully grasp its contributions.

6.1 Findings and contributions

6.1.1 Sustainability calls for a change of paradigm

Our case study confirmed the absolute necessity for private players to be guaranteed some sort of revenue. If this is not a surprise, the in-depth study of Longship does audibly reveal that market incentives regarding CCS are lacking. Indeed, sustainability seems to operate on a different paradigm where there are inconveniences to being the first-mover, where being green is more costly than polluting, and where operators are not guaranteed revenue from their activities. Accumulated, these represent contextual barriers that durably repel industry players from getting involved in such environmental initiatives. This represents a stark contrast with other non-sustainability-related projects, and we recommend that these specificities should be clearly grasped when referring to a PPP for sustainability.

If the market incentives are to such a point absent from the scene, then why push for it? If we have extensively described the conditions that hamper private investment in CCS, the story obviously does not stop here. Our work on Longship brought to light the extent to which private as well as public players need such sustainability projects. CCS indeed appears crucial to capture plants as well as to transport and storage operators for diverse reasons. The first is personal values: our interviews have highlighted individuals' conviction and determination to reduce the negative externalities of their companies' activities. This is all the more relevant as, in the case of Longship, capture plants are

companies that operate in the heavy industry and as such, are very high polluters. This latter fact links to the second point: beyond people's personal willingness to change, companies today have very high stakes to change. Indeed, either propelled by soaring regulation or by civil society, companies are increasingly urged to take concrete actions to reduce their carbon footprints. Conversely, on the other side of the spectrum, states are also inclined to intensify their climate action as more commit to international accords like the Paris Agreement. More specifically, regarding Norway, we understand that this country has taken its own share of responsibility as one of Europe's crucial energy providers.

If we highlight the reasons why sustainability is, as it should be, paramount to companies and public entities, we must also stress that both parties realize they cannot do it alone. Indeed, as argued by Brinkerhoff and Brinkerhoff (2011), the government needs the private sector for its complementary expertise. In parallel, the private sector's profit-making motif categorically requires the state to correct market failures (Rangan et al., 2006). This mutual dependence endorses the legitimacy of public-private partnerships as an organizational structure that offers promising solutions to sustainability.

Given these market failures and insufficient regulations, our research demonstrates that sustainability needs a shift in paradigm. This necessary shift requires unprecedented governmental intervention. Concerning CCS, we highlighted that it takes the government to perform four different functions. Above and beyond the regulatory framework that is set up either by the national (Norwegian government) or supranational entities (EU), the government needs to provide extensive financial support, bear a large part of the risk, and needs to pilot and monitor the project (see figure 6.1). These four governmental interventions largely echo Koppenjan and Enserink's (2009) work on infrastructure PPP for good which emphasized the need to create prospects of return on investment for the private players, and reduce the overall risks and political uncertainty associated with PPPs.

6.1.2 What a PPP for good takes to succeed

It is not enough to get the private and public sector speaking. It is a whole new challenge to make their partnership succeed. Based on the case study on CCS, we outlined key management concerns and success factors that we believe to be relevant to extrapolate to

other green technology PPPs. Overall, our research shows that formal elements such as agreements are equally important as the softer elements, including trust, respect and willingness to collaborate. Our elements do corroborate previous literature on the success factors of infrastructure projects and PPPs for good (Kwak et al., 2009; Pinz et al., 2018). However, we add to the literature by shedding light on new elements such as the need to have embedded industry incentives in the agreements, mechanisms to secure public goals, and a clear role definition of the public entities. Additionally, our research brought forward the benefits of a sustainability cross-sector collaboration. Indeed, we reveal that the sustainability dimension represents a substantial motivational drive that increases players' willingness to collaborate. Hence, we stress that there are not only challenges to a public-private partnership for good, but there are also evidently benefits to such endeavors.

Figure 6.1: The government's four levers for sustainability

6.1.3 Contributions

This thesis attempts to enrich the emerging literature on public-private partnerships for sustainability by generating theory. We contribute to it by emphasizing the necessary collaboration between industry players and the government to align economic incentives with sustainability projects. We also hope to complement the literature on the management of PPPs for good as we provide a dense list, albeit non-exhaustive, of success factors for such a cross-sectoral climate project. As the key success factors for PPPs in the CCS sector have been little analyzed before, we hope to play a part in the future successful deployment of CCS. Furthermore, while we generate insights that are partly unique to the observed example, we think that our findings and developed theory on governmental levers may also be relevant to unlocking further projects beyond CCS. As such, findings may be particularly useful for infrastructure or environmental PPPs in general.

Our work is useful to an array of actors. On the upstream, findings may assist the public sector in better understanding the challenges and market failures that must be addressed prior to collaboration. More specifically, our findings may be particularly pertinent to other strong welfare states similar to Norway that have the means and legitimacy to intervene to such an extent for sustainability. On the downstream, conclusions may be useful to the public or private-sector managers to empowering them to successfully manage a cross-sector project for good.

6.2 Limitations

This research paper is limited in a number of ways. Firstly, only one case study on public-private partnership has been explored. The limited amount of time we had to complete our thesis affected our choices heavily. Moreover, we chose to study a cross-sectoral collaboration in terms of infrastructure, particularly CCS. As mentioned before, there is a lack of prior research on the topic, as this thesis represents one of the first case studies on CCS cross-sectoral collaboration. Therefore, the results are not supported by another existing study on CCS. In addition, the sensitivity of this study is also increased due to the fact that the research focused on a project based in Norway, limiting it to a national context. The implications of this thesis might not be valid for public-private projects in other industries or countries. Furthermore, our research was mostly past

and present-oriented due to the high uncertainty of the future of the project and of the development of the European carbon market. The study covers the history of the project, the present state, and a 10-year plan as agreed in the contacts. However, we cannot predict how the public-private partnership will be affected and changed in the future.

Another limiting factor is linked to our decision to heavily focus on one sustainability dimension: the environment. The economic and social dimensions of the project were hence not covered to such a great extent. Had we analyzed Longship under these three dimensions, we would probably have found different relevant success factors. However, we justify our decision to scrutinize amply one dimension based on our time constraints which urged us to have a narrow research focus.

Lastly, limitations may be tied to the choice of our data. Beyond the primary data, we also leverage secondary data sources. However, since neither of us had appropriate Norwegian language skills, we made use of a translated English version of the official public publications. To some extent, utilizing translated versions may represent a limitation and bias to our work we could not circumvent.

6.3 Call for further research

While working on this research topic, we have discovered some potential suggestions for future research. One area to explore in the future can be more research on the front-end of PPPs: what means and strategies can be leveraged by governments to get the private sector stepping into a PPP for good? We believe that this angle on PPPs for sustainability can be enriched by the environmental economics literature that looks precisely into these public-sector mechanisms that aim to repair market failures. Furthermore, after analyzing our primary data and discovering that the soft elements such as trust and commitment are of equal importance as the formal elements, we suggest further research to pay equivalent attention to both types of management tools, structural and process.

We recommend that more research is done regarding the many promising markets that need to integrate industry players' preoccupations. On a first note, we urge researchers to follow up on our thesis's topic and explore how new industrial plants may profit from Longship and what are the necessary incentives for these new plants to capture their emissions. In addition, we recommend further investigation of public-private partnerships

for climate-related technologies such as carbon capture and utilization. This may be done firstly through exploratory case studies like we have, given the very nascent nature of these projects.

7 Conclusion

Answering the two research questions: "What does it take to unlock a public-private partnership for good?" in the context of infrastructure PPPs for good and "How to best manage a public-private partnership for good?" has been the goal of this thesis. It was achieved through conducting an exploratory and qualitative case study on the Longship project, the world's first full-fledged carbon capture and storage project in Norway. To answer the above research questions, we explored the contextual barriers that limit the private sector's interest in CCS, the key steps taken by the Norwegian government to bring industry players to the table, and lastly, good practices for the management of such cooperation.

An extensive review of the existing academic literature was performed, and we were able to discover an important literature gap that led us to our research questions and strategy. While the topics of cross-sectoral collaborations and public-private partnerships were vastly covered, only a small amount of literature focused on those PPPs for sustainability objectives. Among the social, economic, and environmental dimensions of sustainability, the environmental one received the least attention. Moreover, there exists, up to this date, only an extremely limited number of theoretical case study on CCS deployment projects. Therefore, we decided to fill this specific gap by exploring Longship as an unprecedented public-private collaboration for the climate.

In order to answer our research questions, we conducted seven semi-structured interviews with all the participants of the Longship project. During these interviews, we inquired about the barriers to the private sector's investment, the reasons why the state's intervention is necessary and the management elements that contributed to the project's success. We complemented these qualitative interviews with observations-as-participant during an Open Day at the temporary storage facility in Øygarden. In addition to this primary data collection, we reviewed other secondary data sources such as the Report to the Storting (White Paper), which covers the history of the Longship project and the government's need to step up; the Northern Lights' annual report that sheds light on the development of the storage and the transportation parts of the project; the Agreement on Support for Capture of CO_2 between the Norwegian government and Norcem Brevik

cement plant; and multiple official websites of the public and private players within this project. This utilization of different sources enriched our data collection and assured the triangulation of our work.

Based on the collected and analyzed data, we were able to develop our own framework that visualized the findings. We found out that two specific market failures, the first-movers disadvantage and the superior cost of abating emissions, combined with insufficient regulation halt altogether private involvement. For these reasons, the Norwegian government that considers CCS as a useful tool to achieve its climate goals is confronted with the need to step in and develop the incentives to embark industry players. We have created a framework revealing the four governmental levers that may be leveraged to get private players on board. Namely, this change of paradigm for sustainability calls upon the government's capacity to create adapted regulatory frameworks, provide unprecedented financial support, bear considerable risks, and monitor the overall project. Our findings further elaborate on appropriate management mechanisms which include, among others, the need to have an incentivizing agreement, goal alignment and willingness to collaborate, project management tools, trust and respect, HR management, and stakeholder engagement.

Through the in-depth study of the Longship project, we exemplify that both the private and public sectors are cardinal to such sustainability projects. Both sectors must work together to successfully carry out the partnership, given that economic incentives are aligned for industry players. To elaborate, the public needs the private for its extensive industry knowledge and expertise. In return, the private sector needs the public sector to address and correct the market failures as well as rectify the insufficient regulations. These demonstrated synergies endorse the promising future of public-private partnerships for sustainability.

The rich era of sustainability-related innovations is only beginning. Like Longship, we hope that our work is the first of many and that we will, with experience, learn to better collaborate for the common good.

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Appendix

Interview guide:

I) Introduction of the respondent and role of company/organization within Longship:

- Describe your job and function
- What role does your company/organization have in the project?
- How is the public-private collaboration going so far?
- Why is this project important for your organization?

II) The need for the Longship project and missing incentives:

- Why do you need your private/public counterparts?
- What are the difficulties you face in investing in CCS (regulations, profitability illegibility, political uncertainty)
- What helped to unlock this collaboration?

III) Managing the Longship PPP:

- Which players do you interact with in the Longship project?
- Who do you have a contract with?
- Describe your interactions with the players of Longship: How do you cooperate? Do you have meetings, calls, etc.?
- What is the main difference/challenge between working with the private/public sector?
- How do you enable trust? Is there any information asymmetry or conflicts?
- Do you have the same level of commitment?
- How has it been challenging to cooperate with the private/public sector?
- Do you have different values/priorities? Style of management?
- How has your relationship evolved with the other players over time?