

An aerial photograph of a coastal region at sunset. A long, winding road or bridge stretches across the water, connecting several small, rocky islands. The islands are covered in green vegetation and have a few small buildings, including red-roofed houses and a larger white building. The water is a deep blue, and the sky is a mix of orange, yellow, and blue. In the background, there are more islands and a range of mountains under a hazy sky.

SUSTAINABLE OCEAN ECONOMY

Mapping of Nordic Strongholds



Nordic
Innovation

About this publication

SUSTAINABLE OCEAN ECONOMY **Mapping of Nordic Strongholds**

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Foreword

The Nordic Prime Ministers decided in 2019 on a new vision for the Nordic cooperation: The Nordic region is to become the most sustainable and integrated region in the world by 2030. As a result of this, the five Nordic ministers of trade and industry launched eight initiatives for 2021-2024 to support the economy recover in a greener direction in the wake of COVID-19. The eight initiatives will make it easier for Nordic businesses to operate across borders and support the vision for the Nordic region to be the most sustainable and integrated region in the world by 2030. This is to be achieved through three priorities: A competitive Nordic region, a socially sustainable Nordic region and an equal Nordic region. The five Nordic Ministers of Trade and Industry have followed up and launched eight initiatives for the period 2021-2024. The initiatives will make it easier for Nordic businesses to operate across borders and become more competitive.

Sustainable Ocean Economy is important in making the Nordics more competitive. Three quarters of the earth's surface is ocean, and Ocean Economy is crucial for the green transition.

On assignment from Nordic Innovation, Gaia Consulting Oy has carried out this Mapping of Nordic Strongholds. The mapping seeks to give an overview of Nordic Strongholds and to identify business areas that are most likely to give the greatest Nordic added value of cooperation within the Ocean Economy. We would like to extend a special thanks Gaia and to all who have given their valuable input through interviews and workshops throughout this process.

In addition to being a thorough source of information for Nordic Innovation, we hope this report will benefit a broad range of Nordic businesses, decision makers and other relevant actors of the Ocean Economy, as well as help them identify business opportunities and stimulate cooperation across borders and sectors to create new sustainable solutions.

The prime objective of this initiative is to make the Nordics a global leader in the development of a Sustainable Ocean Economy. The five Nordic countries and the three autonomous regions are all situated next to the ocean, and together we are in a unique position to develop a strong and sustainable Ocean Economy.

Oslo, November 2021, Svein Berg, Managing Director, Nordic Innovation

Table of contents

Executive summary	5
1. Introduction	6
1.1. Background and aims of the study	6
1.2. Scope and definitions	7
1.3. How this study was conducted	9
2. Brief description of the global operating environment of the Ocean Economy	11
2.1. Sustainable Ocean Food	12
2.2. Sustainable Ocean Energy	13
2.3. Sustainable Ocean Transport	14
2.4. Sustainable Ocean-based Tourism	15
2.5. Sustainable New Ocean Industries	16
2.6. Seabed Mining	16
3. Brief overview of the Ocean Economy in the Nordic countries	18
3.1. Denmark	19
3.1.1. The Ocean Economy – facts and figures	
3.1.2. Policy development and strategic priorities	
3.1.3. Business and innovation ecosystems	
3.2. Finland	25
3.2.1. The Ocean Economy – facts and figures	
3.2.2. Policy development and strategic priorities	
3.2.3. Business and innovation ecosystems	
3.3. Iceland	32
3.3.1. The Ocean Economy – facts and figures	
3.3.2. Policy development and strategic priorities	
3.3.3. Business and innovation ecosystems	
3.4. Norway	37
3.4.1. The Ocean Economy – facts and figures	
3.4.2. Policy development and strategic priorities	
3.4.3. Business and innovation ecosystems	
3.5. Sweden	44
3.5.1. The Ocean Economy – facts and figures	
3.5.2. Policy development and strategic priorities	
3.5.3. Business and innovation ecosystems	
3.6. The Faroe Islands	49
3.6.1. The Ocean Economy – facts and figures	
3.6.2. Policy development and strategic priorities	
3.6.3. Business and innovation ecosystems	
3.7. Greenland	52
3.7.1. The Ocean Economy – facts and figures	
3.7.2. Policy development and strategic priorities	
3.7.3. Business and innovation ecosystems	
3.8. Åland	54
3.8.1. The Ocean Economy – facts and figures	
3.8.2. Policy development and strategic priorities	
3.8.3. Business and innovation ecosystems	
4. Identified Nordic strongholds with cooperation potential	57
4.1. Definition of Nordic strongholds	57
4.2. Identified Nordic strongholds in Sustainable Ocean Economy	57
4.2.1. Sustainable Ocean Food	
4.2.2. Sustainable Ocean Energy	
4.2.3. Sustainable Ocean Transport	
4.2.4. Sustainable Ocean-based Tourism	
4.2.5. Seabed Mining	
4.2.6. Sustainable New Ocean Industries	
4.3. Suggestion of strongholds with specific potential for innovation cooperation	60
4.3.1. Thematic strongholds	
4.3.2. Cross-cutting themes	
4.4. Conclusions	63
References	64

Executive summary

Oceans and seas have always played a significant role, economically, culturally, and socially, in the development of the Nordic countries. As the global ocean economy is rapidly expanding, the importance of ocean ecosystems and the sustainable use of oceans is an increasing global concern. The Nordic countries have set a vision that the Nordic region will become “the most sustainable and integrated region in the world” by 2030. To make this vision reality, actions for strengthening the sustainability of oceans and ocean industries are called for.

This background study was conducted in support of a forthcoming Nordic initiative on Sustainable Ocean Economy with the aim to strengthen Nordic ocean industries by promoting cross-border collaboration, and by creating new opportunities for growth and innovation in the region.

By mapping the global context of the sustainable ocean economy, as well as the state and development of the ocean industries in each Nordic country, the mapping has sought to identify Nordic strongholds and cooperation potential that can help existing innovation ecosystems harness new sustainable opportunities.

Borrowing the transformation framework used by the High Level Panel for a Sustainable Ocean Economy, the mapping identified Nordic strongholds across the sectors of ocean food, ocean transport, ocean energy, ocean tourism, seabed mining, and new ocean industries. Nordic strongholds refer to innovation and business areas within the ocean economy where synergies between the countries can be found that create potential for Nordic added value, where the Nordic countries have the potential to be at the international forefront, and where good opportunities exist for upscaling and extended collaboration with leading global initiatives.

The mapping identified interesting innovation and business opportunities related especially to new developments across the sectors of ocean food, ocean transport, and ocean energy. Cross-cutting opportunities, where the Nordic countries are particularly strong, were found in new applications for technology and know-how, improved use of ocean data and digitalisation, and the access to testbeds across the Nordic region.

Cooperation opportunities in ocean food, more precisely sustainable aquaculture, were found in developing new protein sources, new products and applications, and the increased use of technology, data, and digitalisation. In ocean transport, opportunities for cooperation related especially to electrified and autonomous transport systems. Within ocean energy, opportunities were found in advanced and combined offshore energy solutions, distant monitoring and maintenance of offshore sites, and in exploring new ways to develop co-located, sustainable use of ocean areas for multiple purposes.

Recommendations for the further scoping of the initiative include considering where most added value can be achieved in relation to other ongoing developments, and to maximise the impact of Nordic cooperation in dialogue with national and global initiatives on the identified themes.

1. Introduction

1.1. Background and aims of the study

Oceans and seas have always played a significant role, economically, culturally, and socially, in the development of the Nordic countries. With the Baltic Sea and the North-East Atlantic Ocean providing a natural transport route for trade and travel for centuries, all the Nordic capitals have developed and are located on the coastline. Iceland, Norway, Sweden, Finland, and Denmark, as well as the Faroe Islands, Greenland, and Åland, are all reliant on seaborne trade. In the past decade alone, the Nordic countries imported an average of 8 tonnes of goods per capita by sea annually¹.

For centuries, the Nordic countries have had a leading position in various marine and maritime sectors. However, global competition in these sectors demands that the Nordic countries continuously elevate and develop their ocean economies through innovations and collaboration.

At the same time, production and consumption patterns are placing the health of ocean ecosystems at risk. The Baltic Sea in particular suffers from eutrophication and an oxygen depleted seabed, while the North-East Atlantic Ocean faces challenges especially from oil and gas extraction and production. Both sea areas are affected by pressure from commercial fishing on seafood stocks, increased litter and plastic pollution, shipping and leisure boating discharges, and ecological changes through climate change². In addition to the global environmental effects, this directly impacts the wellbeing of people and coastal communities, and the economies of the Nordic countries.

Globally, acknowledging these risks has led to increased focus on the sustainability of the oceans, reflected in the Sustainable Development Goals (SDGs) of Agenda 2030, specifically SDG 14 Life Below Water, and the proclamation of the UN Ocean Decade 2021-30. The sustainability of oceans also relates closely to the Convention for Biological Diversity, the UN Convention on the Law of the Sea, and the Paris Agreement on climate change.

The Nordic Council of Ministers has set a vision that the Nordic region will become "the most sustainable and integrated region in the world" by 2030³. To make this vision reality, the Nordics must place themselves at the forefront of innovation and development for a sustainable ocean economy. This presents a significant opportunity for the development and growth of the region.

To achieve this, actions for strengthening the sustainability of the oceans and ocean industries are needed. The Sustainable Ocean Economy program's aim is to strengthen Nordic Ocean industries by promoting cross-border collaboration, and by creating new opportunities for growth and innovation in the region.

¹ Lintilä 2017

² European Environmental Agency 2021, John Nurmisen Säätiö 2021

³ The Nordic Council and the Nordic Council of Ministers 2019

1.2. Scope and definitions

This mapping covers the Nordic ocean economy in a broad sense, including all economic activity taking place in the space above the seas, the surface of the sea and subsea, as shown in the Figure from the Sustainable Ocean Economy program (Figure 1).



Figure 1. The Nordic Sustainable Ocean Economy (Source: Nordic Innovation)

With this boundary in mind, the ocean economy comprises all sectors and industries related to oceans, seas, and coasts, whether based directly in the marine environment or on land. In this sense, the scope of the term “ocean economy” in this mapping almost equals the European Union’s (EU) definition of a “blue economy” (see Table 1). In addition to the sectors in Table 1, the ocean economy of this mapping includes carbon capture and storage (CCS).

This mapping covers both established and emerging sectors within the ocean economy. With reference to the table above, it is important to note that the stage of maturity of a sector may differ between the Nordic region and the EU average, as well as across the Nordic countries.

The forthcoming Nordic innovation programme, Sustainable Ocean Economy, has defined the following preliminary focus areas: aquaculture, ocean technology, and emerging areas.

Bearing this in mind, the mapping will specifically focus on forward-looking and novel development in technology and digitalisation, looking at how new innovations can support both the further development of already established sectors, as well as emerging sectors.

Established Sectors	Subsectors	Emerging Sectors	Subsectors
Marine living resource	Primary production Processing of fish products Distribution of fish products	Blue bioeconomy and biotechnology	Algae sector development and e.g. offshore aquaculture
Marine non-living resources	Oil and gas Other minerals, incl. marine aggregates (e.g. sand and gravel)	Marine minerals	Other minerals and metals (excl. marine aggregates of e.g. sand and gravel): e.g. manganese, titanium, copper, zinc and cobalt) and chemical elements dissolved in seawater (e.g. salt and potassium)
Marine renewable energy	Offshore wind energy	Ocean energy	Floating offshore wind Wave and tidal energy Floating solar photovoltaic energy Offshore hydrogen generation
Port activities	Cargo and warehousing Port and water projects	Infrastructure	Submarine cables Maritime technology: Robotics, underwater drones, airborne drones
Shipbuilding and repair	Shipbuilding Equipment and machinery	Other* (*less relevance in the context of this mapping)	Maritime Defence, Security and surveillance Research on emerging topics Skills development Desalination
Maritime transport	Passenger transport Freight transport Services for transport		
Coastal tourism	Accommodation Transport Other expenditure		

Table 1. Established and emerging sectors of the ocean economy according to the EU definition⁴.

This mapping takes an ecosystem approach to ocean economy, meaning that a focus on ecosystems will be the common thread throughout the study. Here "ecosystems" refers to both:

- Innovation and business ecosystems in the Nordic region, referring to the network structures that are built on interaction between companies, entrepreneurs, research, public administration, and third-sector actors. An ecosystem is both a structure and an interactive process, in which actors complementing each other join forces to create value⁵.
- Ocean ecosystems and the interrelation between ocean health and wealth that is the main focus in sustainable ocean economy.

The term sustainable ocean economy refers to "reconciling the ever-growing use

⁴ European Union 2021

⁵ VTT Technical Research Centre of Finland 2021

of marine resources with the need to safeguard and improve the health of ocean ecosystems”⁶. It combines economic, social, and environmental sustainability to secure both economic growth and the resilience and well-being of ocean-dependent societies, while preserving marine ecosystems and the biodiversity of oceans. Under this umbrella, the following issues are kept in mind throughout the mapping⁷:

- the health of ocean ecosystems and their biodiversity (as they provide critical ecosystem services such as food and oxygen production and carbon sequestration)
- the wellbeing and resilience of coastal communities and their people (note that the share of the population living in coastal communities is high in all Nordic countries, especially in Iceland, Norway, and the autonomous areas)
- improved resource efficiency and circularity in the use of resources (note that the circular transition is a key priority in all Nordic countries)
- innovation as a key to sustainable use of the oceans (note that the Nordic countries are among the top in the EU in all major innovation indexes)

With industries, we refer in the report to a group of businesses that are related based on their primary activities (such as fish processing or shipbuilding).

With sectors, we refer to the broader categories of ocean food, ocean transport, ocean energy, ocean-based tourism, and new ocean industries. These categories are borrowed from the transformation topics outlined by the High Level Panel for a Sustainable Ocean Economy in 2020. This framework was chosen, because it correlates well with the contents of Nordic ocean industries, at the same time as it presents the key sustainability challenges of the ocean economy.

1.3. How this study was conducted

This study was conducted by Gaia Consulting Ltd for Nordic Innovation between June – September 2021. It was based on a desk study of national ocean strategies and maritime spatial plans, basic industrial statistics, as well as innovation programs and other relevant studies, reports, and websites; surveys and interviews with a total of 42 informants across the Nordic region, as well as meetings and discussions with Nordic Innovation and the Nordic reference group for the forthcoming program. The results were presented to Nordic Innovation in September 2021 as background material for scoping the themes of the Sustainable Ocean Economy program.

The mapping consists of the following parts:

Chapter 2 contains an introduction to the topic of the mapping, by scoping the sustainable ocean economy in its global context.

Chapter 3 contains a mapping of the ocean economy in each of the Nordic countries and self-governing areas. The chapter borrows the same structure as in chapter 2, with main developments presented.

Chapter 4 contains a summary of Nordic strongholds and cooperation opportunities identified in the mapping. The chapter forwards preliminary suggestions for the scoping of the forthcoming programme.

⁶ OECD June 2020

⁷ OECD December 2020



2. Brief description of the global operating environment of the Ocean Economy

The global annual economic value of the ocean economy has been valued at 2.1 trillion EUR, making it the world's seventh largest economy⁸. The oceans' asset value is estimated to be 20 trillion EUR⁹. Back in 2016, the Organization for Economic Co-operation and Development (OECD) predicted a doubling of the value creation of the global ocean economy from 2010 to 2030, and an employment estimate of around 40 million people by 2030¹⁰. It is estimated that 90% of the world's goods are traded across the ocean, and that harnessing just 0.1% of the renewable energy potential of the ocean would be able to satisfy annual global energy demand five times over¹¹. In the EU, turnover in the ocean economy was estimated at 750 billion EUR in 2018, with 5 million employed in the sectors. This turnover represented an increase of 11.6% compared to the previous year, speaking to the large potential growth in the ocean economy particularly in tourism and offshore wind energy¹².

Despite the effects of the COVID-19 pandemic, it is still valid to predict rapid growth in the economic activity in the ocean. This growth is in part thanks to the potential of ocean economy investments. Investments into sustainable ocean-based interventions, such as decarbonisation of international shipping, ocean-based food production, and offshore wind energy production, could yield benefit-cost ratios between 3:1 and up to 12:1 over a 30-year time horizon¹³. The European Investment Bank has provided financing to ocean economy activities like offshore wind and green shipping to the tune of over 3 billion EUR within the past four years¹⁴.

Equally of concern in the ocean economy is the sustainability of industrial activities. Issues such as climate change, acidification, ocean warming, marine pollution, overfishing, and loss of habitats and biodiversity threaten not only the natural environment of the ocean but its economic potential, as well¹⁵.

These current developments place increasing pressure on the Nordics to keep up as well as pay closer attention to the sustainability of ocean industries. As leaders in key areas of interest such as digital and innovative technologies, sustainability, and renewable energy, the Nordic countries are well placed to take advantage of this growth and potential.

In this section, we describe the current global trends in six key sectors of the ocean economy, using the framework created by the Ocean Panel for a transformation to a sustainable ocean economy and their "Vision for Protection, Production and Prosperity"¹⁶.

8 UNEP 2021

9 High Level Panel for a Sustainable Ocean Economy December 2020a

10 OECD 2016

11 Lloyd's Register 2013

12 European Union 2020

13 High Level Panel for a Sustainable Ocean Economy December 2020b

14 European Investment Bank Group 2021

15 High Level Panel for a Sustainable Ocean Economy December 2020b

16 High Level Panel for a Sustainable Ocean Economy December 2020a

2.1. Sustainable Ocean Food

Demand for fish and seafood has increased dramatically in the past 30 years: from 1990 to 2018, the global demand for fish rose 122%. By 2030, consumption is expected to be 18% higher than in 2018, largely driven by rising incomes and urbanization, better distribution channels, as well as trends towards healthier diets. Per capita fish consumption is expected to grow particularly in Asia, Europe, Latin America, and Oceania. It is expected that richer nations, like those in the EU, will remain highly dependent on fish imports to meet domestic demand. Norway, however, is expected to stay on top as one of the largest exporters in the world¹⁷.

Massive growth has occurred on the supply side, though this has mainly occurred in the field of aquaculture. Global capture fisheries production grew to 96.4 million tonnes in 2018, a 14% increase from 1990. Comparatively, aquaculture production rose 527% over the past three decades, reaching 114.5 million tonnes in 2018. The growth in supply has largely been driven by Asia, in particular China, but all continents have had their share of growth. This growth in the supply of fish is expected to continue, with Asia and China remaining on top as the largest global suppliers. Growth in supply is expected to come particularly from aquaculture, with capture fisheries' growth remaining fairly modest. In Europe, the EU is expected to see growth of around 3.1% by 2030 in exports compared to 2018, with Norway alone seeing growth of 2.5% by 2030¹⁸.

This growth, however, has come at the expense of sustainability. Fish stocks have suffered, and only 66% of fish stocks were within biologically sustainable levels in 2017, down from 90% in 1990. Driving this poor trend is unequal progress in fisheries management: while some fisheries have even reached biologically sustainable levels thanks to improved management systems, this has not replicated across the industry. Climate change poses risks to the industry in the form of rising water temperatures and acidification of the ocean, although this risk is not uniformly distributed across the globe. Here the Nordics are in a lucky position, as these risks are estimated to be lower for the region than more southern parts of the globe¹⁹.

The Ocean Panel has set priority actions for the transformation to sustainable ocean food with the targeted outcome in 2030 that "wild fish stocks are restored and harvested at sustainable levels, aquaculture is sustainably grown to meet global needs, and waste is minimised and managed throughout the value chain". Especially the following innovation-related priority actions are highly relevant for the Nordic countries:

- Explore in a precautionary manner the potential to sustainably harvest new species from the ocean, without undermining ecosystem health
- Put in place policies and management frameworks to minimise the environmental impacts of aquaculture, including inefficiencies in the feed supply chain, and enable the acceleration of fed and non-fed aquaculture production that fits local environmental, governance, and economic priorities.

¹⁷ Food and Agriculture Organization of the United Nations 2020

¹⁸ Food and Agriculture Organization of the United Nations 2020

¹⁹ Food and Agriculture Organization of the United Nations 2020

2.2. Sustainable Ocean Energy

As the population of the world grows, so does the demand for energy. By 2030, energy demand is predicted to be 40% higher than today. This demand needs to be addressed with low-carbon fuels and more diverse and sustainable energy sources²⁰. The ocean economy provides opportunities for providing renewable energy from wind, wave, tidal, current, thermal, and solar energy sources. It's estimated that if 0.1% of the ocean energy available was converted to electricity, it would satisfy global demand five times over²¹. Ocean energy holds potential not only for replacing fossil fuels, but also as an investment. By some estimates, globally, investments into offshore wind energy production could see 12:1 benefit-cost ratios²².

Global renewable energy capacity additions hit a new record in 2020, expanding by over 45% year over year, with wind accounting for 90% of this change. Offshore wind additions are projected to rebound in 2021-22 from its slight dip in the share of wind additions, led by China but diversifying geographically in 2022²³. Offshore renewable energy is a key component of the EU's energy strategy, with offshore sources set to account for up to 25% of the EU's electricity production by 2050. This includes not only wind energy, which the EU plans to scale to 60 GW by 2030 and 300 GW by 2050. The EU is looking to scale the marine renewables industry by 5 times by 2030 (capacity totalling 1 GW) and 25 times by 2050 (capacity of 40 GW) to reach the EU's Green Deal objectives²⁴. 98% of the EU's installed offshore wind capacity is in the North and Baltic Seas, making this an industry that is highly interesting to the Nordics²⁵.

The Nordic countries have an energy-demanding climate, as well as an energy-demanding industry structure. Therefore, shifting the region's energy consumption towards sustainable renewable forms is a high-level priority in all Nordic countries, and all countries have made political commitments to be carbon neutral in the coming decade(s). The Nordics have the potential to become exporters of wind power to mainland Europe²⁶. The region already hosts big industry, especially in wind power: 55% of Denmark's energy technology exports come from wind turbine technology, and wind technology and services hit a record of 8.9 billion EUR in 2019²⁷. This year, Denmark revealed plans to invest in an artificial energy island in the North Sea that could power 3 million households, and the government is looking to engage with the private sector to expedite its construction²⁸. In Norway, this past summer the Ministry for Petroleum and Energy announced its new energy transition plan, which put hydrogen and offshore wind power at the centre of its strategy to reduce dependency on oil²⁹.

The Ocean Panel has set priority actions for the transformation to sustainable ocean energy, with the targeted outcome in 2030 that "ocean-based renewable energy is fast-growing and on the path to becoming a leading source of energy for the world". Especially the following innovation-related priority actions are highly relevant for the

20 Lloyd's Register 2013

21 Lloyd's Register 2013

22 High Level Panel for a Sustainable Ocean Economy December 2020b

23 International Energy Agency 2021

24 European Union 2020

25 European Union 2021

26 Nordic Energy Research 2020

27 State of Green 2020

28 The Guardian 2021

29 Reuters, June 2021

Nordic countries:

- Invest in research, technology development, and demonstration projects to help make all forms of ocean-based renewable energy—including wind, wave, tidal, current, thermal, and solar—cost-competitive, accessible to all, and environmentally sustainable.
- Work collaboratively with industry and other stakeholders to develop clear frameworks addressing environmental impacts of ocean-based renewable energy, enabling capacity, co-existence, and integration with other uses of the ocean.

2.3. Sustainable Ocean Transport

The ocean plays a critical role in international trade and in facilitating globalization: around 90% of international trade is seaborne³⁰. Maritime trade has been hit hard by the COVID-19 pandemic, plunging by 4.1% in 2020. However, the UN Conference on Trade and Development is cautiously optimistic about the industry's ability to bounce back assuming global economic recovery. The industry itself, the UNCTAD notes, is at a turning point in many respects. The pandemic has increased awareness of the fragility, but also the necessity of global supply chains, even creating some pushback towards outsourcing from far away countries³¹.

Alongside these concerns is the threat of climate change and increasing scrutiny on emissions. The ocean transport sector emits 940 million tonnes of CO₂ annually, making up 2.5% of global greenhouse gas emissions. Although more efficient in terms of exhaust emissions than air or road transport, in the EU 13% of transport emissions come from shipping³². Without action, these emissions are expected to rise globally between 50-250% by 2050, which would be catastrophic for climate targets³³. Many are looking to the potential of new technologies, operational measures, and digitalisation to modernize the sector as well as deliver on these much-needed sustainability measures³⁴.

With generations-long traditions, strong industry actors, research programs and fresh innovations in alternative fuels, shipping design, and propulsion systems, the Nordic countries have a great competitive edge in this sector. As part of national goals towards carbon neutrality, several of the Nordic countries are putting increasing focus on green and emission-free shipping through e.g. ecosystem support and innovation partnerships³⁵. In addition, the battery industry is in rapid growth in the Nordic countries, with big investments underway, fuelled by promising predictions for the European battery market as a result of the growth in electric traffic and renewable energy³⁶.

The Ocean Panel has set priority actions for the transformation to sustainable ocean transport with the targeted outcome in 2030 that "shipping investments have effectively accelerated the shift towards zero-emission and low-impact marine vessels". Especially the following innovation-related priority actions are highly

30 Lloyd's Register 2013

31 United Nations Conference on Trade and Development 2020

32 European Union 2021

33 European Commission 2021

34 United Nations Conference on Trade and Development 2020

35 International Transport Forum 2020

36 More information on the cooperation of Business Finland, Business Sweden, Innovation Norway and EBA250 – EIT InnoEnergy on Nordic battery webinars, autumn 2021, at <https://nordic-battery-thursdays.b2match.io/home>

relevant for the Nordic countries:

- Stimulate the development and adoption of technologies for producing and storing new zero-emission fuels
- Incentivise sustainable, low-carbon ports that support the transition to decarbonised marine transport and shipping fleets through renewable energy and zero-carbon fuel supply chains
- Promote the transition of the global fleet to modern modes of propulsion and renewable fuels [...] and support technical cooperation for international capacity building.

2.4. Sustainable Ocean-based Tourism

Coastal and ocean-based tourism is a major economic contributor worldwide, making up 189 billion EUR in goods and services globally. 30% of tourism worldwide takes place in the near proximity and on the seas. According to EU definitions, coastal (incl. ocean-based) tourism is the largest economic contributor (45%) and the largest employer (64%) within the ocean economy³⁷. It should be noted that there are no generally agreed definitions for ocean-based tourism, and the EU definition of coastal tourism covers a large part of the general tourism in the Nordic countries. The COVID-19 pandemic has hit the tourism sector particularly hard, meaning growth in the tourism industries is expected to lag that of the rest of the economy. That said, some countries, including Denmark, actually saw an increase in coastal tourism during the pandemic, thanks to an increase in domestic travel³⁸.

The EU has identified tourism as a sector with “special potential to foster a smart, sustainable, and inclusive Europe”³⁹. While good for the economy, there are major concerns about the sustainability of the industry and especially the strain tourism puts on coastal and ocean regions. The cruise industry, which grew significantly in the decade before the pandemic, has heavy impacts on the environment in the form of air and water pollution⁴⁰. In general, overcrowding and spoiling of the unique and authentic nature experience of the Nordics risks the very foundation of the tourism industry in the region⁴¹. Climate change poses risks to coastal regions in the form of flooding, erosion, and droughts⁴². Not adequately addressing these sustainability concerns risks putting the industry that relies on these natural resources at risk⁴³.

The Ocean Panel has set priority actions for the transformation towards sustainable ocean-based tourism, with the targeted 2030 outcome that “coastal and ocean-based tourism is sustainable, resilient, addresses climate change, reduces pollution, supports ecosystem regeneration and biodiversity conservation, and invests in local jobs and communities”. Especially the following innovation-related priority actions are highly relevant for the Nordic countries:

- Implement mechanisms to increase the reinvestment of tourism revenue into local and indigenous communities to build capacity and skills for increasing

37 European Union 2021

38 Using the EU definition, up to 72% of the Danish tourism market goes under the definition of coastal tourism. For the Iceland, Faroe Islands, Greenland and Åland the share can be expected to be even higher.

39 European Union 2021

40 European Union 2021

41 Nordic Council of Ministers 2019

42 European Union 2021

43 Kabil et al. 2021

local employment in tourism, diversify economic opportunities, and increase resources for coastal and marine restoration and protection.

- Accelerate financial incentives for including nature-based solutions in sustainable tourism infrastructure.

2.5. Sustainable New Ocean Industries

The EU's Blue Economy report for 2021 highlights the potential of innovations in the ocean economy to advance the goals of the Green Deal, as emerging ocean economy technologies can help sustainability issues and contribute to economic growth⁴⁴. The Ocean Panel notes the vast potential for emerging innovation and business opportunities, especially related to the novel and combined use of waters, together with better ecosystem services. The Nordic countries, with their strong innovation environments (several Nordic countries top international innovation indexes⁴⁵) have great potential to contribute to these new and better solutions. Here the renewable energy industry is just one of the potential areas for innovation: for example, Norway has already noted the potential of its seabed resources for carbon capture and storage⁴⁶ and Finland's Baltic Action Sea Group⁴⁷ has initiated collaborations for better nutrient cycling.

The Ocean Panel has set priority actions for the transformation of sustainable new ocean industries with the targeted outcome in 2030 that "Innovation and investments in new ocean industries have boosted environmentally responsible and inclusive economic growth". Especially the following innovation-related priority actions are highly relevant for the Nordic countries:

- Scale up environmentally responsible commercial farming of seaweed and algae to provide food and create alternatives for products such as fuels, aquaculture and agriculture feedstocks, biotech, and viable and sustainable plastic alternatives.
- Explore and incentivise smart and sustainable cross-sectoral and co-located activities, such as ocean-based renewable energy sites to fuel zero-emission shipping and aquaculture farms.
- Promote fair and equitable sharing of benefits from research and development from marine genetic resources within national waters.
- Advance carbon capture and storage in the sub-seabed through international collaboration, appropriate incentives, and mapping the storage potential of sub-seabed geological formations

2.6. Seabed Mining

The last transformation outlined by the Ocean Panel concerns "a precautionary approach to seabed mining", with the goal for 2030 that "sufficient knowledge and regulations are in place to ensure that any activity related to seabed mining is informed by science and ecologically sustainable".

It should be noted that deep seabed mining is not yet at a commercial stage in European waters, and both scientists and environmentalists have raised concern

⁴⁴ European Union 2021

⁴⁵ Sweden, Denmark, and Finland have been among the top 10 most innovative countries in the Bloomberg Innovation Index for several years, followed by Norway among the top 20.

⁴⁶ Reuters June 2021

⁴⁷ More information on the activities of the Baltic Action Sea Group at <https://www.bsag.fi/en/action/>

over the risk of inevitable and irrevocable biodiversity loss⁴⁸. That said, the Nordic countries have strong RDI environments, including some EU funded projects, involved in research on deep-sea marine mineral resources and ecosystems which will help in understanding these environmental impacts. It is worth noting that the Norwegian University of Science and Technology has included deep seabed mining as one of its strategic research areas until 2023.⁴⁹

The priority actions of the Ocean Panel under this theme suggest "initiating an international research agenda to improve understanding of the environmental impacts and risks of seabed mineral activities (especially regarding deep ocean ecosystems)." To our understanding it is highly relevant for Nordic research and innovation ecosystems to participate in this dialogue.

48 European Union 2021; Reuters April 2021

49 See the Norwegian University of Science and Technology, which offers an ocean pilot program on deep seabed mining: <https://www.ntnu.edu/oceans/deep-sea-mining>

3. Brief overview of the Ocean Economy in the Nordic countries

This section gives a brief overview of the ocean economy in each Nordic country, including basic facts and figures on the ocean industries, current policies and strategic priorities, and key business and innovation ecosystems related to the ocean economy.

The overviews of the industry structures are divided into overarching categories of

- ocean food
- ocean energy
- ocean transport
- ocean-based tourism and
- new ocean industries (incl. enabling technology development, digitalisation, and space).

All data presented is based on available national and Nordic statistics⁵⁰.

The overviews of current policies and strategic priorities are primarily based on national strategies for the ocean economy and its sectors and industries, where available. Strategies for the bioeconomy, climate, and energy were selectively consulted, as they have direct links to the ocean economy. In addition, maritime spatial plans as required by the EU's maritime spatial planning directive⁵¹ have been selectively consulted in the country overviews.

The overviews of business and innovation ecosystems include relevant data on regional or national-level ecosystems of major relevance for the given country's ocean economy, as well as information on current support provided by national innovation funding agencies for ocean-related innovation ecosystems. The summaries illustrate both the current strengths and the cooperation potential of these ecosystems.

⁵⁰ As there are no comprehensive data sets covering all ocean industries variations in the quality and comparability of the data may occur.

⁵¹ Directive 2014/89/EU of the European Parliament and the Council of 23 July 2014 establishing a framework for maritime spatial planning. OJ L 257, 28.8.2014, p. 135–145.



3.1. Denmark

3.1.1. The Ocean Economy – facts and figures

Ocean transport

Ocean transport is of particular importance for the Danish ocean economy. “Blue Denmark” (as defined by the Danish Maritime Authority) includes shipowners and shipping companies and a wide range of related businesses, such as shipbrokers, ports and logistics companies, shipyards and industrial and service companies that supply equipment, components, and service to ships.

Shipping is the largest export industry in Denmark and accounts for 1/5 of total Danish exports. Shipping employs approximately 100 000 people. Denmark is the sixth largest merchant ship operator in the world and a major part of the world's fleet has Danish equipment onboard.⁵²

Danish Shipping is the trade and employer organisation for more than 90 shipowners and offshore companies, with members from Mærsk to Ørsted presented in the directory⁵³.

Danish Maritime is the business association for Danish manufacturers of maritime equipment and ships and involves nearly 150 member companies in networking and

⁵² Danish Shipping 2021

⁵³ More information can be found in the membership directory at <https://www.danishshipping.dk/en/om-os/danske-rederier/medlemmer/>

lobbying activities. Prominent maritime companies, from ABB to Wärtsilä, are part of transnational corporations with headquarters or subsidiaries in Denmark, and their competencies are presented in the member directory of the business association⁵⁴.

Danish Shipping and Danish Maritime, together with the Danish Ports association⁵⁵ and Danish Infrastructure⁵⁶, form the business community of companies working with the ocean transport sector broadly.

Ocean energy

As a pioneer in offshore wind energy, Denmark established the first offshore wind farm in the world in 1991, and in 2021 is now a global leader in the field. In addition to offshore wind power, Denmark is leading in developing and testing wave power solutions and Power-to-X technologies for storage and conversion of renewable energy. These emerging areas, with great potential for the future, are the subject of several significant development projects and demonstration platforms.⁵⁷

Denmark is preparing to establish the world's first energy islands in the North Sea and the Baltic Sea. The artificial energy island in the North Sea is a huge investment aimed at providing energy beyond domestic needs and will be able to export electricity to neighbouring countries⁵⁸. The somewhat smaller investment in the Baltic Sea is located at the island of Bornholm. Both projects are being considered for Power-to-X solutions (producing and exporting hydrogen and storing energy in large-scale batteries) and for organising refuelling posts for shipping⁵⁹. The large energy company Ørsted is involved in the development of the energy island, as well as the green hydrogen project H2RES that will transform offshore wind power into green hydrogen to fuel zero-emission road transport in the Greater Copenhagen area.⁶⁰

The main industry associations for ocean energy are Danish Energy⁶¹ and to some extent Danish Ports. In recent years, Danish shipping companies in the offshore sector have shifted focus from oil and gas to wind and are now built and equipped primarily to support the wind industry.⁶²

Ocean-based tourism

Tourism in coastal areas forms a significant part of the Danish tourism and hospitality sector overall, but the direct share of ocean-based tourism is assessed to cover only a minor part of this. In addition to the overarching business and industry association in the hospitality sector, Denmark has a dedicated industry and business foundation, Danish Coastal and Nature Tourism, working to maintain and increase the competitiveness and sustainable growth of Danish tourism in the increasingly competitive market through a common agenda and action plans.⁶³

54 More information can be found in the membership directory at <https://danskemaritime.dk/medlemmer/?lang=en>

55 More information can be found in the membership directory at <https://www.danskehavne.dk/en/om-danske-havne/medlemsliste/>

56 More information can be found in the membership directory at <https://www.danskindustri.dk/medlemsforeninger/dansk-infrastruktur/medlemmer>

57 Energistyrelsen 2021

58 World Economic Forum 2021

59 European Commission 2021

60 More information can be found at <https://greenhydrogen.dk/update-on-the-h2res-project/>

61 More information can be found in the membership directory at <https://www.danskeenergi.dk/om-dansk-energi/medlemmer>

62 Danish Shipping 2021

63 More information about the activities and development plans at <https://investin.kystognatur-turisme.dk/en/om-os/>

Ocean food

Aquaculture in Denmark employs more than 500 people and produces around 10% of the consumed fish in Denmark. The commercial cultivation of mussels, oysters, and seaweed is growing. In the coming years, the role of cultivated mussels in preserving marine ecosystems is high on the agenda, as well as increasing the sustainability and circularity of fish farms.

The Association of Danish Aquaculture⁶⁴ is the forum for the aquaculture ecosystem, spanning from feed producers to fish farmers, recirculating aquaculture system plants, as well as shellfish and algae plants, processing companies, and exporters as well as business-to-consumer companies.

New ocean industries

Denmark hosts interesting developments in various emerging ocean industries. In addition to the novel development in emerging ocean energy industries and seafood cultivation, described above, Denmark has a strong cluster in robotics and artificial intelligence (AI) related to the ocean industries, which is being expanded into new applications for offshore solutions (more information on Odense Robotics in chapter 3.1.3.).

3.1.2. Policy development and strategic priorities

The Plan for Growth in Blue Denmark⁶⁵ outlined 37 initiatives that aimed at increasing Denmark's role as a hub for testing new maritime technologies and developing better use of data digital systems. In addition, the plan aimed at establishing good framework conditions for maritime production and operations, including offshore energy. The strategy included specific actions for the development, testing, and use of autonomous maritime technology, accelerating new business models, digitalisation, and common reporting platforms, and work for the increased availability and utilisation of data to promote maritime innovation and business. Although the strategy has not been updated during the current government term, it still shows some of the strongholds that Denmark is developing.

The Danish Climate Act⁶⁶ includes the target to reduce greenhouse gas emissions by 70% by 2030 compared to 1990 levels and towards net zero by 2050. As one major step to achieving this goal, the Climate Agreement for Energy and Industry⁶⁷ includes the plan to build the energy islands described in the previous section.

The Danish green transition is furthermore boosted by the decision in 2020 to establish a new Green Future Fund, by channelling capital through the four existing innovation and business funds: EKF Denmark's Export Credit Agency, the State Investment Fund Vækstfonden, the Green Investment Fund, and the Investment Fund for Developing Countries (IFU).⁶⁸

In addition, several industrial sectors have developed their own strategies and put forward targets for the coming years. For example, the Danish Shipping Industry's Climate Partnership for Blue Denmark⁶⁹ includes six initiatives that the industry is committed to investing in, as well as 15 recommendations to the Government. The

⁶⁴ More information can be found at <https://danskakvakultur.dk/om-os/>

⁶⁵ The Danish Government 2018

⁶⁶ Danish Ministry of Climate, Energy and Utilities 2020

⁶⁷ The Danish Government 2020

⁶⁸ Danmarks Grønne Fremtidsfond 2020

⁶⁹ Climate Partnership for Blue Denmark 2020

industry initiatives include sharing of shipping data, a partnership for test ships⁷⁰, establishing a Maritime Center of Excellence, initiating a global innovation fund for the shipping industry, and co-ordinated efforts to attract more EU research and innovation funds to the Danish shipping industry.

Danish energy industries have developed recommendations for a strategy and national ecosystem on Power-to-X. The aim is to capitalize on Denmark's strengths and release the potential in Power-to-X to support the green transition both in Denmark and globally, through export of Danish expertise, technology, and energy.⁷¹

The Danish energy cluster has formed a partnership for wave power that has developed targets and recommendations to the government concerning the need for a coordinated national effort on wave energy. Suggested efforts include setting political targets for the share of wave energy in Denmark's energy mix, integrating test and demonstration activities in major offshore projects (such as the energy islands), and earmarking funds for wave power research, export, and industry support through the green investment funds of Denmark.⁷²

The Danish aquaculture industry's strategy for 2021-27 focuses on increasing sustainability and circularity in aquaculture, protecting biodiversity, and developing the use of data and digital tools for climate and environmental monitoring. The role of aquaculture in the green transition is emphasized, linking to the EU strategy for blue growth.⁷³

The action plan for Danish coastal and nature tourism⁷⁴ includes actions for increased innovation and technology transfer in the tourism industries. New strategies for the tourism industries are currently under way. Ocean-based and coastal tourism is emphasized in the local tourism strategies of key destinations.

Denmark's maritime spatial plan (MSP)⁷⁵ outlines the future use of marine resources and the development of new maritime business opportunities. It introduces holistic spatial planning for the entire Danish marine area, including the territorial sea and the Exclusive Economic Zone (EEZ). The MSP has been coordinated by the Danish Maritime Authority under the Ministry of Industry, Business and Financial Affairs, involving a broad range of ministries and agencies. A significant part of the sea area is allocated for future offshore wind farms and energy islands, ensuring the green transition of the Danish society and industries, as well as export potential to Europe. Some coastal areas are preserved for ocean-based and coastal tourism, which contributes billions of DKK in revenue to the Danish economy. Stable, good conditions are ensured for fisheries and aquaculture, the mineral resource industry, maritime transport, and other ocean-based activities, while ensuring that marine ecosystems and biodiversity is protected at critical sites.⁷⁶

3.1.3. Business and innovation ecosystems

In past years, Denmark's strong tradition of industrial clusters based on regional strengths has been supported by the government through dedicated cluster

⁷⁰ More information on the testbed ShippingLab can be found at <https://shippinglab.dk/>

⁷¹ Danish Energy 2020

⁷² More information can be found at <https://wavepartnership.dk/politik/>

⁷³ Dansk Akvakultur 2021

⁷⁴ Danish Coastal and Nature Tourism 2019

⁷⁵ See www.havplan.dk/en

⁷⁶ Danish Maritime Authority 2021

funding. In recent years, the focus has increasingly been on building strong cluster organisations on the national level. Several of the 14 publicly funded national clusters for 2021-24 relate to the ocean economy⁷⁷.

Energy Cluster Denmark⁷⁸ is Denmark's cluster organisation for the entire energy sector, aimed at turning Denmark into a leading green nation in the development and demonstration of innovative and global energy solutions. Among the anchor companies are global players Vestas, Siemens Gamesa, Ørsted, and Vattenfall. As an example of current activities, in 2021 the innovation project ADD2wind will develop the provisioning of spare parts for offshore wind farms based on drone technology.

Maritime & Logistics Innovation Denmark (MARLOG)⁷⁹ focuses on digitalisation and green transformation in transport chain piloting, maritime energy transition, and carbon capture and storage. It also links to offshore wind energy in terms of the decommissioning of and emission-free service vessels. MARLOG has nearly 200 members from large to small corporations, from freight companies, shipbuilders and brokers, ports, technology providers, to universities and municipalities. Among its members are actors like ABB, Ørsted, and Mærsk.

Food & Bio Cluster⁸⁰ has more than 300 members from the food value chain, research, and public actors, and is the host for e.g. the EU-funded WaSeaBi project that develops and tests new concepts for efficient, sustainable, and novel utilisation of side streams from aquaculture, fisheries, and aquatic processing industries. Among the anchor company partners are several big players within the aquafood industry, including Jeka Fish and Royal Greenland.

Odense Robotics⁸¹ is the national cluster for Danish companies operating within robotics, automation, and drones as well as other stakeholders within the cluster's ecosystem. Stemming from shipyard-related robotics research carried out at the Mærsk Mc-Kinney Møller Institute (University of Southern Denmark), the robotics cluster in Southern Denmark now includes more than 130 robotic companies, including Universal Robots (UR) and Mobile Industrial Robots (MiR). The cluster supports innovation and business growth of robot, drone, and automation businesses through diverse activities.

DigitalLead⁸² is Denmark's cluster organisation for companies developing digital solutions as well as for other industries in need of innovative digital solutions. In a project in cooperation with the MARLOG (Maritime & Logistics Innovation Denmark) cluster, DigitalLead is establishing a testbed for maritime companies to test the use of digital services utilising VHF Data Exchange System (VDES) technology⁸³ for maritime communications.

Clean – the national cluster in environment technologies⁸⁴ gathers, among other themes, the frontrunning Danish companies in water management solutions and export of clean water technologies.

77 Cluster Excellence Denmark 2021

78 More information on the cluster can be found at <https://www.energycluster.dk/>

79 More information on the cluster can be found at <https://www.marlog.dk/en/home>

80 More information on the cluster can be found at <https://foodbiocluster.com/>

81 More information on the cluster can be found at <https://www.odenserobotics.dk/>

82 More information on the cluster can be found at <https://digitallead.dk/english/>

83 More information can be found at <https://digitallead.dk/innovation/projekter/vdes-living-lab/>

84 More information on the cluster can be found at <https://cleancluster.dk/en/>

CenSec Centre for defence, space, and security⁸⁵ leads a range of innovation projects that have potential implications on the ocean economy. For example, these projects are developing better means of synthesizing data generated in global and local natural systems (related to e.g. climate, meteorology, and ice sheet properties) with data generated by human-made systems and activities (e.g. over and under the sea surface) by combining physics-based modelling, simulations, and analytics with statistical and machine learning (ML) based data analytics⁸⁶.

Other maritime ecosystem developments include:

- The Mærsk McKinney Møller Center for Zero Carbon Shipping that provides a platform for the entire shipping ecosystem to identify and demonstrate new solutions for zero carbon shipping⁸⁷.
- The Testbed Shipping Lab, a non-profit innovation and project collaboration for the partners of Blue Denmark⁸⁸.
- Danish Maritime Days, a major event for the global maritime industry and an open platform for collaboration across the industry. The Maritime Days will be organised next in 2022⁸⁹.

Innovation and business funding in the ocean economy is provided by Innovation Fund Denmark through ecosystem support, targeted research and innovation programs, the State Investment Fund (Vækstfonden), and the Green Investment Fund. Denmark's Green Future Fund adds funding targeted directly at the global export of green energy solutions, especially wind power⁹⁰. Innovation in offshore energy solutions is funded through the Energy Agency's Energy Technology Development and Demonstration Program (EUDP)⁹¹. The Danish Maritime Fund supports the shipping and shipbuilding industries with funding for co-financing the development of novel products and technologies with annual calls for funding.⁹²

85 More information on the cluster can be found at <https://censec.dk/>

86 <https://censec.dk/blog/2021/04/12/pgda-physics-guided-data-analysis/>

87 More information can be found at <https://zerocarbonshipping.com/>

88 More information can be found at <https://shippinglab.dk/>

89 More information on the Danish Maritime Days and the Platform can be found at <https://www.danishmaritimedays.com/>

90 More information can be found at <https://dgff.dk/>

91 More information can be found at <https://ens.dk/en/our-responsibilities/research-development/eudp>

92 More information can be found at <https://www.dendanskemaritimefond.dk/english/>



3.2. Finland

3.2.1. The Ocean Economy – facts and figures

Ocean transport

Ocean transport is of particular importance for the Finnish ocean economy, including the ship-building industry, transport and ports. Together this sector contributed to approx. 14 billion EUR of turnover in 2019.

Finland is among the world leaders in ship technology and ship operations, especially for arctic and harsh environments (including ship design, shipbuilding, material technology, icebreaking, monitoring, engine and steering technology, ship electrification and automation, navigation and shipping operations, as well as port technology and infrastructure).

Ocean transport is vital to the country's exports and imports⁹³: about 90% of Finnish imports and exports travel by sea. Passenger ships are used to transport goods, especially to and from Sweden and Estonia. For exports in 2020, general cargo, oil products, and paper were the most exported goods and accounted for 46% of exports in maritime transport.

Finnish Marine Industries⁹⁴ is the business association and co-operation forum for high

⁹³ Finnish Shipowners' Association 2021

⁹⁴ More information about Finnish Marine Industries can be found at <https://meriteollisuus.teknologia-teollisuus.fi/en>

technology maritime solution providers, leading marine equipment manufacturers, turnkey suppliers, design offices, system suppliers, software providers, shipbuilding, and ship repair and offshore yards. It has approximately 100 member companies presented in its member directory⁹⁵. According to the association, the whole industry, consisting of some 1 100 companies, has an annual turnover of 9 billion EUR. Export is central, making up 90% of activities.

The Finnish Port Association has 29 members, including both sea and inland ports. According to the association⁹⁶, the Finnish Port Authorities invest 100-120 million EUR yearly in real estate, port equipment, and the development of port areas and waterways.

The Finnish Shipowners' Association⁹⁷ has 25 member companies that together own more than 100 ships. It represents cargo ships, passenger ships, tankers, and speciality ships such as icebreakers. According to the association, around 7 000 people work onboard the vessels and the yearly turnover is approximately 2.3 billion EUR.

Shipbrokers Finland⁹⁸ is an association of 40 companies: ship agents, port operators, liner agents, container shipping, and chartering brokers. Members operate or are based in Finland. The association's members transport approximately 70% of Finnish import and export-related marine transports.

Ocean energy

The ocean energy sector is not very large and mainly comprises of wind energy. However, there are start-up companies in this field. One such example is Wello, which produces wave energy converters aiming at minimal environmental impact⁹⁹.

The offshore industry designs and manufactures offshore equipment to serve e.g. the oil industry and wind power as well as various types of service vessels. The industry covers established companies such as Wärtsilä, who work in both the transport and energy markets. There are examples of innovative start-ups, such as Norsepower, which develops modern sail power for shipping¹⁰⁰.

The Finnish Wind Power Association¹⁰¹ supports the development and growth of the Finnish wind power industry. FWPA has approximately 140 company members which comprehensively represent the companies working in the wind energy industry.

Ocean food

Fisheries and aquaculture are important when it comes to development and innovation, although much smaller in scale than the ocean transport sectors.

The Finnish Fish Farmers' Association¹⁰² is a Finnish association for the field of aquaculture. It represents aquaculture companies that produce fish or other

95 Finnish Maritime Industries 2020

96 Finnish Port Association 2019

97 More information about the Finnish Shipowners' Association can be found at <https://shipowners.fi/en/>

98 More information about Shipbrokers Finland can be found at <https://shipbrokers.fi/en/>

99 One Initiative 2021

100 One Initiative 2021

101 More information about the Finnish Wind Power Association can be found at <https://tuulivoimayhdistys.fi/en/>

102 More information about the Finnish Fish Farmers' Association can be found at <https://www.kalankasvatus.fi/>

products, as well as individual people working in the field and companies and other organisations with connections to aquaculture. The association has more than 100 members all over Finland.

The Finnish Fishermens' Association¹⁰³ is an umbrella association for five regional professional fishers' organisations in Finland. In 2020, the catch from all fishing vessels registered in Finland was 112 million kg and was worth 31 million EUR. In the same year, 3 352 vessels were registered for professional marine fishing in Finland¹⁰⁴.

Ocean-based tourism

The tourism industries are important in Finland. Although a significant share of tourism is targeted at coastal locations, there is little focus specifically on ocean-based tourism.

3.2.2. Policy development and strategic priorities

The Finnish government has set a goal to make the sustainable ocean economy one of Finland's key strengths. An action plan for maritime policy is being prepared and is expected to be published during autumn 2021¹⁰⁵.

The policy determines the four focus areas of Finland's maritime policy: 1) the maritime cluster, 2) maritime logistics (part of the cluster but highlighted as its own spearhead), 3) marine production, and 4) protection of the seas. Together these four focus areas support sustainable ocean economy and the ocean-related Sustainable Development Goals (SDGs) of Agenda 2030¹⁰⁶. Cross-cutting themes common for these four focus areas are automation, digitalisation and data; competences, education and research; influence at the EU and international level; a secure operating environment; and financing.

- Protection of the seas has connections to all the other focus areas and the prioritized measures refer to stopping the loss of marine biodiversity, reducing marine litter and micro-plastics as well as eutrophication, preventing oil spills and chemical accidents and developing capacity for damage prevention, and stopping ocean warming and acidification.
- Maritime logistics are key to Finland's competitiveness and the aim is to develop them into an efficient, safe, digitalised, and low-emission system, to make the Baltic Sea a testbed for autonomous logistics, and to build competencies around these areas. One of the main goals is to enhance the globally competitive maritime shipping business in Finland.
- Within the maritime cluster, Finland is looking to level the operational environment internationally, encouraging innovation in companies (in e.g. maritime cleantech and environmental protection), ensuring availability of competent workforce, and securing the availability of critical defence technologies.

Marine production, on the other hand, includes developing sustainable aquaculture globally, developing sustainable recreational use of marine areas, and the development and export of ocean energy solutions by e.g. investing in research.

The draft action plan for the maritime policy consists of concrete measures to implement the objectives of Finland's maritime policy guidelines and the EU's

¹⁰³ More information about the Finnish Fishermen Association can be found at <http://sakl.fi/>

¹⁰⁴ Luke 2021

¹⁰⁵ Prime Minister's Office 2021a. The policy document behind the action plan is the "Government Resolution on Finland's Maritime Policy Guidelines – from the Baltic Sea to the oceans" (2019).

¹⁰⁶ Prime Minister's Office 2019

integrated maritime policy. It outlines the more detailed implementation actions in the marine policy focus areas as well as timelines, resources, and responsibilities for each action.¹⁰⁷

The Finnish Bioeconomy Strategy from 2014 included a development plan on the blue bioeconomy (published in 2016) and the research and competence building agenda on the blue bioeconomy (published in 2018)¹⁰⁸. The aim of the research agenda is to boost business based on the sustainable use of waters and aquatic natural resources. The Finnish Bioeconomy Strategy is currently being updated and the new strategy is expected to be ready by the end of 2021¹⁰⁹. The update takes into account e.g. changes in the operating environment and the government program.

Finland has endorsed a separate strategy for the Baltic Sea Region¹¹⁰, with the purpose to make the Baltic Sea region a global leader in the bioeconomy and the circular economy; well-connected, innovative, competitive, and at the cutting edge of utilising new technologies; and a producer of model solutions for safe and clean shipping, the maritime industry, and sustainable use of the marine environment. The strategy highlights the following six themes:

- Sustainable blue growth highlights the good state of the marine environment as a prerequisite for growth. The areas mentioned are marine competencies, marine industry, blue bioeconomy, tourism, and the maritime spatial plan.
- Bioeconomy and circular economy include nutrition recycling, material circulation, littering and harmful substances, and renewable energy.
- Connecting Finland to the Baltic Sea Region covers logistics, telecommunications, smart energy grids, and security of supply
- Safe and Secure Baltic Sea emphasizes the significance of comprehensive security models, maritime and aviation safety, national security, and public sector cooperation
- Innovations and competitiveness are approached from the point of view of networks among SMEs, business accelerators, digitalisation, research, and education
- International impact and cooperation where the Baltic Sea region is seen as a global forerunner and influencer. Cooperation and networks are embraced on different levels e.g. between cities, in international forums, and with NGOs.

Finland's Strategy for the Arctic Region¹¹¹ outlines objectives regarding Finnish competencies in ocean industries, networks, clusters, and business and innovation ecosystems. Aquaculture is seen as a growing field that should be developed, in addition to possibilities for the use of fish side streams. Environmental and social sustainability are highlighted regarding tourism in Arctic regions and cross-cut other themes. The space industry is mentioned, as developing better forecasting of environmental conditions is seen as important for climate change adaptation as well as for business potential for Finnish companies. Research on the Arctic region and arctic issues is seen as relevant for science-based decision-making. Active participation in developing and implementing international regulation further influences marine logistics and transport in the Arctic. Here Finland's know-how in winter seafaring is to be utilized and further developed.

107 The Finnish version of the draft can be found at <https://www.lausuntopalvelu.fi/FI/Proposal/Participation?proposalId=40c095ab-7405-4450-a90c-15bba524cc68&proposalLanguage=da4408c3-39e4-4f5a-84db-84481bafc744>

108 More information can be found at <https://mmm.fi/biotalous/sininen-biotalous>

109 <https://www.bioeconomy.fi/facts-and-contacts/finnish-bioeconomy-strategy/>

110 Prime Minister's Office 2017

111 Prime Minister's Office 2021b

Finland's maritime spatial plan 2030¹¹² consists of three planning areas: the Gulf of Finland; the Archipelago Sea and southern Bothnian Sea; and the northern Bothnian Sea, Kvarken and Bothnian Bay. Each of the three planning areas has its own set of regional councils. The regional councils are responsible for the preparation of maritime spatial plans according to the Land Use and Building Act¹¹³. Finland's maritime spatial plan (MSP) is a strategic plan which has been formed together with a large variety of stakeholders and is supporting the sustainable use of the marine area and the good status of the marine environment. The implementation of the MSP is partly conducted alongside the national maritime policy action plan. The MSP outlines the large potential for offshore energy, mainly wind, in the Bothnian Sea, and Kvarken and the Bothnian Bay. When implemented, the MSP will enable the production of significant offshore wind power (15.7 GW) (the Regional Council of Southwest Finland 2020). The construction of offshore wind power in Finnish territorial waters may, at its best, reflect in the operations of shipyards as a factor increasing demand and supporting the vitality of the ocean industries. The MSP helps to secure well-functioning maritime logistics connections and support the vitality of the industry. In addition, the MSP promotes the vitality of maritime tourism and recreation. The areas' potential for aquaculture is scattered but resides mainly in the Archipelago Sea and the Bothnian Sea.

The Finnish government has set a target to be carbon neutral by 2035, leading to ambitious target setting that affects the ocean economy, among other sectors. A government resolution to reduce emissions from maritime and inland waterway transport (2021) ties the Finnish targets to EU and International Maritime Organization (IMO) targets¹¹⁴. The key means raised in the resolution are related to vessel energy efficiency improvements and development of low-emission vessels, together with exerting influence on international decision-making. The National Roadmap for fossil-free transportation by the Finnish Ministry of Transport and Communications (2021)¹¹⁵ focuses on land transportation but mentions the use of hydrogen and e-fuels as one option in marine transportation. In the long-term plan, reaching to 2045, some biofuels could possibly be utilized in marine transportation and aviation if land transport and biofuel production develops as anticipated. The National Battery Strategy 2025 mentions the electrification of seafaring as an interesting topic for Finland¹¹⁶.

Several Finnish industry associations have created their own roadmaps for decarbonisation. Technology Industries of Finland connects ocean economy to decreasing carbon emissions through research, development, and innovation e.g. in optimizing port operations and energy efficiency and carbon neutral energy sources on vessels¹¹⁷.

The Finnish Marine Industries Association has developed a vision to make every ship smart by 2025 and with this raise the level of safety in maritime operations, journey into arctic territories, and support sustainable transport at sea¹¹⁸.

112 meriskenaarit.info 2021

113 In Finnish Maankäyttö- ja rakennuslaki, 132/1999.

114 Finnish Government 2021

115 Roadmap to fossil-free transport: Government resolution on reducing domestic transport's greenhouse gas emissions, <https://julkaisut.valtioneuvosto.fi/handle/10024/163260>

116 Ministry of Economic Affairs and Employment 2021

117 Technology Industries of Finland 2020

118 Business Finland Maritime & Offshore 2020

3.2.3. Business and innovation ecosystems

Innovation funding for companies is available mainly from Business Finland. Especially the following on-going funding programs contribute to a sustainable ocean economy:

- Smart Energy including e.g. Team Renewable Arctic Finland ecosystem (described below)
- Smart Mobility and Batteries from Finland focuses on digital and autonomous smart ships and passenger vessels, smart ports, marine logistics, and icebreaking
- New Space Economy funds innovations, networks, and export services as well as research

Business Finland has several funding instruments to support ecosystem development. Growth engines are business ecosystems that aim at a minimum of 1 billion EUR in new business, exports, or investments in Finland. Funding can be in the form of a capital loan or funding for companies which facilitate ecosystem development. Several of the Growth Engines target the development of the ocean economy.

Team Renewable Arctic Finland (TRAF) is a business ecosystem focusing on competitive solutions to offshore wind and supporting infrastructure, as well as vessels for both construction and operation of offshore wind farms. The ecosystem is funded by 22 member companies under Business Finland's Smart Energy program. TRAF is a merger of two former ecosystems: Team Arctic Finland, that focused on exports of turnkey solutions, and the Baltic Offshore Wind ecosystem. TRAF includes companies from the whole offshore wind value chain, including ABB, Ampner, Aker Arctic, Arctia, Boskalis Terramare, Corporatum, Danfoss, Destia, Enersense, EPV, ESL Shipping, Fortum, Finnish Sea Service, Hyötytuuli, Pori Offshore Constructions, Ponvia, Rauma Marine Constructions, Savcor, Skarta, Steerprop, VTT, and Wärtsilä.

The Business Finland-funded Space Technology Growth Engine provides earth imaging data as a platform for innovation. The ecosystem is led by ICEYE Oy, a company that develops radar satellites.

One Sea¹¹⁹ is aiming to create an autonomous maritime ecosystem by 2025. Members include e.g. ABB, Cargotec, Finnpiilot, Ericsson, TietoEVERY, Wärtsilä, and relevant industry associations.

Awake.AI¹²⁰ develops smart ports with the help of artificial intelligence.

Energy systems is an ecosystem that aims at developing an ecosystem around renewable energy on the system level. It hosts the Smart Energy Åland demonstration project, where the Åland Islands function as a testbed for an energy system based on renewables like solar and offshore wind energy. The company developing the ecosystem is Flexens¹²¹.

The GreenE2¹²² ecosystem, facilitated by CLIC Innovation, is targeted towards Power-to-X solutions that are linked to hydrogen. Solutions can be connected to

¹¹⁹ More information about One Sea can be found at <https://www.oneseaecosystem.net/>

¹²⁰ More information about Awake.AI can be found at <https://www.awake.ai/smart-port-as-a-service>

¹²¹ Business Finland 2019

¹²² More information can be found at <https://www.businessfinland.fi/ajankohtaista/uutiset/2020/greene2-verkottaa-toimijat-vedyn-ja-hiilidioksidin-hyodyntamisessa>

offshore wind energy production. Power-to-X solutions that are linked to hydrogen. Solutions can be connected to offshore wind energy production.

Besides programs and growth engines, Business Finland has innovation aid specifically for shipbuilding¹²³, to support the development of solutions that are significantly better than the current ones topping the EU shipbuilding industry¹²⁴.

The national hydrogen cluster, founded in 2021, involves 30 member companies interested in the future potential of hydrogen solutions. Key companies include ABB, Aurelia Turbines, Gasgrid Finland, Fortum, Neste, SSAB, UPM, and Wärtsilä.¹²⁵

The Ministry for Agriculture and Forestry coordinates the Finnish operational program under the European Maritime and Fisheries Fund¹²⁶. The upcoming program period 2021-2027 is being prepared and is estimated to start in early 2022 after the legislation has been accepted nationally and the European Commission has approved the Finnish program.

123 More information on the innovation aid for shipbuilding can be found at <https://www.business-finland.fi/en/for-finnish-customers/services/funding/innovation-aid-for-shipbuilding>

124 Business Finland 2020

125 More information can be found at <https://h2cluster.fi/>

126 More information can be found at <https://merijakalatalous.fi/en/>



3.3. Iceland

3.3.1. The Ocean Economy – facts and figures

Ocean food

The fishing industry is one of the key industries of the Icelandic ocean economy. Around 7 500 people worked directly in fisheries and fish processing (amounting to approximately 3.9% of the total workforce) in 2019. Fishing along with fish processing accounted for 8.1% of GDP in 2019. Over 600 000 tonnes of marine products were exported, accounting for 40% of the value of exported goods.¹²⁷ Aquaculture, in particular salmon farming, is a growth industry. Overall, the ocean food sector is expected to continue growing.¹²⁸

Fisheries Iceland is the industry association for the ocean food sector, including companies in fisheries, fishing vessel owners, fish processing plants and aquaculture.¹²⁹

The Federation of Icelandic Industries (SI)¹³⁰ is the largest industry association, covering most of the industries in Iceland. SI brings together fisheries and industry to further develop technology to increase the value of fish and related products. It is engaged in the transformation of the energy market.

¹²⁷ Iceland Responsible Fisheries 2020

¹²⁸ Government of Iceland 2019

¹²⁹ More information can be found at <https://www.sfs.is>

¹³⁰ More information can be found at <https://www.si.is/>

Ocean-based tourism

Tourism is an important sector in Iceland, and has been increasing over the past decade with a focus on nature, coastal and ocean-based tourism. In the pre-pandemic years of 2018-19, tourism was the biggest source of export revenue, making up more than 1/3 of the total value of exports¹³¹. Despite a decline during the pandemic, tourism is still among the key industries in the Icelandic ocean economy.

The Tourism Association SAF is a stakeholder organisation for all companies operating in the tourism industries. It does not have a specific focus on coastal and ocean-based tourism, but as an island society most tourism activities in Iceland are related to the coastal areas and ocean. SAF governs an innovation fund that can award prizes to innovations in the tourism industries.¹³²

Ocean transport

Ocean transport is another important sector for Iceland. There are several Icelandic shipping companies operating locally as well as organising sea freight between Iceland and Europe (and some between Iceland and the US).

Eimskip (Eimskipafélag Íslands hf) is a leading logistics company in the North Atlantic, and the oldest shipping company with origins in Iceland. Today it has offices in 19 countries. In cooperation with the Greenlandic Royal Arctic Line, Eimskip is developing more sustainable shipping between Iceland, Greenland, the Faroe Islands, and Scandinavia. Another major logistics company is Samskip, an international company established in Iceland, nowadays headquartered in the Netherlands.

Fossil fuels are still used to a large extent in ocean transport and fisheries, although almost all electricity and heating in Iceland stems from renewable, hydro, and geothermal energy. Increased government resources have been allocated to decarbonize ocean transport, including the development of infrastructure for electric vehicles.

Ocean energy

Due to Iceland's abundance of low-cost hydro and geothermal power, there has been little pressure to invest in ocean power, although the circumstances for it would be favourable. Some innovation projects on osmotic energy and tidal power have been realised, alongside development of marine turbines. Submarine hydrothermal systems is a topic of growing interest.

New ocean industries

The fisheries and aquaculture value chains provide novel business opportunities in the form of innovative, higher-value use of by-products for use in pharmaceuticals, cosmetics, and other applications.

The seaweed industry is an emerging promising industry. In 2019, the industry consisted of approximately 15 companies and start-ups. Seaweed is mainly harvested from wild cultivations, and significant opportunities for innovation and increased value creation is seen by the industry¹³³.

Icelandic ecosystems have been key partners in Nordic networks linked to seafood, feed, and novel applications from ocean biomass. These included, among others,

¹³¹ OECD 2020

¹³² More information can be found at <https://www.saf.is/um-saf/nyskopunarsjodur/>

¹³³ Iceland Ocean Cluster 2020

projects from the Nordic Marine Innovation 2.0 program that explored seaweed as food, superfood, and fish feed, as well as the use of collagen from fish skin¹³⁴.

The data and digitalisation industry is also strong in Iceland, with novel application possibilities for the ocean industries. As an example, Marorka, a leading global provider of data-driven energy management and operational performance solutions for the maritime industry is headquartered in Reykjavík. The company provides combined onboard/onshore systems based on data-driven analytics, which have been installed on more than 600 vessels globally.

Icelandic research environments, including Iceland Geosurvey and the University of Iceland, are involved in research on the seabed and view the sharing of know-how and technology across the Nordics as an opportunity¹³⁵.

3.3.2. Policy development and strategic priorities

Iceland does not currently have any comprehensive national blue strategy in effect, but the ocean economy plays a prominent role in key national policies and strategies. Sustainable fisheries is one of the main priorities of the Icelandic Government.¹³⁶

At the writing of this report (September 2021) Iceland is in the process of forming a new government and it remains to be seen how ocean economy-related topics will be addressed in the Government's program. Issues of relevance for the ocean economy are monitored as part of Iceland's national implementation of Agenda 2030¹³⁷. Of special concern to Iceland is ocean acidification, which may have a profound impact on the marine ecosystem. This is addressed in national policies and monitored by the Marine and Freshwater Research Institute.

For several years, the Government's policy on fisheries management has already set quotas and operating frameworks for fisheries. As a member of the European Economic Area, Iceland is developing its maritime spatial plan (MSP)¹³⁸ in line with EU directive. The Icelandic National Planning Agency Skipulagsstofnun is a state authority under the Ministry for the Environment and Natural Resources, and is responsible for the administration and implementation of the Planning Act, the Act on Marine Spatial Planning and the Act on Environmental Impact Assessment. The MSP is developed in cooperation with national and regional stakeholders. Spatial plans are being updated for the East Fjords and the West Fjords. The Icelandic authorities emphasize the importance of completing the mapping of the seabed within Iceland's territorial waters, as mapping provides the foundation for scientific advice on the protection of sensitive marine ecosystems located on the ocean floor, as well as advice on where diverse economic activities can be located¹³⁹.

The Climate Action Plan¹⁴⁰ (2018, updated in 2020) is the main instrument to reach Iceland's commitments in the Paris Agreement, specifically its emissions reduction goals for 2030. It is the main instrument to reach Iceland's stated goal of carbon neutrality by 2040. The plan includes climate mitigation actions in all major sectors, including ocean transport and ocean food.

134 Nordic Innovation 2019

135 Based on information received in discussions with Icelandic stakeholders, August 2021

136 Government of Iceland 2019

137 Government of Iceland 2019

138 More information can be found at <https://www.hafskipulag.is/>

139 Government of Iceland 2019

140 Government of Iceland / Ministry for the Environment 2020

Actions of specific relevance to the ocean economy include¹⁴¹ :

- energy transition in fisheries, where emissions from the fisheries industries will be reduced using various incentives
- banning the use of heavy fuel oil, where regulation will be issued to tighten fuel requirements which effectively bans the use of heavy fuel oil in the territorial sea of Iceland
- energy transition of ferries, where ferries that are a regular part of the transport system will be required to use fossil free fuel
- energy transition of state-owned vessels, with measures aiming to reduce the use of fossil fuel in state-owned vessels other than ferries
- electrification of fishmeal production plants

Iceland's Energy Policy¹⁴² is based on a vision for a sustainable energy future. It includes taking measures for an energy transition that makes Iceland independent of fossil fuel for transport on land, on the sea and in the air. The energy transition at sea will cover all ships, boats, and other seafaring vessels, for fishing, transport of cargo or people, or any other use, as well as port activities. It will require infrastructure development in the harbours to ensure renewable energy for all shipping related operations. It will require development that allows industrial building complexes (like geothermal power plants) to make the fullest use of energy resources by connecting energy sites to different industry clusters to use the side streams and surpluses from one another (in the ocean economy this encompasses e.g. the energy, food, biotechnology, and chemical industry). Innovation and the transfer of technology between the energy sector and environmental sectors is emphasized.

The Government's waste prevention work includes actions for sustainable tourism and actions for dealing with by-products from fish processing¹⁴³.

The Icelandic Ocean Cluster has set its own agenda for the next decade with the aims of promoting circular seafood economy and blue start-ups both domestically and internationally, safeguarding the ocean environment in the arctic region, and assisting other countries in building ocean ecosystems in harbours worldwide through the establishment of ocean clusters¹⁴⁴.

3.3.3. Business and innovation ecosystems

The Iceland Ocean Cluster connects entrepreneurs, businesses, and knowledge in the ocean industries. The national cluster consists of more than 70 companies focusing particularly on the fishing fleet and fish value chains, including the use of fish side streams. The Ocean Cluster House in the Reykjavík Harbour is an incubator for new companies within the ocean economy. The cluster has been active for more than 10 years and holds an important position in the Icelandic ocean economy. The cluster is actively working on spurring ecosystem development in other parts of the world through its global networks.¹⁴⁵

¹⁴¹ Government of Iceland / Ministry for the Environment and Natural Resources 2020b

¹⁴² Government of Iceland / Ministry of Industries and Innovation 2020

¹⁴³ Government of Iceland 2019

¹⁴⁴ Iceland Ocean Cluster, May 2021

¹⁴⁵ More information on the Iceland Ocean Cluster can be found at <https://www.sjavarklasinn.is/en/>

The Fish and Ships project¹⁴⁶ (one of the key activities of the cluster) targets the whole fish value chain through the themes:

- Fishing ships, with measures targeted at improved ship design, equipment, innovative software, revolutionary cooling methods, and high-quality fish processing onboard, leading to both energy efficiency and 100% use of the fish
- Seafood processing technology, with measures targeted at resource efficient, high-quality, and sustainable waste-reducing seafood processing systems and technologies, including information technologies
- 100% fish, with measures targeted at showcasing the whole range of innovation happening in products made from fish in Iceland, including seafood, supplements, medical products, and design made from fish and fish parts, and other novel products.

Research infrastructures and testbeds in public and private ownership are diversely located in Iceland. As an example of the services available, Matis Ltd., Iceland's national Food and Biotech RDI institute organisation, operating under the Ministry of Industries and Innovation, provides support to Icelandic industries and authorities through R&D collaboration and analytical services, with a very strong expertise in marine biomass and value-added marine products¹⁴⁷.

¹⁴⁶ More information on the Fish and Ships project can be found at <https://www.sjavarklasinn.is/en/iceland-fish-ships/>

¹⁴⁷ More information on Matis services can be found at <https://matisiceland.org/research-and-innovation/infrastructure/>



3.4. Norway

3.4.1. The Ocean Economy – facts and figures

Norway's wealth traces back to the sea. According to the definitions of ocean economy sectors used by the Norwegian government, the value creation in Norwegian ocean industries amounts to approximately 72 billion EUR, where the share of value creation in coastal communities is significant. The most significant sectors are ocean energy (traditionally oil and gas), ocean transport (shipping and maritime industries), and ocean food (fishery and aquaculture). Coastal tourism is bound to be among key sectors, although no figures equivalent to those of the EU member states were found.

The Federation of Norwegian Industries is the common association for various industries such as the oil and gas contractors, aquaculture and aquaculture suppliers, maritime industry, and mining. Members include major companies such as Norsk Hydro, Aker and Equinor.

Ocean transport

Norway has a strong maritime and shipping industry and is among the world leaders in shipping (measured by value). The Norwegian maritime cluster includes the shipping industry, the shipbuilding industry, service providers, and equipment suppliers to all types of ships and other floating vessels. It includes vessels and maritime technology related to other maritime industries, as well as RDI activities of importance to the maritime industry¹⁴⁸.

¹⁴⁸ Norwegian Shipowners Association 2021

The Norwegian Shipowners' Association is the trade organisation for Norwegian controlled companies within the shipping and offshore industry. Member companies employ about 50 000 seafarers and offshore workers from nearly 50 different nations. The association engages in national and international industry policies, employer issues, competence and recruitment, environmental issues and innovation, in addition to safety at sea.¹⁴⁹

Ocean energy

Norway has a strong oil and gas industry with leading companies including Equinor, operating in 36 countries with considerable additional investments in renewable energy. While domestic electricity is produced almost entirely by hydropower, supplemented mainly by onshore wind, electricity generation from floating offshore wind (FOW) is estimated to grow in the long term (particularly after 2030) and will mainly be exported¹⁵⁰.

Norway leads in floating offshore wind development, with Equinor establishing the world's largest floating offshore wind farm, Hywind Tampen¹⁵¹, to power oil and gas fields in the North Sea. In addition, Norwegian ocean energy covers tidal power.

Energy Norway is the industry association for production, distribution, and trading of electricity in Norway. The Norwegian Oil & Gas Association represents more than 100 companies associated with oil and gas activities on the Norwegian continental shelf.¹⁵²

Ocean food

Fishery and aquaculture are significant industries in the Norwegian ocean economy and important export industries. The fisheries and aquaculture industries are Norway's second largest export industry after oil and gas, with products exported to more than 150 countries. The biggest export product is salmon.

Sjømat Norge, the Norwegian Seafood Federation represent approximately 800 member companies covering the value chain from fisheries and aquaculture, feed production, biomarine industry, technology and service, seafood logistics, and others in Norway¹⁵³.

The Norwegian Seafood Council, a public company owned by the Ministry of Trade, Industry and Fisheries, works together with the Norwegian fisheries and aquaculture industry to develop markets for Norwegian seafood¹⁵⁴.

Ocean-based tourism

Coastal ocean-based and nature tourism is significant in Norway, with long coastal areas and inland fjords attracting travellers. On the national level, there is no current development of significance in ocean-based tourism.

New ocean industries

New ocean industries emerge in the cross-sections of and overlaps with established

¹⁴⁹ More information on member companies can be found at <https://rederi.no/>

¹⁵⁰ Norwegian Industries 2020

¹⁵¹ More information can be found at <https://www.equinor.com/en/what-we-do/hywind-tampen.html>

¹⁵² More information on members companies can be found at <https://www.norskoljeoggass.no/en/about-us/member-companies/>

¹⁵³ More information can be found at <https://sjomatnorge.no/>

¹⁵⁴ More information can be found at <https://en.seafood.no/about-norwegian-seafood-council/about-us/>

industries. Significant activity is found in seaweed production for food, feed, and bio-based replacements of other products, where Norway is among the leading countries in Europe and has pioneering companies in these industries. Seaweed Solution AS¹⁵⁵ has already established a commercial seaweed farm off the island of Frøya in the Trøndelag county. Other examples are the pilots of Norway Seaweed AS¹⁵⁶ in Arendal, and the start-up Norwegian Seaweed Production AS¹⁵⁷ in Bergen. In recent years there have been investments in RDI projects led by SINTEF.

3.4.2. Policy development and strategic priorities

Norway's first ocean strategy "New Growth, Proud History: The Norwegian Government's Ocean Strategy" (2017) and its update "Blue Opportunities" (2019) are the first comprehensive strategies for the key ocean industries in Norway. Diverging from the other Nordic countries, the Norwegian strategies focus on the main established industries: oil and gas, the maritime industry, the seafood industry, and emerging industries in the intersection of these industries. The most recent governmental report "Blue Ocean, Green Future. The Government's Commitment to the Ocean and the Ocean industries"¹⁵⁸ follows the same structure and outlines development in the focus areas of:

- a high-tech oil and gas industry
- greener and smarter shipping
- sustainable coastal seafood industry
- open ocean aquaculture
- offshore wind
- carbon capture and storage (CCS)
- hydrogen development for reduced emissions and increased value creation
- mineral activities on the seabed that open new business opportunities
- digitalisation, technology, and the transfer of skills creating synergies across ocean industries

The Norwegian Government's priorities for aquaculture¹⁵⁹ include fish health and welfare, the production of sustainable seafood with low climate and environmental impact, healthy and secure seafood that covers nutritional demands and dietary preferences, good access to markets where Norwegian seafood products have competitive advantages, followed by documentation on food security, sustainable production and fish health and welfare, supporting employment and socio-economic impacts along the coastal areas and incomes to the community.

The Norwegian shipping industry prioritizes developing, testing, and implementing high-tech solutions. In 2019 the Norwegian government published the Government's Action Plan for green shipping¹⁶⁰, which forecasts that by 2022 one third of the country's car carrier ferries will use electric propulsion systems. As a pilot example, the world's first fully electric and autonomous container ship, Yara Birkeland, launched in 2020¹⁶¹.

The Government's Hydrogen strategy¹⁶² points out the strengths of Norway in relation to hydrogen development, including strong competences in the petroleum

¹⁵⁵ More information can be found at <https://seaweedsolutions.com/>

¹⁵⁶ More information can be found at <https://norwayseaweed.no/>

¹⁵⁷ More information can be found at <https://norwegiansp.no/>

¹⁵⁸ Ministry of Trade, Industry and Fisheries 2021

¹⁵⁹ Ministry of Trade, Industry and Fisheries 2021

¹⁶⁰ Norwegian Government 2019

¹⁶¹ Ministry of Trade, Industry and Fisheries 2021

¹⁶² Ministry of Petroleum and Energy & Norwegian Ministry of Climate and Environment 2020

industry, carbon capture and storage, and maritime technology. The strategy points out the main focus areas for hydrogen opportunities, including ocean transport that strongly links to the Government's Action Plan for green shipping.

The National Tourism Strategy 2030¹⁶³ puts focus on nature tourism, which in Norway implies coastal and ocean-based activities but does not target ocean-based tourism as such.

The Norwegian Climate Act (2017, updated in 2021)¹⁶⁴ sets targets for greenhouse gas emissions to be reduced by at least 50-55% by 2030 (from the reference year 1990) and for Norway to reach the status of a low-emission society by 2050. However, a report commissioned by Norwegian industries points out that the targets will be challenging to meet¹⁶⁵.

During the early 2010's, Norway developed regional spatial plans for the Barents Sea and the ocean areas of the Lofoten archipelago, the Norwegian Sea, and the North Sea and the Skagerrak. The latter plan was updated in 2016 as part of a Barents Watch project¹⁶⁶. There was no recent information found regarding the current state of national level maritime spatial planning.

The Government's Arctic policy was updated in 2021¹⁶⁷ and will continue focusing on creating good framework conditions for companies in North Norway across industries, especially in ocean industries, the maritime industries, petroleum, green power-intensive manufacturing, mineral extraction, agriculture, tourism, space infrastructure, and the services sector.

"Sea and Oceans" was one of seven priority areas in the Government's long-term plan for research and higher education in 2019–2028¹⁶⁸. Key areas were marine bioresources and marine management in fisheries, aquaculture, new industries, and the knowledge basis for managing ecosystems and resources; marine technology and maritime innovation related to vessels, the shipbuilding industry, and the service and supply industry; and the petroleum and minerals industries with innovation, demonstration and piloting of relevance to the Norwegian continental shelf. Norway has had a targeted maritime research and innovation strategy, Maritim21, that is being revised in 2021.

3.4.3. Business and innovation ecosystems

The Norwegian business and innovation scene is focused on ocean-related industries to a considerable extent. According to Innovation Norway, at least 30-40% of the organisation's total budget is used to advance ocean-related business development through loans and grants. In addition to more generic instruments, Innovation Norway offers targeted support for different sectors of the ocean economy, including the purchase and construction of fishing vessels or for equipment and tools, fishing quotas and rights; collaborative projects on climate and environmentally friendly domestic shipping; piloting and demonstration of future offshore solutions; and grants for bio economics projects based on e.g. ocean resources.

163 Innovation Norway 2021

164 Ministry of Climate and Environment 2021

165 Norwegian Industries 2020

166 See <https://www.barentswatch.no/tjenester/> : Arealverktøy for forvaltningsplanene

167 The Norwegian Government 2021

168 Ministry of Education and Research 2018

Norwegian Innovation Clusters are supported through a national program, funded by Innovation Norway, Siva, and the Research Council of Norway. More than 25% of the supported clusters are directly related to the ocean economy. These include¹⁶⁹:

GCE Blue Maritime: The maritime cluster at Møre has more than 210 companies that design, build, equip, and operate advanced vessels for the oil-based industry globally.¹⁷⁰

GCE Ocean Technology in the Bergen region consists of over 100 companies that develop and supply expertise and technology for installation, operation and maintenance of subsea installations globally. The cluster has a strong professional environments in the field of underwater and marine technology.¹⁷¹

GCE NODE provides advanced technology, products, and services to the global energy and maritime industry. It aims to improve the development of new products and services and transfer knowledge and technology to new markets in a sustainable way.¹⁷²

NCE Aquatech Cluster for suppliers to the aquaculture industry has more than 100 companies and organisations as its members. The goal is to deliver technology for sustainable growth in aquaculture-based food production around the world, and to establish a global position for fish farming technology from Norway.¹⁷³

NCE Seafood Innovation consists of 70 partners, representing a total of 150 small and medium-sized businesses. The cluster is centred in Hordaland but is represented along the entire Norwegian coast and in international seafood regions. The cluster targets sustainable development of the industry through investments in research, development, and innovation.¹⁷⁴

NCE Blue Legasea gathers resources, experience, and knowledge from all parts of the marine value chain. It aims to developing the Norwegian sustainable fishing industry towards 100% utilization of marine raw material.¹⁷⁵

NCE Maritime CleanTech includes businesses from across the maritime value chain, renewable energy suppliers, as well as research and educational institutions. It works with innovative solutions for energy efficient and environmentally and climate friendly maritime activities.¹⁷⁶

Interesting clusters in earlier phases include:

Ocean Autonomy Cluster: An emerging cluster consisting of companies that work with autonomy for the ocean space, together with research and development environments, expertise environments, technology suppliers, component and system

¹⁶⁹ More information and links to the website of each innovation cluster is found on https://www.innovasjon Norge.no/no/subsites/forside/om_klyngeprogrammet/kart/. The program provides support for clusters on three levels: Arena (early phase of collaboration), Norwegian Centres of Expertise NCE (established collaboration and Global Centres of Expertise GCE (established collaboration with international potential, as part of global value chains)

¹⁷⁰ More information can be found at <https://www.bluemaritimecluster.no/gce>

¹⁷¹ More information can be found at <https://www.gceocean.no/>

¹⁷² More information can be found at <https://gcenode.no/>

¹⁷³ More information can be found at <https://aquatechcluster.no/>

¹⁷⁴ More information can be found at <https://seafoodinnovation.no/>

¹⁷⁵ More information can be found at <https://www.legasea.no/legasea>

¹⁷⁶ More information can be found at <https://maritimecleantech.no/>

suppliers, investors, and innovative customers. The cluster is based in Trøndelag.¹⁷⁷

SAMS - Sustainable Autonomous Mobility Systems Norway, works with combining maritime, land-based, and air-based mobility. Goals include increased use of shipping and zero-emission shipping.¹⁷⁸

Ocean Hyway, a national hydrogen cluster, works to exploit the commercial opportunities of new hydrogen technology solutions.¹⁷⁹

RENERGY facilitates cooperation and develops innovation projects and new energy business models with a focus on hydrogen (especially relevant as fuel for ships), cargo and passenger transport on land and sea, energy production, and new technology for energy systems.¹⁸⁰

The Norwegian Offshore Wind Cluster aims to become the strongest supply chain for floating offshore wind worldwide. Companies like Equinor, Aker Solutions, and Kværner are at the forefront already, as are a number of other Norwegian-based companies. Membership is open to any type of company or organisation, including international ones.¹⁸¹

Stiim Aqua Cluster is an innovation ecosystem for aquaculture-related businesses in South-West Norway, working with technology transfer. It aims to connect environments in oil and gas, automation and electronics, robotics, the maritime advanced mechanical industry, and IT with the established aquaculture industry.¹⁸²

NOSCA Clean Oceans develops technology, services, value chains, and markets for the detection, classification and handling of marine oil spills, plastic pollution, and undesirable effects of algae in cooperation between 27 cluster members.¹⁸³

The Marine Recycling Cluster works with technology development, products, and services that can streamline marine clean-up and prevent ocean pollution. It consists of 19 members and partners based in Vesterålen and Lofoten.¹⁸⁴

The Cod Cluster is a corporate cluster centred around Lofoten that works with the entire value chain for cod fish from capture to sales and exports.¹⁸⁵

Centres of Excellence for research-based innovation are supported by the Research Council of Norway (the so-called "SFI scheme"). One ecosystem is formed around the EXPOSED Aquaculture centre that works with innovation to enable fish farming in exposed locations. The centre brings together a network of four leading research institutions and 14 industry partners to develop technologies in autonomous systems and technologies for remote operations, monitoring of aquaculture sites and operations, and structures and vessel designs for exposed locations.¹⁸⁶

177 More information can be found at <https://oceanautonomy.no/>

178 More information can be found at <https://sams-norway.no/>

179 More information can be found at <https://www.oceanhywaycluster.no/>

180 More information can be found at <https://renergycluster.no/en/>

181 More information can be found at <https://offshore-wind.no/>

182 More information can be found at <https://www.blueplanet.no/>

183 More information can be found at <https://www.nosca.no/>

184 More information can be found at <https://marinerecycling.no/>

185 More information can be found at <https://codcluster.no/>

186 More information on the centre can be found at <https://exposedaquaculture.no/>

In 2021 funding decisions were made for 22 new Centres for research-based innovation. These include at least four Centres directly related to the ocean economy. Activities will be launched during the latter part of 2021¹⁸⁷:

- SFI AutoShip: Safe autonomous ships for sustainable operations (NTNU)
- Floating structures for the next generation ocean industries (SINTEF OCEAN AS)
- SFI Smart Ocean - Flexible and cost-effective monitoring for management of a healthy and productive ocean (UNIVERSITETET I BERGEN)
- SFI Harvest - Technologies for sustainable biomarine value creation (SINTEF OCEAN AS)

In addition to the SFI centres, the Research Council of Norway has a separate portfolio for ocean-related research and innovation, including actions to support marine ecosystems, maritime industries, aquaculture and blue bioeconomy, and ocean technologies. Support is available for industry-led innovation projects that utilise research results.¹⁸⁸

ENOVA, under the Ministry of Climate and Environment, contributes to reductions in greenhouse gas emissions, improved security of energy supply, and the development of technology that will bring about reductions in greenhouse gas emissions in the longer term. Enova governs the national Climate and Energy Fund (updated mandate for 2021-24) and provides funding for investments in climate and energy projects in all industrial sectors.¹⁸⁹

¹⁸⁷ Published results can be found at <https://www.forskningradet.no/en/call-for-proposals/2019/centre-for-research-based-innovation/>

¹⁸⁸ More information can be found at <https://www.forskningradet.no/om-forskningradet/portefoljer/hav>

¹⁸⁹ More information on funded activities can be found at <https://www.enova.no/>



3.5. Sweden

3.5.1. The Ocean Economy – facts and figures

Ocean transport

Ocean transport, shipbuilding and repair, and port activities form the Swedish shipping cluster. Although the number of merchant ships in the Swedish register has declined significantly (almost 40%) during recent years due to outflagging¹⁹⁰, ocean transport is still one of the most significant ocean industries in Sweden. The shipping cluster employs over 100 000 people indirectly, and 10 000 onboard ships. Shipping is important for accelerating the growth and development of Swedish industry in general. Already today, more than 90% of Sweden's trade happens via shipping. The yearly turnover in Swedish shipping companies amounts to more than 3 billion EUR. Ships and ferries transport more than 130 million tonnes of goods and 30 million people to and from Swedish ports per year. In 2019, the total cargo handling in Swedish ports was 170 million tonnes.¹⁹¹

The Swedish Shipowners' Association has more than 50 member companies, presented in the membership directory¹⁹². Approximately 80% of the shipping industry is concentrated in the metropolitan regions of Gothenburg, Stockholm,

¹⁹⁰ Flagging out or Flag of convenience refers to the registering of ships in open or international registers so that the ship can fly a flag of a country other than the country of ownership.

¹⁹¹ Swedish Shipowners' Association 2021

¹⁹² More information on the association's membership directory can be found at <https://www.sweship.se/medlemskap/vara-medlemmar/>

and Malmö. Other maritime industry associations include the Swedish Shipbrokers' Association with member companies within liner agency operations, purchasing and sales, chartering and ship clearance¹⁹³, and the Passenger Shipping Association with 13 member companies.¹⁹⁴

Ocean energy

Sweden's other strong ocean sector is in the energy sector, with international leader Vattenfall, and the Swedish government is investing strongly in off-shore projects. Sweden's technology and innovation environments offer solutions to different ocean-related industries, including offshore industries.

Swedenergy¹⁹⁵ is the overall industry association for the Swedish energy industries. The value chain of offshore developers collaborate through the Ocean Energy Sweden network¹⁹⁶.

Ocean food

Sweden is a net importer of fish and fish products. In 2018, Sweden produced 0.2 million tonnes of fish including molluscs and crustaceans, with a value of 155 million EUR. Approximately 73% of this value came from fisheries and only 27% from aquaculture¹⁹⁷. The Swedish Fishermens' Producer Organisation (SFPO) is Sweden's largest organisation for professional fishermen and has about 250 member vessels.

Fish farming is a small, but growing industry, currently concentrated to nine companies with facilities in approximately 30 locations around Sweden. It employs little more than 100 people. The production consists of rainbow trout (approximately 75% of the total volume) and char. Most of the char is sold on the domestic market, while rainbow trout is exported to a higher degree. Swedish Food Fish farmers is the industry association for the major fish farming companies.¹⁹⁸

Ocean-based tourism

With several archipelago areas, canals, and a unique maritime cultural heritage, Sweden has good conditions for ocean tourism and recreation.

In addition to the generic tourism and hospitality associations (including the Swedish Tourist Association and the association for the Swedish hospitality industries Visita), Sweden has a specific association for nature tourism companies (Naturturismföreningen) with approximately 400 members. It organises an annual forum for ecotourism, the theme in November 2021 being sustainable tourism on coasts and seas¹⁹⁹.

Visita, together with approximately 170 other companies and organisations in the hospitality industries have established the company Svensk Turism Ab as a forum for strategic development of the whole tourism sector. No specific focus was found on ocean-based tourism.

¹⁹³ More information can be found at <http://www.swe-shipbroker.se/#Medlemsinfo>

¹⁹⁴ More information can be found in the member directory at <http://passagerarrederierna.se/medlemmar/>

¹⁹⁵ More information can be found at <https://www.energiforetagen.se/in-english/>

¹⁹⁶ More information can be found on <https://oceanenergy-sweden.se/>

¹⁹⁷ OECD 2021

¹⁹⁸ More information on members in the membership directory can be found at <https://matfiskodlarna.se/om-matfiskodlarna/medlemmar-26753377>

¹⁹⁹ More information on the event can be found at <https://naturturismforetagen.se/fo-rum-for-naturturism/>

New ocean industries

Within new ocean industries, the most interesting development is within technology development, digitalisation, automation and electrification that provides new opportunities especially in the transport and energy sectors described above.

On a smaller scale, interesting development is emerging in seafood aquaculture, from the pioneer Scanfjord to more recently established companies. Swedish Aquaculture and Seafood is the industry association for companies that farm, harvest, or process wild mussels, oysters, algae, and other marine raw materials in the sea or on land.²⁰⁰ The association is involved in Nordic networks for companies within oyster farming and algae farming.

3.5.2. Policy development and strategic priorities

The Swedish Maritime Strategy (2015) was the most holistic attempt, as of yet, to gather a common plan for the ocean economy. The Swedish Agency for Marine and Water Management has been responsible for conducting follow-up of the strategy, with a comprehensive report published in 2018²⁰¹. This report outlined that an in-depth follow-up will be completed in 2021. While the strategy from 2015 has not been renewed, there are several national-level policies and strategies of relevance for the ocean economy.

The new strategy for sustainable fisheries and aquaculture in 2021–2026²⁰² focuses on preserving well-functioning and sustainable marine ecosystems, while enhancing the competitiveness of domestic fish production. It includes targeted actions on knowledge and communication and the establishment of a common platform for stakeholders across the fishery, aquaculture and food production industries.

The Climate Act 2018 followed by the integrated national energy and climate plan outlines how Sweden contributes to reaching the EU's goals in renewable energy and energy efficiency by 2030²⁰³. The action plan contains goals and actions for the digitalisation, electrification and automation of vessels, including transport and mobility on oceans. It outlines the necessary actions for fossil-free transport, including ocean transport²⁰⁴. Various industries, including the maritime industry, have developed sector-specific roadmaps for a carbon-free future²⁰⁵.

The Government's Research and Innovation Bill outlines the direction of Sweden's research policy over the next four years (2022-2025). Resources will be increased considerably to tackle major societal challenges, including ocean-relevant themes related to the climate and environment, health and welfare, and digital development. The innovation system will be strengthened through investments in strategic innovation programs and test and demonstration environments²⁰⁶.

Sweden's strategy for the Arctic region includes development of Swedish strongholds in arctic testing, space activities, digital services, and the visitor industry²⁰⁷.

200 More information on member companies can be found at <https://vattenbrukochsjomat.se/#Services>

201 Swedish Agency for Marine and Water Management 2018

202 Swedish Agency for Marine and Water Management & Swedish Agency for Marine and Water Management 2021

203 Government Offices of Sweden / Ministry of the Environment and Energy 2018

204 The Ministry of Infrastructure 2020

205 Fossil free Sweden 2020

206 Ministry of Education and Research 2021

207 Government Offices of Sweden 2020

The marine spatial plans for the three areas, Marine Gulf of Bothnia, Baltic Sea and Skagerrak/Kattegat, is Sweden's first national-level spatial plan²⁰⁸. This plan outlines goals for the continuous use of the Baltic Sea for maritime shipping, commercial fishing, and defence and security. It further identifies potential new areas for offshore wind power and extraction of marine sand, while preserving areas of cultural heritage and recreational value.

3.5.3. Business and innovation ecosystems

The Maritime Cluster of West Sweden is a network for collaboration on innovation and knowledge-based blue growth in the western part of Sweden, spanning a wide range of industries from seafood and marine biotechnology, to maritime tourism, maritime operations, and ocean energy, and with ocean governance as a cross-cutting aspect. Collaborative partners include Region Västra Götaland, Chalmers University of Technology, University of Gothenburg, RISE, SSPA, Swedish Agency for Marine and Water Management, and the County Administrative Board of Västra Götaland. The larger network includes a range of private and public partners within the maritime industries, including business and industry associations.²⁰⁹

OffshoreVäst²¹⁰ is a cluster within renewable energy with more than 80 members from private companies, higher education institutions and government organisations. OffShoreVäst supports the Ocean Energy Sweden²¹¹ business network that developing products and systems in the area of ocean energy. The ecosystem aims to include suppliers, universities, research institutions, test centres and others.

Lighthouse is a neutral collaboration platform for research, development, and innovation in the maritime industries. The platform gathers leading maritime stakeholders from industry, society, and research institutes to develop solutions for the future.²¹²

Fairway Forward is a collaboration between the Swedish and Finnish Maritime Clusters with the participation of Swedish Shipping, Ports of Sweden, Finnish Shipowners' Association, Finnish Ports Association, and Finnish Marine Industries. The aim is to collaborate to foster knowledge sharing and collaboration within maritime research and innovation between Finland and Sweden.²¹³

Vinnova finances strategic innovation programs in several themes relevant for the ocean economy, e.g. energy (based on the innovation agenda for ocean energy), mobility, infrastructure, and bioeconomy. One project under the Bioinnovation cluster has focused on water-based biomass production through the use of duckweed to produce high value-added products.²¹⁴

As part of the Swedish national research program on oceans and water, Formas is launching Blue Innovation preparatory projects, where problem owners (such as trade associations) can work on capitalising information, system understanding, and with stakeholders around a complex problem directly or indirectly related to the

208 Swedish Agency for Marine and Water Management 2019

209 More information on the cluster can be found at <https://www.maritimaklustret.se/>

210 More information can be found at <https://offshorevast.se/en/home/>

211 More information can be found on <https://oceanenergy-sweden.se/>

212 More information can be found at <https://lighthouse.nu/>

213 More information can be found for example at <https://www.sweship.se/event/fairway-forward-seminar-best-practice-and-think-thank-for-green-and-smart-shipping/>

214 Vinnova Strategic innovation programs: <https://www.vinnova.se/en/m/strategic-innovation-programmes/>

aquatic environment. The preparatory phase will pave the way for implementation projects in 2023.²¹⁵

The Swedish Energy Agency coordinates the Shipping program (2018-2023), supporting research and innovation for a sustainable sea transport system, fully based on renewable energy, electrification, and automation. The Swedish Energy Agency runs a national ocean energy program (2018-2024) that supports research, experimental technology development, and innovation within ocean energy with a focus on improved installation, operation, and maintenance strategies, their environmental impacts, and testbed activities. In addition, the Energy Agency supports innovation clusters for a biobased society.²¹⁶

The Swedish Maritime Administration collaborates with public and private organisations in development programs for the maritime industries. The simulator facility, co-located with Chalmers' simulator facility in Gothenburg, is a technology centre that contributes to finding tomorrow's solutions for shipping and maritime operations.²¹⁷ Smart Port Calls is a joint program of the Swedish Maritime Administration, Swedish Shipowners' Association, Ports of Sweden, Swedish Shipbrokers' Association, and the Swedish Transport Agency to create more efficient port calls through digitalisation.²¹⁸

215 More information on funded projects can be found at (available in November 2021) <https://formas.se/en/start-page/archive/calls/2021-04-29-blue-innovation---preparatory-projects-2021.html>

216 More information on the call 2021 can be found at <https://www.energimyndigheten.se/utlysningar/stod-till-innovationskluster-for-ett-hallbart-och-biobaserat-samhalle/>

217 More information can be found at <https://www.sjofartsverket.se/en/shipping-of-the-future/simulator-centre/>

218 More information can be found at <https://www.sjofartsverket.se/en/shipping-of-the-future/smart-port-calls/>



3.6. The Faroe Islands

3.6.1. The Ocean Economy – facts and figures

Few countries depend as highly on the sea and its resources as the Faroe Islands. For decades, the industrial structure of the Faroe Islands has been largely based on the fishing and aquaculture industry.

Ocean food

The fishing and aquaculture industry ranges from e.g. fishing both in Faroese and foreign waters to the fish processing industry. The industry employs approximately 15% of the labour force. The Faroese economy relies heavily on the export of fish products, which makes up 95% of total export value and around 20% of GDP²¹⁹. The catches of demersal fish are either exported fresh or processed. Other species are processed into fish oil, or feed for fish farms.²²⁰

Over the past decades, aquaculture has grown into a significant industry. With total production from both capture fisheries and aquaculture totalling well over 500 000 tonnes annually, seafood products account for about 95% of Faroese exports of goods. Around half of the export value is from farmed salmon, the rest from captured fish²²¹. There are a small number of fish farming companies in the Faroe Islands. The largest of them, Bakkafrost, is listed on the Oslo Stock Exchange²²².

219 The Government of the Faroe Islands 2019a, 2019b

220 House of Industry: The Faroese fishing industry

221 The Government of the Faroe Islands 2019c

222 The Government of the Faroe Islands 2019c

The House of Industries (Vinnuhúsið) is the community of business associations in the Faroe Islands, managed by the Faroese Employers Association.²²³ There are several industry associations under the House of Industries, including the Faroese Fish Fishers' Association, the Fish Farmers' Association, the Fish Producers Association, and the Shipping Industry's Association.

Ocean transport

Ocean transport is an important sector as shipping is expected to increase in the seas around the Faroe Islands, bringing new economic opportunities linked to Faroese ports. Among the big logistics companies in the North Atlantic is Smyril Line that is headquartered in Tórshavn.²²⁴ Like the other Nordic countries, Faroese ocean transport is battling the challenge of reducing offshore emissions.

Ocean-based tourism

Alongside fishing and fish processing, the tourism industry is important to the Faroe Islands²²⁵.

3.6.2. Policy development and strategic priorities

While strategy documents targeted at the ocean economy as a whole were not found, the current government program does address the fisheries management system and its sustainability²²⁶. The government is looking into developing green energy and to reduce emissions in the fishing industry.

As dependence on fishing makes the economy vulnerable to price fluctuations, efforts are being made on diversifying the economy²²⁷. In 2018, Visit Faroe Islands presented a new sustainable tourism development strategy. It aims to grow the tourism industry in a responsible and sustainable manner and preserve and evolve the nation's nature and culture²²⁸.

3.6.3. Business and innovation ecosystems

Vakstrarforum (the Growth Forum, established in 2018) is an initiative of the Faroese Prime Minister to structure and prioritize the most promising clusters for sustainable growth²²⁹. Chaired by the Prime Minister, the Forum includes the Ministers for Finance, Environment & Industry, Foreign Affairs and Culture, and eight key industrial leaders. The first topic has been the potential of the ocean for sustainable growth, where a specific taskforce has been formed to recommend sustainable ocean projects of relevance for the Faroe Islands. Their recommendations are expected in September 2021.²³⁰

Another cluster in development is the Green Energy cluster with the main aim to reach the Faroe Islands' Zero Emission goals by 2030, mainly by reducing offshore emissions²³¹.

223 More information can be found at <https://www.industry.fo/>

224 More information can be found at [smyrillinecargo.com](https://www.smyrillinecargo.com)

225 CIA 2021

226 The Government of the Faroe Islands 2018

227 CIA 2020

228 Visit Faroe Islands 2018

229 TMF 2021b

230 More information can be found at <https://www.tmf-dialogue.net/vakstrarforum-priority-sectors-for-sustainable-growth.html>

231 TMF2021

Ocean Cluster Faroes is a network that is currently being established and is connected to the non-profit research centre Blue Resource. Blue Resource was founded in 2020 by five companies: Christian í Grótinum, Varðin, Framherji, Hiddenfjord, and Syntesa. Its research activities focus on fisheries and aquaculture. Ocean Cluster Faroes will build a network of approximately 20 companies and stakeholders working in innovation and sustainable development within the seafood industries. Relations have already been established to Iceland Ocean Cluster²³².

In addition, companies in the Faroe Islands have built Nordic networks in the former Nordic Marine 2.0. program²³³ on seaweed for food (the Faroes seaweed cultivator Ocean Rainforest), seaweed for fish feed (the Faroes seaweed producer TARI Faroe Seaweed), and optimising quality of fishing value chains (the Faroes pelagic processing plant Varðin Pelagic).

11 Faroese businesses have recently agreed to work together on creating a joint sustainability strategy. The purpose of the business-led initiative Burðardygt Vinnulív is to provide a platform that supports the industrial transition to a sustainable economy. The 11 founding member businesses are: Bakkafrost (salmon aquaculture), Betri Bank (banking), Effen (fuel), Faroe Ship (logistics and transport), Føroya Tele (telecom), JT Electric (marine equipment), KJ Hydraulik (maritime services), MBM (dairy production), Poul Michelsen (wholesale), SMJ (engineering consultancy), Vónin (marine equipment), and Gist og Vist (hospitality)²³⁴. The contact person for the initiative is The House of Industry²³⁵.

232 Blue Resource / Sjókovin 2021

233 Nordic Innovation 2021

234 The Government of the Faroe Islands 2021

235 Details can be found at <https://www.burdardygtvinnuliv.fo/>



3.7. Greenland

3.7.1. The Ocean Economy – facts and figures

Ocean Food

Greenland's most important industry is fishing and fish processing (mainly shrimp and Greenland halibut). The economy of Greenland depends on exports of fish and shrimp.²³⁶ Fisheries accounts for well over 90% of total exports for the past 20 years. More than 4 300 people are directly employed in the fishing industry or fishing-related industries and trade²³⁷. The private company Polar Seafood Ltd. and government-owned Royal Greenland Ltd. are the two largest fishery companies in Greenland²³⁸.

The Greenland Business Association (GE) represents the interests of business life in Greenland, with 350 member companies representing a total of approximately 6 000 employees²³⁹.

3.7.2. Policy development and strategic priorities

Greenland's Government Program sets goals for sustainable fisheries, including a renewal of the Fisheries Act, development of the industry's framework conditions, development of fisheries education, and the establishment of a knowledge centre.

²³⁶ CIA 2021

²³⁷ Royal Greenland 2021

²³⁸ The Government of Greenland 2021c

²³⁹ Greenland Business Association 2021

The Government Program prioritizes the development of the tourism industries, diversification of the industrial base in Greenland, and the production of green and renewable energy.²⁴⁰ There are initiatives to support energy efficiency in fisheries, protect fish stocks, and make use of by-products for other types of agricultural production.²⁴¹

Greenland's first biodiversity strategy²⁴² puts increased focus on the ocean ecosystem and its sustainable economic use.

Visit Greenland's new strategy for 2021-2024 "Towards More Tourism" takes a more focused approach towards nature and adventure tourism. Benchmarking this with Icelandic and Faroese tourism strategies has been done.²⁴³

3.7.3. Business and innovation ecosystems

The Arctic Business Network is a corporate network group of 50 Greenlandic and Danish companies, organisations, and institutions working with expertise in remote regions in the Arctic and the North Atlantic region²⁴⁴.

Sustainable Fisheries Greenland (SFG) is the network of Marine Stewardship Council (MSC) certified companies in Greenland. It has 20 member companies²⁴⁵.

240 Government of Greenland 2021

241 International Trade Administration 2021

242 Government of Greenland 2021b

243 Visit Greenland 2021

244 Arctic Business Network 2021

245 SFG 2021



3.8. Åland

3.8.1. The Ocean Economy – facts and figures

The industrial structure of Åland is mainly based on sea fare, trade, and tourism. As Åland consists of smaller island societies, a majority of the industrial activities relate at least indirectly to the ocean economy. In 2018, the ocean economy employed approximately 3 100 people (more than 20% of the labour force) and it was estimated that it made up 20-30% of the GVA (at basic prices)²⁴⁶.

Ålands Näringsliv²⁴⁷ is the general industry association for entrepreneurs in Åland and represents over 90% of private sector employment.

Ocean transport and ocean-based tourism

Ocean transport is the largest sector, followed by tourism. Åland has a long history of maritime transport, but the last decade has seen some stagnation and flagging out of significant companies²⁴⁸. Today, the ocean transport sector is dominated by a few passenger shipping companies and largely overlaps with the cruise tourism industry.²⁴⁹

²⁴⁶ Ålands statistik- och utredningbyrå 2021

²⁴⁷ More information about Ålands Näringsliv can be found at <https://www.naringsliv.ax/>

²⁴⁸ Ålands statistik- och utredningbyrå 2020

²⁴⁹ Ålands statistik- och utredningbyrå 2019a

Ålands sjöfart²⁵⁰ is the industry association for shipyards and shipping companies. The shipyards involved are presented in the member directory on their website.

Ocean food

Fisheries and aquaculture are the third largest industries, and Åland provides significant amounts of fish to Finland²⁵¹. Fish farming has seen moderate growth, but if future demand is to be filled, there is a clear need for development towards more sustainable fish farming, as new permits have been difficult to get, and onshore RAS systems are currently not commercially viable²⁵². It should be noted that the maritime spatial plan includes some areas tentatively marked for potential aquaculture.

Ocean energy

Offshore wind and wave energy makes up a smaller, but important part of the economy, with energy company Flexens²⁵³ and the Smart Energy Åland cluster demonstrating new renewable energy solutions for the Åland communities.

3.8.2. Policy development and strategic priorities

The Development and Sustainability Agenda of Åland²⁵⁴ consists of seven strategic development goals for 2030, each including a roadmap with targets and indicators. Development goals that relate to the ocean economy are specifically:

- Goal 3, water quality, with specific targets for transforming fish farms through circular innovations, new design, and onshore fish farming. Sales of residual products will be promoted, for example with support from the operational program of the European Maritime Fund. The goal includes other actions for strengthening marine ecosystems.
- Goal 4 includes targets for ecotourism (with actions not yet started)
- Goal 6, renewable energy, includes targets for green energy solutions for island communities and e.g. ferry transports. Carbon-free ferry transports as part of the local traffic system are part of the plan, as well as a vision for large-scale offshore wind power.
- Goal 7, sustainable and mindful patterns of consumption and production, which includes an action plan for industry, and where the need for a specific action plan for the shipping industry has been identified. The work links the importance of the shipping industries for Åland with challenges linked to emissions, but also highlights the significant new opportunities brought by biobased fuels, electric vehicles, and increased resource efficiency through e.g. digitalised solutions. The possibility of marketing Åland as a test zone for e.g. digitalised transport solutions has been discussed²⁵⁵.

Åland's maritime spatial plan²⁵⁶ includes a plan for the use of public waters, including new areas for potential aquaculture and offshore wind.

3.8.3. Business and innovation ecosystems

The maritime cluster is formed by shipyards, shipping companies, and related

250 More information about Ålands sjöfart can be found at <https://www.sjofart.ax/forbundet/>

251 Ålands landskapsregering 2020

252 Ålands statistik- och utredningbyrå 2019b

253 More information about Flexens can be found at <https://flexens.com/>

254 bärkraft.ax 2016

255 Nordic Council of Ministers 2021

256 Ålands landskapsregering 2021

companies (mostly members of the maritime industry association Ålands Sjöfart). The cluster is based around Åland's long maritime history, and today it is dominated by a few passenger shipping companies. The cluster organises networking and communication activities e.g. an Annual Maritime Day on Åland (in 2021, this is organised on 11 November)²⁵⁷.

The sustainability platform Bärkraft.ax has established a network for big industry companies²⁵⁸ to work on profiling their sustainability and contribute to attracting skilled workforce. By exchanging experiences and ideas, companies can learn from each other, do not have to solve challenges alone, and gain the strength to do things together, e.g. in the form of joint purchasing. The network includes industrial actors such as Rederi Ab Eckerö, Transmar, and Viking Line.

Smart Energy Åland²⁵⁹ is a test and demonstration platform led by the energy company Flexens. It aims at showing the way for cost-efficient renewable energy on a system level, by demonstrating and scaling activities in a competitive market. Activities are especially designed for Nordic climates, where both heating and cooling are essential elements of the energy mix.

257 Ålands sjöfart 2021

258 More information on the network can be found at <https://www.barkraft.ax/natverket/natverksgruppen-hallbara-storforetag-pa-aland>

259 More information about Smart Energy Åland can be found at <https://smartenergy.ax/om-smart-energy-aland/>

4. Identified Nordic strongholds with cooperation potential

4.1. Definition of Nordic strongholds

The overview of the ocean economy in each Nordic country (chapter 3) clearly shows that the Nordics hold internationally leading positions in several sectors and industries of the ocean economy, particularly in

- Ocean transport, including maritime transport, shipbuilding and port infrastructure
- Ocean energy, as part of low-carbon renewable energy solutions
- Ocean food, especially technology and innovations in sustainable aquaculture

The Nordics are generally strong in renewing the ocean industries through technologies for demanding environments, digitalisation, robotics, automation, and artificial intelligence

This chapter will summarize the most evident Nordic strongholds found in the mapping. Nordic strongholds here refer to innovation and business opportunities within the ocean economy:

- where synergies between the countries can be found that create potential for Nordic added value, that is, where clear benefits can be achieved through Nordic cooperation,
- where the Nordic countries have the potential to be at the international forefront, and
- where there is significant potential to upscale activities e.g. through collaboration with leading global initiatives

Relevant topics for Nordic cooperation in innovation and business development can be identified by combining Nordic strongholds of common interest.

4.2. Identified Nordic strongholds in Sustainable Ocean Economy

4.2.1. Sustainable Ocean Food

Food security issues and more sustainable sources of protein are among the most burning global challenges that need to be solved in the sustainable ocean economy. Traditionally, aquaculture has been particularly strong in the western Nordic regions, with other countries following on a smaller scale. For example, in macroalgae production, Norway is among the industry leaders in Europe, but other countries are facing interesting developments, as well.

Many environmental challenges still exist e.g. in open sea farming, but new and better solutions are increasingly being developed for both open sea and land. The Nordic countries are increasingly focusing on circular and sustainable nutrient cycles within aquaculture both onshore and offshore, and on gaining a better understanding of marine ecosystem services. When looking at new solutions, it is

possible to harness the technological developments and capacity for innovation of all the Nordic countries.

Nordic networks that were established within previous programs on Nordic Marine Innovation and Nordic Food provide added strengths. For instance, in the Nordic Marine 2.0. program, several networks were established to optimise the quality of ocean food value chains, using new proteins for food and feed, and using the side streams for other novel products²⁶⁰. The NordForsk research program on sustainable aquaculture is a good addition to this stronghold²⁶¹.

4.2.2 Sustainable Ocean Energy

Zero emission goals are increasing the global demand for renewable energy and sustainable energy solutions. The Nordics are leading in several aspects of renewable energy and smart energy systems. The Nordic power market offers a common framework for new solutions. While demand for renewable energy increases, more solutions become viable. Offshore wind is an industry of expansion, with Denmark in the global lead and large investments being made. Other Nordic countries are active in this industry as well, with offshore wind clusters and ecosystems being developed in Finland, Norway and Sweden.

Although the conditions of ocean areas in the North Sea and the Baltic Sea differ, there are synergies to be found in solutions for offshore wind planning, construction, production, and maintenance. These solutions and synergies are not limited to offshore wind but cover all offshore operations and know-how. A better understanding of how to develop sustainable offshore solutions, including co-location and cooperation between different industrial activities, is a topic where the Nordic countries could capitalize on exploring solutions together.

Ocean energy solutions have been advanced on the Nordic level, especially through activities of Nordic Energy Research, but also through e.g. the Nordic Smart Mobility and Connectivity Program of Nordic Innovation. Continued Nordic cooperation on sustainable ocean energy can play a significant role in promoting novel technology and business development.

4.2.3. Sustainable Ocean Transport

The Nordic countries share a very strong position in the maritime technology, shipbuilding, and shipping sector, with several multinational corporations operating across the region. Nordic companies have state-of-the-art know-how in operating in cold, harsh, and demanding environments, with a specific focus on green maritime technology. The green transition supports increased technology transfer and learning across industries, including better use of data and related digital tools, automation, and artificial intelligence. There are strong national ecosystems in this field in Denmark, Finland, Norway, and Sweden.

The Nordic countries are all committed to global zero emission goals, and maritime industries across the region are already actively participating in driving the transition towards net zero. One example is the establishment of the Mærsk Mc-Kinney Møller Center for Zero Carbon Shipping in Copenhagen in 2019. Already in 2019, top Nordic

²⁶⁰ Nordic Innovation 2019

²⁶¹ More information can be found at <https://www.nordforsk.org/programs/nordic-research-and-innovation-programme-sustainable-aquaculture>

maritime companies, such as Wärtsilä, Aker Solutions, Equinor, DFDS, Grieg Star, and Kvaerner, formed a joint statement on Zero Emission Energy Distribution at Sea²⁶².

The maritime sector in the Nordic countries is at the forefront of electrification of vessels and port functions, which will have a vast impact on shipping, the coastal mobility systems, and on the ocean tourism sector. This development is interlinked with the advancement of sustainable battery ecosystems, currently prioritised in several Nordic countries. Automation is another area of great opportunity, linking to digitalisation and robotics. The world's first autonomous and remotely controlled ferry was developed and piloted in Finland in 2018²⁶³ followed by rapid development in the other Nordic countries.

On a Nordic scale, networks established in the Nordic Smart Mobility and Connectivity Program²⁶⁴ include networks for a sustainable and connected maritime industry, as well as zero emission shipping. Sustainable ocean transport is undoubtedly a Nordic stronghold and the new thematic programs of Nordic Innovation in green mobility and smart connectivity (2021-2024) will further serve to strengthen Nordic ecosystems in this field.

4.2.4. Sustainable Ocean-based Tourism

The hospitality and tourism sector in the Nordic countries is strong and diversified, with increasing focus on opportunities provided by nature tourism. National and regional innovation agencies across the Nordics have contributed to the development of sustainable tourism guidelines, and there are strong regional business networks, e.g. the Visit Arctic Europe project²⁶⁵ that advances the economic, social, and environmental sustainability of the hospitality sector in the Northern regions, including coastal areas.

Sustainable tourism has been high on the agenda in Nordic cooperation and the theme is prioritised in Nordic policy development. As an example, Nordic Innovation implemented the Tourism in the Nordics (2018-21) initiative²⁶⁶ aiming to contribute to a more environmentally, socially, and economically sustainable region with a focus on new sustainable business models and innovative digital solutions.

4.2.5. Seabed Mining

The Nordic countries have strong RDI environments involved in research on seabed mineral extraction, and especially Norway acknowledges mineral activities on the seabed to have considerable future potential²⁶⁷. There is also previous Nordic RDI cooperation on sustainable mining to build upon. Nordic Innovations program Sustainable Minerals launched a report²⁶⁸ in 2021 concluding that the Nordic region has a large and untapped potential as a sustainable supplier of the raw materials the world needs to become a low-carbon emission society.

262 More information can be found at e.g. <https://www.nordicinnovation.org/programs/zero-emission-energy-distribution-sea-seeds>

263 Business Finland Maritime & Offshore 2020

264 More information can be found at <https://www.nordicinnovation.org/mobility>

265 More information can be found at <https://visitarcticeurope.com>

266 More information can be found at <https://www.nordicinnovation.org/programs/tourism-nordics>

267 Ministry of Trade, Industry and Fisheries 2021

268 Eilu et al. 2021

4.2.6. Sustainable New Ocean Industries

The Nordic countries are strong in innovation and technology development and home to many promising start-ups and scale-ups with a potential for a global impact. As the ocean industries are transforming, business and industry ecosystems in the Nordics have the capabilities to take a global lead both in the development of new industries, and in the renewal of more established industries. Nordic strongholds with specific potential for innovation cooperation were identified especially in such “new ocean industries”. These are explored in more detail in the following chapter 4.3.

4.3. Suggestion of strongholds with specific potential for innovation cooperation

The mapping identified interesting innovation and business opportunities, especially related to new development (ref. new ocean industries) across the themes of **sustainable aquaculture, maritime technologies, and advanced offshore solutions**. Cross-cutting opportunities for Nordic cooperation were identified in the themes of **new applications for technology and know-how, improved use of ocean data and digitalisation, and utilising the Nordic region as a testbed**. See Figure 2.

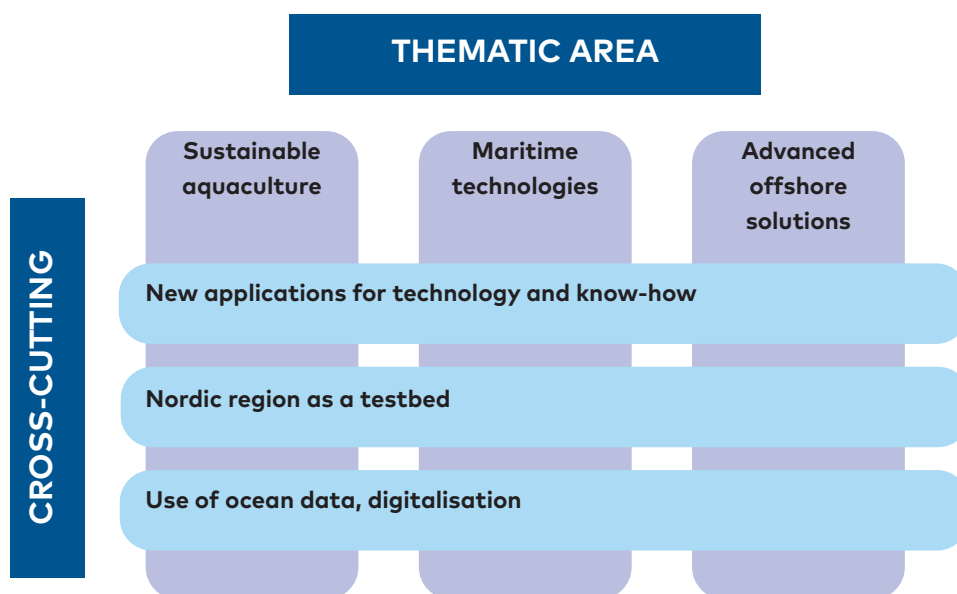


Figure 2. Identified thematic strongholds and cross-cutting opportunities for Nordic cooperation.

4.3.1. Thematic strongholds

Sustainable aquaculture is an area of joint innovation interest, where Nordic strongholds are found in the intersection of:

- **Harnessing technology and data-driven solutions**, with the aim of upscaling sustainable farming of seafood, seaweed, algae for food, feed, and higher-value applications in a circular economy. Opportunities relate both to developing new technologies and finding new use for existing technologies.
- **Securing the future food supply** by investing in the development, testing, and piloting of activities related to new and more sustainable sources of protein. Improved access to existing testing platforms can boost the upscaling of existing solutions and encourage new ways of cooperating.
- **Developing higher-value products** from ocean biomass which can give birth to

competitive advantages and business opportunities for Nordic enterprises.

Cooperation on new approaches and solutions related to new protein sources, new applications for aquaculture products, and better use of technology, data, and digitalisation could further strengthen existing ecosystems in sustainable onshore and offshore aquaculture, as well as promote Nordic solutions on international markets.

Maritime technology is an area of joint innovation interest, where Nordic strongholds are found in the intersection of:

- **Electrification of vessels**, including battery development and solutions for offshore refuelling. New technologies are being developed and tested in most of the Nordic countries within this area, and Nordic cooperation projects have been established.
- **Autonomous shipping** is an area under rapid development in the Nordics and most of the countries have mentioned this in their national or sector-level strategies and ecosystem programs.
- **Sustainable tourism** is of significance for all Nordic regions. The development of greener maritime technologies for tourism transport, and autonomous passenger vessels, will have an impact on the tourism sector.

Cooperation on new approaches and solutions related to low-carbon autonomous transport systems provides good opportunities for innovation and business ecosystem development. The theme is relevant for both large industrial actors and the broader scene of Nordic innovative start-ups and scale-ups, as well as for public-private cooperation with national innovation agencies, municipalities, and end-users.

Advanced offshore solutions are an area of interest for joint innovation, where Nordic strongholds are found in the intersection of:

- **Offshore energy production**, specifically with a focus on offshore wind innovation ecosystems and combined energy systems
- **Distant monitoring and maintenance** solutions for offshore plants based on digitalisation and better use of data.
- **Exploring the use of the seabed for multiple purposes** including sustainable mineral extraction and ecosystem services and seabed carbon capture and storage (CCS).

The innovation and business potential within these areas will manifest at different pace. The strongest Nordic synergies are expected to be in areas that are still more in the research and development phase, but where future potential can be significant. Such opportunities can emerge when exploring new ways for co-located, combined, and sustainable use of ocean areas and sites in the overall ocean ecosystem.

4.3.2. Cross-cutting themes

New applications for technology and know-how need to be developed when traditional industrial sectors are challenged in the green transition. Global economic fluctuations and, more recently, the business effects of the COVID-19 pandemic have also caused changes in technology providers' operating environment. At the same time, new opportunities emerge for more sustainable and circular business models.

The possibility to find new applications for technology and know-how across sectors can help Nordic businesses thrive in a new operating environment, help Nordic

societies maintain their socio-economic wellbeing despite industrial transformation, and help the Nordic countries keep their status as significant innovation environments. This mapping shows just some of the many application examples of technological solutions originating from the Nordics across global industries. When identifying opportunities for Nordic cooperation, specific attention should be paid to identifying opportunities where new applications can be found for existing technologies and know-how.

The Nordic region as a testbed means boosting innovation activity by ensuring easy access to cutting-edge platforms where new solutions can be developed. The Nordic countries host many testbeds related to the ocean economy, and these are found both in private and public ownership. Many of these testbeds are connected to significant clusters and ecosystems in each country. In some areas there is already Nordic cooperation that could be further developed. Examples of relevance to the ocean economy include e.g. the Nordic Testbed Network for digital transformation in the Nordic bioeconomy²⁶⁹, as well as testbeds linked to 5G development in the Nordics²⁷⁰, some of which are of relevance for maritime transport and logistics, ocean monitoring, and aquaculture.

As a first step, increasing awareness of existing testbed opportunities across the Nordics would already be beneficial to both users and owners of testbeds. As testbeds often require large investments and public-private collaboration, helping interested parties find and access testing environments across the Nordic region would increase user volume as well as diversity of users, thus also benefitting the providers of the testing environments. Developing the Nordic regions as a testbed should be a priority for Nordic cooperation on sustainable ocean economy.

Use of data and digitalisation are key drivers of change in the ocean economy, both in technical operations and in business processes. This cross-cutting theme links to the ocean economy in multiple ways. As described earlier in this chapter, use of data and digital tools is crucial for e.g.:

- automation and technology development in maritime transport,
- remote monitoring of offshore constructions, and
- applications for aquaculture.

The Nordic countries are strong in data management and sharing, as well as digitalisation of industry and society. For the Nordic countries, it is vital to stay on top of this innovation trend, and indeed all Nordic countries already prioritize and support ecosystems for digitalisation and better use of data. Developing new and better use of data and digital tools, including the improved use of ocean data, should be a cross-cutting criterion in developing Nordic cooperation on sustainable ocean economy.

²⁶⁹ More information about the Nordic Testbed Network can be found at <https://nordictestbed-network.se/about/>

²⁷⁰ Nordic Council of Ministers 2019

4.4. Conclusions

This mapping was done to support the preparation of a Nordic cooperation initiative on sustainable ocean economy, aiming at strengthening Nordic Ocean industries by promoting cross-border collaboration, and by creating new opportunities for growth and innovation in the region. Bearing this in mind, the mapping has sought to identify Nordic strongholds and cooperation potential that can help existing innovation ecosystems harness new opportunities across the sectors of food, transport, energy, tourism, and resource extraction, with a focus on emerging ocean industries. The mapping finds that cooperation opportunities should build on cross-cutting Nordic strengths of technology and know-how, data and digitalisation, and the availability of testing environments in the ecosystems.

When defining the more specific topics for the initiative, further considerations will need to be made on where the best added value can be found, in relation to the time frame and means available for the initiative, and in relation to ongoing Nordic cooperation on related themes. Considerations can be made on how to initiate dialogue and synergies with relevant ecosystems on the national level, which were identified in the mapping. To support the global sustainable ocean economy and the impact of Nordic countries, dialogue and cooperation opportunities should be considered with leading international initiatives impacting global development. Such initiatives were identified as part of the mapping, however not included in this final report.

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