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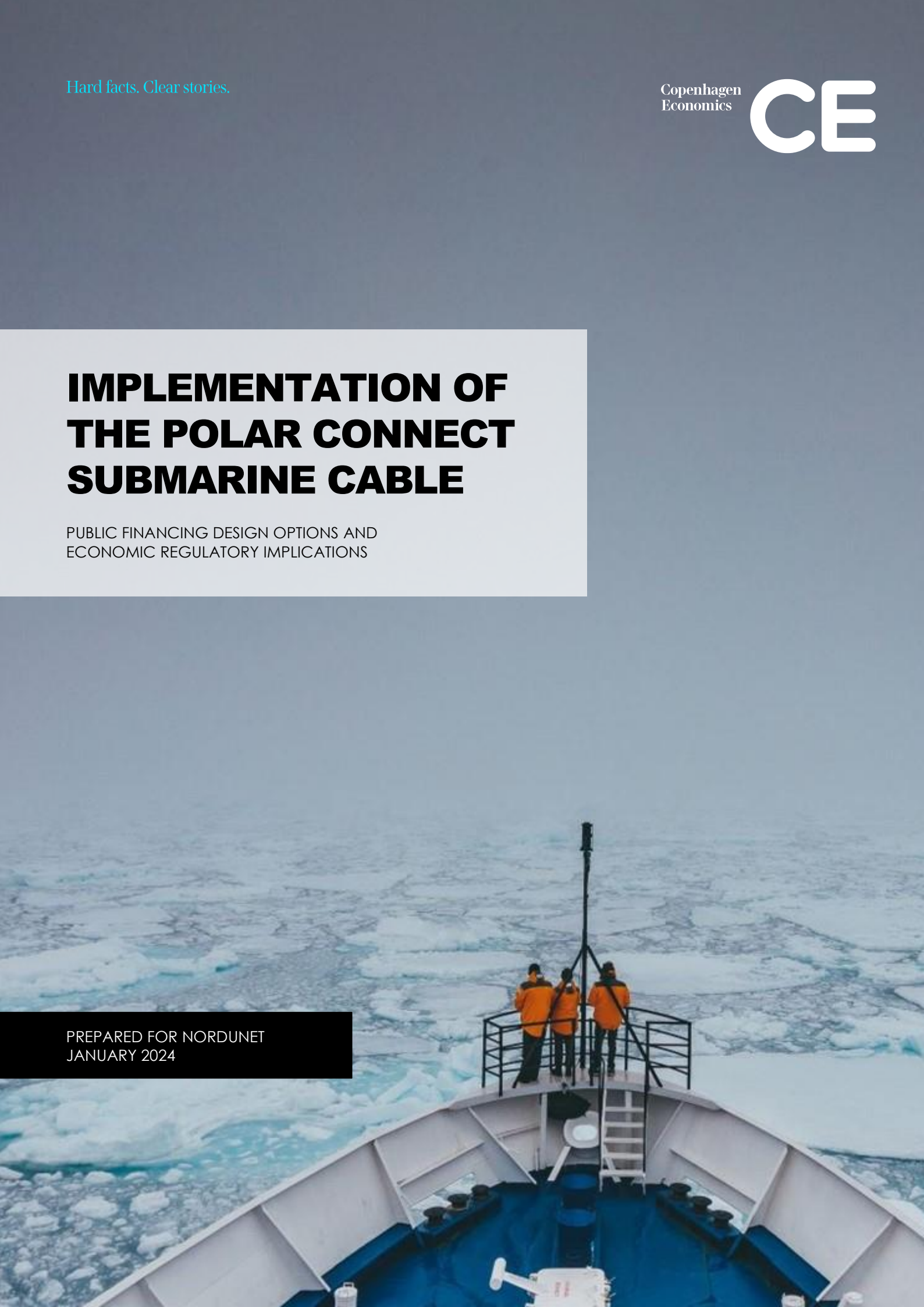
IMPLEMENTATION OF THE POLAR CONNECT SUBMARINE CABLE

PUBLIC FINANCING DESIGN OPTIONS AND ECONOMIC REGULATORY IMPLICATIONS



PREPARED FOR NORDUNET
JANUARY 2024

Copenhagen Economics

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PREFACE

European policymakers have been increasingly convinced of the economic and social benefits of Arctic digital connectivity linking Europe to its East Asian trade partners. In July 2023, the European Commission and Japan signed the "Memorandum of Cooperation on submarine cables for secure, resilient and sustainable global connectivity", in which they acknowledged a shared recognition of mutual advantages enabled by Arctic connectivity.[1] Later that month, Ursula von der Leyen, the President of the European Commission stated that the EU is "working on a possible extension of a submarine cable that we plan to build via the Arctic route to Japan".[2]

Consistent with this emerging policy support, the European Commission has granted funding to the Northern EU Gateways project, supporting, within this framework, the Polar Connect initiative, led by NORDUnet, which investigates the shorter route options for submarine cables through the Arctic Ocean.

Against this background, NORDUnet asked Copenhagen Economics to assess public financing design options and regulatory implications that need to be considered to make Polar Connect a reality – in other words, key aspects of the question: "how to".

In this report, we explore and set out how public investment into Polar Connect could be implemented given the different financing and ownership options available, and how to secure economic regulatory consistency of such investment.

In this study, we gather, structure and analyse existing literature, along with input collected through a purpose-designed large-scale expert interview process. The latter sought and gathered input from over 30 industry experts and policymakers from different types of organisations (providers of cable connectivity, telecom operators, regulators, NRENs, service providers) and with heterogeneous profiles (CEOs, CTOs, policy officers, directors of research networks). This ensures a diverse set of commercial and policy viewpoints and a broad range of expertise, all in the interest of capturing important factual elements specific to the under-researched submarine cable industry and the role and mode of public intervention therein.

1 European Commission (2023). Memorandum of Cooperation signed at the first Japan-EU Digital Partnership Council meeting on 3 July 2023. Available online at: https://ec.europa.eu/commission/presscorner/detail/en/ip_23_3831

2 European Commission (2023). Press statement by President von der Leyen with Philippine President Marcos, 31 July 2023. Available online at: https://ec.europa.eu/commission/presscorner/detail/en/statement_23_4041

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INTRODUCTION AND EXECUTIVE SUMMARY

The economic case for the development of Arctic submarine cable systems is well-documented

The need for increasingly resilient and trusted digital connectivity has long been recognised by policymakers. Several initiatives have been launched to support this strategic objective such as the Digital Global Gateway and the digital part of the Connecting Europe Facility (CEF Digital) in the EU, the Digital Connectivity and Cybersecurity Partnership (DCCP) in the US, and bilateral international digital partnerships like the EU-US Trade and Technology Council, and the EU Digital Partnerships with Japan and South Korea.

In this context, the Arctic region is identified as one of the regions in which to develop secure, resilient and stable submarine connectivity between Europe and Asia.[3] In July 2023, the European Commission and Japan signed the "Memorandum of Cooperation on submarine cables for secure, resilient and sustainable global connectivity", in which they acknowledged a shared recognition of the mutual advantages enabled by Arctic connectivity. The memorandum states that Arctic connectivity not only reduces the latency for communication, increases the redundancies of routes and secures connectivity.

In this study, we take as a starting point the emerging policy support for Arctic connectivity initiatives like Polar Connect. As recognised by policymakers, within the Northern EU Gateway project[4], Polar Connect can contribute to the EU objectives of improving the backbone connectivity between Europe and Asia and strengthening European sovereignty and digital autonomy. Moreover, as set out by NORDUnet, by integrating sensors for climate change observation, the cable can enhance scientific research in the Arctic region, providing sustained and recurrent data aimed at monitoring and detecting sea bottom movements, temperature, salinity, pressure, and other key parameters.[5]

While the benefits of Arctic connectivity and Polar Connect are documented elsewhere[6], this report focuses on *how* this initiative could be implemented, given the financing options available and associated regulatory implications.

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3 European Commission (2021). European Data Gateways as a key element of the EU's Digital Decade. Ministerial declaration. Available online at: https://digital-strategy.ec.europa.eu/en/news/digital-day-2021-europe-reinforce-internet-connectivity-global-partners#:~:text=In%20the%20'Data%20Gateways'%20declaration,into%20account%20the%20international%20strategy.

4 The Northern EU Gateways project supports the creation of Arctic routes for internet traffic between Europe and Asia and North America. https://northern-eu-gateways.nordu.net/about/

5 Friberg, M. (2023). New scientific possibilities. Vision 2030. Available online at: https://nordu.net/wp-content/uploads/2023/09/New-scientific-possibilities-MFriberg_7Sep2023.pdf

6 See https://nordu.net/polar-connect/ and the 2022 Copenhagen Economics report on the Economic Value of Submarine Cables in the Arctic, available here: https://copenhageneconomics.com/wp-content/uploads/2022/06/The-economic-value-of-submarine-cables-in-the-Arctic-Copenhagen-Economics-2022.pdf

Public intervention has the potential to unlock the underinvestment problem for Polar Connect

Any submarine cable deployment project is associated with cost and demand risks, and the risks are pronounced with Arctic submarine cable projects making them particularly susceptible to a potential underinvestment problem. Arctic submarine cables are associated with three notable factors that are conducive to market failures and may limit the business case for private investment:

First, building submarine cables in the Arctic entails substantial cost risks due to unforeseen construction and maintenance costs related to the challenging environment and novel construction solutions to build the first submarine cable over the North Pole through the ice.

Second, Arctic submarine cables are subject to demand risks. While the business case and demand for more established routes, such as the Atlantic one, is well known by industry experts and investors, demand and expected revenues from this unprecedented route are more difficult to predict – even as forecasts confirm the ongoing major increases in demand for cross-border connectivity.[7]

Third, the societal benefits accruing from higher bandwidth and lower latency of an Arctic submarine cable are often not fully considered as part of investment decisions.[8]

Insofar as societally beneficial investments would not materialise through private investment, governments can provide public financial support to unlock any "underinvestment" problems. Carefully targeted public funding can be warranted to de-risk the investment, and improve the business case, for commercial investors.

Against this background, we explore and set out how a public investment into Polar Connect could be implemented, given the different co-investment and ownership options available, and how to secure the regulatory legitimacy of such investment. To inform the discussion of these options, we first provide an overview of the submarine cable market context and its stakeholders and present the alternative business models available to submarine cable projects.

Polar Connect is set to be implemented in a market characterised by growing demand for connectivity and a variety of stakeholders

There is a need for diversified and resilient connectivity that provides the rationale for new investment in digital connectivity in Europe, due to three reasons:

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7 According to reports by Cisco and Gitnux, global internet traffic grew at a Compound Annual Growth Rate of 26 percent between 2017 and 2022, and is expected to continue growing at double figures rates in the future. Gitnux estimates global internet traffic to grow at a CAGR of 24 percent between 2021 and 2026. See Cisco (2019). Cisco Visual Networking Index: Forecast and Trends, 2017–2022; and Gitnux (2023) Marketdata Report 2024. Available online at: https://gitnux.org/internet-traffic-statistics/ .

8 Societal benefits for consumers and businesses in the Nordic region, and more at large, in the EU, are described more in detail in Copenhagen Economics (2022). The economic value of submarine cables in the Arctic. Available online at: https://copenhageneconomics.com/wp-content/uploads/2022/06/The-economic-value-of-submarine-cables-in-the-Arctic-Copenhagen-Economics-2022.pdf.

First, Europe's existing submarine cable connectivity to East Asia is limited: there are only three cables that directly connect Europe to East Asia, two of which are approaching end of life. Moreover, all three of these cables bypass geographical chokepoints: the seismologically active Red Sea area and the Strait of Malacca.

Second, digital sovereignty is emerging as a key policy objective: EU policymakers increasingly recognise the importance of Europe attaining digital sovereignty in the digital connectivity domain.

Third, the increase in global data usage and demand stimulates the need for infrastructure that supports this growth.

The submarine cable value chain comprises various interconnected stakeholders. The upstream value chain is dominated by a few commercial players active in the manufacturing and installation of submarine cables (market leaders include the EU-based Alcatel Submarine Network and the USA-based SubCom; the Japan-based NEC is also a major player in Asia). The market for cable development and ownership is more diverse: historically dominated by telecom service providers, in the past ten years it has witnessed the emergence of new players, namely the hyperscalers (companies such as Google, Meta, Microsoft, and Amazon), which are rising as key investors in the market.

Several business models are available for submarine cable projects

We set out an overview of the several business models adopted in the market to inform the discussion over the available options for Polar Connect.

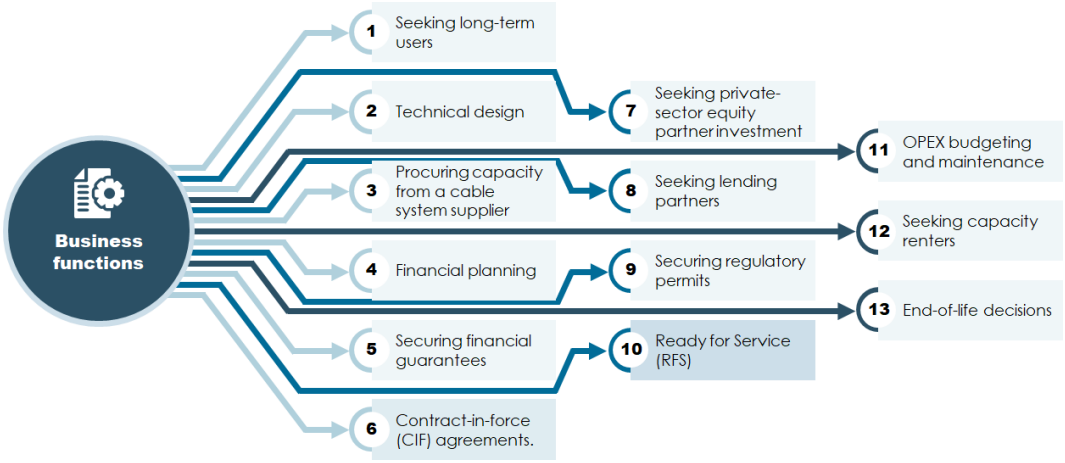
First, we found that there are three distinct financing and ownership models available in the submarine cable industry:

- *The single (private) investor model,* where a single owner is responsible for financing the cable and for any risks associated with it*;*
- *The consortium model,* where multiple industry players collaborate to build a cable, pooling resources and sharing the risks*;*
- *The special purpose vehicle model,* where multiple industry players come together and form an entity with a distinct legal status to finance and manage the cable.

The consortium and SPV models may also be characterised collaboration between private sector and public sector players. We discuss such examples at greater length in this report.

Second, we identified 13 business functions that submarine cable project developers must perform and execute along the life cycle of the cable. These business functions include, but are not limited to, securing long-term anchor tenants, engaging with system suppliers, and performing financial planning. Figure 1 summarises this.

Figure 1
Business functions to be performed over the lifetime of the project



Source: Copenhagen Economics based on interviews

We found that the business functions that precede the '*Ready For Service'* date are highly interrelated. Securing pre-sales commitments from anchor tenants, booking capacity from system suppliers, developing and fine-tuning sound technical and financial planning, and attracting investors are interrelated activities that carry a risk of a "chicken-and-egg" problem, which is typical of project financing. Submarine cable project developers must mitigate these issues in the initial stages, for instance, by offering favourable conditions to anchor tenants that commit to purchasing large shares (e.g., 30-50 percent) of the system capacity.

Third, we explore the different remuneration models that cable owners can employ to sell capacity. We found that three main options for selling capacity exist, namely through i) capacity leases; ii) fibre pair ownership sales; or iii) sales of a portion of the spectrum of a fibre pair (spectrum-sharing) solutions. These three solutions differ in terms of operational aspects and offer different degrees of control and management of the purchased capacity to customers. We also present some of the features of the contractual agreements that entail long- and short-term leases. Submarine cable owners must thus balance the need for ensuring pre-sales commitment from long-term users that allow them to lower the cable investment risk while permitting to charge lower rents and shorter leases to other customers who are willing to pay a small premium.

Three main paths to the public financing of Polar Connect

We have identified three possible (non-exclusive) archetypes of routes to implement a public funding model for Polar Connect:

- *The Anchor Tenant Model*, where the public sector provides funding[9] to a publicly-owned and accountable entity that acts as the anchor tenant. As such, public funding is used to back the purchase of pre-sold capacity by the anchor tenant, thus resulting in

9 Public funding comes in many different forms: grants, subsidies, loans, guarantees and equity.

initial positive cash flows that will unlock manufacturing and de-risk the business case for equity and lending finance to commit to supporting the project. By way of a notable example, the Anchor Tenant Model was used previously by the EllaLink submarine cable which links Europe to South America through Portugal and Brazil. In this case, Latin American and European National Research and Education Networks (NRENs) acted as anchor tenants which ultimately incentivised additional investments into the project. The European Commission co-funded the cable, acting as the *de facto* anchor tenant.[10]

- *The Tender Model* is where a public entity funds the development of a project and allocates a pre-defined amount of funds through a competitive tender process. The objective of the tender is to provide a grant that would cover the costs of an investment that would serve a public objective (e.g., national security). This model was employed in Norway in 2019, when the Norwegian Communications Authority, Nkom, opened a tender for an alternative pathway for electronic communications traffic due to perceived excessive reliance on existing connections between Oslo-Stockholm-Copenhagen.

- *The Direct Procurement Model*, where public entities fund a publicly-owned/accountable entity that takes responsibility for all business functions needed to be performed to build and operate a submarine cable. Under this model, the accountable entity is not only the buyer of the cable infrastructure but is also required to have capabilities across the business functions required for operating and maintaining the cable. This model has been employed with seismic cables in Japan, for submarine cables built to transfer satellite images from Svalbard, in Norway, and the recent in-progress case of the Atlantic CAM SMART cable.

Different ownership options and design features will have implications for regulatory legitimacy

In any situation where a measure involves state resources, confers a selective economic advantage to the aid recipient, and has the potential to affect competition and trade, it must be deemed compliant with State aid regulations. As such, if Polar Connect receives public financing the aid must be reviewed within the two-step State aid process, including (1) identifying the existence of the aid and (2) ensuring compatibility of the aid with the European State Aid Framework.

An important aspect of the second step of the State aid assessment, compatibility, is balancing the positive effects of the aid measure with any potential negative effects. In recent years, we have seen several in-depth State aid investigations opened for cross-border infrastructure projects, including at least one submarine cable, because of complaints arising from competitors. These complaints highlight that the aid can have distortionary impacts on competition within the sector. As such, it is necessary to ensure that the negative impact of an aid measure on competition and trade is minimised when designing an aid measure and assessing State aid compatibility.

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[10] European Parliament (2023). Answer given by Mr Breton on behalf of the European Commission. Available online at: https://www.europarl.europa.eu/doceo/document/E-9-2023-001444-ASW_EN.pdf

In the case of submarine cables, policymakers may consider access regulation over an infrastructure which has been funded by public aid. When publicly-funded infrastructures are not provided under non-discriminatory terms, a potential risk is that selected undertaking(s) could be provided with access conditions that are advantageous compared to market-based terms, which would be considered State aid. Therefore, access conditions should be designed in such a way that the public infrastructure will not confer a selective advantage to any subset of users.

Report structure

The remainder of this report explains our findings in greater detail and is structured as follows:

- Chapter 1 presents the Polar Connect initiative, sets out the policy objectives and its features, and summarises known evidence as to the economic rationale for public funding;
- Chapter 2 summarises the main characteristics of the market and provides an overview of the actors that operate in the market;
- Chapter 3 reviews the business models established for submarine cable projects;
- Chapter 4 examines key options identified for public intervention in Polar Connect; and
- Chapter 5 concludes with the regulatory and policy implications of public intervention.

CHAPTER 1
BACKGROUND ON THE POLAR CONNECT INITIATIVE

OBJECTIVE OF THE CHAPTER	KEY FINDINGS AND TAKEAWAYS
In this chapter, we present the Polar Connect initiative and inform the reader on: • The policy support and benefits of Arctic submarine cable systems; • The main features of the Polar Connect submarine cable systems; • The evidence of market failures and underinvestment in Arctic cable systems.	• Policymakers are convinced of the case for intervening to make Arctic submarine cables a reality, for the benefit of the EU. • The Polar Connect initiative consists of a submarine cable system linking Europe and Asia through the Arctic region. • Polar Connect will also serve research purposes as it aims at integrating scientific sensors. • Arctic submarine cables are associated with three notable market failures, related to: o High costs o Uncertain demand o Societal benefits are not fully considered as part of investment decisions. • Public funding can de-risk the project

In this chapter, we present the Polar Connect initiative. We start by recapping the policy support for Arctic submarine cables and their social and economic benefits. We then describe the Polar Connect submarine cable system. Finally, we summarise the evidence of underinvestment in Arctic cable systems, a case which is well understood and likely factored in the extant policymakers' views on the economic rationale for public intervention. This policy support is the starting point given for the present study.

1.1 Policy objectives

1.1 The economic case for an Arctic submarine cable is increasingly well understood. Policymakers are convinced of the case for intervening to make Arctic submarine cables a reality for the benefit of the EU. These benefits have been documented by Copenhagen Economics (2022),[11] and acknowledged in the Memorandum of Cooperation signed by the EU with Japan and South Korea[12]. The Arctic region is identified as one of the key strategic regions in which to develop secure and stable submarine connectivity between Europe and Asia.[13]

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[11] Copenhagen Economics (2022). The economic value of submarine cables in the Arctic. Available online at: https://copenhageneconomics.com/wp-content/uploads/2022/06/The-economic-value-of-submarine-cables-in-the-Arctic-Copenhagen-Economics-2022.pdf . Copenhagen Economics estimated that an Arctic submarine cable from the Nordic region to Japan can contribute EUR 1.4 billion annually to Nordic GDP from 2024. The effect is a long-term and recurrent annual impact, sustained as long as the infrastructure is in use.

[12] European Commission (2023). Memorandum of Cooperation signed at the first Japan-EU Digital Partnership Council meeting on 3 July 2023. Available online at: https://ec.europa.eu/commission/presscorner/detail/en/ip_23_3831 European Commission (2023). European Union- Republic of Korea Digital Partnership. Available online at: https://digital-strategy.ec.europa.eu/en/library/republic-korea-european-union-digital-partnership

[13] European Commission (2021). European Data Gateways as a key element of the EU's Digital Decade. Ministerial declaration. Available online at: https://digital-strategy.ec.europa.eu/en/news/digital-day-2021-europe-reinforce-internet-

> We are also working on a possible extension of a submarine cable that we plan to build via the Arctic route to Japan. This cable could go all the way down to Southeast Asia, and we believe that it could go via the Philippines. That would give you a strategic position on an infrastructure that could be instrumental both to your prosperity and national security.

Source: European Commission (2023). Press statement by President von der Leyen with Philippine President Marcos, 31 July 2023. Available online at: https://ec.europa.eu/commission/presscorner/detail/en/statement_23_4041

1.2 In our previous report[14], which was researched in 2021 and published in 2022, we emphasised how a focus on new, Nordic-centred digital infrastructure is not only an attractive option for the EU, but also offers an additional source of growth for the Nordic region. This includes new job opportunities and improved connectivity which could provide new local business opportunities and increased productivity and trade.

1.2 The Polar Connect initiative

1.3 The envisioned Polar Connect initiative consists of a submarine cable system linking Europe and Asia through the Arctic region. The cable would connect Norway, Sweden and Finland to Japan and South Korea, with potential extensions towards the South Pacific region (especially the Philippines and Singapore) and is projected to run through or close to submarine areas that are Exclusive Economic Zones (EEZ)[15] of Norway, Greenland, Canada, and the USA. The cable would thus follow a route that purposefully steers clear of Russian and internationally contested waters.[16]

connectivity-global-partners#:~:text=In%20the%20'Data%20Gateways'%20declaration,into%20account%20the%20international%20strategy.

European Commission (2023). Memorandum of Cooperation signed at the first Japan-EU Digital Partnership Council meeting on 3 July 2023. Available online at: https://ec.europa.eu/commission/presscorner/detail/en/ip_23_3831

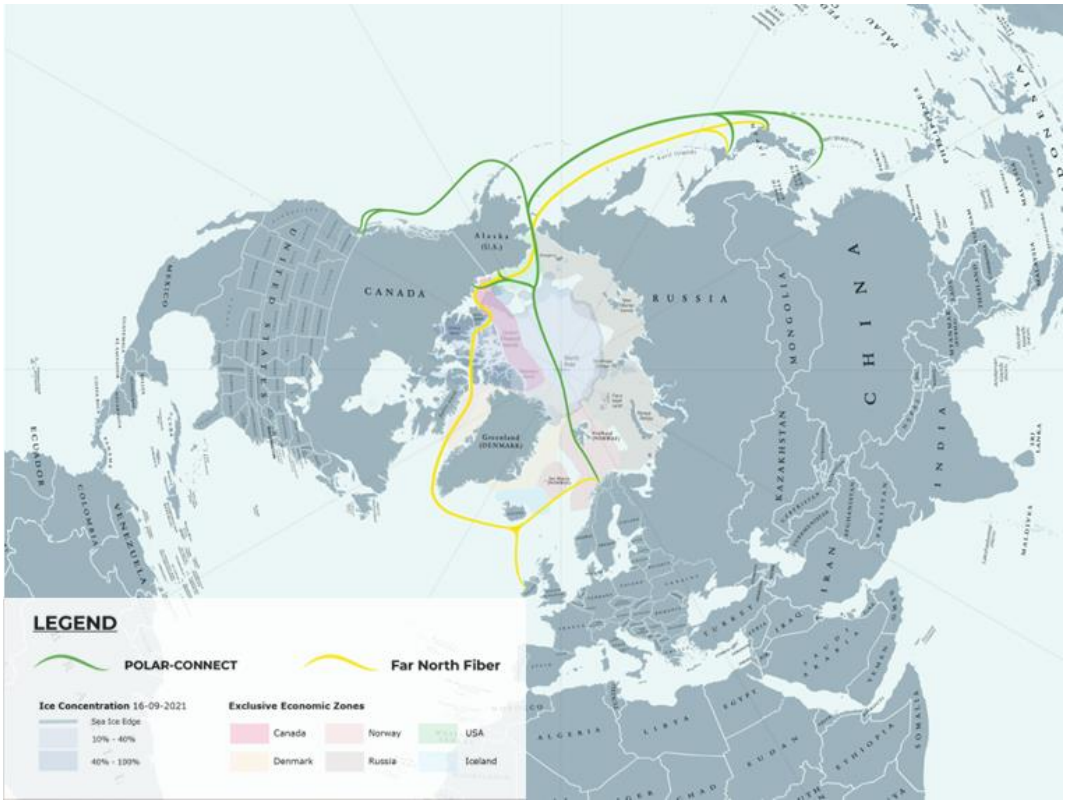
14 Copenhagen Economics (2022). The economic value of submarine cables in the Arctic. Available online at: https://copenhageneconomics.com/wp-content/uploads/2022/06/The-economic-value-of-submarine-cables-in-the-Arctic-Copenhagen-Economics-2022.pdf .

15 Exclusive Economic Zones (EEZ) are areas of the sea, generally extending 200 nautical miles from a country's coastline, that are reserved to the respective country under the United Nations Convention on the Law of the Sea (UNCLOS). Within this region, a country owns the natural resources at the seafloor.

16 For more details, see: NORDUnet (2023). Polar Connect. Available online at: https://nordu.net/polar-connect/ .

1.4 The Polar Connect cable system is one of the two submarine cable projects linking Europe to Asia through the Arctic. The other route has been defined by Far North Fiber (FNF), which is a submarine cable system linking Europe and Asia via the Northwest Passage, with landings in the USA (Alaska) and Canadian Arctic, Norway, Finland and Ireland. FNF is the first cable system to be connecting Europe and Asia across the Arctic region. Arctic submarine connectivity can be viewed as a single system that encompasses two diverse paths, which ensures a more resilient solution for Europe's connectivity to Asia. Cable-using companies spread their networks' capacity over multiple cables so that if one goes down due to damage or disruption, their network can continue to run smoothly over other cables while the damaged one is being repaired. This is referred to as redundancy.[17] Polar Connect will be able to form a redundant system with FNF. The joint communication statement signed between Cinia and NORDUnet in June 2023 reaffirms the complementarity between the two systems.[18]

Figure 2
Illustration of the potential route for Polar Connect and Far North Fiber projects



Source: NORDUnet

[17] Brodsky Paul (2018). Submarine Cable Redundancy, Explained. Available online at : https://blog.telegeography.com/what-is-submarine-cable-redundancy

[18] NORDUnet and Cinia (2023). Joint communications statement June 2023. International connectivity between Europe and Asia will be strengthened and become more resilient through two complementing submarine cable systems – Far North Fiber and Polar Connect. Available online at: https://nordu.net/wp-content/uploads/2023/07/FNF-PC-Communications-by-Cinia_and_NORDUnet-20230629.pdf

1.5 The development of submarine cables in the Arctic will form a highway for data from Central Europe through the Nordic region to the USA, Canada, and Asia. According to NORDUnet and many of the interviewed experts, such a highway could add better connectivity and increased resilience to today's patchwork of submarine and terrestrial data cables between these regions. Moreover, it will complement the existing direct submarine cable connections between Europe and Asia, which all currently pass through the Red Sea area, with a newer and shorter route.

1.6 The Polar Connect initiative would open a new corridor for commercial carriers and cloud providers, enabling increased connectivity between Europe and Asia. In addition, Polar Connect will integrate scientific sensors to support research purposes. These sensors have key applications in risk monitoring, such as detecting earthquakes, tracking tsunami waves, and allowing accurate observations of sea bottom movements, sea level rise, drifts of sea bottom temperature and seawater currents. Real-time monitoring through sensing cable technologies will support Arctic and climate research.[19]

1.7 *Ad hoc* cables that are dedicated exclusively to research purposes, such as those employed in Japan for seismic sensing, are costly and unsuitable for long-distance submarine cables. However, integrating environmental sensors into commercial submarine telecommunications cables would enable economies of scope. Studies on the Atlantic CAM cable system, which will be deployed in Portugal, have shown that the increase in investment attributed to the "sensing" part of a Science Monitoring and Reliable Telecommunications (SMART) cable is estimated to be between 10 and 20 percent of the investment related to the telecommunications part.[20]

1.8 Sensing cable technology applications facilitated by Polar Connect would accelerate the production of sensor-generated data on ocean and geophysical processes, while simultaneously serving market-driven needs for global connectivity.

> A central feature of the SMART cables concept is combining two key themes of the 21st century: the increasing pressure for global connectivity and urgent need for coherent, concerted global effort on climate change and ocean management.

Source: Howe et al. (2022). SMART Subsea Cables for Observing the Earth and Ocean, Mitigating Environmental Hazards, and Supporting the Blue Economy. *Frontiers in Earth Science*, Vol. 9, Article 775544, doi: 10.3389/feart.2021.775544. Available online at: https://www.itu.int/en/ITU-T/climatechange/task-force-sc/Documents/Frontiers-in-earth-science-2022-02.pdf.

[19] OECD (2009). Smart Sensor Networks: Technologies and Applications for Green Growth. Available online at: https://www.oecd.org/sti/44379113.pdf

[20] José Barros (2023). Contributions of SMART CABLES technology to Sustainable Development in Portugal. *Jornal da Economia do Mar*. Lisbon, 29 September 2023. Available online at: https://www.jornaldaeconomiadomar.com/contributions-of-smart-cables-technology-to-sustainable-development-in-portugal/

1.3 Overview of the economic rationale for public funding

1.9 While most submarine cable projects have been traditionally funded by private investment on a commercial basis, several challenges arise in the case of Arctic submarine cables which suggest that public funding support will be necessary to achieve success.

1.10 In this section, we discuss potential market failures related to Arctic submarine cables and explain how public financing could support the case for private investors to contribute to the project.

1.3.1 Arctic submarine cables are subject to potential market failures

1.11 Any submarine cable deployment project has associated risks and benefits, but unlike some other types of submarine cables, Arctic submarine cable projects are a particularly challenging case for private investors leading to a potential underinvestment situation. Arctic submarine cables are associated with three notable factors that are conducive to market failures.

1.12 *First*, Arctic submarine cables are associated with high costs, see Table 1. This is in part due to the extreme weather and climate of the Arctic. Ice in the Arctic constitutes a major unknown for such submarine cable projects since the ice conditions are favourable for laying and intervening (e.g., for repairs) on the cable only few months every year. This makes implementing a cable installation in water with frequent sea ice and icebergs complicated and costly.[21] Additionally, the potential for cable cuts of submarine cables in shallow waters is also a risk due to the prevalence of floating icebergs. These conditions require novel construction solutions which have not previously been implemented in submarine cable projects. This further contributes to the high cost of Arctic submarine cable projects, when maintenance and contingencies are factored in.[22]

[21] See for example The Arctic Institute (2022). Geopolitics of Subsea Cables in the Arctic. Available online at: https://www.thearcticinstitute.org/geopolitics-subsea-cables-arctic/

[22] There has been some development of infrastructure projects in the Arctic. For example Russia and Dubai's DP World are engaged in a project to develop the Northern Sea Route which will provide a container ship connection across the Arctic, see: DAWN (2023). Russia, Dubai's DP World to develop Arctic sea route. Available online at: https://dawn.com/news/1783481/russia-dubais-dp-world-to-develop-arctic-sea-route.

Table 1
Submarine cable project costs

SUBMARINE CABLE PROJECT	KM OF CABLE	TOTAL PROJECT COST OR COST ESTIMATE (EUR)
Polar Connect	10,000	1,500 million EUR
Far North Fiber	14,500	1,100 - 1,200 million EUR
Medusa Cable System	7,100	342 million EUR
EllaLink	5,900	150 million EUR

Note: Blue rows represent Arctic cable projects. Project costs in USD have been converted to EUR using the average exchange rate for 2023 1 USD = 0.9256 EUR. Data for Polar Connect is provisional and does not include sensing technology.

Sources: European Commission (2022). Factsheet Medusa is by far the largest submarine cable project in the Mediterranean to date with 7,100 km. Available online at: https://neighbourhood-enlargement.ec.europa.eu/system/files/2022-11/2022-11-24%20-%20Factsheet%20for%20Media%20-%20Medusa.pdf; Marguerite (2019). Marguerite closes EllaLink submarine cable investment. Available online at: https://www.marguerite.com/2019/01/marguerite-closes-ellalink-submarine-cable-investment/. Polar Connect (2023). The Wall Street Journal (2023). What Will It Take to Connect the Arctic? $1.2 Billion, 10,000 Miles of Fiber-Optic Cable and Patience. 10 March 2023. Available online at: https://www.wsj.com/articles/what-will-it-take-to-connect-the-arctic-1-2-billion-10-000-miles-of-fiber-optic-cable-and-patience-2af75543

1.13 Another potential cost for Arctic submarine cables relates to regulatory costs and complicated regulatory challenges. Laying submarine cables over the Arctic relies on the cooperation and approval of several nations and jurisdictions as the cables cross over different Exclusive Economic Zones.

1.14 These costs create a challenge for a profitable business case for Arctic submarine cables and raise doubts for private investors considering such projects.

1.15 *Second*, there are risks from absent demand which can lower the expected profitability of an Arctic submarine cable. Potential investors in an Arctic submarine cable project need to consider who will use the cable and what kind of traffic will benefit from such a connection. While the business case and demand for an Atlantic submarine cable are well known by industry experts and investors, demand and expected revenues from this unprecedented route are more difficult to estimate. Currently, there are no connections that span across the North Pole, meaning that such traffic is currently being directed through other routes. Increasing demand for digital connectivity could be sufficient to support the need for an Arctic submarine cable in the future, but the current uncertainty around demand represents a risk for private investors.

1.16 *Third*, the wider societal and economic benefits of an Arctic submarine cable are often not fully factored into investment decisions. Building a submarine cable in the Arctic would enhance the digital infrastructure in the Nordic region, which could contribute to productivity, trade, and consumer welfare benefits. Most importantly, developing a new cable route over the Arctic improves European digital resiliency and autonomy. This includes the effect on the competitiveness of Europe as a location for investing in cloud infrastructures and data centres. Furthermore, this would provide better connectivity to communities of users in the Nordic and polar regions.

1.17 There is also significant research potential associated with Arctic submarine cables. For example, SMART cables would allow scientific researchers to measure the effects of climate change by measuring the temperature, flow, and salinity of Arctic waters, assessing seismic activity, and capturing underwater bioacoustic signals. Positive externalities arising from research and development activities are often undervalued and therefore they are not fully reflected in a business case.

1.3.2 Public investment has the potential to crowd in private investment

1.18 One way to incentivise private involvement in an Arctic submarine cable is for governments to provide a signal that the project has important societal, commercial, and scientific value by providing public financial support. As such, public involvement lowers the risk for private investors to get involved in new and innovative projects, which opens up the opportunity for capital from private investors.

1.19 After some public investment is secured first-mover investment challenges are reduced. For example, international initiatives, such as "Connecting Europe and Asia – Building blocks for an EU strategy", can reduce uncertainty for investors as they signal a long-term investment objective for the industry and support from the public sector.[23]

1.20 Such public investment will often account for the financing gap (or funding gap), i.e., the funds that a private investor would require to make an investment profitable, thereby lowering initial investment costs for private investors. This increases the attractiveness of the project and encourages private investment.

1.21 Against this background, in the next chapters, we explore and set out how an investment into Polar Connect could be implemented, given the different co-investment and ownership options available, and elaborate on how to secure the regulatory legitimacy of such investment. To inform the discussion of these options, we first provide an overview of the submarine cable market context and its stakeholders and present the alternative business models available to submarine cable projects.

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[23] European Commission (2018). Joint Communication to the European Parliament, the Council, the European Economic and Social Committee of the Regions and the European Investment Bank – Connecting Europe and Asia – Building blocks for an EU Strategy, Join (2018) 31 final. Available online at: https://www.eeas.europa.eu/sites/default/files/joint_communication_-_connecting_europe_and_asia_-_building_blocks_for_an_eu_strategy_2018-09-19.pdf.

CHAPTER 2
THE MARKET CONTEXT

OBJECTIVE OF THE CHAPTER	KEY FINDINGS AND TAKEAWAYS
This chapter aims to inform the reader about the market context in which Polar Connect is positioned. This overview includes the following aspects: existing submarine cable connectivity, policy context, demand trends, value chain, and key actors. The review of the market context will serve as a basis for assessing the key market functioning mechanisms and the evaluation of the implementation options that will follow in Chapters 3 and 4.	• Europe's existing submarine cable connectivity to East Asia is limited and concentrated around geographical chokepoints. • Digital sovereignty is emerging as a key policy objective in the EU. • Global data demand is increasing substantially. • The submarine cable value chain comprises various interconnected stakeholders. • The ownership of submarine cables by hyperscalers is growing.

In this chapter, we present the defining features of the submarine cable market, with a specific focus on Europe's existing connectivity networks and the rationale for new investment in digital connectivity in Europe. We also outline the submarine cable value chain and the main actors therein.

2.1 Europe's cable connectivity with East Asia relies on a few key routes passing through geographical chokepoints

2.1 Europe benefits from several transcontinental submarine cable links. However, the vast majority are concentrated along the transatlantic route, accounting for around 75 percent of the EU's total interregional bandwidth. Connectivity to Asia, accounting for 10 percent[24] of all routes connecting the European continent to the rest of the world, is more limited.[25]

2.2 The need for more resilient and diverse traffic routes between the EU and Asia was recognised in 2018 in a joint communication on "Connecting Europe and Asia – Building blocks for an EU strategy"[26] and reinforced in the Memorandum of Cooperation signed at the first Japan-EU Digital Partnership Council meeting on July 3rd, 2023.[27] Resilient, secure and high-capacity submarine cable routes are needed to satisfy the projected increase in traffic between Europe and Asia and support the growing interdependence between the two continents.

2.3 At present, only three submarine cables link Europe directly with countries in the East Asia:

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[24] TeleGeography (2022). Cutting off Europe? A Look at How the Continent Connects to the World. Available online at: https://blog.telegeography.com/cutting-off-europe-a-look-at-how-the-continent-connects-to-the-world.

[25] European Commission DG Communications Networks, Content & Technology (2022). Study to Monitor Connectivity, section 3.2.2.2. Available online at: https://op.europa.eu/en/publication-detail/-/publication/a0b01654-9394-11ec-b4e4-01aa75ed71a1.

[26] European Commission (2018). Joint Communication to the European Parliament, the Council, the European Economic and Social Committee of the Regions and the European Investment Bank – Connecting Europe and Asia – Building blocks for an EU Strategy, Join (2018) 31 final. Available online at: https://www.eeas.europa.eu/sites/default/files/joint_communication_-_connecting_europe_and_asia_-_building_blocks_for_an_eu_strategy_2018-09-19.pdf.

[27] European Commission (2023). Memorandum of Cooperation signed at the first Japan-EU Digital Partnership Council meeting on 3 July 2023. Available online at: https://ec.europa.eu/commission/presscorner/detail/en/ip_23_3831.

SeaMeWe-3, FLAG Europe-Asia (FEA) and AAE-1. All cables on this route also connect to Central and Western Asia and Africa. SeaMeWe-3 and AAE-1 are owned by consortia comprising various telecommunications providers[28]; FEA is owned by a single (private) investor, Global Cloud Xchange. We explain ownership models in more detail in Section 3.1.

2.4 The FEA and SeaMeWe-3 cables connect Europe to Japan and South Korea, respectively. The FEA cable was laid in 1997; the SeaMeWe-3 cable was launched in 1999. Hence, both are approaching or have reached the end of their useful life, estimated at around 20 - 25 years. Given that these are the only cables directly connecting Europe to this region, most traffic is redirected via Singapore or the United States.

2.5 New cables linking Europe with South and Southeast Asia include SeaMeWe-5[29] (operational since 2016) and SeaMeWe-6[30] (expected to be Ready For Service in 2025), PEACE[31] (live since 2022, towards Pakistan and Kenya, an extension to Singapore is expected to be Ready For Service in 2024) and Blue-Raman[32] (expected to be Ready For Service in 2025).[33] The map depicted in Figure 3 shows existing and planned connectivity via submarine cables between Europe and South and East Asia.

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28 SeaMeWe-3 is owned by a consortium comprising A1 Telekom Austria, AT&T, Altice Portugal, BICS, BT, CTM, China Telecom, Chunghwa Telecom, Cyta, Deutsche Telekom, Djibouti Telecom, Embratel, Etisalat UAE, Indosat Ooredoo, Jabatan Telecom Brunei, KDDI, KPN, KT, LG Uplus, Maroc Telecom, Myanmar Post and Telecommunication (MPT), National Telecom, OTEGLOBE, Omantel, Orange, Orange Polska, PCCW, PLDT, Pakistan Telecommunications Company Ltd., Rostelecom, Saudi Telecom, Singtel, Singtel Optus, Softbank Corp, Sparkle, Sri Lanka Telecom, Tata Communications, Telecom Argentina, Telecom Egypt, Telekom Malaysia, Telkom South Africa, Telstra, Tunisia Telecom, Turk Telekom, Ukrtelecom, VNPT International, Verizon, Vocus Communications, Vodafone and eir; AAE-1 is owned by a consortium comprising China Unicom, Djibouti Telecom, Etisalat UAE, Hyalroute, Metfone, Mobily, National Telecom, OTEGLOBE, Omantel, Ooredoo, PCCW, Pakistan Telecommunications Company Ltd., Reliance Jio Infocomm, Retelit, TIME dotCom, TeleYemen, Telecom Egypt, VNPT International and Viettel Corporation.

29 Owned by a consortium comprising Bangladesh Submarine Cable Company Limited (BSCCL), China Mobile, China Telecom, China Unicom, Djibouti Telecom, Myanmar Post and Telecommunication (MPT), Ooredoo, Orange, Saudi Telecom, Singtel, Sparkle, Sri Lanka Telecom, TeleYemen, Telecom Egypt, Telekom Malaysia, Telkom Indonesia, Transworld and Emirates Integrated Telecommunications Company (du).

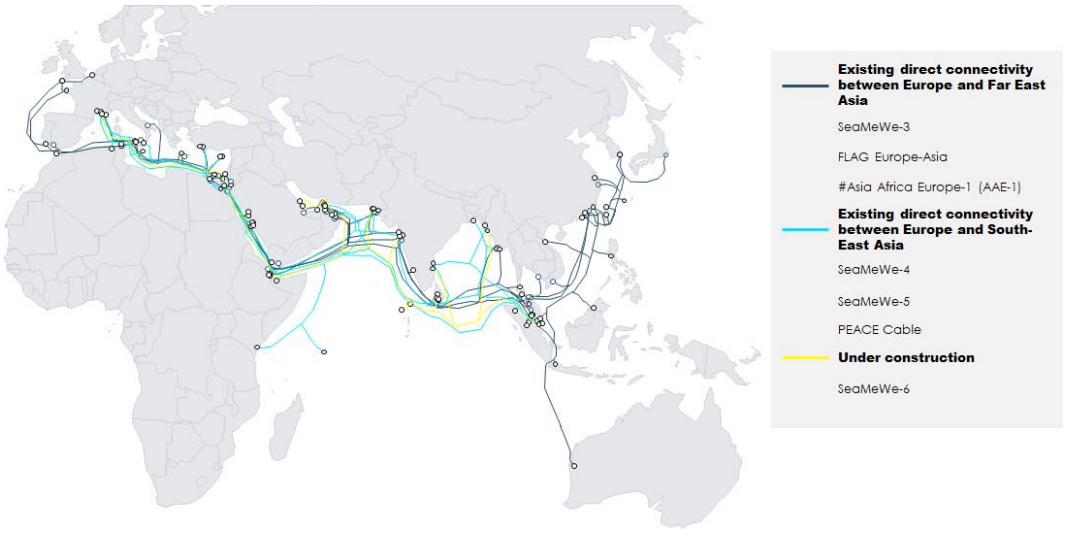
30 Owned by a consortium comprising Bahrain Telecommunications Company (Batelco), Bangladesh Submarine Cable Company Limited (BSCCL), Bharti Airtel, China Unicom, Dhiraagu, Djibouti Telecom, Microsoft, Mobily, Orange, PCCW, Singtel, Sri Lanka Telecom, Telecom Egypt, Telekom Malaysia, Telin and Transworld.

31 Owned by an SPV, PEACE Cable International Network CO., LTD.

32 Owned by Google, Omantel and Sparkle.

33 See: TeleGeography (2023). Submarine Cable Map. Available online at: https://www.submarinecablemap.com/.

Figure 3
Direct connectivity between Europe and East Asia (existing and planned submarine cables)



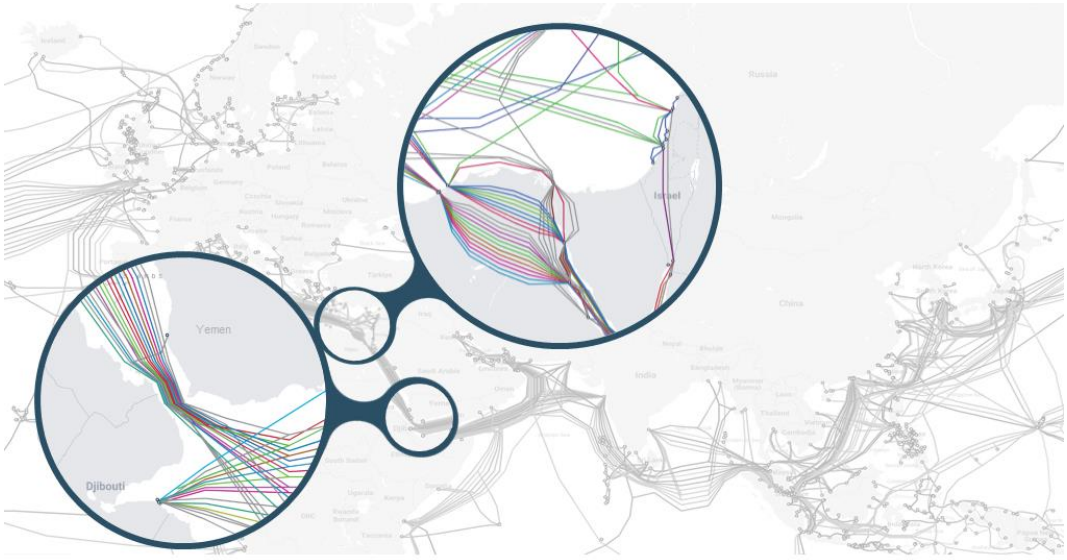
Source: Copenhagen Economics based on TeleGeography

2.6 Europe's intercontinental connectivity is also vulnerable when it passes through geographical chokepoints. Locations where many cables pass or land, known as geographical chokepoints, pose risks due to the concentration of several cables.

2.7 All the cables connecting Europe and East Asia, such as the SeaMeWe-3, SeaMeWe-4, and SeaMeWe-5 cables traverse narrow geographical bottlenecks, such as the Strait of Malacca or the Red Sea, see Figure 4.[34] Any interruptions or incidents in these areas could impact several cables at the same time.[35] For instance, when the AAE-1 cable connecting France to China via Djibouti was accidentally severed , widespread connectivity outages were reported in Europe, East Africa and South Asia.[36]

[34] TeleGeography (2023). Submarine Cable Map. Available online at: https://www.submarinecablemap.com/.
[35] Ibid.
[36] Data Center Dynamics (2022). AAE-1 cable cut causes widespread outages in Europe, East Africa, Middle East, and South Asia. Available online at: https://www.datacenterdynamics.com/en/news/aae-1-cable-cut-causes-widespread-outages-in-europe-east-africa-middle-east-and-south-asia/.

Figure 4
All direct submarine connectivity between Europe and Asia passes through the Red Sea



Source: Copenhagen Economics based on TeleGeography

2.8 Such chokepoints increase the risk of connection blackouts since several cables become vulnerable to natural disasters or geopolitical conflict[37]. Hence, there exists a need to mitigate this vulnerability by expanding connectivity through alternative, underutilised geographical routes such as through the Arctic.

[37] The recent (January 2024) escalation of attacks in the Gulf of Aden have exposed the Red Sea as a weak point of global maritime trade, according to the Center for Strategic and International Studies. "Although the Red Sea is widely recognized as a strategically significant maritime passageway and region, its geopolitical context exacerbates the perilous nature of this choke point." Geopolitical Monitor (8 January 2024). Houthi Attacks and Military Escalation in the Red Sea: What's at Stake?. Available online at: https://www.geopoliticalmonitor.com/houthi-attacks-and-military-escalation-in-the-red-sea-whats-at-stake/ . Other sources: Geopolitical Monitor (9 January 2024). Red Sea Crisis Exposes a Weak Point of Global Maritime Trade. Available online at: https://www.geopoliticalmonitor.com/red-sea-crisis-exposes-a-weak-point-of-global-maritime-trade/ ; Center for Strategic and International Studies (22 January 2024). The Global Economic Consequences of the Attacks on Red Sea Shipping Lanes. Available online at: https://www.csis.org/analysis/global-economic-consequences-attacks-red-sea-shipping-lanes.

2.2 Digital sovereignty is a priority for the EU's international connectivity

2.9 The term "digital sovereignty" in the context of the EU refers to its ability to act independently in the digital world and ensure a secure digital environment for its citizens. Digital sovereignty entails ownership and control of the assets and infrastructure that power the EU's connectivity to the rest of the world. The notion of "digital sovereignty" has recently emerged as a key priority for the European Commission as backbone connections between the EU and third countries assume increasing geopolitical importance.[38]

2.10 As submarine internet cables are becoming a focus of growing geopolitical competition, the dominance and influence of non-EU technology companies have become a concern for EU policymakers.[39]

2.11 Non-EU companies are at the forefront of owning and operating submarine cables. The traditional owners of submarine cables are telecommunications service providers, with Orange, TATA Communications, Telstra, HMN Technologies and AT&T amongst the largest owners. However, in recent years, content providers such as Google, Meta, Amazon and Microsoft[40] have increasingly invested in the construction of their own submarine cables. In terms of submarine cables connected to the EU, Google ranks 11th in terms of the number of active cables owned, but only in the period between 2016 and 2020 did it become the third largest constructor, after TATA and Telxius.[41]

2.12 China and the United States are the largest stakeholders in the global submarine cable landscape, and, as such, have the power to foster the region's digitalisation, but also impose regulatory standards and create technological dependencies that might not be always aligned with EU interests.[42] Furthermore, geopolitical tensions and events, such as the sabotage of the Nord Stream pipeline in 2022[43] and damage to the Baltic-connector gas pipeline between Finland and Estonia in 2023[44], have led to increased attention in Europe towards the diversification and security of submarine cables.

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38 Connecting Europe Facility (CEF) (2023). Call for Proposal – Backbone connectivity for Digital Global Gateways. Available online at: https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/cef/wp-call/2023/call-fiche_cef-dig-2023-gateways_en.pdf.

39 European Parliament (2020). Digital sovereignty for Europe. EPRS Ideas Paper, Towards a more resilient EU. Available online at: https://www.europarl.europa.eu/RegData/etudes/BRIE/2020/651992/EPRS_BRI(2020)651992_EN.pdf.

40 Throughout this report, the terms "content providers" and "hyperscalers" will be used to refer to Google, Meta, Microsoft, and Amazon, the four Big Tech companies that are investing in submarine cables.

41 European Commission DG Communications Networks, Content & Technology (2022). Study to Monitor Connectivity, section 3.3. Available online at: https://op.europa.eu/en/publication-detail/-/publication/a0b01654-9394-11ec-b4e4-01aa75ed71a1.

42 European Council on Foreign Relations (2021). Network effects: Europe's digital sovereignty in the Mediterranean. Available online at: https://ecfr.eu/publication/network-effects-europes-digital-sovereignty-in-the-mediterranean/#the-eu-internet-infrastructure-and-digital-sovereignty.

43 See, for instance, DW (2023). Nord Stream pipelines blasts: A maze of speculation. Available online at: https://www.dw.com/en/nord-stream-pipelines-blasts-a-maze-of-speculation/a-66913853

44 See, for instance, BBC (2023). Finland investigates suspected sabotage of Baltic-connector gas pipeline. Available online at: https://www.bbc.com/news/world-europe-67070389

2.13 Given this backdrop, the EU is placing increasing importance on the promotion of EU interests by ensuring that the EU connectivity infrastructure is secure and resilient. In Section 4.2, we outline some of the public funding support schemes devised and available to pursue this objective.

> In the current interconnected world, with rising geopolitical tensions, we need to ensure full control over our decision-making processes in strategic sectors, such as connectivity, and avoid harmful external interference in our EU connectivity infrastructure. The EU has come a long way in securing 5G networks, which are critical infrastructures in their own right. But there are important loopholes when it comes to securing our network infrastructure in the area of spectrum as well as undersea cables.

Source: Thierry Breton (2023). A 'Digital Networks Act' to redefine the DNA of our telecoms regulation. 10th October 2023. Available online at: https://www.linkedin.com/pulse/digital-networks-act-redefine-dna-our-telecoms-thierry-breton/?trackingId=IqUlGC2iQU%2Bj1%2Bhr6PatFQ%3D%3D

2.3 Increasing data demand and the replacement of assets with better technologies drives the need for new cable investments

2.14 The demand for internet traffic in the global economy is steadily increasing, driven by the growing use of digital tools and cloud services.[45] Previously, the European Commission had estimated that 140 new cables need to be installed between 2021 and 2030 to satisfy increasing bandwidth demand and replace submarine cables which are nearing their end-of-service (EOS) date.[46]

2.15 Although system upgrades and equipment renewals at landing stations and data centres can extend the EOS date in some cases, the Submarine Telecoms Forum 2022/2023 industry report estimates that up to 85 cables will need to be retired in the next five years.[47]

45 Copenhagen Economics (2022). The economic value of submarine cables in the Arctic. Available online at: https://copenhageneconomics.com/wp-content/uploads/2022/06/The-economic-value-of-submarine-cables-in-the-Arctic-Copenhagen-Economics-2022.pdf.

46 European Commission DG Communications Networks, Content & Technology (2022). Study to Monitor Connectivity. Available online at: https://op.europa.eu/en/publication-detail/-/publication/a0b01654-9394-11ec-b4e4-01aa75ed71a1.

47 Submarine Telcoms Forum (2022). 2022/ 2023 Industry report. Available online at: https://subtelforum.com/submarine-telecoms-industry-report-11th-issue-now-available/.

2.16 Internet traffic volume is closely linked to the economic and technological development of regions. Many countries in East Asia are characterised by high levels of internet penetration, arising from well-developed regional connectivity infrastructure and affordable prices for ICT access.[48] In Japan, for example, there were over 196 mobile broadband connections per 100 inhabitants in 2022, relative to an OECD average of 128 mobile broadband connections per 100 inhabitants.[49]

2.17 Demand for high-speed secure internet connectivity is also growing steadily in the research and education community. At present, European and Asian NRENs collaborate on several projects aimed at guaranteeing a high-performance connectivity link between the regions. The Asi@Connect project, for example, links universities and research centres in 21 countries at 10 gigabits per second (Gbps).[50]. Other initiatives have been promoted by the Global Research & Education Network (GREN), the network that brings together NRENs across the world. These initiatives include the Asia-Pacific Europe Ring (AER) and CAE-1, a 10-year collaboration that connects Europe and the Asia-Pacific region with 100 Gbps between London and Singapore.[51]

2.18 The advent of high performance computing (HPC) is expected to further bolster expected increases in data consumption and demand in the future. High performance computing uses supercomputers and computer clusters to execute advanced computational tasks and utilises large amounts of data. Recent collaborative ventures between science and research institutes, such as the one between CSC in Finland and RIKEN Centre for Computational Science in Japan[52], suggest that the demand for data and cross-border connectivity between Europe and East Asia attributable to HPC is likely to be significant.

2.19 Short-term measures during the Covid-19 pandemic, such as the introduction of a special reporting mechanism on internet traffic volumes in each Member State by the Body of European Regulators for Electronic Communications (BEREC), enabled the internet backbone infrastructure to successfully cope with the increased levels of demand.[53] Nevertheless, these actions highlighted the need for long-term investments in better capacity and new cable systems that can help the internet backbone infrastructure overcome additional challenges, such as supply chain delays, permitting, and marine installations.[54]

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48 European Commission DG Communications Networks, Content & Technology (2022). Study to Monitor Connectivity. Available online at: https://op.europa.eu/en/publication-detail/-/publication/a0b01654-9394-11ec-b4e4-01aa75ed71a1.

49 OECD (2022). Mobile broadband subscriptions per 100 inhabitants, Broadband and telecom databases. Available online at: https://data-explorer.oecd.org/vis?tm=mobile%20broadband&pg=0&hc[Indicator%20type]=Mobile%20broadband&snb=2&vw=rw&df[ds]=dsDisseminateFinalDMZ&df[id]=DSD_BB_DATABASE%40DF_BB_TEL_DATABASE&df[ag]=OECD.STI.DEP&df[vs]=1.0&pd=2022%2C&dq=OECD%2BJPN%2BKOR.A.MBB.ALL.100HB&ly[rw]=REF_AREA&to[TIME_PERIOD]=false.

50 Asi@Connect (n.d.). Project. Available online at: https://www.tein.asia/sub/?mc=1010.

51 GÈANT (2023). Navigating the Future of Intercontinental Connectivity. Available online at: https://internet2.edu/wp-content/uploads/2023/05/commex23-thursday-Navigating-the-Future-of-Intercontinental-Connectivity-2-Fryer.pdf.

52 CSC – IT CENTER FOR SCIENCE (2022). News Published on 5 November 2022. Available online at: https://www.csc.fi/en/-/csc-and-riken-center-for-computational-science-to-engage-in-closer-cooperation-involving-supercomputers

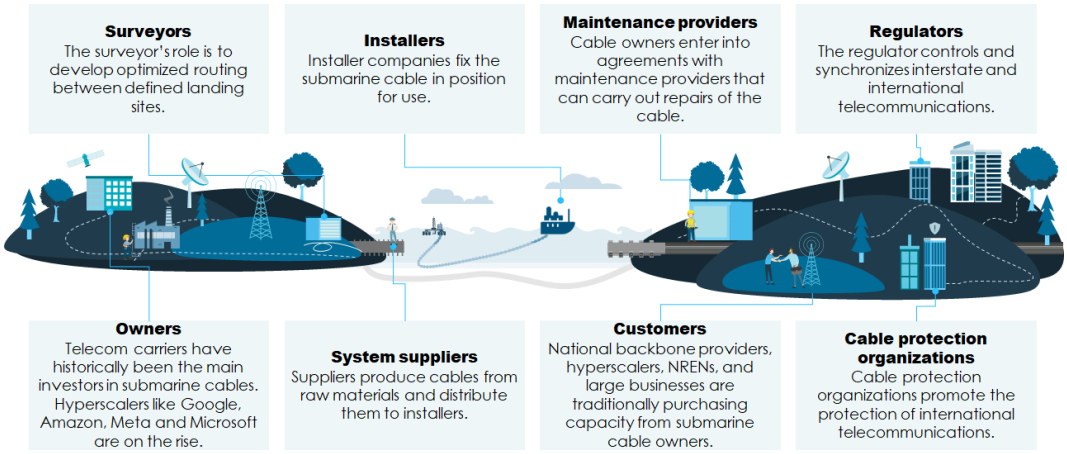
53 Body of European Regulators for Electronic Communications (2021). BEREC Summary Report on the status of internet capacity, regulatory and other measure in light of the Covid-19 crisis, BoR (21) 184. Available online at: https://www.berec.europa.eu/sites/default/files/files/document_register_store/2021/11/BoR-21-184_20211123_Covid-19_Summary-report.pdf

54 European Commission, Directorate-General for Communications Networks, Content and Technology (2022). Study to monitor connectivity: connecting the EU to its partners through submarine cables: final study report, Publications Office of the European Union. Available online at: https://op.europa.eu/en/publication-detail/-/publication/a0b01654-9394-11ec-Surveyorb4e4-01aa75ed71a1/language-en

2.4 The value chain and stakeholder landscape of submarine cables

2.20 The submarine cable value chain includes various stakeholders that cooperate throughout the entire lifetime of the cable, from route design and planning to maintenance and end-of-life operations. Outlining their role is of foremost importance to understanding the market context and how their interplay shapes contract formation and financing and ownership models, discussed in more detail in the next chapters.

Figure 5
The value chain of submarine cables



Source: Copenhagen Economics

Owners

2.21 Traditionally, owners of submarine cables included telecommunications providers such as Orange, TATA Communications, Telstra and AT&T. However, cable ownership by content providers is on the rise. We will discuss their role in Section 2.5.

Surveyors

2.22 The surveyor's role is to identify and develop optimal routes between defined landing sites. This is the first step in the process of laying and operationalising submarine cables. Surveyors provide installers with integrated geophysical and geotechnical data that helps finalise installation plans. Surveyors often conduct comprehensive research to minimise overlap with other submarine cables and exposure to natural hazards. EGS and Fugro are the leading market players in this segment.

System suppliers

2.23 Suppliers are involved in the production of submarine cables from raw materials and distribute them to installers. Four companies dominate this market: Alcatel Submarine Network (ASN, EU-based, market leader), SubCom (US-based), NEC (Japan-based), and HMT (China-based, formerly known as Huawei Marine). These companies are active globally, with ASN being the market leader. However, SubCom has the most active EU-connected cables. Booking capacity and concluding agreements with cable systems suppliers (reaching contract-in-force (CIF) agreements) are necessary conditions for submarine cable project promoters to convince potential investors and customers of the feasibility and maturity of the project. We discuss the role of these agreements in greater detail in Section 3.2.

Installers

2.24 Several installers also manufacture submarine cables themselves, so there is an overlap between suppliers and installers. Installers are entrusted with fixing or laying the submarine cable in position for use. Key market actors are ASN, SubCom, and Global Marine (UK-based).

Maintenance providers

2.25 Maintenance providers ensure that cables are repaired when they are damaged. When a submarine cable is damaged, urgent repair is necessary to limit the downtime of the cable system. To be properly prepared for possible cable failures, cable owners need to enter into agreements with contractors that have the required experience, knowledge, and special equipment to carry out submarine cable repairs. Orange, SubCom, and ASN are among the largest players in the market.

Customers

2.26 Capacity is available for different types of users with different requirements in terms of demand and use. End-users of the internet (consumers, businesses, public sector) mainly use it through internet access links that are connected to internet service providers (ISPs), such as telecommunications companies that provide fixed broadband services to offices and homes, and mobile service subscriptions. These service providers procure capacity on submarine cables to supplement their existing terrestrial networks and provide comprehensive end-to-end connectivity to corporate customers further downstream in the value chain. We elaborate further on submarine capacity sales in Section 3.3.

2.27 As such, national backbone providers such as Deutsche Telecom in Germany, Orange in France, and Arelion (formerly Telia Carrier) in Sweden have traditionally been the largest customers of submarine cable capacity. Hyperscalers, NRENs and large businesses also constitute customers for submarine cable capacity.

2.28 Hyperscalers had already surpassed internet backbone providers as the largest users of international bandwidth capacity in 2017. They accounted for less than 10 percent of total bandwidth usage before 2012;[55] this share increased to more than 60 percent in 2021[56], see Figure 6.

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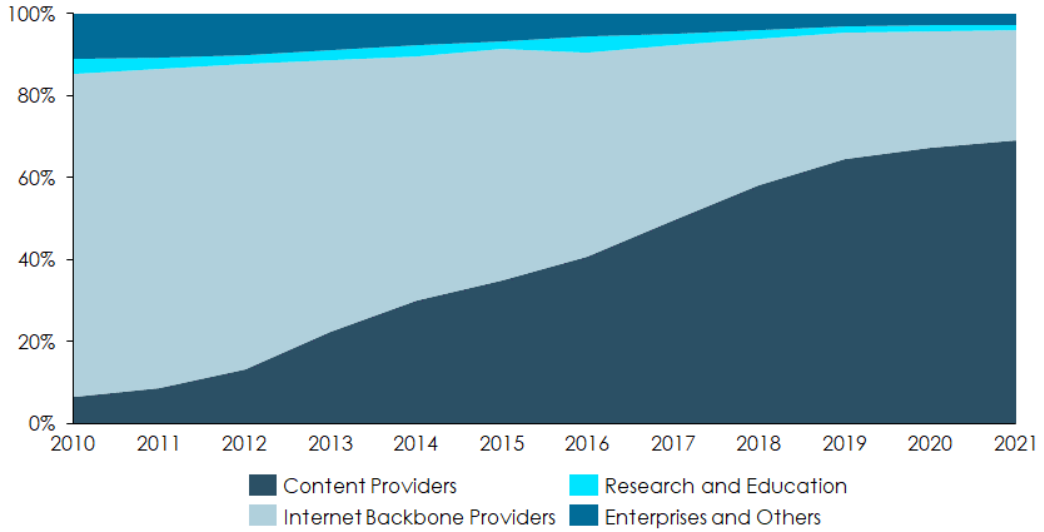
[55] TeleGeography (2017). A Complete List of Content Providers' Submarine Cable Holdings. Available online at: https://blog.telegeography.com/telegeographys-content-providers-submarine-cable-holdings-list.

[56] Le Monde (2023). "Les Gafam mettent la main sur les câbles sous-marins pour mieux contrôler Internet". Available online at: https://www.lemonde.fr/economie/article/2023/01/01/les-gafam-mettent-la-main-sur-les-cables-sous-marins-pour-mieux-controler-internet_6156258_3234.html.

Figure 6
Content providers have grown from less than 10 percent to more than 60 percent of bandwidth usage in ten years
Share of global bandwidth usage in percentage



Source: Copenhagen Economics on TeleGeography data

Regulators and cable protection organisations

2.29 Regulators and cable protection organisations are also relevant stakeholders in the value chain but have a governance role rather than being active market participants. These entities promote the protection of international telecommunications and submarine infrastructure and control international communications. Among the largest organisations are the International Cable Protection Committee (ICPC) and the North American Submarine Association. Recent attacks on submarine infrastructure have heightened concerns over the security of cables and spurred calls for the increased protection of submarine telecommunication cables and the global cable network.[57]

2.5 Telecom providers have historically been the main investors in submarine cables, while hyperscalers have emerged as key investors

2.30 Historically, telecommunication service providers have been the largest group of investors in submarine cables and subsequently resold capacity to content providers such as Google, Meta, Microsoft, and Amazon. However, with content providers driving the bulk of internet traffic today, these content providers are increasingly laying and operating their own submarine cables as part of a strategy to increase control of the vertical value chain.

[57] See, for example, the report prepared by the Congressional Research Service, prepared to inform the USA Congress on government actions to protect subsea cables and policy options for Congress should it consider greater protection of cables. Congressional Research Service (2023). Protection of Undersea Telecommunication Cables: Issues for Congress. R47648. August 7, 2023. Available online at: https://sgp.fas.org/crs/misc/R47648.pdf

2.31 Cloud content providers, such as Amazon (Amazon Web Services), Microsoft (Azure) and Google (Google Cloud), own more than half of the world's hyperscale data centres[58] and seek to connect these data centres with their own submarine cables to ensure seamless connectivity.

2.32 As content providers entered the submarine cable market more recently, their cables enjoy an age advantage over telecommunication service providers. In 2021, a report published by the European Commission estimated that, on average, cables laid by content providers are only 2.5 years old, while cables laid by other owners are, on average, 12.8 years old.[59] Newer cables also ensure that content providers have a technological advantage, as they allow for greater data transmission rates and improved bandwidth thanks to increased fibre count and transmission technology. On average, cables owned partly or wholly by content providers have 74 percent higher capacity, i.e., they have a structurally higher traffic carrying capability.[60]

2.33 Hyperscalers are expected to continue laying their own submarine cables, either independently or by joining forces in consortia (see Section 3.1.2). Between 2022 and 2025, 21 percent of planned systems will be driven by hyperscalers, focusing on routes connecting their data centres in different continents.[61] Hyperscalers generally favour locations that provide economic and cost-saving benefits to reduce the operational expenditure impact of their data centre facilities.[62] Besides the most prominent American content providers, Chinese companies such as Alibaba and Tencent are also investing in their own submarine cables.

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58 Synergy Research Group (2021). Microsoft, Amazon and Google Account for Over Half of Today's 600 Hyperscale Data Centers. Available online at: https://www.srgresearch.com/articles/microsoft-amazon-and-google-account-for-over-half-of-todays-600-hyperscale-data-centers

59 Ibid.

60 European Commission, Directorate-General for Communications Networks, Content and Technology (2022). Study to monitor connectivity: connecting the EU to its partners through submarine cables: final study report, Publications Office of the European Union. Available online at: https://op.europa.eu/en/publication-detail/-/publication/a0b01654-9394-11ec-Surveyorb4e4-01aa75ed71a1/language-en

61 Submarine Telcoms Forum (2022). 2022/ 2023 Industry report. Available online at: https://subtelforum.com/submarine-telecoms-industry-report-11th-issue-now-available/.

62 Ibid.

CHAPTER 3

BUSINESS MODELS AVAILABLE FOR SUBMARINE CABLE PROJECTS

OBJECTIVE OF THE CHAPTER	KEY FINDINGS AND TAKEAWAYS

This chapter aims to guide policymakers by identifying the funding and governance models currently used in the submarine cable market.
 	
This overview covers ownership, business functions, and remuneration models, and is informed by market practices and interviews.
 	
This review provides a conceptual basis for assessing in greater detail the funding options available to Polar Connect, and the regulatory economic implementation challenges that need to be managed.
	• There are three distinct financing and ownership models available in the submarine cable industry:
	  ○ The single (private) investor model
	  ○ The consortium model
	  ○ The special purpose vehicle model
	• Submarine cable project developers must perform and execute various business functions. These include, but are not limited to, securing long-term anchor tenants, engaging with system suppliers, and performing financial planning.
	• Submarine cables generate revenue through long-term or short-term leases on fibre pairs or on a spectrum-sharing basis.

In this chapter, we outline the different financing and ownership models in the submarine cable market. The market is characterised by a variety of co-investment and governance models, involving both private investment and public funding. We then provide an overview of the implementation features of a submarine cable project, outlining the main business functions that need to be performed. Finally, we describe the more common remuneration models in the submarine cable industry.

We describe ownership, business functions and remuneration on a conceptual level in this chapter. We contextualise these topics with reference to Polar Connect in Chapter 4.

3.1 Three main ownership models are available in the submarine cable market

3.1 Ownership models in the submarine cable market may be divided into the following three categories: single investor, consortium, and special purpose vehicles (SPVs). The distinction between these three categories corresponds to the number and legal status of the owners therein and entails different risk-sharing models, see Figure 7.

Figure 7
Three ownership models in the submarine cable market

Source: Copenhagen Economics

3.2 Below we explain each ownership model in greater detail, providing illustrative examples where appropriate.

3.1.1 Single (private) investor

3.3 The single investor model corresponds to a simplified ownership structure with only a single owner. The single investor model is the second most popular financing option today, after the consortium model (see Section 3.1.2). This is largely driven by hyperscalers looking to provide seamless connectivity to their data centres (see Section 2.5).[63]

3.4 In this investment model, submarine cables are typically self-financed using a debt/equity financing structure supported by a combination of investment bank capital and capacity pre-sales.[64] Sometimes individual investors have a broader portfolio of regional investments, such as data centres, whose services are then supported by the additional backbone infrastructure.[65]

3.5 A single (private) submarine cable financing model can enable swift and efficient decision-making processes. However, the investor must also bear the entire risk burden of the project and does not share it with any other entity. Since single investor cables are typically built to serve a specific market need of the investor, the need for an upfront customer commitment does not arise. Nevertheless, the sale of upfront capacity can help raise the initial equity required for construction.

63 Submarine Telecoms Forum (2023). 2022/2023 Industry Report. Available online at: https://subtelforum.com/submarine-telecoms-industry-report-11th-issue-now-available/

64 European Commission, Directorate-General for Communications Networks, Content and Technology (2022). Study to monitor connectivity: connecting the EU to its partners through submarine cables: final study report, Publications Office of the European Union. Available online at: https://op.europa.eu/en/publication-detail/-/publication/a0b01654-9394-11ec-b4e4-01aa75ed71a1/language-en.

65 Reverdy, D. and Skenderoski, I. (2015). Submarine Cables: Structuring and Financing Options, Salience Consulting. Available online at: https://salienceconsulting.ae/wp-content/uploads/2018/09/Submarine_Cables_Structuring_and_Financing_Options_Jan_2015.pdf.

3.6 Since submarine cables offer economies of scale, single investors often find it optimal to build more capacity than they require and resell this additional capacity to third parties later (we will discuss how cable owners can sell capacity on their cables in Section 3.3).[66]

3.7 Hyperscalers are the most prominent examples of single investors today. Their significant financial resources enable them to undertake submarine cable projects with ease.[67] We examine the single investor ownership through a case study of Dunant, the Google-owned transatlantic cable connecting Virginia Beach to the French Atlantic coast, see Box 1.

Box 1 Case Study Dunant: an example of a hyperscaler sole-owner submarine cable

Dunant is Google Cloud's submarine cable connecting Virginia Beach in the United States with Saint-Hilaire-de-Riez on the French Atlantic coast. It is 6,600 km long and transmits 250 terabits per second (Tbps) through its 12-fibre pair space-division multiplexing (SDM) technology. The submarine cable was engineered, manufactured, and installed by SubCom, one of the leading global communications equipment companies.

First announced in 2018, it became Ready For Service in January 2021 and is part of Google's efforts to optimise its network for its cloud consumers. The cable was funded entirely by Google and costs a total of USD 165 million. It lands at La Parè Prènau cable landing station, governed by a landing party agreement between Google and the French telecom operator Orange.

As part of the landing agreement, Orange received an Indefeasible Right of Use (IRU) for two fibre pairs for the entire length of the Dunant cable system and ownership of the portion of the cable extending 12 nautical miles from the French coast. Google maintains control of the submarine cable system in USA territory and international waters. Dunant became Google's third sole-owner submarine cable system, following Junior, which connects Rio de Janeiro to Santos in Brazil, and Curie, which connects Chile to Los Angeles.

Sources: Google Cloud (2021). The Dunant subsea cable, connecting the USA and mainland Europe, is ready for service. Available online at: https://cloud.google.com/blog/products/infrastructure/googles-dunant-subsea-cable-is-now-ready-for-service; Kim, J. (2021). Telxius Joins Trans-Atlantic Dunant and MAREA Subsea Cables, Dgtl Infra. Available online at: https://dgtlinfra.com/telxius-joins-trans-atlantic-dunant-marea-subsea-cables/#:~:text=The%20Dunant%20subsea%20cable%20became,in%20the%20U.S.%20with%20France; Submarine Cable Networks (n.d.). Dunant. Available online at: https://www.submarinenetworks.com/en/systems/trans-atlantic/dunant; Submarine Cable Networks (2019) Complete List of Google's Subsea Cable Investments. Available online at: https://www.submarinenetworks.com/en/insights/complete-list-of-google-s-subsea-cable-investments.

66 Information Technology and Innovation Foundation (2019). Submarine Cables: Critical Infrastructure for Global Communications. Available online at: https://www2.itif.org/2019-submarine-cables.pdf

67 Submarine Telecoms Forum (2023). 2022/2023 Industry Report. Available online at: https://subtelforum.com/submarine-telecoms-industry-report-11th-issue-now-available/.

3.1.2 Consortium

3.8 In a consortium or multi-investor model, multiple industry players, which can encompass both private and public investors, collaborate to build a cable along a specific route and then share the ownership of the cable. Often, operators identify a need for data connectivity between different international landing points and then jointly contribute finances to meet the need.

3.9 Apart from the possibility of pooling together different sources of capital, another advantage of the consortium model is the sharing of risk among consortium members and the fact that a range of expertise is more readily available to the project. [68]

3.10 Traditionally, this has been the most common type of financing and ownership structure, and this remains the case. This was the only option before the deregulation and liberalisation of the telecommunications industry.[69] Historically, consortium cables were laid to connect the networks of incumbent state-owned telecommunications operators.[70]

3.11 The capital costs of the submarine cable are borne by the consortium members according to the terms stipulated in the Construction and Maintenance Agreement (C&MA). Each consortium member must provide guarantees associated with the investment and is then allocated capacity proportional to their capital contribution (Minimum Investment Units, MIUs) and participation (Minimum Assignable Units, MAUs).

3.12 As each consortium member maintains its separate legal status, contractual relationships are managed either through the designation of one of the parties as the "central billing party", responsible for performing all billing and associated financial functions, or set up separate invoicing and billing agreements with each consortium member.

3.13 Landing stations are typically not included in the total cable investment but are owned by a consortium member who bears the total cost of constructing and operating its landing station.[71] In some instances, the landing partners are reimbursed over the lifetime of the cable, as each connected cable operator is required to pay a monthly fee for the use of the landing station.

3.14 Consortia benefit from the division of risk amongst the members. Any risk arising from the submarine cable project, along with any associated costs, is divided among the members, which reduces the firm-level risk. Main cost risk factors include increased project costs, delays, and technical risks such as cable breakage and damage.

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68 Reverdy, D. and Skenderoski, I. (2015). Submarine Cables: Structuring and Financing Options, Salience Consulting. Available online at: https://salienceconsulting.ae/wp-content/uploads/2018/09/Submarine_Cables_Structuring_and_Financing_Options_Jan_2015.pdf.

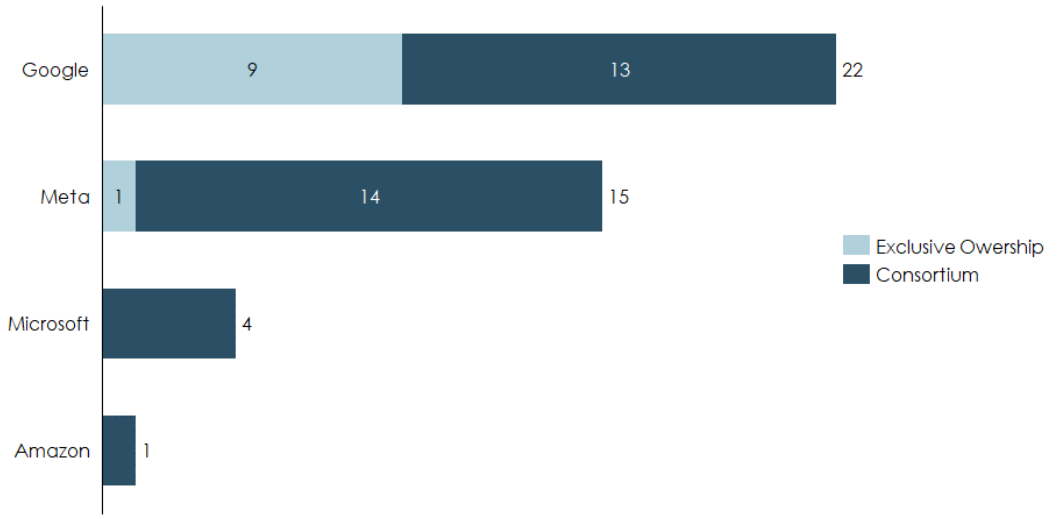
69 Van Zinnicq, C. (2022). Perspectives on the Financing of Submarine Cable Projects, Submarine Telecoms Forum. Available online at: https://subtelforum.com/perspectives-on-the-financing-of-submarine-cable-projects/.

70 Salience Consulting (2015). Submarine Cables: Structuring and Financing Options. Available online at: https://salienceconsulting.ae/wp-content/uploads/2018/09/Submarine_Cables_Structuring_and_Financing_Options_Jan_2015.pdf.

71 Ibid.

3.15 While being pioneers of the single investor model, hyperscalers have also privileged the consortium model (see Figure 8, which allows them to diminish the unit cost of the fibre cables and facilitates the handling of national regulatory issues, especially in relation to permitting landing rights. As no comprehensive and international regulatory framework exists that ensures balanced and common conditions on landing and accessibility rights, submarine cable project promoters often join consortia with national partners on each landing site to speed up and efficiently manage procedures of obtaining permissions and licenses on building or landing submarine cables.

Figure 8
Hyperscalers primarily utilise the consortium model
Number of cables in which hyperscalers invested as of October 2023



Source: Copenhagen Economics based on TeleGeography data

3.16 There is general agreement across the industry experts interviewed regarding the benefits and downsides of the consortium model. While there are well-established benefits related to resources and capabilities pooling and risk sharing, compared to the single ownership model, decisions may be more time-consuming and difficult to coordinate. This is because consensus must be formed amongst the consortium members before a decision can be made or an action taken. This can be challenging when it concerns repairs, end of life, and decommissioning decisions, as parties can have evolved significantly and in different directions throughout the lifecycle of a cable. The consortium members will also need to manage conflicts of interest.

3.17 We present a case in which a consortium model brings together different entities with overlapping connectivity requirements with reference to the INDIGO cables connecting Australia to Singapore, see Box 2.

Box 2 Case Study INDIGO Two submarine cables owned by a 6-member consortium

The INDIGO submarine cable system spans 9,000 km and comprises two distinct cable projects: INDIGO-Central and INDIGO-West. INDIGO-West is 4,600 km long and connects Singapore to Perth via Jakarta; INDIGO-Central is 4,850 km long and connects Perth to Alexandria, near Sydney. The cables have been Ready For Service since the end of May 2019.

The INDIGO consortium brings together members with different backgrounds, capabilities, and objectives. Traditional telecom operators such as Singtel, Telstra, and Superloop collaborated with internet service provider Indosat Ooredoo, hyperscaler Google, and the Australian Research and Education Network (AARNet). Alcatel Submarine Networks (ASN) served as the systems supplier. AARNet highlighted the system's critical support for the future growth of data-intensive collaborative research and cross-border education.

The cable delivers key educational and societal benefits, as it provides critical infrastructure to support future growth in collaborative, data-intensive science projects. For example, the cable supports advancements in scientific research at the Square Kilometre Array (SKA) telescope system in Australia, and played a role in the discovery of the Higgs boson particle at the CERN Large Hadron Collider in Switzerland.

The cable system utilises new spectrum-sharing technology so that each consortium member will have the ability to independently take advantage of technological advancements for future upgrades and capacity increases on demand.

Sources: Submarine Cable Networks (n.d.). INDIGO. Available online at: https://www.submarinenetworks.com/en/systems/asia-australia/indigo; AARNet (2019). INDIGO subsea cable system between Australia and South East Asia now commissioned and is ready for use. Available online at: https://www.aarnet.edu.au/indigo-subsea-cable-system-between-australia-and-south-east-asia-now-commissioned-and-is-ready-for-use.

3.18 Consortia are also the most used vehicles for public participation in submarine cable ventures. In a public private partnership (PPP), a public entity and a private entity enter a long-term contract for the provision of a public good or service in which they share risk, management responsibility, and performance-based compensation.[72] This type of partnership brings benefits to all stakeholders in the submarine cable value chain, especially in complex international telecommunications projects. This is because the involvement of public entities can facilitate permitting procedures and landing rights and encourage local support for the project. At the same time, private investor participation reduces project risk for the public sector by ensuring technical expertise, industry knowledge, and operational capabilities, and by often constituting the customer base of capacity on the cable. Ultimately, a consortium with public participation can also lower the total cost of ownership for both parties.[73] We elaborate further on how public participation can take place in Section 4.

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[72] The World Bank (2022). What is a PPP: Defining "Public-Private Partnership". Available online at: https://ppp.worldbank.org/public-private-partnership/what-ppp-defining-public-private-partnership.

[73] Reverdy, D. and Skenderoski, I. (2015). Submarine Cables: Structuring and Financing Options, Salience Consulting. Available online at: https://salienceconsulting.ae/wp-content/uploads/2018/09/Submarine_Cables_Structuring_and_Financing_Options_Jan_2015.pdf.

3.1.3 Special Purpose Vehicle

3.19 Special Purpose Vehicles (SPVs) are distinct legal entities that are created to fulfil narrow, specific or temporary objectives. SPVs are typically used by companies to insulate the parent entity from financial risk. In this context, the ownership of SPVs can comprise private investors, public investors, cable users (mobile and fixed telecom companies, international telecom operators needing transit), or any combination of the three.

3.20 Although the SPV confers distinct legal status to the organisation formed to own the cable, the parent entities must form a consensus amongst themselves in a manner similar to a consortium. In terms of project financing, SPVs may also be granted debt financing concerning the parent entities. The creditworthiness of the parent entities becomes relevant to a project's lenders as they consider how to hold each entity liable. Some of the distinctive features of consortia and SPVs are summarised in Figure 9.

Figure 9
Consortia and SPVs: two possible business models with different features

	Consortium	SPV
Legal status	**Each participant retains its separate legal status** The consortium is formed by contract. Each member is responsible to the group only in respect to the obligations set out in the Consortium Agreement	**A new entity is formed** The parties agree to create a new entity for a specific project only
Decision making process	**Potentially lengthy** Potentially time-consuming decision-making process since consensus is required	**Fast and efficient** Faster decision-making process since consensus amongst several members is not necessarily needed.
Contractual relationships	**Different options available** The consortium can designate a central billing party responsible for performing all financial functions or set up separate invoicing and billing agreements with each consortium members	**Directly managed by the SPV** SPVs are capable of contractual relationships because of their legal status.
Risk sharing	**Risk is shared** The risk is shared amongst consortium members	**Risks are entirely assumed by the SPV** Parent companies form SPV to isolate the financial risks associated with the project from its main business

Source: Copenhagen Economics, based on interviews

3.21 Insofar as the parent entities establish a distinct entity or organisation for the purposes of ownership and management, SPVs constitute a specific form of financing and ownership in the context of submarine cables. The establishment of a separate legal entity is the primary point of distinction between consortia and SPVs. EllaLink and FNF are instances of SPV ownership in submarine cables.

3.22 Like consortia, SPVs allow private and public entities to come together under one umbrella when investing in, developing, and managing a submarine cable system.

3.23 Occasionally, submarine cable projects can involve public participation taking advantage of both a consortium and SPV structure simultaneously. This was the case with the ACE submarine cable along the West African coast, where the public contribution from several government bodies amounted to more than 50 percent of the total. We discuss the specific case of the Africa Coast to Europe (ACE) cable, which constitutes an SPV that is also a PPP, see Box 3.

Box 3 Africa Coast to Europe (ACE): Public participation through consortium and SPV structure

The Africa Coast to Europe (ACE) submarine cable spans 17,000 km and traverses the west coast of Africa, connecting 19 countries. ACE was the first submarine cable link to be established in seven African countries, including the Gambia, Guinea, Equatorial Guinea, Liberia, Mauritania, Sao Tome and Principe, and Sierra Leone.

Managed by a consortium of 20 members, the cable entailed a total investment of USD 700 million and included financial support from the West African Regional Communications Infrastructure Program. In the construction of the ACE cable, the World Bank also made a significant financial contribution by extending a grant of USD 35 million to Gambia Submarine Cable Co. Ltd.

The public private partnership entails elements of both a consortium and an SPV. The consortium includes technical partners such as ASN and telecom operators like Orange, but also government bodies, such as the République de Guinée Equatoriale.

The consortium also includes SPVs specifically created to join this consortium. One of the consortium members is the Gambia Submarine Cable Co. Ltd, which is an SPV established by Global System for Mobile Communications, internet service providers, the Government of Gambia, and the Gambia Telecommunications Company. Additionally, STP Cabo is a PPP SPV created specifically to incorporate Sao Tome and Principe, one of the world's smallest economies. Also, Benin's involvement in the ACE consortium was managed via a local SPV named Benin ACE GIE, a joint venture which includes local mobile operators and internet service providers.

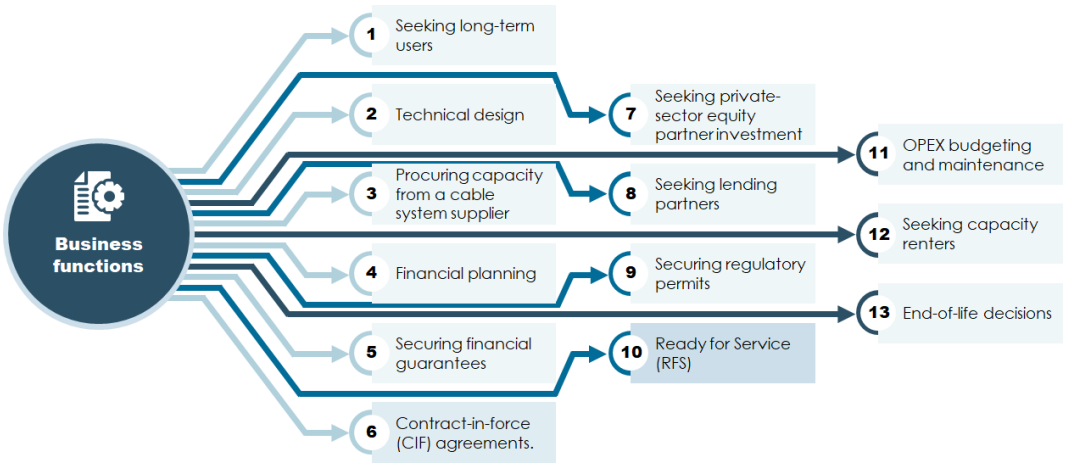
This example illustrates the fluid nature of PPPs, which often require the cooperation of many public and private entities. In the case of the ACE submarine cable, the privately owned members of the consortium benefitted greatly from the involvement of public authorities, as they have influence over the rights to deploy the ICT infrastructure in their countries.

Sources: Submarine Cable Networks (n.d.). ACE. Available online at: https://www.submarinenetworks.com/en/systems/euro-africa/ace; Ministry of Information, Communication, and Information Technology (The Gambia) (2017). West Africa Regional Communications Infrastructure Program (WARCIP) Financial Statements & Reports For Sixteen Months Ended 30th April 2017. Available online at: https://documents1.worldbank.org/curated/fr/974961511168226747/pdf/WARCIP-2017-FINANCIALS-FINAL-PRINTING-27-06-2017-With-Signatures.pdf; Reverdy, D. and Skenderoski, I. (2015). Submarine Cables: Structuring and Financing Options, Salience Consulting. Available online at: https://salienceconsulting.ae/wp-content/uploads/2018/09/Submarine_Cables_Structuring_and_Financing_Options_Jan_2015.pdf.

3.2 Submarine cables involve a range of business functions

3.24 Consolidating input from various interviews, we identified 13 core business functions that the entities active as project developers of submarine cables must execute throughout the lifecycle of a cable, see Figure 10.

Figure 10
Business functions to be performed over the lifetime of the project



Source: Copenhagen Economics, based on interviews

1. **Seeking long-term users**. Long-term users are also known as anchor tenants as they commit to purchasing a portion of the cable's capacity *before* the cable is Ready For Service.
2. **Technical design**. This design can include the scope for branching that can unlock further revenue once the cable is Ready For Service.
3. **Procuring capacity from a cable system supplier**. Examples of such suppliers include ASN, SubCom, etc.
4. **Financial planning**. Such planning includes, but is not limited to, break-even analysis, calculating the internal rate of return (IRR), cash flow forecasting, etc.
5. **Securing financial guarantees** to support the agreement with the cable systems supplier. These guarantees document evidence of funds and intent to construct the cable.
6. **Concluding the agreement with the cable systems supplier**. This entails reaching contract-in-force (CIF) agreements.
7. **Seeking private sector equity partner investment** and negotiating terms. This can include forming a consortium and agreeing on terms for management activities.
8. **Seeking lending partners**. Creditors may want to see evidence of financing from other equity partners and anchor tenants before agreeing to provide funds.
9. **Securing regulatory permits**. Permits are required for each landing jurisdiction. The authority to grant licenses for the construction of digital infrastructure lies with individual member states. These activities may be managed by telecom companies who also act as landing partners.
10. **Ready For Service (RFS)**. Once the above-mentioned functions have been executed and completed, the cable is deemed Ready For Service and can commence transmitting data.
11. **OPEX budgeting and maintenance**. Once a cable is operational, maintenance issues may arise. These can include damage that necessitates repair work and ongoing maintenance activities.

12. **Seeking capacity renters**. Cable owners also seek short-term capacity renters for unused capacity. Such connectivity is time-limited and can complement cash flows for long-term renters.
13. **End-of-life decisions**. Submarine cables typically have a useful life of between 20 and 25 years. Beyond this point, the owners must decide between extending the life of the cable by carrying out maintenance and overhaul activities or decommissioning the cable.

3.25 The business functions that precede the RFS date are highly interrelated. Securing pre-sales commitments from anchor tenants, booking capacity from system suppliers, developing and fine-tuning sound technical and financial planning, and attracting investors are interrelated activities that carry a risk of a multi-sided "chicken-and-egg" problem (see Figure 11, which is typical of project financing. Project developers must mitigate these issues in the initial stages.

3.26 Seeking anchor tenants is one of the most crucial business functions. Typically, a planned system has at least one anchor tenant. This is a prerequisite for obtaining credit financing and commencing operations. A share between 30 and 50 percent of the system capacity (nowadays often at fibre pair or spectrum level) is typically pre-sold at the time of the initial debt and/or equity funding. It is a prerequisite for manufacturers to "accept" the order.[74] Preferential terms and discounts are offered to incentivise early uptake and down payment. This down payment, in turn, reduces the finance costs that cable owners must bear.

3.27 The participation of anchor tenants reduces the risk for other tenants to commit and purchase capacity. This creates a circuitous chicken-and-egg problem wherein prospective customers wait for anchor tenants and investors to join before agreeing to commit their own funds. This chicken-and-egg problem also concerns the engagement of other equity partners and cable suppliers, who would prefer to invest their resources in a project that is already well-funded by customer contracts.

3.28 Considering the above, ensuring the commitment of anchor tenants, system suppliers and equity partners is the most significant challenge for the project promoters of submarine cables. A new submarine venture should seek to balance the involvement and commitment of these different stakeholders almost simultaneously to achieve project maturity.

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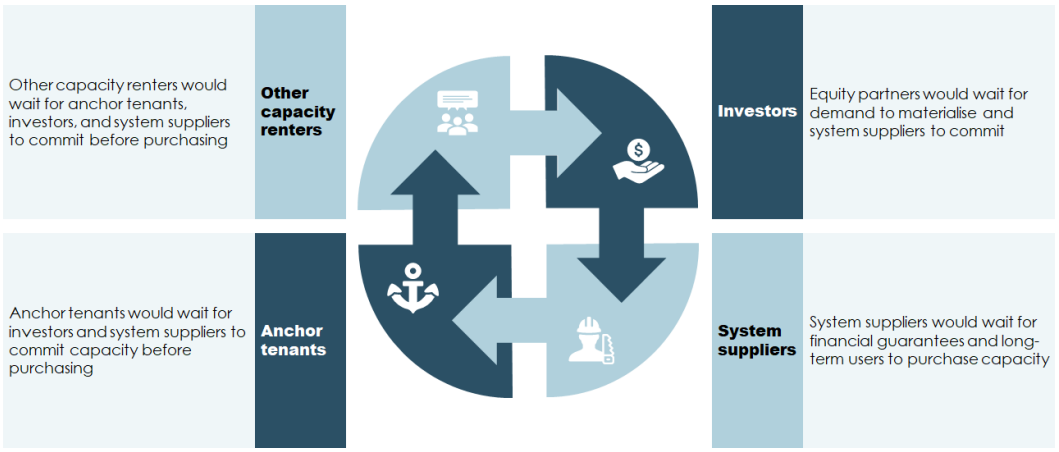
74 Interviews conducted by Copenhagen Economics.

Figure 11
Project financing chicken-and-egg problem



Source: Copenhagen Economics

3.29 Assessing future demand from anchor tenants when building a new infrastructure project is paramount to ensure that the project meets the requirements and expectations of the market. However, this can be difficult with innovative infrastructures or unexplored routes, as is the case with Polar Connect that entails new sensing technologies and crosses unchartered waters. The experience of Open Season-type processes in the energy sector and infancy or emerging markets such as the green hydrogen market can provide a guide for Polar Connect, see Box 4.

Box 4 Open Season-type procedures to assess market demand and de-risk infrastructure investments: the experience of the energy sector

Open Season-type procedures are non-legally binding dialogues well known and employed in the development of gas infrastructures to assess market demand and thus de-risk the projects before investment decisions.

Open Season-type processes stimulate dialogue with potential future users and thus support the project promoters in designing an infrastructure that is scaled to meet a future, long-term demand. The purpose of the Open Season-type processes is to assess long-term demand and investment signals in an open, non-discriminatory way before the investment decision is taken and the infrastructure is built.

These procedures have been extensively used in the gas market. For instance, in Denmark for the Green Gas Lolland-Falster project, and for the Baltic Pipe connection between Norway and Poland. In the hydrogen market, the Belgian Fluxys has embraced Open Season procedures for point-to-point pipelines around Antwerp, Gent, Liège, etc.

Engaging in such dialogues, project promoters can de-risk infrastructure investment. As for the market for green hydrogen, the demand for connectivity in the Arctic remains underdeveloped. The public sector can play an active role when it comes to reducing the risks involved in establishing such infrastructure. By assessing current demand and engaging with present-day users (as identified by an Open Season process), the public sector can limit its own upfront risk.

Source: Copenhagen Economics (2023). A market design fit for purpose. How to maximise the value of the North Sea's wind resources. Available online at: A market design fit for purpose (cipfonden.dk)

3.30 Once the cable is deployed and operational, submarine cable project developers must also be prepared for contingencies and unforeseen events. Cable damage can be difficult to predict or prevent. Large nets cast by fishing trawlers, anchor drops by ships, or natural disasters can dislodge, damage or break cables. Cable faults can occur when the copper sheath conducting electricity is exposed to water or when cable fibres are crushed or broken. Specialised shipping vessels must be dispatched to retrieve the damaged or faulty cables and repair or replace them. These repairs can be costly and time-consuming. As referred to in Section 1.3.1, these costs can be even higher for Arctic cables.

3.31 The end of a submarine cable's life cycle also involves several decisions on the part of the cable project developers. Submarine cables typically have a useful economic life of 20 to 25 years. Older submarine cables are typically rendered obsolete or inefficient after a few years of use. There is no global convention that mandates the removal of unused or decommissioned cables from the ocean floor. After the cable's useful life is exhausted, the owner is faced with several options. Most cable owners take no further action: it is estimated that 94 percent of unused submarine cables lie abandoned on the ocean floor. However, submarine cable owners can opt to invest in extending the cable's operational life. They can also opt to recover the cable and recycle the material used. Lastly, they can also choose to relocate the cable to an area where relocation might be cost-effective relative to laying a new cable.

Box 5 Ancillary business functions

Submarine cable deployment projects entail complex contractual arrangements, starting with the non-disclosure agreement (NDA), followed by the memorandum of understanding (MOU), the Joint Build Agreement (JBA) governing relations between the various entities forming part of a consortium, and finally the construction and maintenance contract (C&MA). Hence, procuring the legal expertise to oversee these contracts also becomes a relevant, albeit ancillary, business function for submarine cables.

Sales and marketing activities are also relevant in the planning and preparation stage. Submarine cable project developers attend conferences, seminars, and workshops to generate awareness and interest in the project. Sales and marketing efforts are crucial in generating capacity pre-sales and attracting anchor tenants and lenders. These are, in turn, key sources of finance.

Sources: Escolano, M. L. (2022). The Legal Status and Applicable Regime of International Submarine Cables. Available online at: https://subtelforum.com/legal-status-of-submarine-cables/ and interviews conducted by Copenhagen Economics.

3.3 Submarine cable owners can choose various remuneration models based on capacity purchase options and contractual agreements

3.32 Once a submarine cable is deployed, the owners can either sell capacity (or transmission network capabilities)[75] to other users on a long-term or short-term basis, or utilise the capacity themselves, as seen with hyperscalers.

3.33 Cable owners can sell capacity on their cables through i) capacity leases; ii) fibre pair ownership sales; or iii) spectrum-sharing solutions. These three solutions differ in terms of operational aspects and offer customers different degrees of control and management of the purchased capacity. We elaborate on these three options below.

3.3.1 Options for purchasing capacity

Capacity-based purchase

3.34 One of the options available to customers to procure capacity is leasing or purchasing "lit" fibre capacity on a third party's fibre-optic cable network. In this way, the purchaser of capacity does not have to "light" the fibre using its own equipment and instead can start using the service on day one.

3.35 This option is relatively simple and convenient as the lit fibre networks are ready to plug and play and do not require much management effort given that installation, maintenance, and upgrades are usually managed by the service provider. On the other hand, this option offers limited flexibility and control if capacity requirements change.

Fibre pairs ownership

3.36 Submarine cables are comprised by several fibre pairs. The long-term lease of a full fibre pair offers the entire spectrum capacity available on that pair. At present, the remuneration framework of the fibre pair ownership model is akin to the "condominium" model in real estate development, wherein construction culminates in the sales of designated portions of capacity to individual buyers, generally ISPs.[76]

3.37 Unlike the managed capacity services described in the paragraphs above, fibre pair ownership entails full control and management of the fibre pair. This allows for greater flexibility and scalability.

Spectrum Sharing

3.38 Spectrum sharing is a technological innovation that utilises virtualisation to partition the optical spectrum in a submarine optical fibre pair among multiple different end-users.[77] As such, each end-user sees only its own dedicated "virtual" fibre pair, which is a subset of the overall spectrum of the same, shared physical fibre (see Figure 12 for an illustration).

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[75] With the advent of new technologies, new business models are being proposed based on optical technology capabilities, where customers who previously may have purchased wavelength capacity, are seeking increased control of the technology being used.

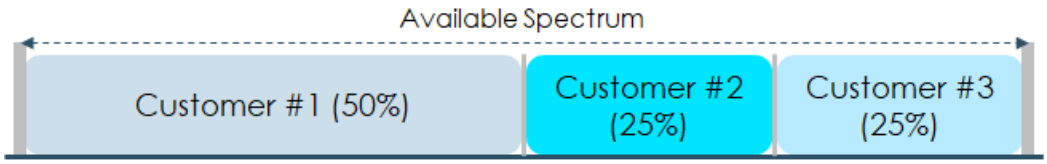
[76] Interviews conducted by Copenhagen Economics.

[77] Ciena (n.d.). What is spectrum sharing? Available online at: https://www.ciena.com/insights/what-is/What-Is-Spectrum-Sharing.html.

3.39 Spectrum sharing enables end-users to purchase or lease capacities greater than a few wavelengths yet less than a full fibre pair.[78] It represents a middle-ground solution between the limited capacity and control in a capacity-based purchase that customers may find not flexible, and the high capacity and control offered in a fibre pair that customers may deem complex to manage and expensive.[79]

3.40 Spectrum sharing provides flexibility to end-users and further monetisation options to submarine cable owners. Recent advancements in the underlying Submarine Line Terminating Equipment (SLTE) technology ensure that the virtualisation is secure and changes in one end-user's spectrum do not impact other end-users.[80]

Figure 12
Spectrum allocation



Note: Illustrative
Source: Copenhagen Economics based on Ciena (2020). Ciena Spectrum Sharing Handbook. Available online at: https://media.ciena.com/documents/Ciena_Spectrum_Sharing_Handbook+_1_.pdf?utm_campaign=X1411821.

3.3.2 Contractual agreements

3.41 Often, much of the total cash flow is generated shortly after the RFS date, when the capacity is successfully tested and operational, or can be sold.

3.42 Typically, capacity (in all its forms: lit capacity, fibre pairs, and spectrum) is sold through i) long-term contractual agreements, "indefeasible rights of use" (IRUs), or ii) short-term leases (typically of 12, 24 or 36 months).

3.43 Under an IRU, the purchaser of capacity has an unrestricted and exclusive right to use a specified amount of capacity or bandwidth on the cable system for an agreed period for any lawful purpose, including subleasing to a third party. The duration of IRUs can correspond to the useful economic life of the cable (up to 20 years). Hence, IRUs essentially amount to a transfer of the rights of use of the specified portion of the cable's capacity.

[78] Fibre Systems (n.d.) Connecting continents. Available online at: https://www.fibre-systems.com/feature/connecting-continents.
[79] Ciena (2020). Ciena Spectrum Sharing Handbook. Available online at: https://media.ciena.com/documents/Ciena_Spectrum_Sharing_Handbook+_1_.pdf?utm_campaign=X1411821.
[80] Ciena (n.d.). What is spectrum sharing? Available online at: https://www.ciena.com/insights/what-is/What-Is-Spectrum-Sharing.html.

3.44 Typically, fees are paid as a lump sum when the capacity is available to the IRU contract owner. During the term of the IRU, the customer pays the network owner an annual amount for "operation and maintenance," which is typically between 2.5 and 4.0 percent of the IRU fee.[81]

3.45 Submarine cable owners also generate cash flow through short-term leases. Short-term leases are time-limited and are offered to tenants for a shorter period (usually between 12 and 36 months). Short-term leases are usually offered when there is spare capacity on a cable that is already operational. They also allow for the optimisation of revenue streams. Consistent with a “condominium model”, generally, short-term leases are more costly than longer-term agreements, which bear more risks related to the uncertainty of long-term commitments. Also, lower prices on long-term leases are consistent with the logic of incentivising long-term access seekers before RFS to demonstrate the viability and bankability of the project and engage with system suppliers and investors, as discussed in Section 3.2.

[81] Submarine Telecoms Forum (2022). Perspectives on the Financing of Submarine Cable Projects. Available online at: https://subtelforum.com/perspectives-on-the-financing-of-submarine-cable-projects/

CHAPTER 4

IMPLEMENTATION OF A FUNDING MODEL FOR POLAR CONNECT

OBJECTIVE OF THE CHAPTER	KEY FINDINGS AND TAKEAWAYS
This chapter sets out key implementation aspects related to the public funding of Polar Connect and outlines the role of public intervention in shaping the financing structure of Polar Connect. This chapter provides an overview of the EU funding initiatives that are directed to provide financial support to large-scale infrastructure projects in the digital sector and could therefore co-fund Polar Connect.	• There are three main routes to the public financing of Polar Connect: o the Anchor Tenant Model o the Tender Model o the Direct Procurement Model • There are several funding initiatives promoted by the EU which could be used to source the public funding for the investment. These initiatives include CEF funding, Global Gateways initiatives, funding from the EIB, and IPCEI State aid.

This chapter sets out key implementation aspects related to the public funding of Polar Connect and outlines the role of public intervention in shaping the financing structure of Polar Connect. The assessment of implementation paths for different options draws on the experience of investment models employed to finance other submarine cable projects. This covers both:

- the large set of private sector-led experiences analysed in Chapter 3, reflecting the role of private investment over the past decades;
- the smaller but more relevant set of cases where public intervention is the key driving force in the development of new submarine cable systems.

Our assessment finds that there are three possible paths for engaging public funding in the Polar Connect initiative: The Anchor Tenant Model, the Tender Model, and the Direct Procurement Model, see Table 2.

Table 2
Overview of the three models for public funding intervention in Polar Connect

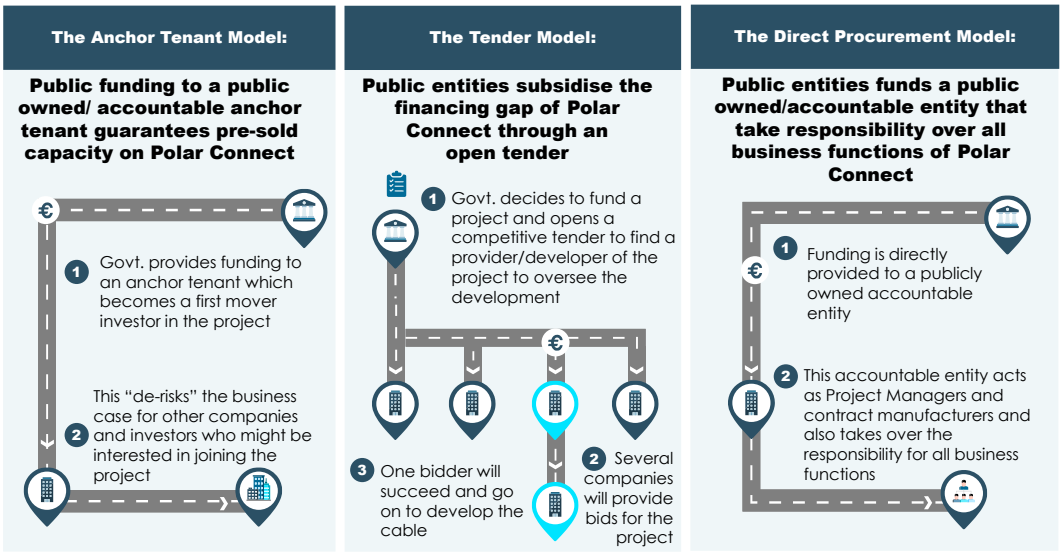
	ANCHOR TENANT MODEL	TENDER MODEL	DIRECT PROCUREMENT MODEL
Public funding mechanism	Funding provided directly to a publicly-owned company	Funding provided through a public tender – the winning bidder receives the public funds	Funding provided directly to a publicly-owned company
Involvement of private investors	Other private investors will be incentivised to join the project due to the anchor tenant de-risking business case	No other private investors will be involved in the project	No other private investors will be involved in the project
Ownership model	Ownership divided among investors equivalent to their respective shares of the investment	The winning bidder owns the infrastructure, however, profits from using the infrastructure may be capped due to a claw-back mechanism to ensure compliance with EU State aid regulations	The infrastructure will be publicly-owned and the funded company will be responsible for operations and other business responsibilities
Business operation responsibility	Business responsibilities are decided upon by the investor group and decision-making is divided according to investment size	The winning bidder is responsible for business decisions (potentially subject to conditions specified in the tender)	The funded entity operates as a Project Manager and takes responsibility for all other business functions

Source: Copenhagen Economics

4.1 Public funding intervention: three possible paths for Polar Connect

4.1 We have identified three possible (non-exhaustive) archetypes of financing interventions to make the Arctic submarine cables a reality: the Anchor Tenant Model, the Tender Model, and the Direct Procurement Model. All three models rely on government funds to support the development of the infrastructure, but the three models have different approaches to how public funding is incorporated and how ownership and business responsibilities are split, see Figure 13.

Figure 13
Public funding intervention: three possible paths for Polar Connect



Source: Copenhagen Economics

4.2 The three funding models each engage public funding in different ways, either through providing direct funding to an undertaking or by allocating funds through a tender service. Each funding model also relies on slightly different governance structures regarding how decision-making responsibilities and ownership are split. These differences make it possible for each potential project to identify the model that best suits the needs of the investment project.

4.3 In addition to the three funding models, there are also potential opportunities for public funding to support the SMART functionality of Polar Connect specifically. The scientific sensors that will be integrated into the fibre-optic cables' signal repeaters could warrant public funding devoted to scientific research, such as that provided by Horizon Europe, the EU's research and innovation programme for 2021-2027. Currently, there is no evidence in the literature or previous cases for a financing model that would combine two funding streams, one for a submarine cable and one for a research project integrated into the same infrastructure. Such evidence would serve as the basis for understanding potential opportunities and/or complexities which might result from this type of co-financing model.

4.4 In the following sections (including Chapter 5), we therefore explore funding mechanisms and potential public support that consider the Polar Connect cable as one project, combining its sensing and telecommunication capabilities in one single infrastructure.

4.1.1 The Anchor Tenant Model: Public funding to a publicly-owned/accountable anchor tenant guarantees pre-sold capacity on Polar Connect

4.5 The first model for public intervention for Polar Connect is the Anchor Tenant Model. In the Anchor Tenant Model, the public sector provides funding to a publicly-owned and accountable entity that acts as the anchor tenant. The concept of an anchor tenant originally stems from retail shopping centres and refers to a large department store or brand, an anchor tenant, which is likely to draw substantial numbers of customers to the shopping centre. Because of the store's potential to draw customers, they might be offered better terms on their lease. This in turn also incentivises and encourages smaller shops to take up a lease in the shopping centre. The Anchor Tenant Model is used in the context of large-scale infrastructure and investment projects where the involvement of an anchor tenant creates a positive externality as it stimulates demand for investment.[82]

4.6 In the case of submarine cables, public funding to an anchor tenant is used to back the purchase of pre-sold capacity. Anchor tenants will ensure pre-sold capacity, thus resulting in initial positive cash flows that will unlock manufacturing financing and de-risk the business case for equity and lending finance to commit and support the project.

4.7 The Anchor Tenant Model was used previously by the EllaLink submarine cable which links Europe to South America through Portugal and Brazil. In this case, Latin American and European NRENs acted as anchor tenants, which ultimately incentivised additional investment from equity investors. These NRENs partnered in the BELLA (Building the Europe Link to Latin America and the Caribbean) consortium, which aims to improve digital interconnectivity and create a common research area for the European Union and Latin America. The construction of the EllaLink submarine cable system represents one of the main elements of the BELLA programme. The European Commission co-funded the BELLA programme through the European NREN Association, GÉANT. The funding was provided through Horizon 2020, DG CONNECT, DG DEVCO and DG DEFIS.[83]

4.8 Public support for the project was also validated by the contribution that the EllaLink cable has made to earth observation, especially through the Copernicus programme.[84] Indeed, the cable allows a much larger volume of earth observation data and information to be shared at a higher speed, thereby bolstering its uptake by users on both sides of the Atlantic.

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82 See: NBER (2002) University research, Industrial R&D, and the anchor tenant hypothesis. https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=fe691e3aeb54df667770acacc0a4573443fbf031 ; and Oxera (2013) Feasibility and implications of a shared fibre access model in UK towns and cities https://www.oxera.com/wp-content/uploads/2018/03/Feasibility-and-implications-of-a-shared-fibre-access-model-3.pdf

83 See: Géant, Connect online (2020). Connecting Europe and Latin America for the next 25 years, 9 December 2020. Available online at: https://connect.geant.org/2020/12/09/connecting-europe-and-latin-america-for-the-next-25-years

84 See: European Commission, BELLA – Building the Europe Link to Latin America. https://international-partnerships.ec.europa.eu/policies/programming/programmes/bella-building-europe-link-latin-america_en

> The Commission co-funded the Building the Europe Link to Latin America (BELLA) programme with a total of EUR 26.5 million. The EUR 18.5 million dedicated to co-funding a submarine cable connecting Portugal and Brazil secured the participation of the Commission as an anchor tenant to the EllaLink project. The remaining EUR 8 million were dedicated to the co-funding of terrestrial connectivity with Brazil, Argentina, Chile, Ecuador, Panama. Latin America's contribution amounted to EUR 27.2 million. An extension of the network (BELLA II) is underway, for which the Commission is contributing EUR 13 million.

Source: Answer given by Thierry Breton on behalf of the European Commission, 29 September 2023. Available online at: https://www.europarl.europa.eu/doceo/document/E-9-2023-001444-ASW_EN.pdf

4.1.2 The Tender Model: Public entities cover the financing gap of Polar Connect through an open tender for the lowest subsidy

4.9 The second model for public intervention for Polar Connect is the Tender Model, which is largely based on the model for public funding often used for sustainability infrastructure projects such as wind farms.[85] In this model, a government or a national authority allocates a pre-defined amount of funds to support a project of national interest through a competitive tender process. The winning bidder in the tender process would own and operate the infrastructure. In the case of submarine cables, the bidders could be, for example, telecom operators who can contract cable manufacturers to develop submarine cables.

4.10 Since the Tender Model involves the use of State resources to support an undertaking, it is necessary to consider State aid and ensure compliance. To ensure compliance with State aid regulations several factors need to be considered when designing a mechanism or tender for providing public funds (more details about State aid compliance can be found in Section 5.1 of this report).

4.11 *First*, it is necessary to identify the objective or purpose of the aid. This includes identifying the market failure which is preventing the project from being developed without additional financial support and aligning the objective of the potential financing with the relevant principles of the State aid guidelines in the EU, e.g., the principles of the Broadband Guidelines.[86]

[85] See for example State aid cases: SA.57858; SA.38758; SA.102871 and SA.60596

[86] European Commission (2023). Guidelines on State aid for broadband networks (2023/C 36/01). Available online at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52023XC0131(01)

4.12 *Second,* the allocated funds must be proportionate and limited to the minimum amount necessary. Along with a competitive tender, bidders can provide evidence of their business case for the project which details the estimated financing gap. Developing a detailed financing gap analysis is complex and it is therefore important that bidders can support the key components and assumptions of the assessment, including future revenues, future costs, discount rate (rate of return/WACC), and a credible counterfactual scenario.

4.13 The Tender Model was employed in Norway in 2019, when the Norwegian Communications Authority, Nkom, opened a tender for an alternative pathway for electronic communications traffic due to overreliance on existing connections between Oslo-Stockholm-Copenhagen, see Box 6.

Box 6 Norwegian public tender case

In 2019, the Norwegian government allocated NOK 100 million of the state budget to fund new submarine fibre cable projects. Funding was awarded following a tender procedure and aimed at creating additional secure and robust routes to improve traffic management. This aid measure was deemed compatible with State aid guidelines by the EFTA Surveillance Authority (ESA).[87]

Objective of the aid:
The objective of the measure is to build an alternative cable system to strengthen national security by reducing Norway's vulnerability in the case of the failure of the existing infrastructure. The cable is also intended to be used actively for internet traffic and therefore should not only be held in reserve as a back-up in case of emergency.

Incentive effect:
The results of market research and public consultations found that there was no market operator currently investing or planning to invest in building an alternative pathway. To show the incentive effect, bidders provided an NPV analysis of the fibre pair and their required rate of return which demonstrated the funding gap.

Proportionality:
In this case, proportionality, i.e., limiting funding to the minimum amount necessary, was ensured through five safeguards:

- Detailed mapping of the problem and close and continuous dialogue with the industry;
- The use of a competitive selection procedure to select the most economically advantageous offer;
- Limiting financial aid to the reserved fibre pair;
- Passive and active wholesale access to the subsidised infrastructure;
- Monitoring and a clawback mechanism to prevent excessive profits.

Source: ESA (2019). Alternative pathway for electronic communications traffic 065/19/COL. Available online at: https://www.eftasurv.int/state-aid/state-aid-register/alternative-pathway-electronic-communications-traffic

[87] ESA monitors state aid granted by Iceland, Liechtenstein and Norway in order to allow fair competition and an open Internal Market in the European Economic Area.

4.1.3 The Direct Procurement Model: Public entities fund a publicly-owned/accountable entity that takes responsibility for all business functions to develop and run Polar Connect

4.14 The third model for public intervention for Polar Connect is the Direct Procurement Model. In this model, public funding is given to support a publicly-owned or accountable entity, for example, an NREN. This accountable entity acts as a Project Manager and contract manufacturer and takes responsibility for all business functions. Under this model, the accountable entity is not only the buyer of the cable infrastructure but is also required to have capabilities across the business functions required for operating and maintaining the cable. This model has been employed with seismic cables in Japan and for submarine cables built to transfer satellite images from Svalbard, Norway, see Box 7.

Box 7 Svalbard case

Svalbard, Norway, located north of the Arctic Circle, is an ideal location for downloading data from satellites. This requires efficient transfer of large amounts of data to the mainland which is best achieved through a cable connection.

The telecom operator in Svalbard had no commercial basis for investment in a submarine fibre cable of this type, which meant that the development of this project would not come to fruition solely through relying on commercial investment. As a result, Stiftelsen Norsk Romsenter (NRS – Norwegian Space Agency) stepped in and started assessing and planning the project in 2002. In addition to NRS, additional customers and partners included NASA, NOAA, KSAT, Andøya Rocket Range (today Andøya Space Center), Telenor, and Uninett.

Source: Space Norway (2022). The Svalbard fiber optic cable connection. Available online at: https://spacenorway.no/en/what-we-do/operational-infrastructure/the-svalbard-fibre-optic-cable-connection/

4.15 The Atlantic CAM project, the submarine telecommunication fibre-optic cable system that will connect the Portuguese mainland with the Azores and Madeira archipelagos in a ring, is another example of a project using the Direct Procurement Model, see Box 8. In this project, Portugal designated Infraestruturas de Portugal, SA (IP, SA) to develop and manage the Atlantic CAM project since no other company expressed an interest in doing so. As part of the agreement, Infraestruturas de Portugal received State support to develop the project.

4.16 Currently, the submarine cable infrastructure is still owned by the state of Portugal, but Infraestruturas de Portugal is fully responsible for the management of the cable and its operations. In this way, this project is fully aligned with the main characteristics described in the Direct Procurement Model.

Box 8 The Atlantic CAM project: safeguarding Portuguese territorial cohesion and introducing SMART cable technology for science and national protection

Continent/Azores/Madeira (CAM) is the submarine telecommunication fibre-optic cable system that connects the Portuguese mainland with the Azores and Madeira archipelagos in a ring. The Atlantic CAM cable, which will be Ready For Service in 2025, will integrate SMART technologies to observe the seabed to study climate change and will contribute to earthquake and tsunami hazard mitigation.

In 2020, the Portuguese government, after taking into consideration the obsolescence of existing cables (expected to occur in 2024) connecting the Azores and Madeira assigned to the 100 percent state-owned Infraestruturas de Portugal (IP Telecom) the management and maintenance of the Atlantic CAM cable. The government authorizes IP to launch pre-contractual and contractual procedures necessary for the implementation of the submarine cable system.

Infraestruturas de Portugal, SA (IP, SA), a public company that centralises infrastructures suitable for electronic communications in the road and railway public domains, was considered the appropriate entity to "take on and promote the conception, design, construction, exploration, operation and maintenance of the […] CAM ring".

Moreover, in its decree, the Portuguese government emphasised the multipurpose objective of the cable, emphasising that the replacement of the current submarine cable system should serve "to add new functionalities and services, such as seismic detection, environmental monitoring, support for national defence actions to control submarine activity in our Exclusive Economic Zone (EEZ)".

The total investment is estimated to amount to EUR 54.4 million. The decree emphasises that there will be recourse to "national public funds, up to a maximum amount of €100 million from the revenues of the '5G auction and other relevant bands'", using the price paid or to be paid by the entities to which they have been allocated rights to use frequencies.

Among the sources of financing to be obtained by IP Telecom are also loans to be made from the European Investment Bank (EIB) and other financial institutions, CEF Funding (EUR 40.5 million) and the use of the operating results of the submarine cable.

This project is expected not only to attract new connections but also to promote the location, in Portugal, of "digital platforms and data storage and computing centers, in the context in which their processing constitutes a fundamental factor of the digital economy".

Sources: Diário da República (2020). Despacho n.º 9333/2020, de 30 de setembro. Available online at: https://diariodarepublica.pt/dr/detalhe/despacho/9333-2020-144137764; Expresso (2022). Telecomunicações: Anacom transfere €35,8 milhões do 5G para a IP arrancar com novo cabo submarine. 13th December 2022. Available online at: https://expresso.pt/economia/2022-12-13-Telecomunicacoes-Anacom-transfere-358-milhoes-do-5G-para-a-IP-arrancar-com-novo-cabo-submarino-42c541af.

4.2 Several EU public funding streams are available for supporting digital infrastructure projects in the EU

4.17 This section addresses some of the funding initiatives throughout Europe which could be used to source public funding for the investment. These initiatives include CEF funding, Global Gateways initiatives, loans from the EIB, and IPCEI State aid. We focus on EU funding initiatives since, despite other countries, like the United States, Japan and South Korea, having also recognised the need for increasingly resilient and trusted digital connectivity, they have not devised targeted funding instruments to achieve this aim.

4.18 The EU has started to become a key political actor by providing financial support to digital infrastructure projects through the Connecting Europe Facility - CEF Digital funding mechanism.

4.19 The Digital part (the second and third parts are concerned with energy and transport) of the CEF allocates EUR 2.07 billion to digital networks and infrastructure over the 2021-2027 period. The launch and success of CEF Digital confirm that the EU is aware of the digital realm's political importance, especially concerning the deployment of very high-capacity and secure networks.

4.20 The latest call of CEF Digital includes a specific allocation (EUR 90 million) to support backbone connections "mainly via submarine cables, to improve the performance and resilience of connectivity networks in islands and seaside regions, as well as in remote, outermost and sparsely populated areas, and between the EU and third countries." [88]

4.21 In practice, CEF grants are budget-based grants that can reimburse up to 70 percent of eligible costs of project works, with the aim of "overcoming a financial gap generated by insufficient commercial viability, high upfront costs or the lack of market finance".[89]

4.22 The CEF Digital call is part of the broader Digital Global Gateway Strategy of the EU. Launched in 2021, the initiative is focused on developing secure connections in the digital, energy, and transport sectors. These connections should be developed to support health initiatives, education and research. Several projects have already been supported by Global Gateway, including the EurAfrica Gateway Cable which connects the EU with Africa along the Atlantic Ocean coast to improve data flows between the two continents, and the Medusa Optical Fibre Cable, see Box 9.[90]

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[88] Connecting Europe Facility (CEF) (2023). Call for Proposal – Backbone connectivity for Digital Global Gateways. Available online at: https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/cef/wp-call/2023/call-fiche_cef-dig-2023-gateways_en.pdf.

[89] Ibid.

[90] See: European Commission (2023). International Partnerships: Digital. Available online at: https://international-partnerships.ec.europa.eu/policies/global-gateway/digital_en.

> Through Global Gateway, the EU is strengthening connections between Europe and the world and helping partner countries address the digital divide and further integrate into the global digital ecosystem.

Source: European Commission, Global Gateway

4.23 The Global Gateway is delivered through a Team Europe approach. The Team Europe approach aims at bringing together the EU, its Member States, and coordinating and pooling financing partners and sources, including the EIB and the European Bank for Reconstruction and Development (EBRD).

Box 9 The Medusa cable system received financial support from EU institutions

The Medusa Submarine Cable System will directly interconnect five southern European countries with four northern African countries for the first time, thereby addressing multiple connectivity needs. It is owned by a private European capital company, the infrastructure and telecom operator AFR-IX Telecom. The construction contracts have been awarded to industry leaders Alcatel Submarine and Elettra Tlc. Orange will provide landing structures in France, Tunisia, and Morocco. The estimated cost of the project is EUR 342 million (USD 374 million).

The construction of Medusa is funded by AFR-IX Telecom, Orange, and the European Union. It is the European Commission's first Digital Global Gateway project and is funded through grants from the Connecting Europe Facility (CEF) as well as grants and loans from the EIB. The various EU fund grants include:

- a EUR 40 million EU grant to AFX-IX telecom by the EIB and debt finance for the infrastructure with a contribution of up to EUR 100 million in loans.
- a EUR 7.79 million grant to AFX-IX telecom for the deployment of a pair of dark fibre between Lisbon, Zahara de los Atunes, Barcelona, Marseille and Mazara del Vallo, i.e., the Atlantic-Mediterranean Data Gateway (ATMED-DG) project, as part of the CEF (Connecting Europe Facility) Digital programme
- a EUR 10 million grant to Orange by the EU Commission for the development of a submarine cable between Marseille (France) and Bizerte (Tunisia), as part of the CEF (Connecting Europe Facility) Digital programme
- a EUR 1.39 million grant to AFX-IX telecom by the EU Commission for studies on Medusa Canary Island Submarine Cable, as part of the CEF (Connecting Europe Facility) Digital programme.

Sources: Medusa (2023). Mediterranean Subsea Infrastructure Operator. Available online at: https://medusascs.com/; Géant (2023). GÉANT signs EUR 40 million agreement with the European Commission, the European Investment Bank and AFR-IX Telecom on MEDUSA submarine cable project to boost trans-Mediterranean R&E connectivity. Available online at: https://connect.geant.org/2023/11/01/geant-signs-eur-40-million-agreement-with-the-european-commission-the-european-investment-bank-and-afr-ix-telecom-on-medusa-submarine-cable-project-to-boost-

trans-mediterranean-re-connectivity; Submarine Cable Networks (2023). EU and EIB Sign €40 million Investment Grant on MEDUSA Submarine Cable Project. Available online at: https://www.submarinenetworks.com/en/systems/asia-europe-africa/medusa/eu-and-eib-sign-40-million-investment-grant-on-medusa-submarine-cable-project; European Commission (2022). Factsheet: Medusa is by far the largest submarine cable project in the Mediterranean to date with 7,100 km. Available online at: https://neighbourhood-enlargement.ec.europa.eu/system/files/2022-11/2022-11-24%20-%20Fact-sheet%20for%20Media%20-%20Medusa.pdf.

4.24 Important Projects of Common European Interest (IPCEIs) are large-scale projects which involve funding from a consortium of Member States which provide funding from their national budgets. These projects can be both integrated projects and single investment projects, such as the Øresund Bridge project and the Fehmarnbelt Link, see Box 12 and Box 13 for more details. Integrated IPCEI projects have been initiated to support innovation in the battery value chain, microelectronics, and hydrogen. [91]

4.25 These projects bring together knowledge and financial investments from organisations across Europe to address market failures. In particular, the IPCEI State aid guidelines mention that IPCEIs can support all initiatives that seek to achieve a common European objective. This could include any initiatives that support some of the Commission's strategies, for example, the Digital Strategy.[92] In this way, a submarine cable infrastructure which strengthens Europe's digital connectivity could meet the objectives of an IPCEI project. [93]

4.26 IPCEIs are supported by national budgets so that Member States control the identification of future IPCEIs and ultimately define the scope of the identified projects, selecting participants and projects to support. Although an IPCEI has not been announced to support the connection of telecommunication services through submarine cable infrastructures, if there is broad political support and willingness to support a submarine cable infrastructure, such an initiative could lead to financial support under the IPCEI framework.

4.2.1 EU Public funding and cooperation with third countries

4.27 EU funding tools and instruments are directed to projects with a European dimension. However, most cross-border infrastructures require cooperation with third country' entities: financial institutions, commercial partners, and public authorities.

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91 European Commission (2023). Important Projects of Common European Interest (IPCEI). Available online at: https://competition-policy.ec.europa.eu/state-aid/legislation/modernisation/ipcei_en.

92 European Commission (2020). Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions – 'Shaping Europe's digital future', COM(2020) 67 final, 19 February 2020. Available online at: https://eur-lex.europa.eu/legal-content/en/TXT/?uri=CELEX%3A52020DC0067.

93 European Commission (2021). Criteria for the analysis of the compatibility with the internal market of State aid to promote the execution of important projects of common European interest. Available online at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv%3AOJ.C_.2021.528.01.0010.01.ENG&toc=OJ%3AC%3A2021%3A528%3ATOC.

4.28 Cooperation can take the form of strategic partnerships such as the "Memorandum of Cooperation on submarine cables for secure, resilient and sustainable global connectivity" signed between the Ministry of Internal Affairs and Communications of Japan and the European Commission on behalf of the European Union in May 2022. The Memorandum establishes the Japan-EU digital partnership that aims, among other objectives, at exploring "opportunities to provide financial support as appropriate in line with their respective mechanisms".[94]

4.29 Financing instruments such as CEF grants also account for cooperation with third countries. Despite being subjected to strict exclusion of non-EU controlled entities "for duly justified security reasons", in some circumstances, the CEF call is opened up to legal entities established in third countries where there are infrastructures that connect with the EU. Under its digital security requirements, the CEF call provides that "legal entities established in third countries shall exceptionally be eligible to receive Union financial support under the CEF where this is indispensable for the achievement of the objectives of a given project of common interest and conditional on submitting a declaration, approved by the connected associated third country or other third country", providing specific guarantees.[95]

4.30 Ad hoc financing tools aimed at cooperation are also in place. Global Europe, for instance, is the main financial tool for EU international cooperation from 2021 to 2027. With an overall allocation of EUR 79.5 billion, Global Europe covers EU cooperation with all third countries and unifies grants and guarantees. The EIB provides support that comes in the form of loans, guarantees, equity investments and advisory services. Pooling financial resources from a heterogeneous group of lenders is key to ensuring the bankability of complex cross-border infrastructure. In this regard, the experience of NeuConnect represents a success story, see Box 10.

Box 10 NeuConnect: a success story of a multi-borrower financial structure

The NeuConnect Interconnector is a planned submarine power line between Germany and the UK. It will be 720 km long, have a capacity of 1.4 GW and is expected to cost around **EUR 2.8/GBP 2.4 billion** to construct.

The project planning started in 2018, reached financial close in 2022, and construction started in 2023. It is expected to be completed by 2028. Upon completion, it will become the first direct power link between Germany and the UK.

The project is a privately financed interconnector led by a consortium of investors comprising Meridiam, Allianz Capital Partners, Kansai Electric Power and TEPCO. The project attained financial close through a consortium of more than 20 national and international banks and multilateral financial institutions including the UK Infrastructure Bank, the EIB and Japan Bank for International Cooperation.

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94 Ministry of Internal Affairs and Communications of Japan and the European Commission (2022). Memorandum of Cooperation on submarine cables for secure, resilient and sustainable global connectivity, 12 May 2022. Par. 12. Available online at: https://www.soumu.go.jp/main_content/000890460.pdf.

95 European Commission (2023). Connecting Europe Facility (CEF), Call for proposals, CEF Digital – Backbone connectivity for Digital Global Gateways. 17 October 2023. Page 10. Available online at: https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/cef/wp-call/2023/call-fiche_cef-dig-2023-gateways_en.pdf

80 percent of the project is financed using debt, with the debt being denominated in EUR and GBP. The consortium has signed loan agreements in project financing amounting to approximately GBP 1,069 million and EUR 910 million in total co-financing.

The Japan Bank for International Cooperation provides lending of up to GBP 270 million in the GBP tranche and EUR 156 million in the EUR tranche, given the involvement of Japanese investor Kansai Electric Power. The EIB is lending around EUR 381 million to the consortium since the project supports both EU and German renewable energy policies.

The NeuConnect interconnector is one example of a European submarine cable project attracting lending capital from around the world, including non-EU entities and financial institutions.

Sources: NeuConnect (2023). A new energy connection to power the future. Available online at: https://neuconnect-interconnector.com/; Japanese Bank for International Cooperation (2022). Project Financing for NeuConnect, UK-Germany Interconnector Project. Available online at: https://www.jbic.go.jp/en/information/press/press-2022/0728-016560.html; European Investment Bank (2022) Neuconnect Interconnector: Signatures. Available online at: https://www.eib.org/en/projects/all/20200756; IJGlobal (2022). NeuConnect – debt, tranches, pricing. Available online at: https://www.ijglobal.com/articles/166513/neuconnect-debt-tranches-pricing.

CHAPTER 5

REGULATORY AND POLICY IMPLICATIONS OF THE FUNDING MODEL OF POLAR CONNECT

OBJECTIVE OF THE CHAPTER	KEY FINDINGS AND TAKEAWAYS
In Chapter 4 we set out three possible routes to implement a public funding model for Polar Connect. It is necessary to review and assess economic regulatory and policy implications that are associated with public intervention. As such, this chapter informs the reader on the relevant regulatory and policy implications and provides the reader a guide to the main implications concerning State aid regulation and non-discriminatory access considerations.	• Potential State aid should be assessed to determine the extent of distortions to competition and trade. • Ensuring that State aid has been assessed and approved by the relevant enforcer could minimise the potential for complaints from competitors and formal investigations regarding the aid by the European Commission in the future. • Possible State aid issues in submarine cable infrastructures could arise for access considerations. When publicly-funded infrastructures are not provided under non-discriminatory terms there is a potential for an undertaking to be provided access conditions at below-market rates which would be considered State aid.

In this chapter, we focus on economic regulation, and more specifically on (i) the circumstances under which the role of public funding could trigger concerns over distortions under EU State aid rules, and (ii) the circumstances under which access to cables and/or landing stations could warrant economic regulation.[96]

5.1 Public funding must manage State aid compliance considerations

5.1 It is necessary to ensure aid is deemed compliant with State aid regulations in any situation where a measure involves state resources, confers a selective economic advantage to the aid recipient, and has the potential to affect competition and trade. The Treaty on the Functioning of the European Union generally prohibits State aid due to potential negative effects on the internal market, but aid can be deemed compatible if it meets a well-defined objective of common European interest and is considered proportionate. The European Commission follows a two-step process to assess the compliance of State aid. In any case, where a measure is deemed legal and compatible with State aid, the potential positive effects are found to outweigh the potential negative effects.

5.1.1 Assessment of the burden of the State aid regulation

5.2 The assessment of State aid cases in Europe follows a two-step process: (1) prove the existence of aid and (2) prove the compatibility of the aid, summarised in Figure 14. The first step, the existence of aid, is shown by identifying if four cumulative criteria are fulfilled. If all four criteria are fulfilled, aid must be shown to be compatible by conducting a three-step balancing test.

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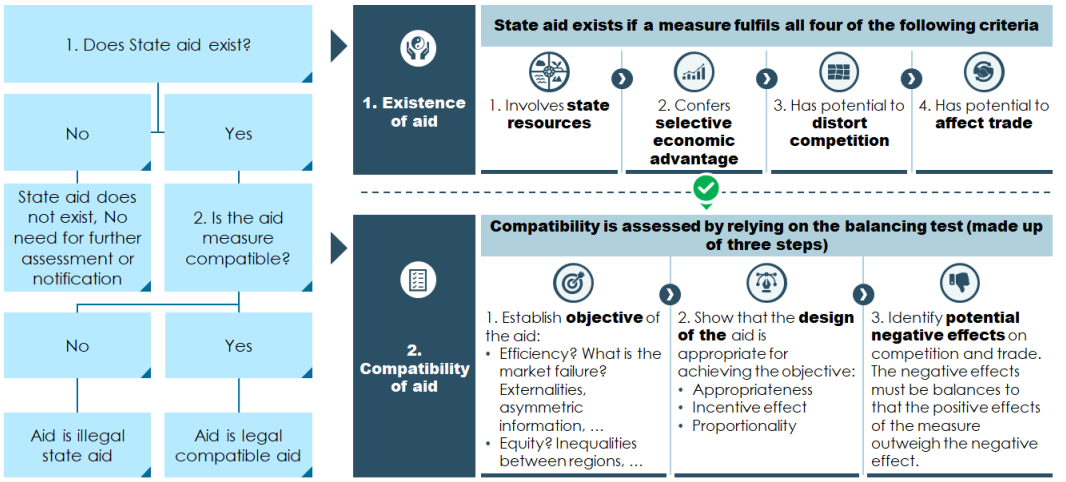
[96] In this Chapter, we focus on the economic considerations surrounding State aid regulation and we do not provide legal advice which would need to be sought in the context of specific arrangements.

Figure 14
EU State aid assessment – a two-step process



Source: Copenhagen Economics

5.3 Compliance with the State aid notification process is central to achieving legitimacy and addressing any potential for undue distortions to competition which could ultimately impact the market for private investments. By way of an example of State aid concerns materialising, in Iceland aid granted for developing submarine cables has resulted in a formal investigation into the measures because of issues related to selective economic advantage, see Box 11.

Box 11 Lessons learned from conflict case in the granting of State support in submarine cable: the Iceland example

In 2018, Farice was given compensation to construct Iceland's third submarine cable, IRIS, connecting Iceland with the Republic of Ireland. The project started in early 2019 with preparation work and was finished in March 2023.

In February 2023, Sýn, a mass media company in Iceland and a competitor which had offered to build the same cable, complained to the ESA that Farice had received financial support through two measures which breached the EEA Agreement.

- Measure 1: In 2018 the Telecommunications Fund and Farice signed a contract granting compensation to Farice for seabed research in preparation for the possible construction of the cable, IRIS. The estimated cost was EUR 1.9 million.
- Measure 2: The Icelandic authorities selected Farice to build and operate the IRIS cable connecting Iceland and Europe. This was financed by the Icelandic state through an estimated EUR 50 million capital increase in Farice.

Based on the complaint of Measure 1, the ESA decided that it could not exclude the possibility that the measure entailed State aid. In particular, the ESA cannot exclude the possibility that the funds did not confer a selective economic advantage to Farice. Further, if the aid is shown to be State aid, the ESA has doubts over whether this aid will be compatible.

Measure 2 was originally notified to the ESA by Icelandic authorities in March 2021 and received a compatible State aid decision based on the EEA agreement. After concerns were raised by Sýn, the EFTA Court annulled the ESA's decision. The ESA now has doubts as to whether the positive effects of Measure 2 outweigh the possible distortion of competition and adverse impact on trade.

This has led to the opening of a formal investigation into the measures, which is still ongoing.

Sources: Capacity Media (2023). European court to investigate 'state aid' for IRIS subsea cable. Available online at: https://www.capacitymedia.com/arcticle/2be9sx9aypei3bwvawg74/news/european-court-to-investigate-state aid-for-iris-subsea-cable; European Union (2023). Decision No 44/23/COL of 8 March 2023 to open a formal investigation into alleged state aid to Farice. Available online at: https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX%3AE2023C0413%2801%29; Farice (2023). IRIS is Ready For Service from March 1st. Available online at: https://farice.is/iris-is-ready-for-service-from-march-1sr/

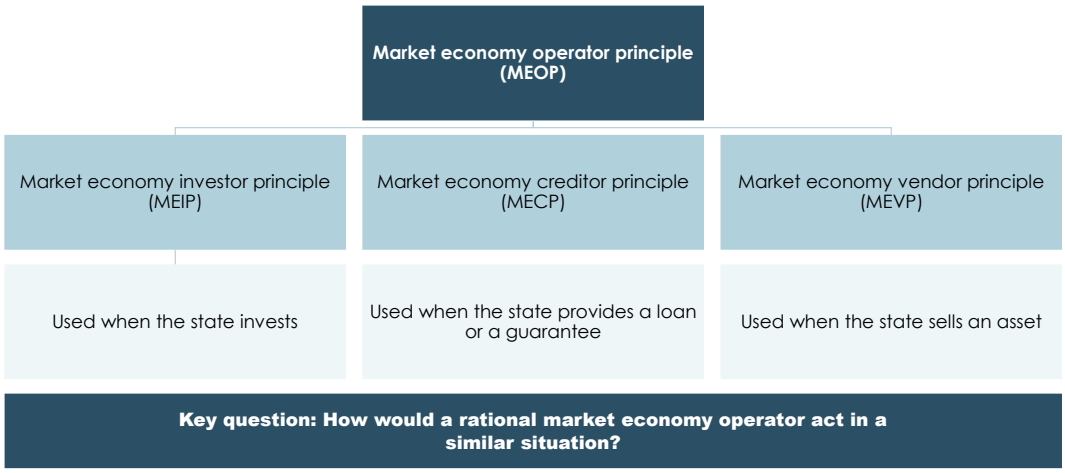
5.4 *In the first step* of a State aid assessment, State aid is deemed to exist if four cumulative criteria are met:

- The measure must involve state resources
- The measure must confer a selective economic advantage
- The measure must have the potential to affect trade
- The measure must have the potential to distort competition.

5.5 The first criterion is fulfilled when the state invests or provides funding, which can often be directly observed, particularly in the case of public funding or investments that involve state resources. It is important to note that the involvement of state resources can also originate from publicly-owned institutions and does not need to come directly from the government to fulfil this criterion.

5.6 To show that a measure confers a selective economic advantage, it must be shown that the aid measure was not provided on market terms. Therefore, aid would not be classified as State aid if evidence can demonstrate that the economic transaction (aid) provided by the state was carried out in line with market conditions. To do this, State aid assessments rely on the Market Economy Operator Principle (MEOP) test, which asks how a rational market operator would act in a similar situation, see Figure 15.

Figure 15
Market Economy Operator Principle



Source: Copenhagen Economics

5.7 In the case of Polar Connect, public aid to the project could be shown not to be state aid if it can be proven that the terms applied to the aid are provided on market terms. For example, if the terms of the investment from the state are provided on the same terms as the terms offered to other private investors, or consortia members, the measure would not be considered State aid and would not require notification and assessment from the Commission.

5.8 Under some State aid guidelines, aid can be deemed proportionate simply if the allocation process is a competitive tender. Since a competitive tender process will limit the amount of aid allocated to the project, the aid would be both proportional and compatible. This would be one benefit of relying on the Tender Model (described in Section 4.2.2.) as the funding mechanism for Polar Connect.

5.9 Finally, the measure should be assessed to determine its effect on trade and competition in the market. State aid control focuses on the impact of public investments on the European economy as a whole and therefore should protect against large distortions to competition and trade in the European internal market.

5.10 If an aid measure is found to be State aid because it meets all four of the above criteria, it must also be deemed compatible to be considered legal State aid.

5.11 *In the second step* of a State aid assessment, a measure can be deemed compatible if it meets the three requirements of the balancing test:[97]

- The aid must meet one of the objectives of the State aid regulation and guidelines;
- The design of the aid must be proven to be appropriate for achieving the identified objective, must be proven to have an incentive effect, and the aid must be shown to be

[97] European Commission (n.d.). Common Principles for an Economic Assessment of the Compatibility of State aid Under Article 87.3. Available online at: https://ec.europa.eu/competition/state_aid/reform/economic_assessment_en.pdf.

proportionate to the amount of aid needed to provide the identified incentive effect without overcompensating;
- Negative effects, i.e. distortions to competition and trade, must be limited to ensure a balance of a positive effect from the aid measure.

5.12 Establishing the objective of an aid measure involves identifying any potential efficiency and/or equity objectives which might be achieved by granting the aid. In many cases, State aid is used to address a specific market failure which would cover an efficiency objective. Within the State aid regulatory framework, there are several horizontal and sector-specific State aid guidelines which can be used to support the identified objective. Currently, State aid guidelines do not specifically identify submarine cables as a common objective for aid measures, but previous submarine cable projects receiving aid have relied on, for example, the State aid Broadband Guidelines which provide a framework to support the digital transition in Europe.[98]

5.13 To show that the design of the aid is appropriate for achieving the identified objective, it is necessary to show that due to the aid the recipient engages in an activity that contributes to a common European objective in which the recipient would not otherwise be engaged in in the absence of aid (i.e. there is an incentive effect) and the aid is limited to the minimum amount necessary to have the desired effect (proportionality). Business cases and funding gap assessments can be key points of evidence in showing both the incentive effect and proportionality.

5.14 Finally, any negative effects on trade and distortions to competition must be identified and balanced. It must be documented that the positive impacts of the aid measure outweigh these potential negative impacts and that the aid is limited to ensure that the negative impacts are minimised. In cases where the effects on competition and trade are disputable, it may create the potential for complaints. For example, aid granted for the development of cross-border infrastructure for both the Øresund bridge and the Fehmarnbelt Link has resulted in complaints from ferry services which argue that they are competing in the same market and that the new infrastructure is making it difficult for ferry services to compete, see Box 12 and Box 13.

[98] European Commission (2023). Guidelines on State aid for broadband networks (2023/C 36/01). Available online at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52023XC0131(01).

Box 12 The State guarantee model: Øresund link between Denmark and Sweden

The Øresund link is a fixed combined bridge and tunnel link between Amager, Denmark, and Skåne, Sweden, inaugurated on July 1, 2000. It consists of a freeway and a railroad line with a total length of 15.9 km. The link is owned and operated by Øresundsbro Konsortiet, a special purpose vehicle (SPV) established for the project, which is owned equally by A/S Øresund and the Swedish-Danish Broförbindelsen (SVEDAB) AB. The latter is owned by the Swedish state (Ministry of Trade and Industry) through Vägverket and Banverket (50 percent each), while A/S Øresund is wholly owned by Sund and Bælt, which is owned by the Danish state (Ministry of Transport and Building).

The total cost of the coast-to-coast section was calculated at DKK 19.6 billion and was financed by loans on the international credit market, with the Danish and Swedish governments acting as guarantors for Øresundsbro Konsortiet. This state guarantee model allowed the project to be financed through loans on favourable terms thanks to the Danish state's high credit rating. A Trans-European Transport Network loan of DKK 780 million was also granted for this section. It is estimated that the bridge will have financed itself by 2050, being 100 percent user-funded through toll revenues from road traffic and railway fees.

Initially, the European Commission found the project financing compatible with State aid rules and the IPCEI framework. However, as commercial use of the infrastructure increased, HH Ferries, which operates ferries between Helsingborg and Elsinore, filed complaints in 2013, claiming that the Danish and Swedish guarantees for the consortium loans were illegal under state aid rules. Hence, funding for the bridge has been under assessment since 2018 under EU State aid rules but a final decision is still pending (Case numbers SA.52162 & SA.52617).

To comply with competition regulations regarding other means of transport, the pricing mechanism for road tolls is capped and is based on ferry fares. The rail fee is set and paid equally by the national rail companies of the two countries, which in turn charge the train operators for using the link. Revenue is dependent on the development of financing costs and thus interest rates, as well as traffic volumes.

Differently from public procurement and PPP models, in the state guarantee model, the costs of the project are paid by the users of the project, not by all taxpayers, and, in addition, this implies lower financing costs as the state ultimately bears the risks.

Sources: Sund & Bælt (n.d.). The Øresund Bridge. Available online at: https://sundogbaelt.dk/en/road-and-rail-links/oresund/oresund-bridge/; Global Infrastructure Hub (2020). The Øresund Fixed Link. Available online at: https://www.gihub.org/connectivity-across-borders/case-studies/the-%C3%B8resund-fixed-link/.

Box 13 Fehmarnbelt Link

The Fehmarnbelt Tunnel is an envisaged four-lane motorway and two-track electrified rail line connecting Denmark to Germany. The construction budget is DKK 52.6 billion (2015 prices) and the connection will be user-financed. The fully Danish state-owned company Femern is tasked with planning and constructing the tunnel.

The project is mainly financed by the Danish state with a state guarantee finance model, with additional funding from the EU. Germany is responsible only for the hinterland connections, i.e., connecting the tunnel to its existing rail and road network.

State-owned Sund & Bælt Holding A/S has injected EUR 68.4 million/DKK 510 million as capital between 2005 and 2009, of which EUR 67 million/DKK 500 million is still reported as equity in 2022. In November and December 2018, Femern A/S obtained state loans for a nominal value of EUR 1 billion/DKK 7.4 billion to secure funding for initiating the construction phase. For the construction phase, the EU has granted Femern A/S roughly EUR 1.1 billion/DKK 8.4 billion under the IPCEI framework.

Various ferry operators offering services between Germany and Denmark have challenged the legality of the funding provided by the Danish state. In 2009, the Commission approved the financing planning phase. In 2015 the Commission decided not to raise objections to the measures granted by Denmark to Femern A/S and A/S Femern Landanlæg, thereby approving the financing model. Following this decision two ferry operators, Scandlines and Stena Line, brought the Commission before the General Court.

In 2018, the General Court annulled the European Commission's decision from 2015 and directed the Commission to conduct a fresh investigation. The decision arising from this new investigation was published in 2020.

The Commission deemed that capital injections, state guarantees, and state loans all constituted unlawful state aid. All the other measures were determined not to be state aid. Nevertheless, the Commission approved the financing model conditional on the following mitigating actions:

- All capital injections, state guarantees, and state loans must be terminated at latest 16 years after the start of operations.
- The annual premium on state guarantees and state loans increases from 0.15 percent to 2.00 percent.
- The Danish state must review costs by five years at the latest after the start of operations, and the maximum guaranteed amount and the maximum payback period will be reduced if costs turn out to be lower than expected.

Scandlines and the Danish state have both appealed the decision and the case is still ongoing.

Sources: Femern.info (n.d.). Femern Belt Link – the world's longest immersed tunnel. Available online at: https://www.femern.info/en/femern-belt-link-worlds-longest-immersed-tunnel; Sundogbaelt.dk (2023). The Fehmarnbelt Link. Available online at: https://sundogbaelt.dk/en/road-and-rail-links/the-fehmarnbelt-link/; Scandlines (2022) Annual Report 2022; European Commission (2020). ON THE STATE AID SA.39078 - 2019/C (ex 2014/N) which Denmark implemented for Femern A/S. Available online at: https://femern.com/media/5ykbvkwi/finansieringen-er-statsst%C3%B8ttegodkendt-af-europakommissionen.pdf; The Danish Ministry of Transportation (2022). Finansiering – Statsgarantimodellen. Available online at: https://www.trm.dk/temaer/den-faste-forbindelse-over-femern-baelt/femern-artikler/finansiering-statsgarantimodellen; Femern.com (2023). Finance. Available online at: https://femern.com/finance/; InfoCuria (2018). Case T-630/15. Available online at: https://curia.europa.eu/juris/document/document.jsf?text=&docid=209013&pageIndex=0&doclang=en&mode=lst&dir=&occ=first&part=1&cid=2295678; InfoCuria (2018). Case T-631/15. Available online at: https://curia.europa.eu/juris/document/document.jsf;jsessionid=994227E205C25C721B0E0E32323DAAC9?text=&docid=209017&pageIndex=0&doclang=EN&mode=lst&dir=&occ=first&part=1&cid=9277415.

5.1.2 Is there a risk of crowding out private investment?

5.15 Whenever the state provides public funding, there is a risk that private investors will be crowded out of the investment opportunity (and future opportunities) because they can wait for the state to provide the funding instead. However, this risk is limited when clearly defined market failures have been identified as this helps to identify the extent of the role state funding should play in the investment.

5.16 The process of identifying the specific role and the extent of the role of public funding is consistent with State aid rules which do not allow state funding intervention if the funding does not provide (i) an **incentive effect** (i.e. motivates the involved parties to take the intended action/make the intended investment the aid is intended to support) and if the aid (ii) is not **proportionate** (equal to the exact amount of the funding gap necessary to provide an incentive effect without overcompensating the entity).

5.2 Non-discriminatory access considerations could arise for publicly-funded infrastructure

5.17 The market of submarine cables is characterised by significant barriers to entry given the high fixed and sunk costs and consequently high requirements for financial resources to undertake the necessary investment. There are therefore reasons why it might be relevant to consider access regulation over the infrastructure, particularly for landing stations which are a critical point of connection between terrestrial and submarine cables. Access considerations could arise if the market for submarine transmission capacity (or part thereof) is not competitive, i.e., if there are concerns about excessive market power (e.g., dominant position). Access considerations could apply also to a public or partially public entity owning and/or operating the submarine cable.

5.18 While we have not investigated whether any of the current submarine cables might have concerns with market power, i.e. abuse of dominance or excessive pricing, the initial evidence we have gathered seems reassuring. Based on a cross-comparison of multiple interview sources with different positions in this sector, we found no evidence of economic incentives or ability for an entity to restrict access to its submarine cables. On the contrary, practically all players (including those active as users of the service) seem determined to generate income by providing capacity on the market relying on the latest advances in capacity-enhancing technology. If landing stations become a competition bottleneck, then forms of focused access regulation could avoid a situation where a single player unduly restricts the usage of the entire submarine cable, thus limiting the fullest socioeconomic benefits of the infrastructure itself.

> In practice, considerable excess capacity has so far ensured both more than enough capacity and reasonable prices. Consequently, except for reasons of protectionism or national security (see the specific regime for landing station licences in the United States), access to submarine cables are rarely subject to specific rules in regulatory frameworks.

Source: ITU (2013). Access to Submarine Cables: Assessment Report. Available online at: https://www.itu.int/en/ITU-D/Projects/ITU-EC-ACP/HIPSSA/Documents/FINAL%20DOCUMENTS/FINAL%20DOCS%20ENGLISH/submarine_cables_assessment_wa.pdf.

5.19 On the other hand, although there is a competitive market, it is still important to protect against potential State aid issues when aid is used to fund essential infrastructures. As such, it is necessary to provide non-discriminatory access to third parties to secure capacity for smaller users when public funding is involved. Fully or partially state-owned infrastructure should not result in selective economic advantages to users as this special treatment could be identified as State aid and could have a distortive effect on competition in the market.

5.20 Selective advantages could arise if users of fully or partially state-owned infrastructures are provided different rates, or if some users were offered long-term agreements which would result in prices below-market terms. Such discriminatory pricing policies have the potential to distort competition. Policymakers can thus carefully consider whether to impose conditions that ensure that the operator of this publicly-funded infrastructure supplies services on terms that avoid undue discrimination.

5.21 Some State aid decisions explicitly outline conditions for remedies which should be implemented to protect competition. If state funding is granted for Polar Connect, it will be important to adhere to the same code of conduct to maintain competition on the market and avoid any potential State aid issues in the future. For example, when the Norwegian government opened a tender which would provide State aid for developing a submarine cable connection (see Box 6), the terms clearly state that "the bidder must commit to providing international connectivity services on open and non-discriminatory terms for a period of at least seven years" to protect competition on the market.[99]

5.22 A final remark is that there is an inherent trade-off between the two policy aims. One aim is to ensure maximum return for taxpayers, which may require the pricing and commercial terms set by the operator of this publicly-funded infrastructure to be such as to obtain profit maximisation. A parallel aim is to avoid competition distortion and limitations in the fullest economic benefit from the usage of the infrastructure, which may require some fettering in the commercial and pricing conduct of the operator of such infrastructure (e.g., non-discrimination rules). This is a trade-off for policymakers to remain aware of, lest they apply regulatory conditions that are ultimately disproportionate as to the efficient operation of this complex and costly type of infrastructure.

[99] ESA (2019). Alternative pathway for electronic communications traffic 065/19/COL. Available online at: https://www.eftasurv.int/state-aid/state-aid-register/alternative-pathway-electronic-communications-traffic and Box 6 for more details on the case.

APPENDIX

SUMMARY OF INTERVIEWS: TYPES OF ORGANISATIONS AND EXPERT ROLES

To complement the literature review and quality assure our assumptions and analysis of the submarine cables' business model, we have carried out 26 semi-structured interviews with over 30 industry experts and policy makers from different types of organisations (providers of cable connectivity, telecom operators, regulators, NRENs, system suppliers, etc.) and heterogeneous profiles (CEOs, CTOs, policy officers, directors of research networks, etc.).

In the Table below, we present an overview of the interviewed experts, by detailing the type of organisation and their role within it.

Table 3
List of interviews conducted by type of organisation and role

TYPE OF ORGANISATION	PROFILE	DATE
NREN	Head of International Relations	01-09-2023
Telecom operator	Vice President	06-09-2023
Provider of cable connectivity	Vice President	08-09-2023
NREN	General Director	08-09-2023
NREN	Director General	11-09-2023
NREN	Director	11-09-2023
NREN	Director	12-09-2023
Telecom operator	Infrastructure business development	13-09-2023
NREN	Director	20-09-2023
Digital infrastructure provider	Business development	21-09-2023
Hyperscaler	Senior Director	22-09-2023
Industry association	CEO	22-09-2023
Provider of cable connectivity	CEO	27-09-2023
Regulator	Advisor	02-10-2023
NREN	CTO	02-10-2023
Provider of cable connectivity	CEO	03-10-2023
Digital infrastructure consulting	CEO	03-10-2023
NREN	CEO	04-10-2023
Investor in cable connectivity	Responsible cable planning	05-10-2023
Telecom operator	Product manager	10-10-2023
Regulator	Policy officer	10-10-2023
Digital infrastructure provider	Director	17-10-2023
Regulator	Director	25-10-2023
Regulator	Director	08-11-2023
Telecom operator	Director	14-11-2023
System supplier	Vice President	15-11-2023

Source: Copenhagen Economics