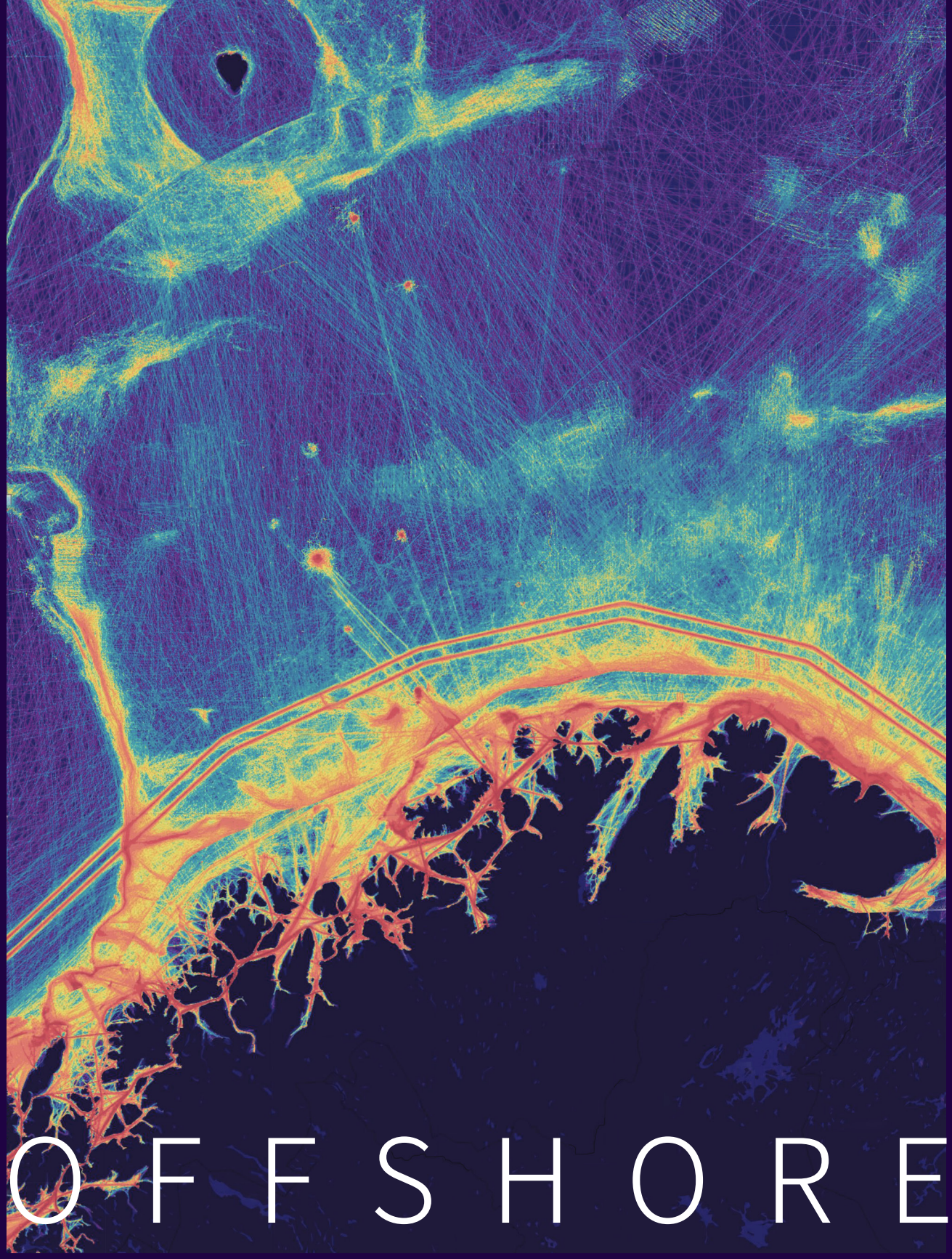

OFFSHORE URBANISM

Using design to understand, represent and employ human-sea relations in the spatial reorganisation of the Barents Sea.

TU Delft, Faculty of Architecture
MSc Architecture, Urbanism and Building sciences
Graduation thesis

Marijne Kreulen
4451309

01 July 2021

COLOFON

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Offshore Urbanism
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1st mentor, Taneha K. Bacchin
2nd mentor, Denise Piccinini

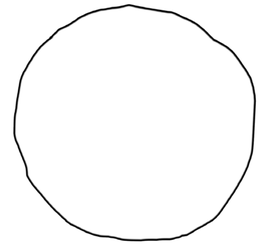
PERSONAL MOTIVATION

I have always aspired to understand at least one thing in life completely. To unravel a complex system like the human hand, the building, or the dynamics of a river. To know that system from beginning to end. Now, after 5 years of pursuing this goal, I have come to the frustrating conclusion that it might be unachievable. Because, it rests on the assumption that a complex system is a closed one, that it has an end, and that it can be understood totally.

To explain this I would like to take you back a couple of weeks ago to a conversation I had with a friend. We were discussing scale and the scope of the universe. There are now many who believe that the universe is endlessly large and my friend argued that it must then also be endlessly small. Certainly, as a neuroscientist to-be she daily studies the small (electrodes, neurons, atoms) just as astrophysicists study the large. She also explained that neuroscientists draw a lot of knowledge from (astro)physics and in that sense, the two professions are quite similar. In other words, professions may seem to operate on different scales, but this is not necessarily the case. Because, the study of the large always includes the study of the small, and vice versa.

You cannot understand the sun without understanding photons. And you cannot know the sea without knowing the sand, nor the river without the delta. We, as urbanists, work in critical territories that seem to be confined by a certain scale: the street, the city, the region. But the performance and development of those territories are without exemption linked to larger and smaller systems. In theory, the problems that make a zone critical ramify through endlessly smaller and endlessly larger scales.

You can imagine my state of mind by the end of this conversation. Surely, it must then be impossible to understand anything in its entirety! This terrifies and at the same time motivates me. Because, how beautiful and interesting is it to make a slight change in this complex system. To be and know a part of it, understand and change it for the better



This is a critical zone

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ABSTRACT

This thesis builds on the proposition that the ocean is both an urban space and a social space. Therefore, marine planning needs to consider socio-cultural risks and opportunities to be deemed sustainable. This reconceptualization is especially relevant for the Barents Sea, where retreating sea ice leaves the ocean more accessible to marine traffic and resource extraction every year. However, the current practice of marine spatial planning (MSP) responds predominantly to geopolitical and economic demands for resources like gas and oil - only the monetary value of the ocean is considered. It fails to provide an understanding of the ocean as a space of cultural values, memory, and meaning. As a result, the socio-cultural impacts of offshore development remain alarmingly unmapped and unknown. As an interplay between research and design, urbanism can understand human-sea relations and employ this understanding in spatial interventions, where MSP cannot.

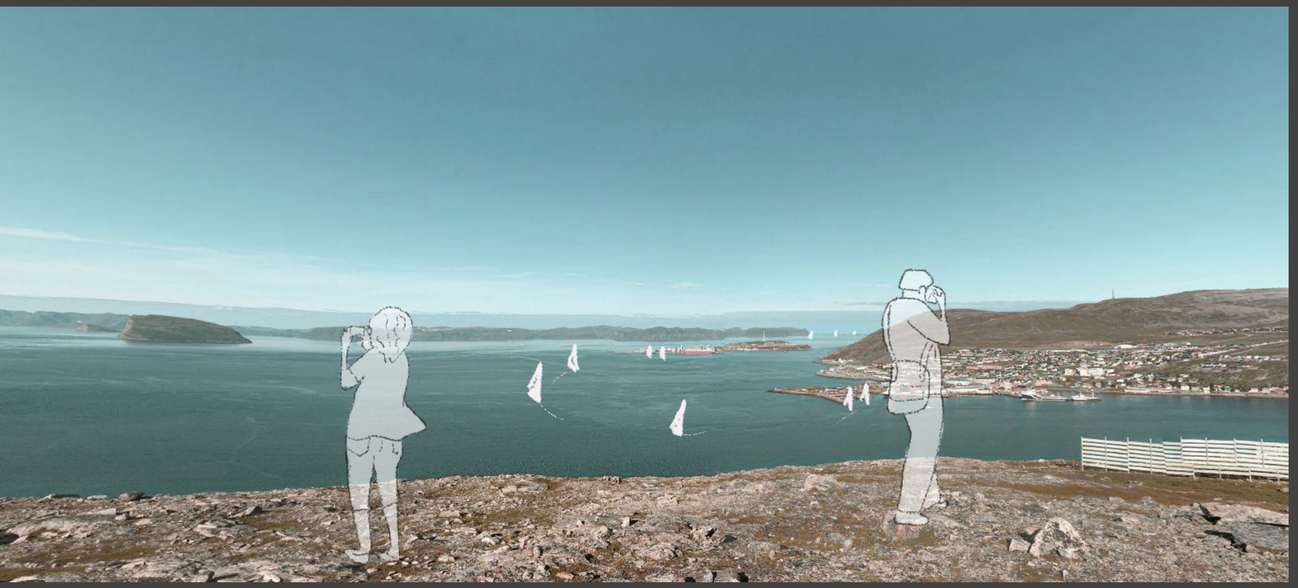
Following this hypothesis, I aim to approach the Barents Sea as an urban and local project. What does it mean to be at sea, to be changed by the sea, and to change it in return? How is the local economy of life dependent on conditions of marine space? And how can we, as urban designers, use this knowledge to affect change. In the first place, this is a theoretical work. I hypothesize what offshore urbanism should entail, propose entrances of design, and compose principles for offshore urbanism in the Barents Sea.

The theories and principles are tested in a case study: Hammerfest, a coastal community in Norway that heavily depends on offshore petroleum industry. The project proposes two pathways of change towards a future where Hammerfest depends on a variety of alternative marine industries. As such, the community becomes more resilient to changes in offshore petroleum. Particularly after 2035, when the current production fields are depleted and extraction moves further seaward, away from Hammerfest.

Network analysis forms a key point of entrance for the maritorial design. The project regards ships as islands that are inhabited, occupied, and built by humans. They are urban nodes at sea. The maritory can thus be read as an interdependent network of nodes (islands, platforms, pipelines, ships) connected by the movement of goods and people. I use marine traffic density data to analyze the nodal patterns of movement. From it, we can read the organization of marine uses and their spatial relation to coastal communities

I then select one node from the current network, the island Melkøya, to redevelop as the root of the proposed transition. The prospected departure of the gas industry established on Melkøya provides an opportunity to repurpose the island. Through the act of deconstruction and rehabilitation, the gas processing island is repurposed as a public port, harboring local marine industry and recreation. From the island Melkøya, a new economy of life is allowed to grow seawards.

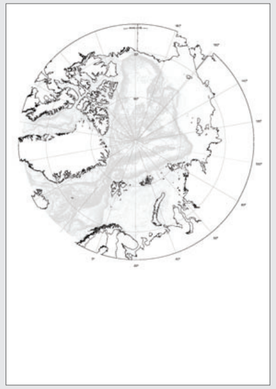
Ultimately, the purpose of this research is to actuate academics and urbanists to use design as a means to inform and inspire MSP, and to open the discourse on offshore urbanism.



Top / View of Hammerfest, Melkøya and Håja. Image by Google Earth (2021), edited by author.

CHAPTER 1.

INTRODUCING THE COMMUNITY



ARCTIC

1 : 20,000,000

BARENTS SEA

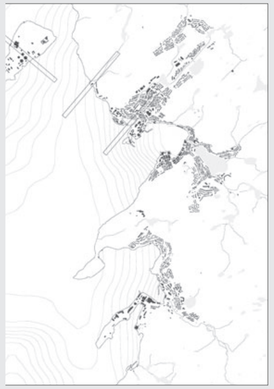
1 : 7,000,000

FINNMARK COAST

1 : 2,000,000

MARITORY

1 : 500,000

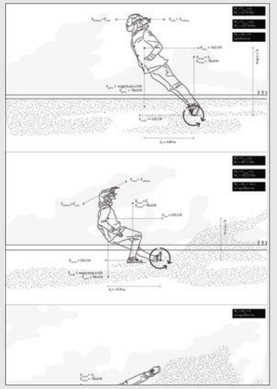


HAMMERFEST TOWN

1 : 50,000

ISLAND MELKØYA

1 : 5,000



HUMAN BODY

1 : 1

INTRODUCING THE COMMUNITY

Hammerfest, Melkøya and Håja

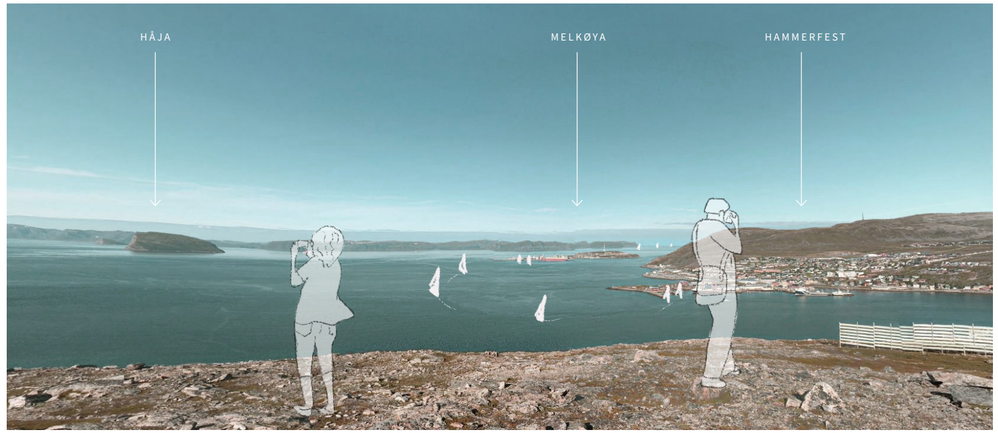
Hammerfest is a small harbour town of approximately 11,500 inhabitants. It is situated on the island Kvaløya on the coast of northern Norway at 70 ° latitude within the Arctic circle. As a coastal community of the Barents Sea Hammerfest has historically relied on the Barents Sea as a space of resources, transport and trade. The town was initially established as a fishing community in 1789 and has since then been the northernmost town in the world. Owing to relative warm currents that flow from the North Sea into the Barents Sea, the natural harbour is ice-free and enjoys year-round access. Due to its strategic position the town' s geopolitical importance grew steadily in the 19th century as a trading point between western Europe and Russia.

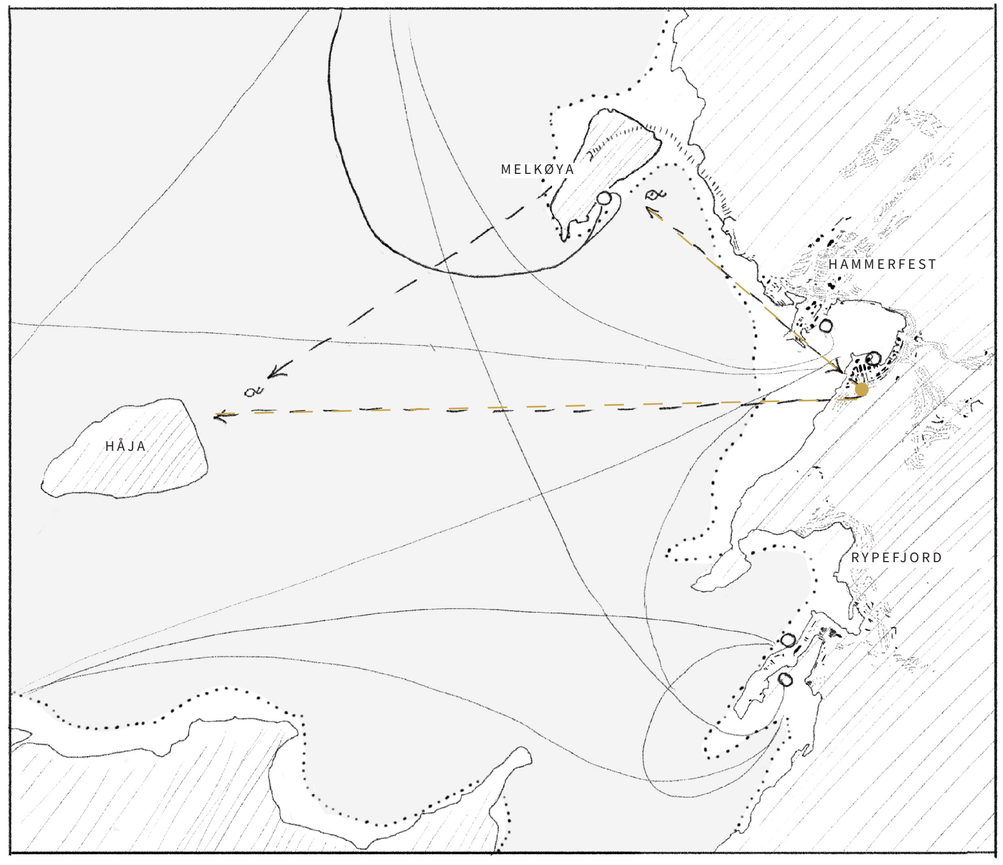
In 1984 a gas pocket, later named Snøhvit (Snow White), was discovered 140 kilometres off the coast of Hammerfest. An island close to Hammerfest was redeveloped for the purpose of processing and offloading the gas produced at Snøhvit. The reconstruction of this island, Melkøya, marked the start of the petroleum era in Hammerfest. Jobs in the local petrol industry attract immigrants from Finland and Russia, causing the population to grow steadily. Job prospects and economic security also attract local young men and women, encouraging them to stay in Hammerfest when they reach the age of 18, instead of moving south to cities such as Oslo and Bergen.

The island Melkøya lies in close proximity to shore (360 m) and to Hammerfest (ca. 2 km). It is easy to reach from Hammerfest by car, via a tunnel, or by boat. Unfortunately, the island is currently not accessible to the public. From Hammerfest, the striking industrial facilities on the islands are clearly visible.

Opposite Melkøya lies an island of similar morphology: Håja. It is the first thing you see after emerging from the tunnel onto the island. Håja is a large island, very recognisable and a natural landmark. It has a cultural status being named by Sea Sami, the indigenous people of this region. A number of schools in Hammerfest are named after the island. Although the island is not meant to be accessed by humans, locals sometimes climb it to collect seagull eggs, which are used in a traditional dish.

Hammerfest, Melkøya and Håja form a remarkable trio that reflects the three pillars of the current community: the industrial, the natural and the anthropocene.





Hammerfest, Melkøya and Håja

Top / View of Hammerfest, Melkøya and Håja. Image by Google Earth (2021), edited by author.

Bottom / Situation map of Hammerfest, Melkøya and Håja and the visual relation between the three.

⁙ Bathymetric depth below -35 m
--- Visual relation
— Marine traffic route
— Gas export route

N
0 1 km

Hammerfest scale

THE TWO SIDES OF MELKØYA

The island has a surface area of approximately 0,69 km^2. Natural gas produced in Snøhvit is transported through a 160 kilometer pipeline over the seabed to the island. There, the gas is cooled into Liquified Natural Gas (LNG) and stored in the tanks before it is offloaded onto specialised gas carriers that transport it to the market. The gas carriers each have a capacity of 145,000 m^3 and export 30 batches per year. During processing, CO^2 is seperated from LNG and transported back through the pipeline to Snøhvit, where it is injected into the seabed to increase pressure.

Gas operation happens mainly at the south side, where the island is flattened and close to sea level. Here, the architecture is of a heavy industrial nature. Steel pipelines vein through the island connecting the processing facilities with the storage tanks. In between the facilities are empty, concrete spaces, resembling dross-scapes with a post-industrial harbour character.

The north side of the island shows a completely different picture. Here, *banded gneiss rock* formations remind us of its original character. From the rock formations the island steeps up to a 46 meter hilltop that has the potential to provide beautiful views of the surrounding area.

NORTH SIDE

SOUTH SIDE

Current situation Melkøya

Right top / Current plan Melkøya
Right bottom / Situation of Melkøya in the situation of Hammerfest.

1 / Rock formations on the north side. Image by: unknown.
2 / Elevation on the north side of Melkøya. Image by: unknown.
3 / Gas processing facility on the south side of Melkøya. Image by: Helge Hansen, Equinor (n.d.).
4 / Harbour on the south side of Melkøya. Image by: unknown.

Melkøya scale

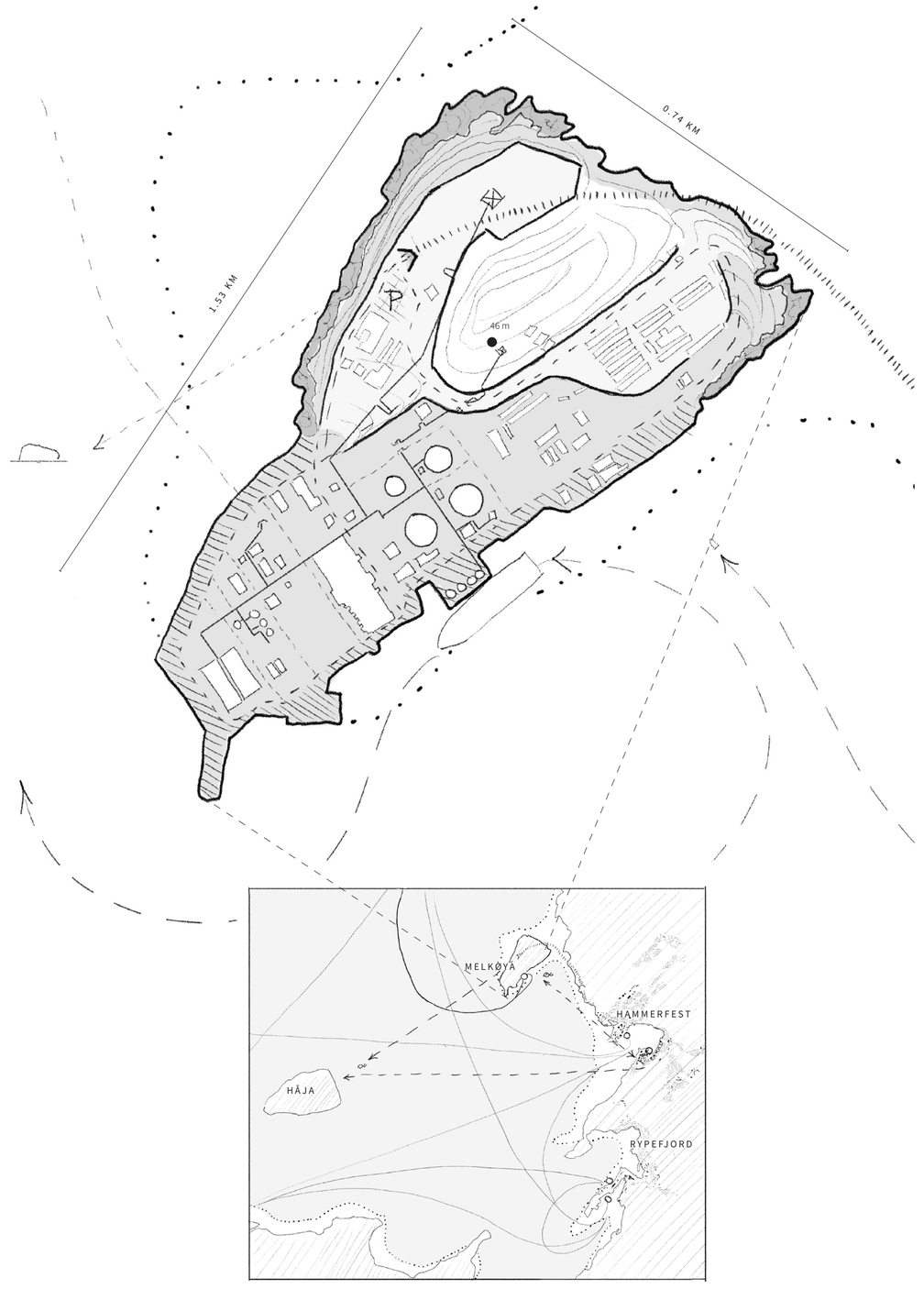


Image / Bing Maps (2021), edited by author.

The islands in context

01. Morphology of the Norwegian shoreline
02. Settlement at the coast
03. Historic settlement at the coast

Definitions:

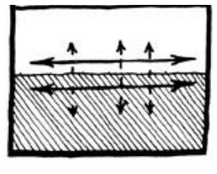
Shore(line)
A zone where sea meets land, or, the edge between water and soil. The shoreline is the boundary between bathemetry and topography.

Coast(line)
A zone where inland meets seaward. In this thesis, I theorise that the coastline is not necessarily positioned at the shore.

Hammerfest, Melkøya and Håja are positioned at the coast of Finnmark. Finnmarks shoreline is fragmented and non-linear. More than 18.000 islands lie scattered along the coast, some inhabited and some not. Through a heavy meandering shoreline, fjords and archipelagos, the seascape reaches deep into the mainland and the land stretches her arms out towards the sea. Over a section of more than 100 kilometres the border between inland and seaward is hard to define.

As a reference in scale, if you would travel 100 kilometres from The Hague (at the western coast of The Netherlands) to the east, you would arrive in Arnhem. I do not know a dutch person who would ever think of Arnhem as a coastal city. In this sense, the coastal zones of The Netherlands and of Norway are rather different. We can conclude that the width of the coastal zone varies with the morphology of the coastline.

The shoreline is not only an edge between land and sea, it is also an edge between two habitats. The marine habitat and the terrestrial. If we follow the Landscape Ecology Principles by Dramstad, Olson and Forman (1996), the morphology of this edge directs movement of species across and along it. A linear shoreline forms a strong division between water and land and stimulates movement along the edge. Whereas a meandering shoreline, as is the case in Finnmark, forms a diffuse border between water and land and allows for a stronger interaction across the shore. Due to this, the coast of Finnmark provides a unique opportunity to study relations between land and sea.



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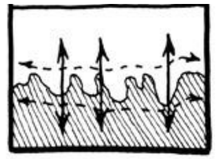


2

Comparison of shorelines

1 / a lineair border between two habitats stimulates movement along the edge.
2 / a meandering border stimulates movement and interaction across the edge.

Source: Dramstad, Olson & Forman (1996).

Right / Comparing a segment (Belgium, The Netherlands and Germany) of the shoreline of the North Sea with a segment (Norway) of the shoreline of the Barents Sea. Both shorelines are projected in Arctic Polar Stereographic on the same scale. Note the difference in morphology and fragmentation of the shore.

Source: EEA (2018).

— shoreline

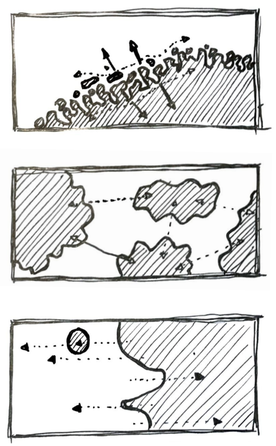
0 | 50 km | N

Finnmark scale

CONTEXT
Morphology of the Norwegian shoreline

On the previous page, we viewed the meandering coastline of Finnmark on quite a large scale. Yet, when we zoom in, the morphology of the coastline seems to change. On the territorial scale Finnmark' s coastline might be diffuse, but on the human scale, the scale that we actually experience, it is quite linear.

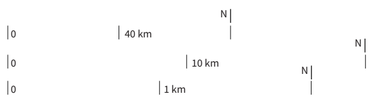
Although it is tempting to conclude that the diffuse morphology of the Finnmark coast induces stronger interaction and movement between land and sea, this might not actually be the case. Perhaps the Principles of Landscape Ecology (1996) only apply when they are used at the appropriate scale. In other words, when studying human interaction and movement between land and sea, we should look at the coast on the local scale.



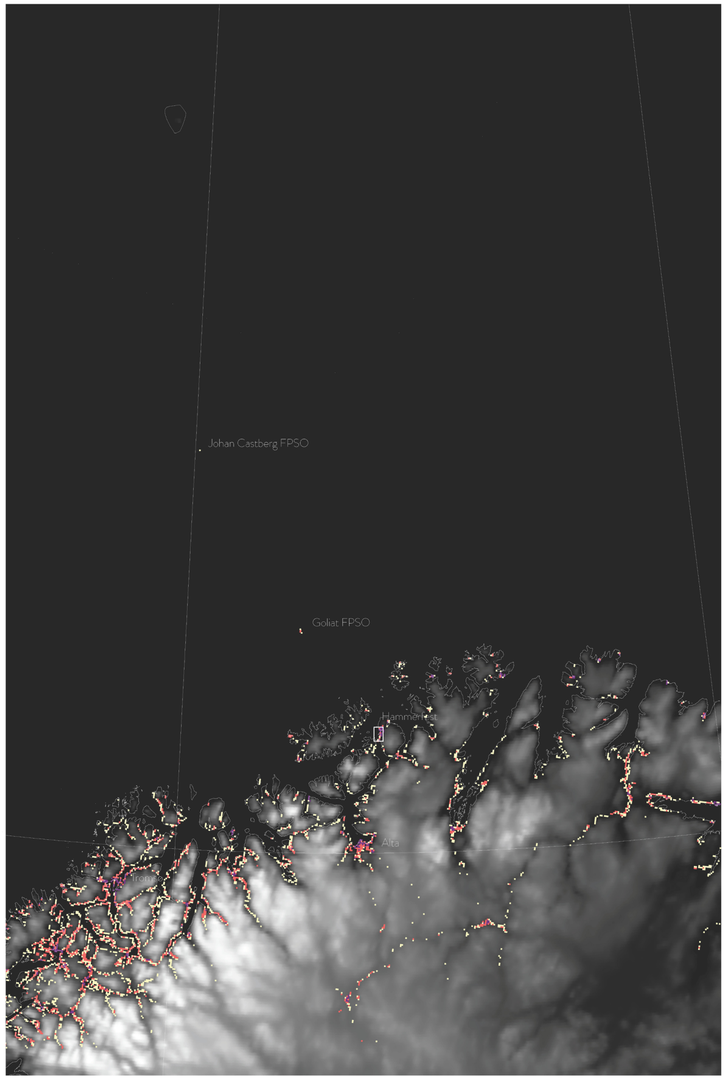
Morphology and scale

Viewing the shoreline in different scales provide different morphologies. In analysis of cross-coastal interaction it is important to select an appropriate scale.

Data: Bing Maps (2021)



The oldest Norwegian settlements were located at the coastline (Møller 1987). Since historic settlement, coastal communities have relied heavily on the ocean for food, trade, transport and livelihood (Gee 2019). Human-sea relations have developed since then, embedding into local culture and heritage (MEA 2003). At present, the vast majority of the Finnmark population resides at the coast (EEA 2020). Their dependency on marine resources is reflected in Norway' s main industry sectors: oil and gas, aquaculture, hydropower and shipping (Statistics Norway 2019).



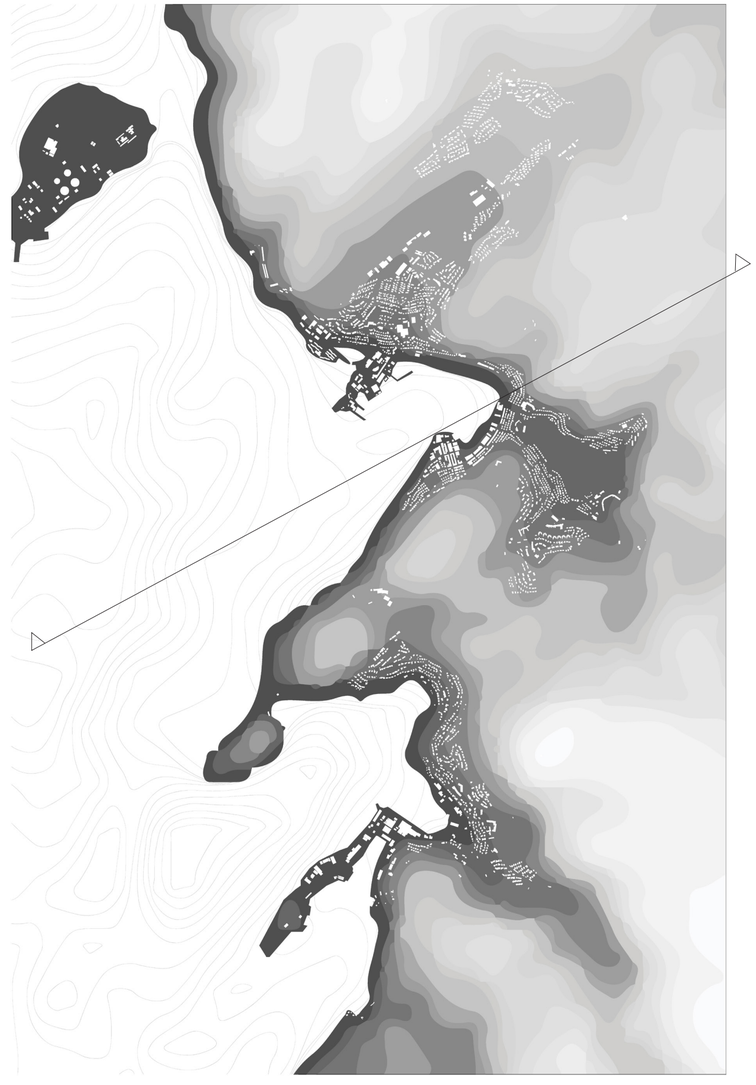
Settlement at the coast

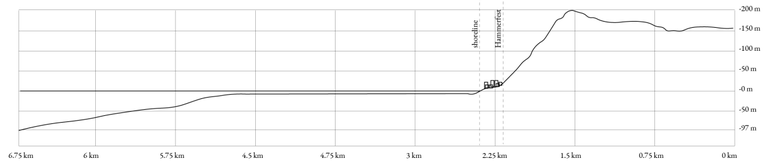
Population density along the coast of Finnmark. Source: OSM (2019). With elevation of the land in the background. Data: NOAA (2019).

- sea
- high population density
- average population density
- low population density

0 | 50 km | N

Finnmark scale





Aside from a dependency on the ocean' s resources, the agglomeration of human settlement on the coast could be explained by the topography of the land. A characteristic typology of the Finnmark coast is the 'strandflat' , roughly translated as 'beach flat' . The strandflat is a low and wide bedrock plane, eroded and partially submerged. Inland, sudden steep cliffs outline the flats. Providing a surface suitable for human settlement and occupation, yet one that limits inland expansion and extensive agriculture. As such, coastal communities in Finnmark expand along the coast and rely on the ocean as a field of production and means of transportation.

Settlement at the strandflat

Top / Urban agglomeration along the coast of Hammerfest. With simplified elevation. Data: GEBCO (2020); OSM (2019).

Bottom / Section of the Hammerfest Strandflat. Data: Google Earth (2021).

- 00-10 m elevation
- 10-20 m elevation
- 20-30 m elevation
- 30-40 m elevation
- 40-50 m elevation
- 50-60 m elevation

- building
- bathemetry

0 | 1 km | N

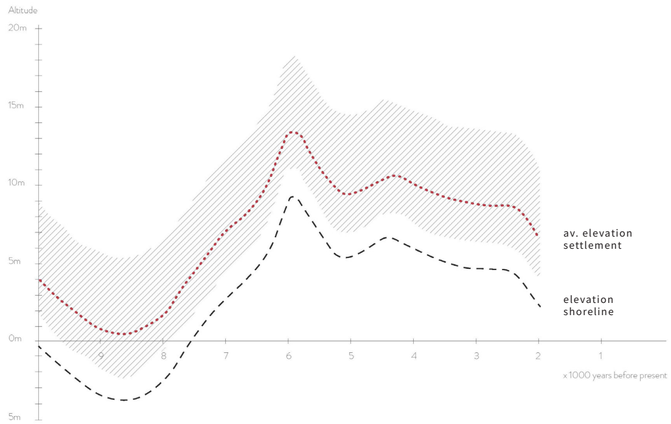
Hammerfest scale

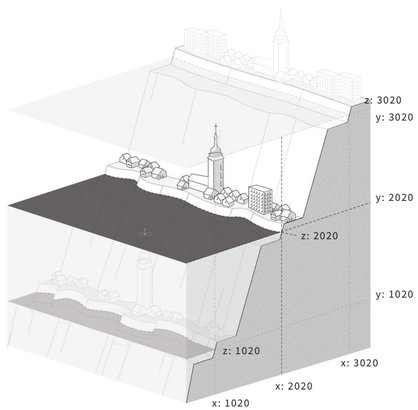
CONTEXT
Historic human-sea relation

Nordic settlements were historically always positioned in approximation of the coastline. Since the first settlement in 8000 B.C. the shoreline has shifted alternately seaward then inland due to changing sea levels in the Holocene time period. Interestingly, archaeological research has provided evidence that the average altitude of prehistoric settlements shifted along with the shoreline displacement during that time, maintaining an average altitude of 4.8 meters above sea level.

When the sea level rises, it affects the shoreline in three dimensions. In the y-axis, the shoreline changes in elevation. In the x-axis, the shoreline shifts seaward or inland. The shorline cuts the soil and divides it into topography and bathymetry. When the sea level rises that division rises as well. What was once considered topography is now (submerged) bathymetry. This translation forms the third dimension. Along the z-axis, the morphology of the coastline changes as it cuts through a different topography.

Human-sea dependency is a fundamental element of coastal communities in Finnmark both now and in the past.





Prehistoric settlement at the shore

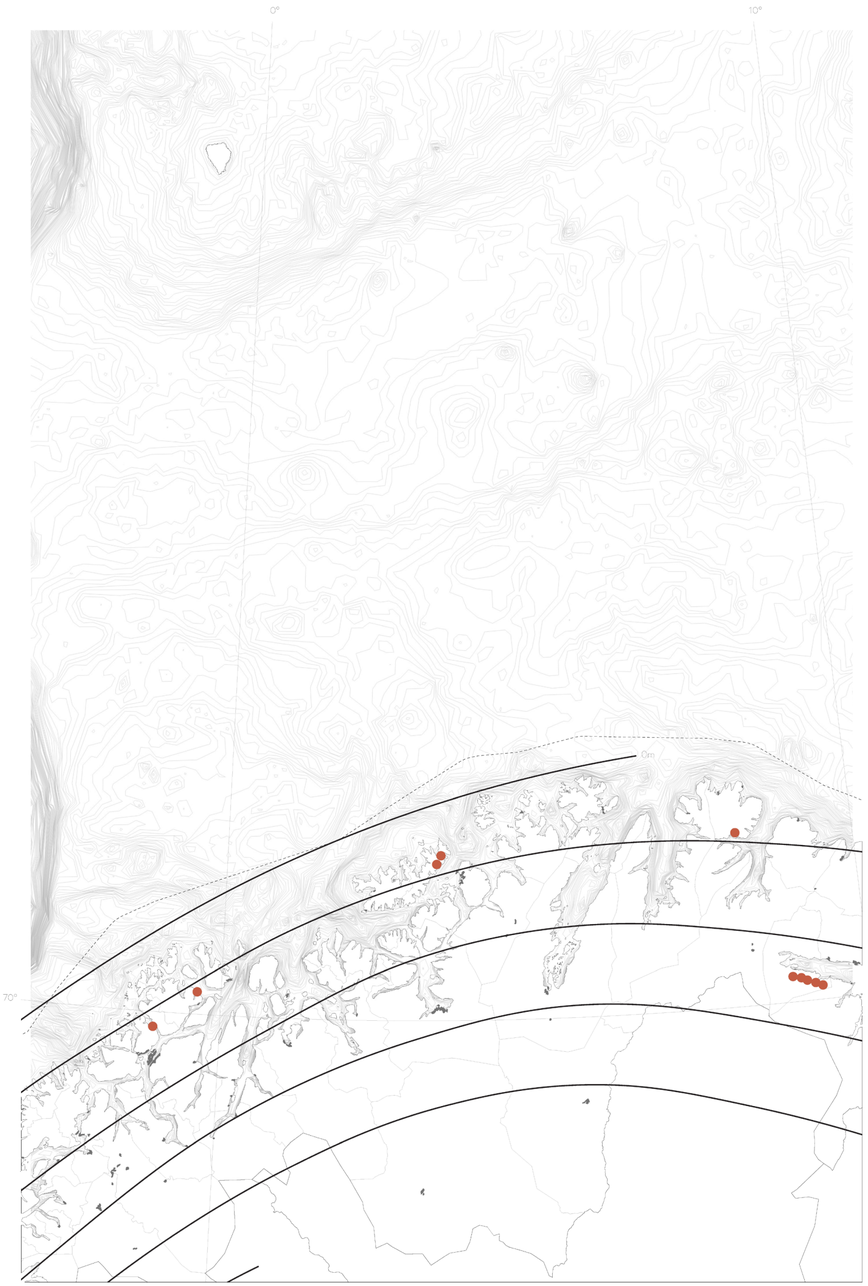
Map / Some prehistoric settlements (red dots) at the coast of Finnmark and corresponding sea levels. Data: Møller (1987).

Graph / Showing the rise and fall of the sea level (black dotted line) in prehistoric times, and the average elevation of prehistoric settlements during that time (red line). Source: Møller (1987).

Transect / A schematic transect of the Hammerfest coast depicting sea level in 1020, 2020 and 3020. When the sea level rises or falls, the position of the coastline changes in three dimensions. Simultaneously, the division between above and below water landscape is translated.

● prehistoric settlement

N
0 50 km
Finnmark scale



Seaward trends

SEAWARD TRENDS
Arctic climate

In the last 20 years, air temperatures in the Arctic have been rising rapidly, exceeding global trends at more than twice the rate of average global warming (Overland et al. 2018). It is the velocity of change that threatens us. Because, it affects not only us as individuals, or communities, but our generations as well. Each child is delivered to a changing world that is more extreme than the world of their parents. It is important to view climate change from a socio-cultural perspective, beyond the scope of our own lifespan.

Ultimately, air is both global and local (Horn. E, 2018). It is the agglomeration of local impacts that causes the global phenomenon of climate change. Its effects are shared by everyone, everywhere, now and in the time to come.

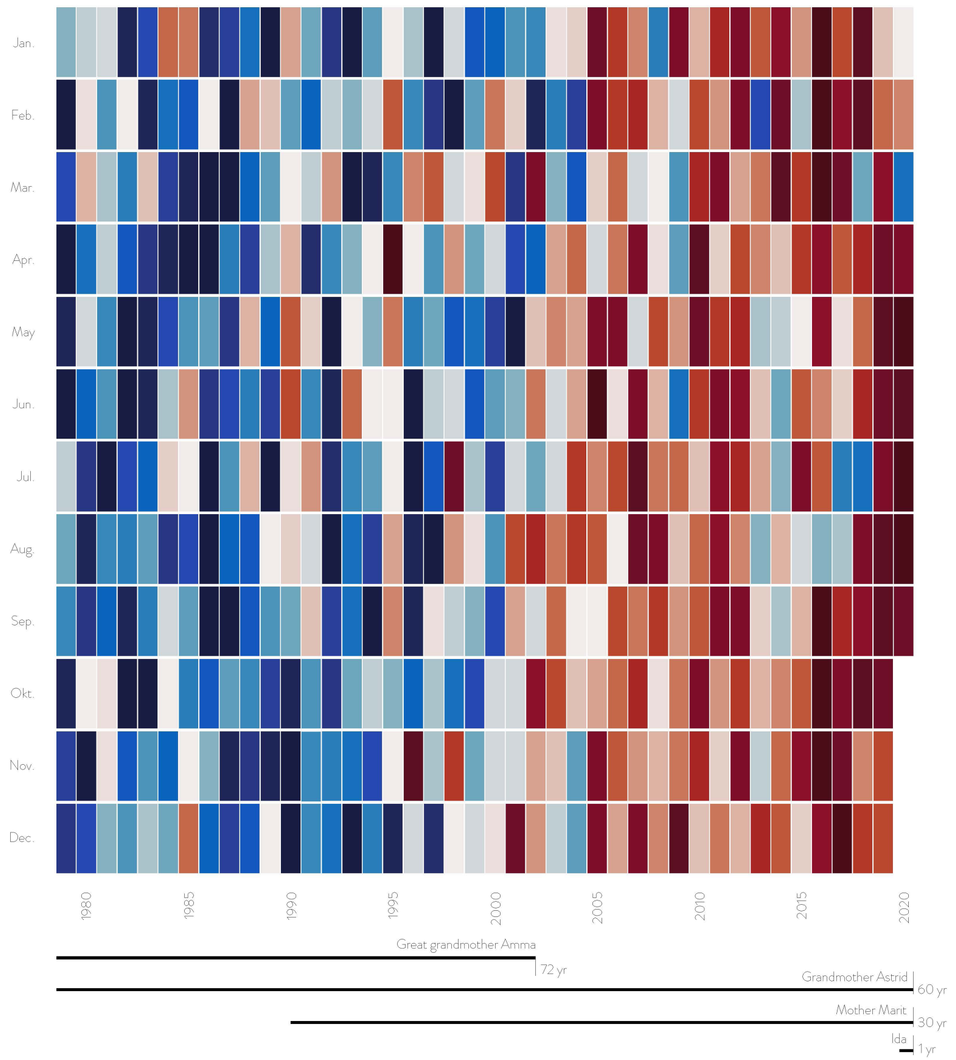
Air as heritage

Ranking of average monthly air temperature anomality from 1979-2020 compared to the 1981-2010 baseline. Measured at surface level for the Arctic (70N+). Juxtapositioned to the expected lifespan of four generations of women in Finnmark.

Source data: NCEP (2020); Plecher (2020).
Inspired by: (Zachary Labe, 2020).

Warmest monthly average temperature

Coldest monthly average temperature

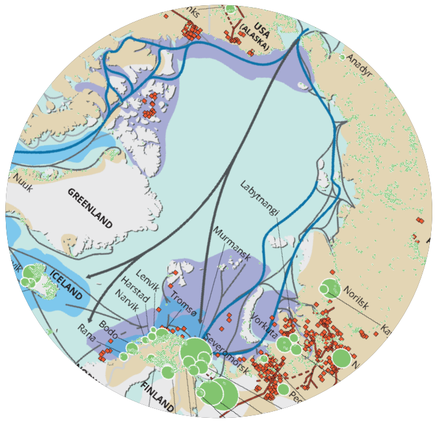


SEAWARD TRENDS
Arctic industrialisation

Rising air temperatures cause the regression of sea ice and leave the Arctic Sea more accessible to transport and resource extraction every year (Overland et al. 2017; Schütz 2018). As a result, oil production in the Barents Sea alone is expected to increase to 115 million standard cubic meters. That is the size of 23.000 soccer fields and a 40 percent increase from 2019 (Staalesen 2019). The increasing transportation and production of petrol are both a cause and a result of climate change. The production and transportation of petrol is a major source of CO^2 emission contributing to climate change and global temperature rise (UNCTD 2020; Staalesen 2019).

The expansion of marine industry due to the effects of climate change is seen throughout the whole Arctic. Yet, a striking agglomeration of its symptons are centered in the Barents Sea. Here, offshore extraction, fishing, and transportation come together. Due to warm currents coming from the Atlantic and the relatively low depth fo the continental shelf, the Barents Sea is a prime location for offshore extraction and fishing. The Northern Sea Route, a major shipping route connects the Bering Sea to the Barents Sea; the East to the West. When the regression of sea ice will allow it, the Trans-Arctic shipping route will form a shorter and thus more profitable alternative, possibly shifting a political-economic point of gravitation towards the Barents sea in the future.

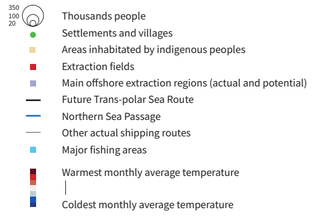
In addition to this, the Barents Sea coasts are densely populated, compared to other coasts of the Arctic Sea. Considering all this, the Barents Sea forms an ideal area to study the socio-cultural dimension of marine urbanisation.

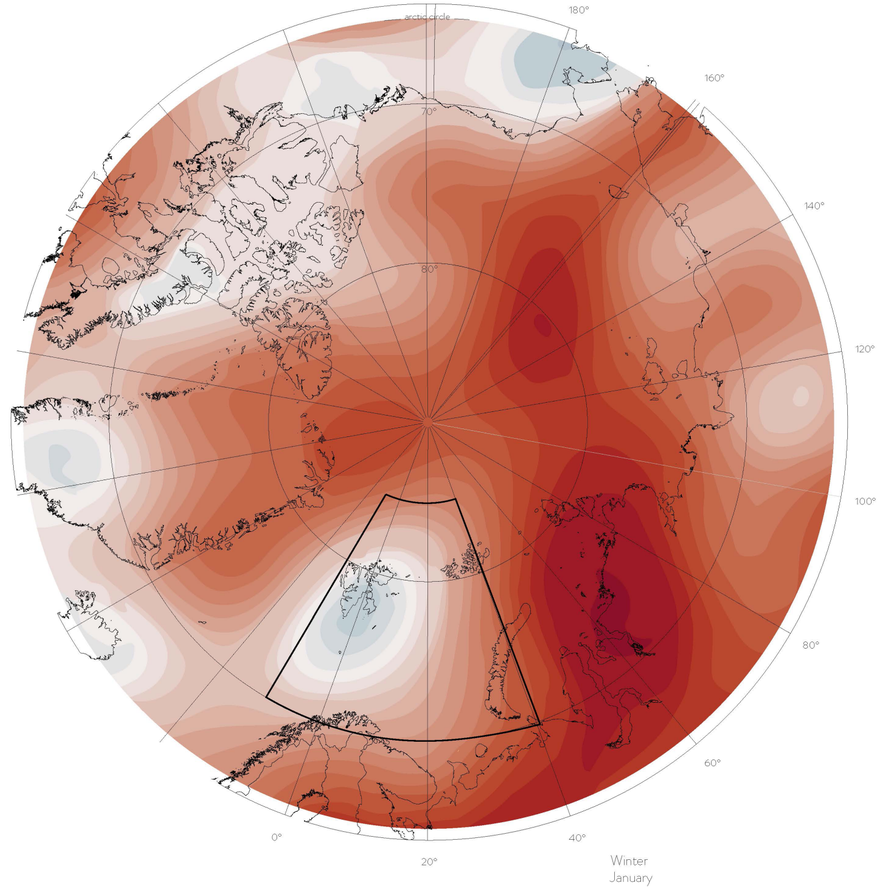


Climate and industrialisation in the Arctic

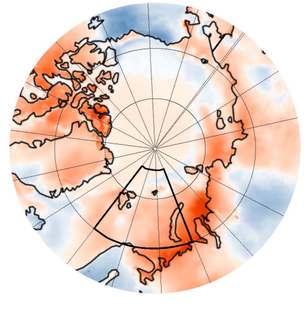
Right / Surface air temperature anomaly projected on a map of the Arctic for January and July 2020. Reference period: 1981-2010. Source: Copernicus Climate Change Service (2020).

Top / Towns and industrial activities in the Arctic. Note the density of both people and industry in the Barents Sea. Source: Pravettoni (2010).





Winter
January

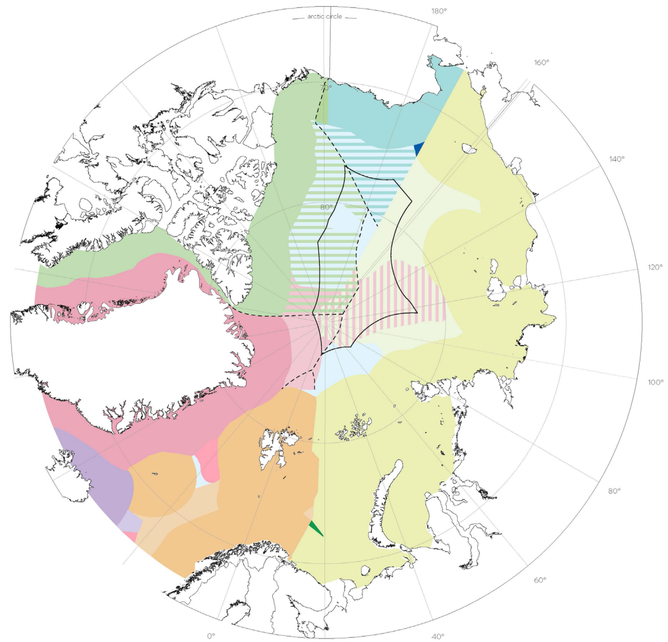


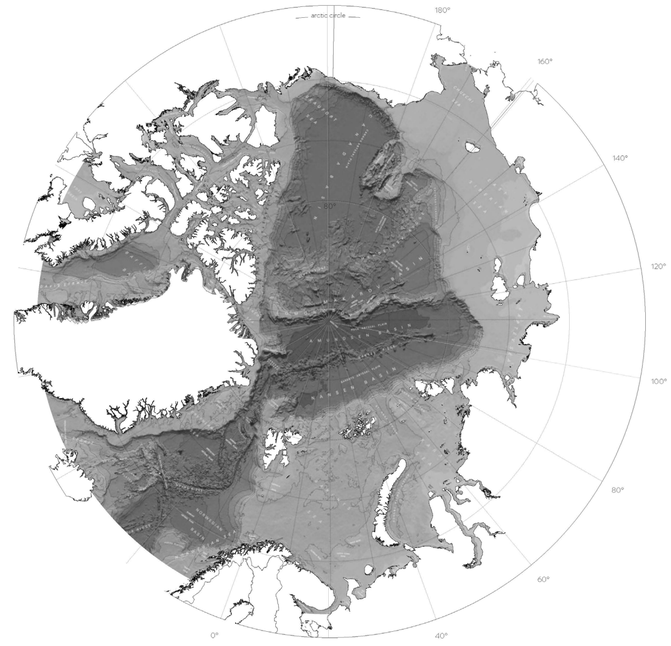
Summer
July

SEAWARD TRENDS
Acts of claim

The urbanisation of the Barents Sea became a fact as soon as nations laid claim on its water. In 1635, John Seldon developed the doctrine Mare Clausum, the enclosed sea. In principle, Mare Clausum allowed nations to claim the right to resources and jurisdiction over their neighbouring waters up to 200 nautical miles from the coastline. These borders are still applied today to enclose the Exclusive Economic Zones (EEZ). Where the exclusive economic zones overlap, the position of the border needs to be discussed and agreed upon by the nations in question. In the Barents Sea, the border between Norwegian and Russian ownership remained an area of dispute up until 2014. Before that, both countries maintained their preferred border seeking rights to the precious gas and oil underneath.

Countries now have a right to claim the ocean beyond their 200 nautical miles from shore up to the edge of the continental shelf (see map on the right). As such, the bathymetry of the ocean floor sets conditions for claim.





Seabed as a condition for claim

Top / Maritime jurisdiction and boundaries in the Arctic region
Source: IBRU: Centre for Borders Research (2017).

Bottom / International Bathymetric Chart of the Arctic Ocean, in which the edge of the continental shelf is clearly visible.
Source: NOAA (2014).

- 350 NM from shore baseline
- Median line
- Norway territorial sea and EEZ
- Norway claimed continental shelf beyond 200NM
- Russia territorial sea and EEZ
- Russia claimed continental shelf beyond 200NM
- Denmark “
- Iceland “
- Canada “
- United States “

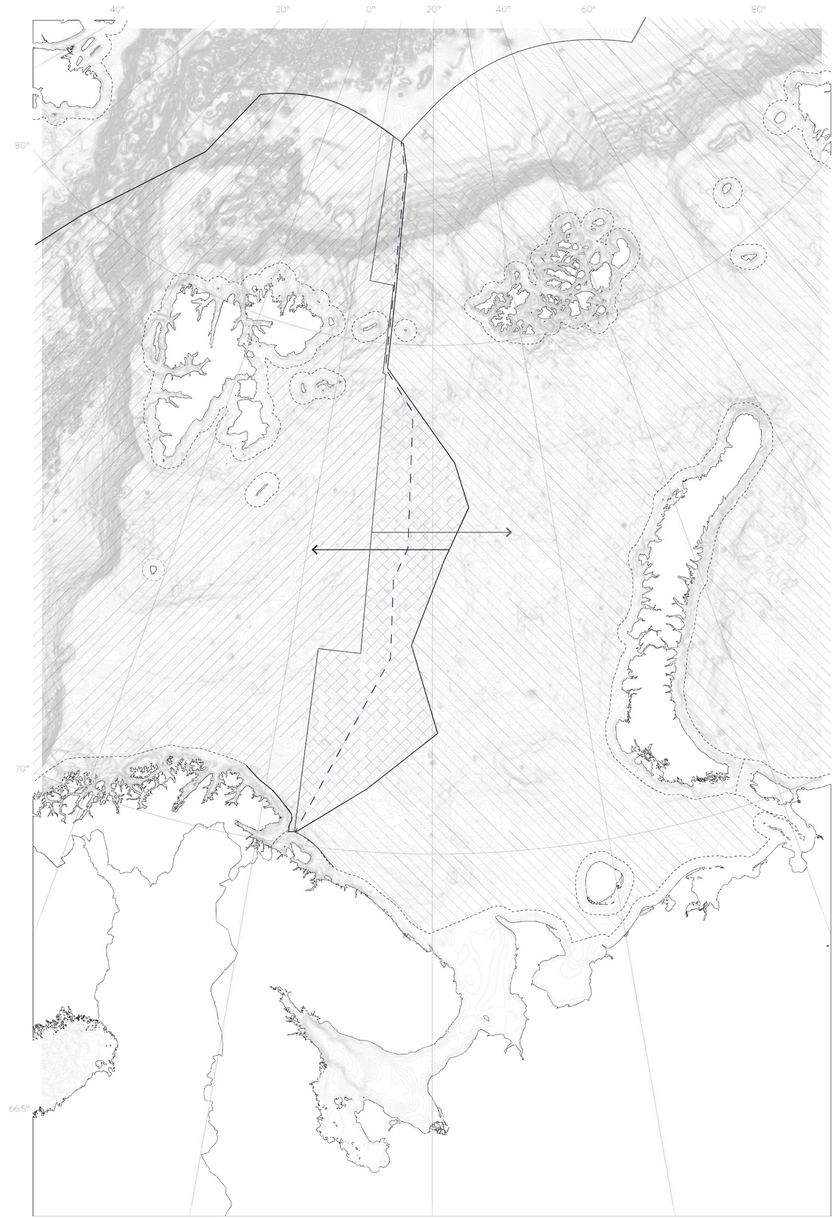
N
0 500 km

Arctic scale

MARE LIBIRUM
Rights and responsibilities

Claim always starts by drawing borders on the map. Whatever lies within these borders becomes owned land or sea. In drawing borders you claim both rights and responsibility of the sea. More so than land, the ocean is dynamic and ever changing. Maps and planning documents falsely represent the ocean as a static surface, obscuring the constant movement of the water itself (Gee 2019), the people that cross it, and the matter that it carries. In terms of ownership this provides some difficulties, as no particle of water nor anything carried by water stays ever in the same place. Due to its mobility, water cannot be bound by administrative borders and can thus not truly belong to a nation. According to Hugo Grotius, a Dutch jurist and philosopher, private or public ownership of the sea is thus impossible if not immoral. A free ocean, Mare Libirum (Grotius 1609), is an ocean that owns itself ("Embassy of the North Sea" 2020). This attitude creates some difficulties for marine planning. How can we represent the constant movement of the ocean in planning, how can we locate anything on sea, and how do we plan for an ocean that we do not own?

Mare Libirum



Mare Clausum

Showing the parts of the Barents Sea fall under the EEZ of Norway and Russia and the area of dispute where these two areas overlap in the center. Source data: Norwegian Ministry of the Environment (2011).

⟋ Norwegian claim
⟍ Russian claim
⤫ Area of dispute

N
0
200 km

Barents Sea scale

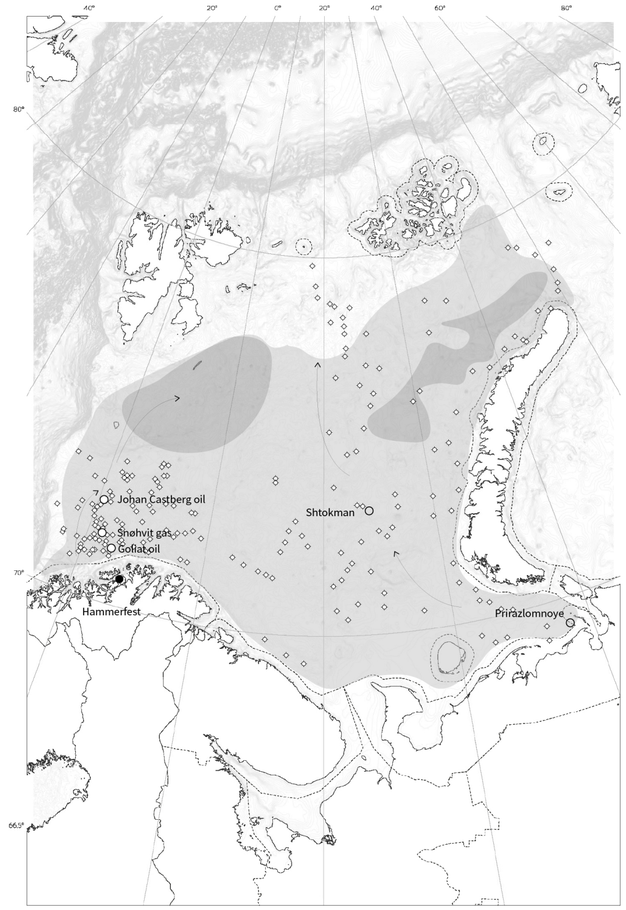
SEAWARD TRENDS
Projection

1/ Regressing sea ice allows more access to traffic and resource extraction in the Barents Sea.

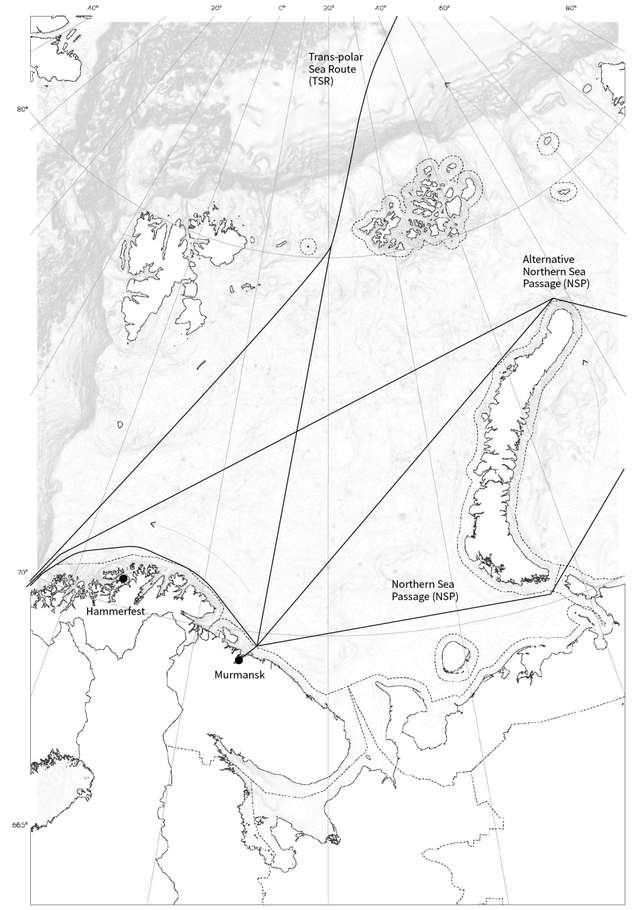
2/ Current oil and gas operation in Hammerfest runs out in 2035, after which extraction is prospected to move north.

3/ In 2050 sea ice is prospected to have regressed so far as to allow seasonal traffic across the pole. Opening the Trans-polar Sea Route as a more economic alternative to the current Northern Sea Route.

1



2



3

Seaward trends

Three seaward trends as a result of rising air temperatures in the Arctic and global demands for petrol and trade. Data source: Norwegian Polar Institute (2021); Mareano (2021); Humpert (2011).

- Ice extent
- Main marine traffic route
- Prospected gas
- Prospected oil
- Exploration well
- Extraction facility

0 200 km N

Barents Sea scale

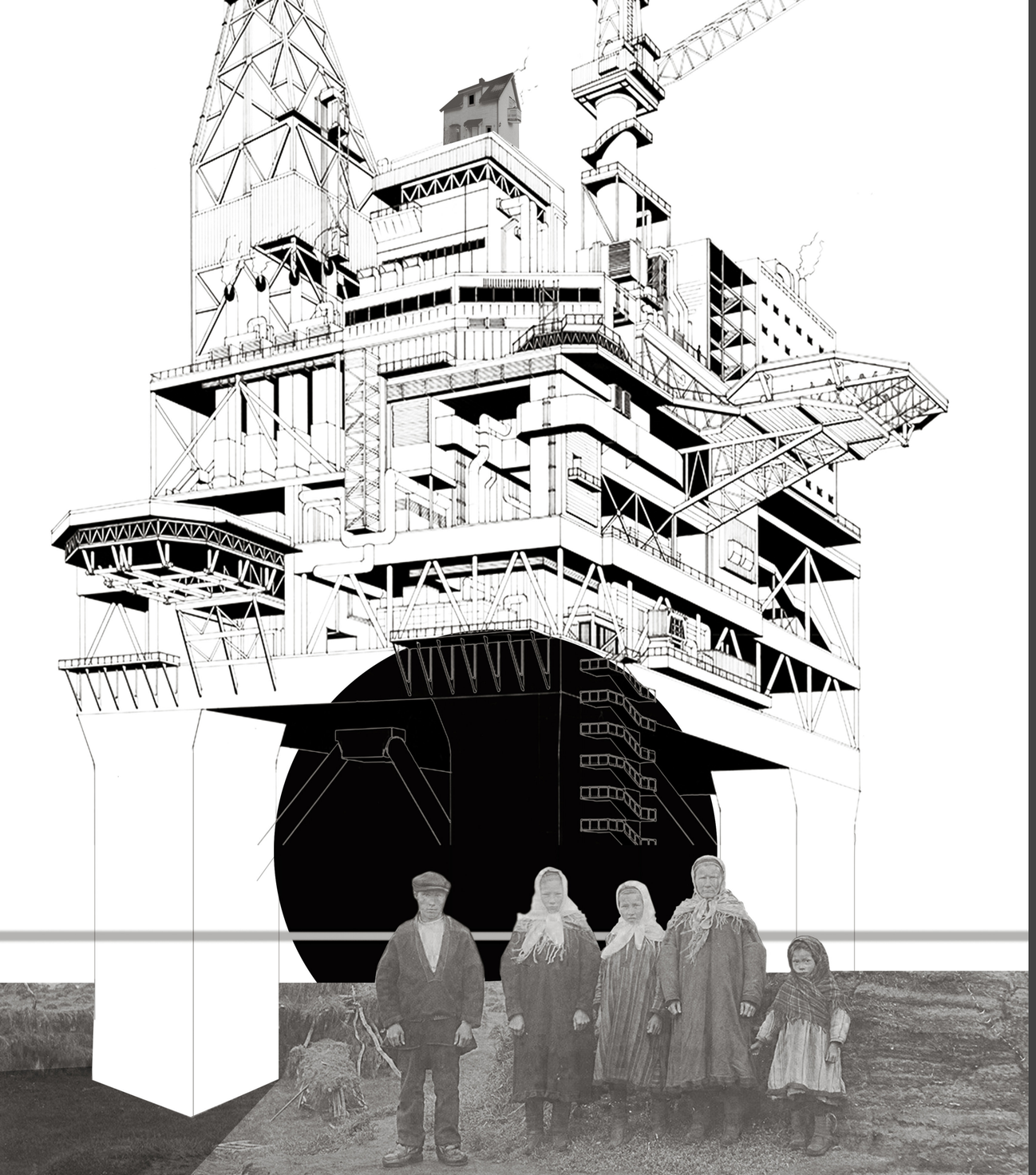


Image / A coastal Sami family posing proudly before their home in Adamsfjord, Laksefjord, Finnmark in 1909. And an architectural drawing of a typical oil rig.

Edited from: Hanna Resvoll-Holmsen (1909); Julien Nolin (n.d.); Pen RiG Study (n.d.).

CHAPTER 2.

WHY OFFSHORE URBANISM?

WHY OFFSHORE URBANISM?

Since the first rafts embarked onto the sea, the ocean has been subject to the Anthropocene. As the population is growing, so is our hunger for habitable land and resources, causing urban territory to expand far beyond the coastline. Already, a variety of industries compete for marine space and resources. Oil and gas extraction, fishing, renewable energy production, transport and tourism are expected to crowd the seascape in the future (Dafforn et al. 2015). Traces of this offshore urbanisation can be found in human occupation, settlement and inhabitation. As a consequence, ocean ecosystems, already at a tipping point by the ongoing effects of climate change, face overuse and ecological degradation (Santos et al. 2018; Halpern et al. 2008). This is especially relevant for the Barents Sea, where retreating sea ice leaves the ocean open and accessible to an expanding petrol industry and trans-arctic transportation.

The increasing spatial demand of marine uses and the risks that come with it triggered the first applications of marine spatial planning (MSP) in 2005 (Ehler 2020), a political planning process adopted by countries across the globe to ensure sustainable development at sea. However, recent studies have pointed out the lack of socio-cultural considerations in the MSP process, suggesting that MSP does not possess the appropriate tools to represent non-monetary values (McKinley, Acott, and Stojanovic 2019; St. Martin and Hall-Arber 2008; Shucksmith and Kelly 2014). As a result, the impacts of offshore development on communities on shore remain unknown.

This thesis builds on the proposition that the Barents Sea is an urban space and a social space. Therefore, marine spatial planning needs to consider socio-cultural demands, risks and opportunities in order to be deemed sustainable. In fact, if we understand the complexity of human-sea relations and purposely employ them in marine spatial planning, they could even play an important role in reaching climate objectives. As an interplay between research and design, urbanism can offer the necessary tools to understand, represent and employ human-sea relations where MSP cannot.

This chapter provides an argumentation for i) why a socio-cultural perspective in MSP is imperative for sustainable development, ii) the issues with representation of socio-cultural values that complicate its inclusion in MSP, and iii) what urbanism can offer as a means to inform and inspire MSP; and to bridge the gap towards offshore development that is both environmentally and socially sustainable.

The ocean is urban

On the contrary to popular belief, the urban territory is not limited to land. The term urban, descendant from the Latin conjugation urbanus (meaning: of the city), is most simply defined as: relating to the city. Urban territory is characteristically inhabited by humans and occupied by humans functions. Both inhabitation and occupation manifest physically in the form of architectural elements like houses, highways, factories. Or in other words: the human settlement. We can find human occupation, settlement and inhabitation not only on land, but also on sea.

01. Occupation of the Barents Sea
02. Settlement on the Barents Sea
03. Inhabitation of the Barents Sea

THE OCEAN IS URBAN

Occupation of the Barents Sea

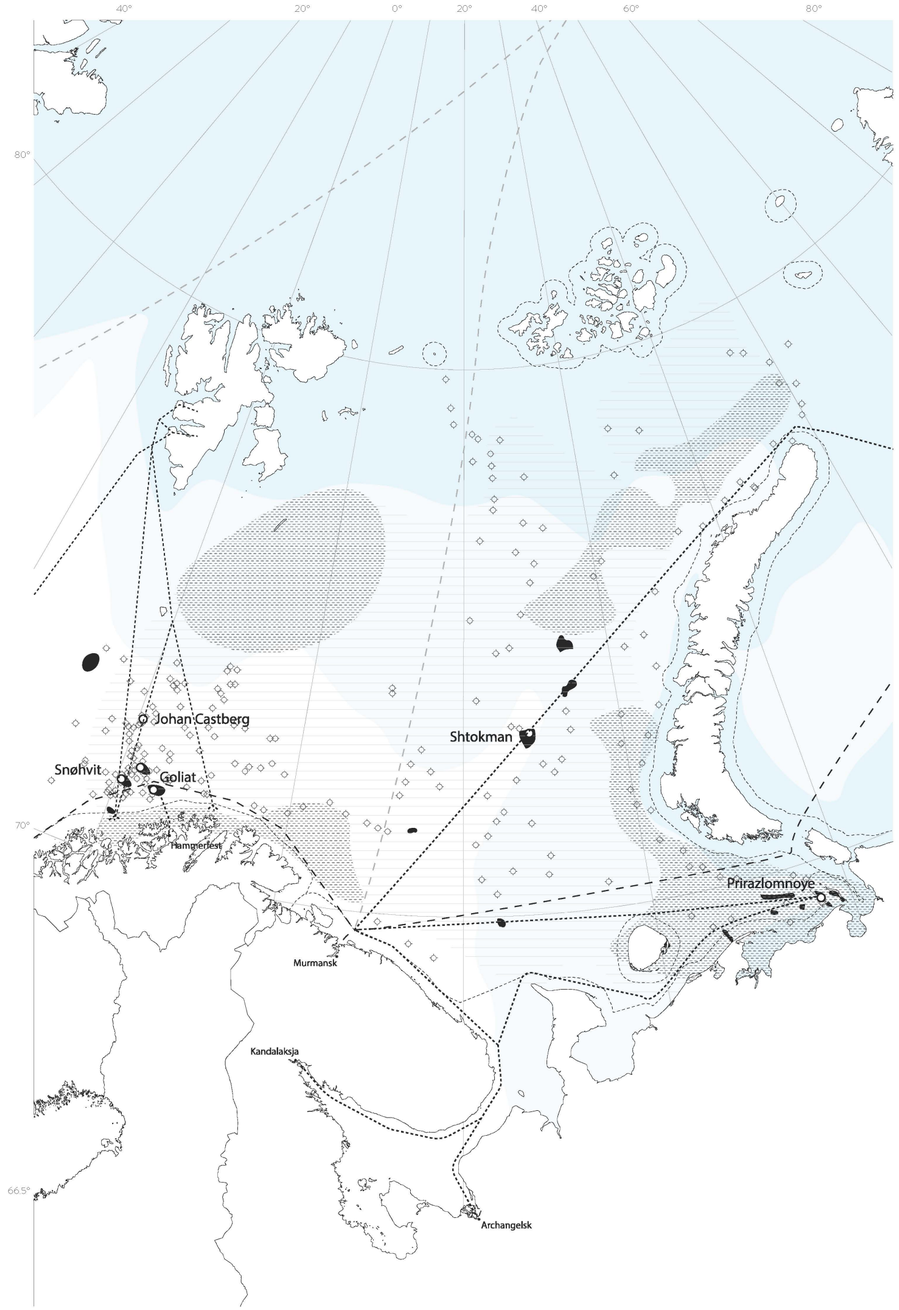
When we stand on shore, looking out over the water to the horizon, we might not expect human occupation of the sea to be very extensive, but it is. In fact, due to the many resources that the ocean supplies, marine uses are numerous and wide spread (Ehler and Douvere 2006). Mostly, marine use is related to resource extraction, including fishing, sand mining and oil and gas extraction (table 1). But there are also commercial, recreational, environmental, scientific and military uses.

Oil and gas extraction is one of the main forms of human occupation in the Barents sea. Oil and gas fields are expected to be found almost everywhere on the continental shelf. Both Norway and Russia invested largely in the exploration drillings, extraction facilities and the transportation infrastructure.

Aside from resource extraction, the ocean has always been a medium for transport. In the past, man crossed the ocean to claim new land, a trend particularly evident in the 15th century during the western colonization. Now, marine transportation mostly concerns the trade of goods. According to the 2020 review of maritime transport (United Nations 2020), an average of 80 per cent of the volume of international transportation of goods is carried overseas. The world fleet consists of bulk carriers, oil tankers, container ships, ferries, passenger ships, fishing vessels and more. Marine transportation has been increasing steadily in the last years (fig. 1), especially the transportation of gas and oil.

Additionally, the production of renewable energy is emerging as marine use. Although there are no offshore windfarms positioned in the Barents Sea yet, wind energy is starting to become a key player in the marine energy sector. The technology is readily available and large scale wind farms can find more space and social acceptance on sea than on land (Sijmons, Hugtenburg, and Veul 2017). Similairily, the experimentation of other renewables such as wave energy and algae harvesting are likely to be introduced to the ocean space in the future (IOC 2006).

Although the abovementioned marine uses vary in sustainability, none of them are risk free. Oil spills, overfishing and pollution are never far away (United Nations 2017). Even the construction of wind farms can easily disturb the delicate ecosystem of the sea floor (Halpern et al. 2008; Santos et al. 2018). As marine uses increase in variety and number, so do the risks.



Petrol industry in the Barents Sea

Occupation of the Barents Sea, mapping petroleum industry and marine traffic. Data source: Mareano (2021); Norwegian Petroleum Directorate (2021).

- Prospected oil
- Prospected gas
- Oil/gas field
- Exploration well
- Fixed facility

- Shipping route
- Northern Sea route
- Trans-Arctic route

- Maximum sea ice extend Jan. past 30 years
- Maximum sea ice extend Sep. past 30 years

N

0 | 200 km

Barents Sea scale

THE OCEAN IS URBAN

Settlement on the Barents Sea

The spatial manifestation of marine occupation can be found in both fixed forms, such as oil rigs and windfarms, and in flows, such as shipping routes, vessels, piping and cables.

Just as terrestrial settlement, the architecture and construction of marine settlement is dependent on the topos. The tools of a woodman are fitted to the forest and the tools of the miner are shaped to handle rock. Reeds are long and sturdy to emerge from the shallow riverbed and lillys are flat-leafed in order to stay afloat on the water surface. And yes, the morphology of an oil rigvaries for different depths, soil types and functions. Offshore construction requires a knowledge of marine dynamics and environment.

If offshore construction is approached from a design perspective, it could be possible to design structures to be multifunctional. For instance, oil platforms can simultaneously be designed as artificial reefs or stepping stones for species migration (Dafforn et al. 2015). The design of human settlement in the Barents Sea has the opportunity to create synergetic solutions to marine issues.

1

2

3

4

1 / +40 to 0m Island. Melkøya gas processing island in winter. Source: Øystein Ingilæ (2012).

2 / +20 to -20m Ship. One of four gas carriers designed specifically to export Liquid Natural Gas (LNG) from Melkøya to market. Source: Ole Jørgen Bratland / Helge Hansen, Equinor ASA (2021).

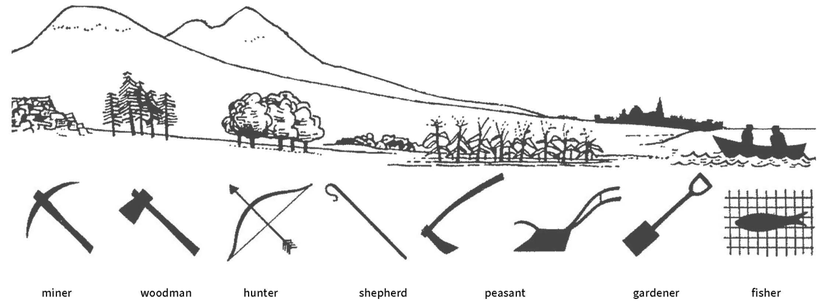
3 / +110 to -360m Platform. Goliat oil rig in winter. Source: Zuma Press, The Wallstreet Journal (2016).

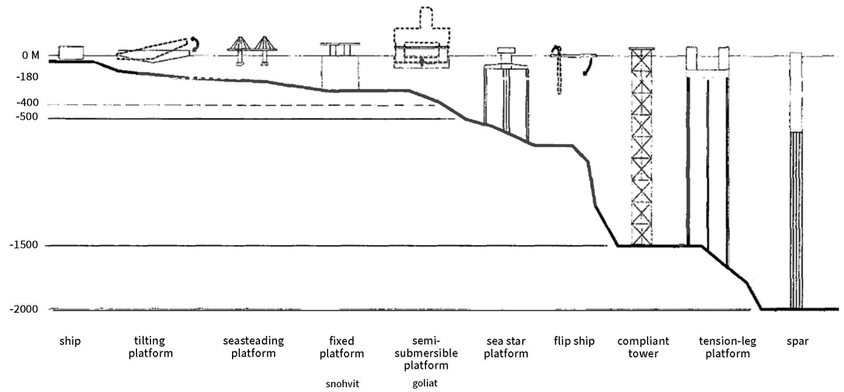
4 / -335to -340m Floating Storage, Production and Offloading (FSPO) platform. Render of Johan Castberg, now in development. Source: Aker Solutions (2019)

Land use and marine use taking shape

A comparison of three sections that demonstrate the way land use or marine use takes shape in correspondence to topos.

Top / Patrick Geddes, The Valey Plan of Civilization (1909).
Middle / Plant species across a section of a relaxed riverbed slope, by author.
Bottom / different constructions of offshore platforms and water depth, author unknown (n.d.).



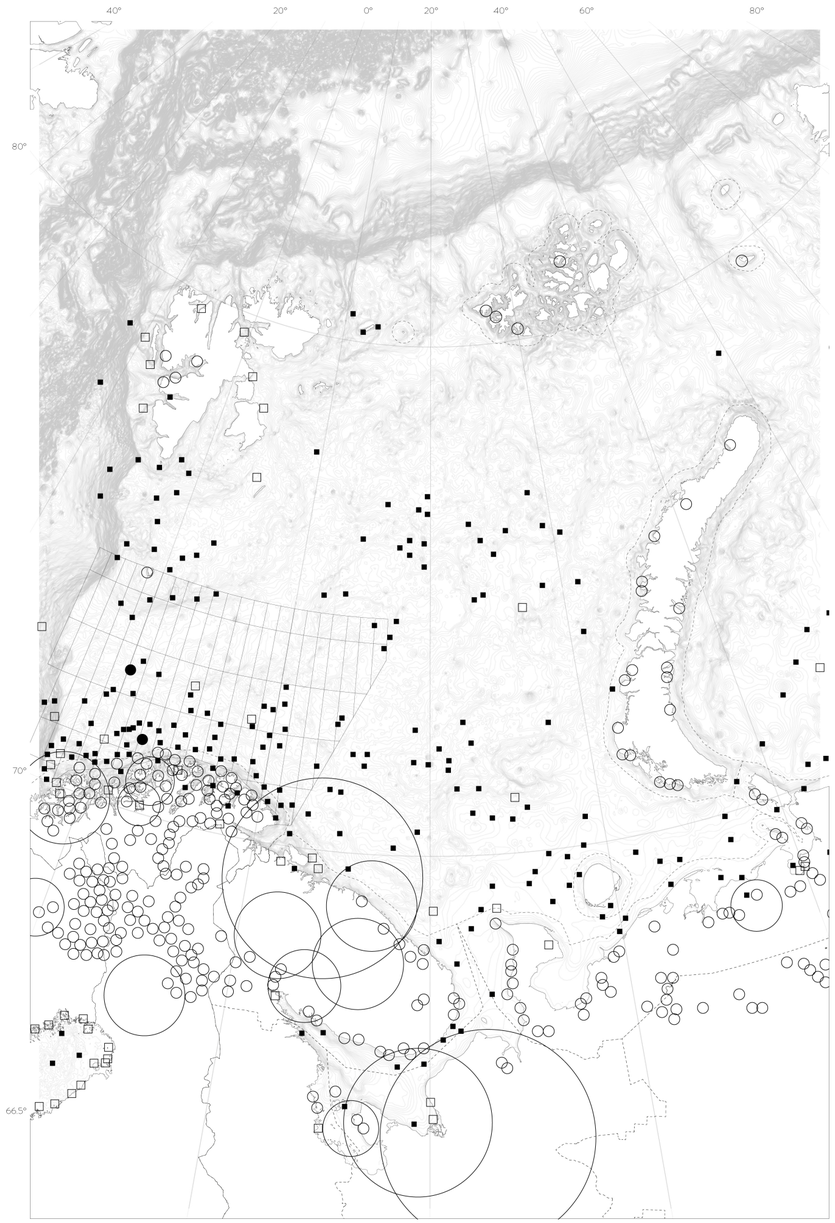


THE OCEAN IS URBAN

Inhabitation of the Barents Sea

The most densely inhabited part of the ocean is the coast. Perhaps this statement seems strange, as we are used to think of coastal communities as the inhabitants of land. However, I argue that coastal communities are just as much inhabitants of the sea, because the coast forms the threshold between both domains. Certainly, coastal communities are often dependent on marine resources (Gee 2019) and sensitive to changes in both their terrestrial and marine hinterland. In 2017, nearly 2.4 billion people live within 100 km of the coast, which is about 40 per cent of the world' s population (United Nations 2017).

Considering the extensive occupation, settlement and inhabitation of the ocean, we can conclude that the scope of the city reaches far beyond the coastline into the maritime space. Thus, the ocean is an urban space. The increasing urbanisation of the ocean pressures the marine ecosystems on which so much of the human population relies. Therefore, we need a spatial planning process to organise marine uses and ensure sustainable development offshore.



Marine population density

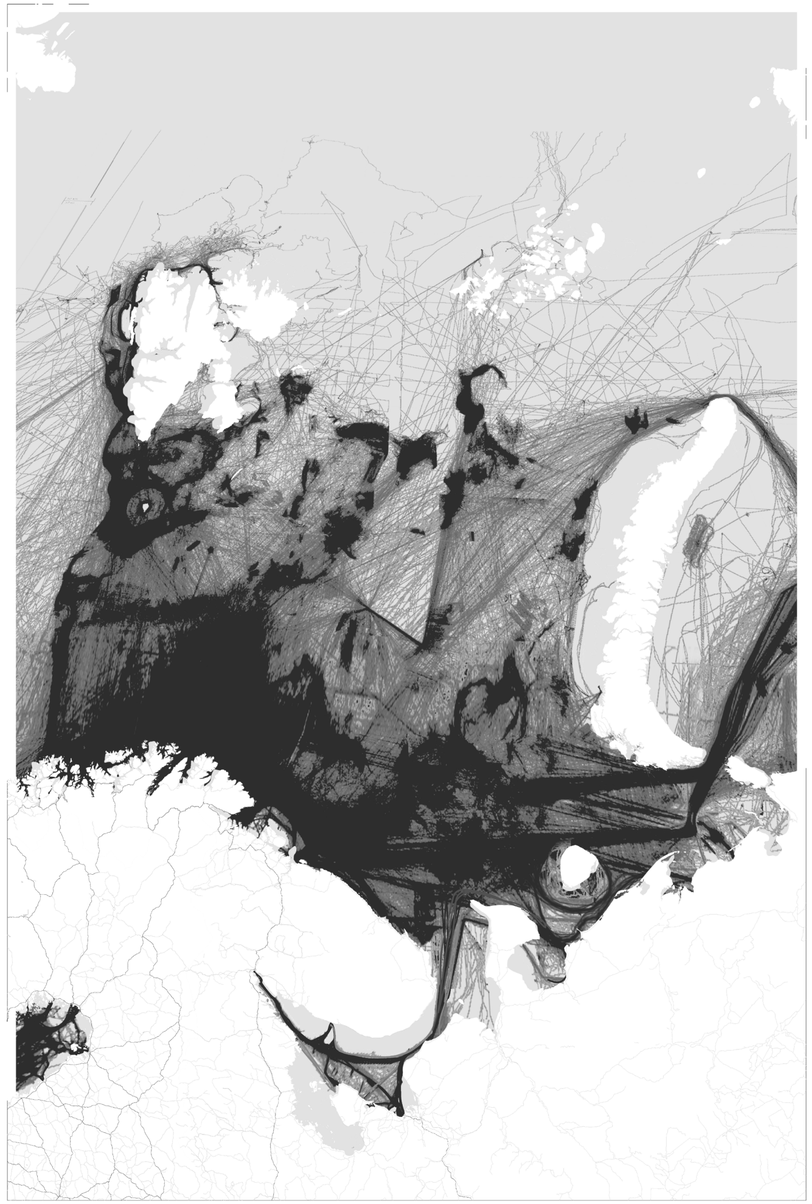
Data source: MarineTraffic (2020/12/23 10:00 AM); Nordregio (2015).

350
100
20

Population density on land x 1000
Population fixed node offshore
Population on ship in movement
Population on ship anchored

0 200 km N

Barents Sea scale



The marine population is dynamic. People constantly move across the coast. The captain of a ferry might arrive at and depart from the coast more than twenty times per day, whereas a technician working on an oil rig spends two full weeks off-shore after every three weeks on land. At any given time hundreds if not thousands of people reside at sea (MarineTraffic 2020).

The question remains, when we go offshore and leave our terrestrial houses, what happens to the home? Does it remain, or does it travel with us when we traverse the sea. Let us propose the latter. In that case, human habitat is not stationary, but mobile. With every raft we push onto the ocean, with every ship we board, we take a part of our habitat and sail it away from shore. In this sense, human inhabitation is not confined to land at all. If a house can be a home, why not a boat or an oil rig?

Crossing the coast, traversing the sea

Traces of all seafaring routes in 2019 on the Barents Sea. Darker lines indicate a higher density of routes per 4.89 km^2. Also depicted is the main roadnetwork on land. Note the difference in fabric of these networks of movement. Crossing the coast to move inland or seawards means to change to a different mode and network of movement.

Source data: MarineTraffic (2020); OpenStreetMap (2014).

500.000 routes / 4.89 km^2 / year

1 route / 4.89 km^2 / year

0 200 km N

Barents Sea scale

The ocean is social

If the ocean is an urban space, including a population density, then it is inevitably a social space as well (Gee 2019). Since historic settlement, coastal communities have relied heavily on the ocean for food, trade, transport and livelihood. Human-sea relations have developed since then, embedding into local culture. The dependency of humans on the ocean ecosystem can be described by means of ecosystem services. Ecosystem services, first defined by the Millennium Ecosystem Assessment board in 2003, are the benefits people derive from nature. Four types of services are identified: provisioning (e.g. food, water), regulating (e.g. floods, drought), supporting (e.g. nutrient cycle, photosynthesis) and cultural services (Millennium Ecosystem Assesment 2003). For now we focus on the latter. Cultural ecosystem services (CES) include non-material benefits, such as aesthetic, recreational, religious or spiritual values. CES may also refer to mental well-being, sense of belonging, perceived dependency, identity and heritage (Millennium Ecosystem Assesment 2003). Just like the landscape, the seascape is built out as many layers of soil as of layers of memory (Schama 1995). It should come as no surprise that the ocean forms a popular stage for folklore and myths.

01. People impact the Barents Sea
02. The Barents Sea impacts the people
03. Perceived dependency

THE OCEAN IS SOCIAL

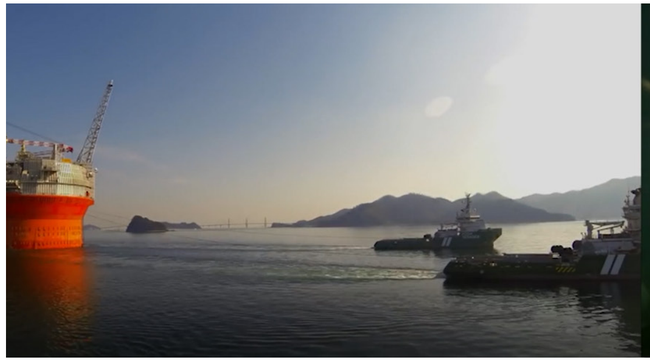
People impact the Barents Sea

In the previous chapter I stated that the urbanisation of the Barents Sea is the result of climate change. But the regressing sea ice merely provides the opportunity for industrial expansion in the Arctic Ocean, not the incentive. The real reason for marine urbanisation lies in the societal demand for resources. Our reliance on marine resources, in daily life. Is it not us, humans, who cause climate change, sea level rise and water pollution? Is the increasing petrol industry at the Barents Sea not also a result of consumer behaviour (Staalesen 2019), of the cars we drive and the furnaces we cook on? The problem, then, is of socio-cultural nature.

Goliat, an arctic oil platform, 64,000 tonnes of steel and a beacon of technological advancement. Seemingly, Goliat is the physical evidence of the transcendence of man beyond the natural world. But in its heart, it is nothing else than the building of human habitat.

By building habitat we add to the landscape and reform it. When the beaver builds his dam he influences the delta. Similairiliy, when we build an oil rig, we change the ocean. It is an act of terraformation.

1. Altering matter



2. Migration

3. Terraforming

Filmstills of ‘Goliat and the beaver’

A montage of video material that juxtapositions the positioning of the FPSO Goliat in the Barents Sea and the building of a beaver dam. It shows the paralels between the two processes of terraforming on a sequence of scales. Highlighted on this page are: the scales of the body and its role in the building proces (above), the migration (middle) and the settlement in the surrounding landscape.

The video can be seen at https://vimeo.com/470144995.

Edited by author, using video material from the sources: ENI Video Channel, National Geographic, PBS Nature, Josh Cassidy (Deeplook).

THE OCEAN IS SOCIAL

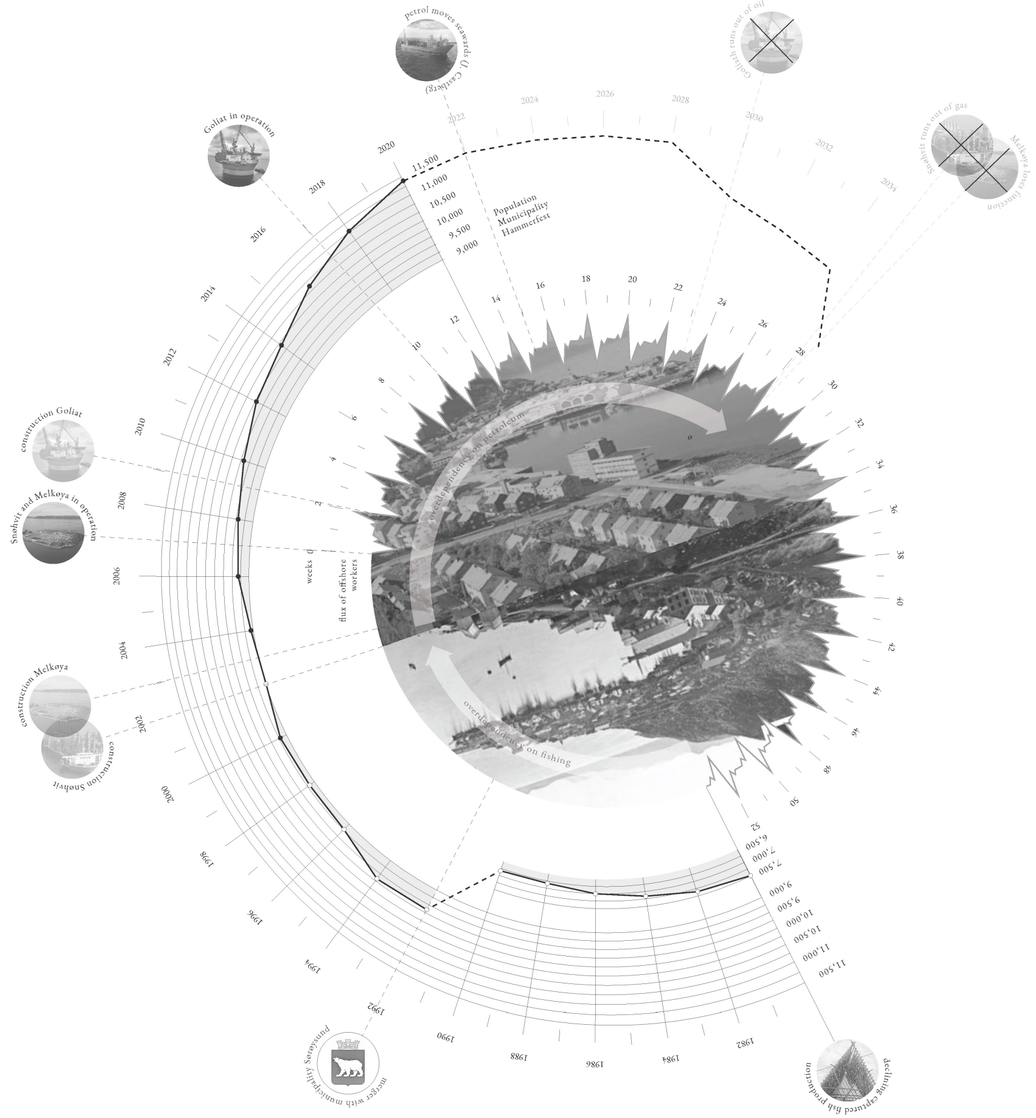
The Barents Sea impacts the people

It is clear that changing conditions at sea impact us, but we should not forget that the reverse is true as well. Hammerfest owes its current prosperity to offshore oil and gas industries. Yet, up until 2002, the towns economy relied heavily on fishing and a little tourism. Due to the declining fish industry Hammerfest could offer little livelihood prospects and unvaried job opportunities. This lead to severe depopulation and unemployment. The arrival of oil industry revived Hammerfest, creating job opportunities and cultural development which attracted a new, younger population. Local interviewees describe the offshore petrol development as “a blessing”. (Loe and Kelman 2016).

The socio-economic benefits of the oil industry in Hammerfest are easy to measure, but the offshore developments did more than just increase local job opportunities. According to the interviewees it also changed the mindset and lifestyle of the inhabitants. Transitioning from a culture where neighbours, family and ‘soft’ values were important to a society that emphasises status and income (Loe and Kelman 2016).

The question remains, if Hammerfest’ s current economy is socially sustainable, considering the Snøhvit and Goliat extraction sites are expected to run out within 20 years.

We can conclude that marine industries have a socio-cultural impact on the ocean. Especially in Hammerfest, where the welfare of the population is closely tied to marine industries. Marine spatial planning should acknowledge coastal communities as a group of people that strongly relates to the ocean and is sensitive to its alterations. As agreed upon in 2015 during the UN sustainable development summit in New York, sustainable development should consider the relationship between society and the natural world (UN 2015). To achieve sustainable oceans, social sustainability cannot be forgotten.



Impact of oil on Hammerfest residance

The outer ring represents the population decrease and increase in the municipality of Hammerfest from 1980 - 2020 and some milestones in the developing of oil industry off the Hammerfest coast. Note the population rise after the start of construction of Snøhvit in 2002.

The Inner ring represents the short term effects of oil industry on the Hammerfset population. After every two weeks at sea, oil rig workers spend two weeks on land. As such, the population of Hammerfes fluctuates every two weeks. Pushing and pulling, inland and seawards like the tide.

Source data: Statistics Norway (2013, 2020); Loe & Kelman (2016). Photos by: Axel Lindahl (1889); Oskar Puschmann (2004).

THE OCEAN IS SOCIAL

Perceived dependency

When studying socio-cultural impacts, the perceived impact is just as important. From local perceptions we can learn how people experience changes at sea, how it affects their daily life and how they will adapt and react to it. Public attitudes towards marine issues could reflect or forecast public behaviour.

In 2016, Loe and Kelman conduct interviews with inhabitants of Hammerfest from different ages and sectors and ask them about the impact of the petrol industry on their community (Loe & Kelman 2016). The results show a multitude of voices that sketch a better image of the real socio-cultural impacts than my analysis on the previous page. From local attitudes we can learn what the societal priorities are, what the people value as important.

The quotation marked in yellow is especially interesting. The interviewee expresses frustration, anger even, towards academics that argue against petrol for environmental reasons, while they are far removed from Hammerfest unknowing and unsensitive to the socio-cultural importance of oil to the community. While at the same time, these academics "sitting in cafes in [a trendy neighbourhoods] in Oslo" reap the benefits of the petrol industry as well. Considering the petroleum sector is Norway' s largest industry in terms of government revenues, investments and export value, contributing to over 12 per cent of Norway' s gdp in 2020 (Statistics Norway 2020).

In short, perceived dependency can be just as real as actual dependency. It might slow down or resist change. For example, in the case of Hammerfest, the community can be expected to resist a post-oil transition. If one would propose cha as it requires them to let go of their sense of security. If one were to try and change the economy of life in Hammerfest, they must design strategically, with perceived dependency in mind to ensure local acceptance.

Local opinions on Hammerfest oil

The quotations are fragments taken interviews taken in Hammerfest on perceived impacts of oil industry in the Barents Sea and corporate responsibility of Statoil. Interviewees were all inhabitants of Hammerfest of different ages and occupation.

Source data: Loe & Kelman (2016).

"Petroleum is extremely important for the whole region. It creates jobs, and that is the most important – if not it would have been quite empty here."

"If you care so much about the environment, then why are you living here and reaping all the benefits from oil and gas?"

"Environment? Only a small group focuses on that. We feel that the oil companies inform us well, handle things well, take challenges seriously, have good emergency preparedness. **We feel safe** that the environment is taken care of. We see more benefits than disadvantages from oil and gas."

"Snow White turned everything upside down – the situation went **from sunset to sunrise.**"

"Everything changed with Snow White. That was when the future came back to Northern Norway."

"Environment? Well, national environmental organizations such as WWF and 'Nature and Youth' were against the development of SnowWhite in Hammerfest – but again, they are against everything.

"It has been a blessing. This is a strong word, but there has been a total change **from pessimism to enormous optimism."**

"The most important is to hire local people so there is more to do [job opportunities] here, so that one is able to keep people here."

"I am pissed off at academics and people sitting in cafes in Grünerløkka in Oslo [a trendy neighborhood in Norway' s capital] arguing against petroleum. They have their things—so why should they begrudge us to have something as well?"

"We care about the environment, we have untouched nature here, and we don' t want it to be destroyed. A blowout would be negative, especially because it would damage our reputation in the global market for fish. **It would be considered negative to buy fish from an area where there has been an oil spill"**

"A blessing for Hammerfest, but..."

"less focus on softer values"
"increased class differences"

"The petroleum industry has led to, well, not exactly a snobfactor, but money means more than before... . People care more about status, [material] things and expensive cars. People talk about buying new snow scooters and where they are planning to travel. The petroleum industry has created an illusion that having much money is happiness. It was different before. Calmer."

"In the construction phase, 3000–4000 people came here from different places. There were many cases of drugs and violence. Statoil should have planed for this... . It was not good for the local community—**a tough time."**

"Concerns about negative effects for the environment mostly come from outside. **They are not taken seriously here,** they are given no recognition or respect here whatsoever. I think many people trust the authorities to regulate the industry, and that regulations are followed. But I do know there is some risk."

"I think it is important not to create **social differences**, through high salaries for some groups, and pushing housing prices up. Big companies should think about the social effects of their operations."

"For us, it has not been a question of environmental risk but of survival and having a place to work. Our nature and culture in this region is to survive, and we know there is a risk in all activities.

PROBLEM STATEMENT 1
Human-sea relations

The socio-cultural impacts of marine industrialisation at the Barents Sea on coastal communities remain unmapped and underrepresented in both research and practice.

GAP IN THEORY AND PRACTICE

Marine spatial planning

The increasing demand of marine uses and the risks that come with it triggered the first applications of marine spatial planning (MSP) in 2005 (Ehler 2020). Many definitions of MSP coexist, but the most commonly agreed upon is “a public process of analysing and allocating the spatial and temporal distribution of human activities in marine areas to achieve ecological, economic and social objectives that have been specified through a political process” (IOC 2006). An easier definition might be: the political process of spatial organisation of marine uses. In order to guide this process, the European Committee developed an MSP framework providing directives for decision-makers for the planning of sustainable marine space and development (EC 2014).

Although MSP initiatives can be found in numerous countries across the globe, only the Netherlands, Belgium, Germany and Norway (not a member state of the EU) have been so far committed to a long-term planning process and have published revisions of their first plans (Ehler 2020), including a management plan for the norwegian part of the Barents Sea (Norwegian Ministry of the Environment 2011).

The topic of marine planning is quite new, especially compared with terrestrial planning, which has been an object of study for centuries in urbanism, city planning, architecture, social studies and philosophy. The principles that currently guide terrestrial planning have been formed over years of research, trial and error. Marine spatial planning, being roughly 20 years old, does not enjoy this advantage.

In addition to this, the majority of the ocean space remains unmapped and unknown (Santoro et al. 2017). Although the whole ocean floor has been mapped at a 5 km resolution, less than 0.05 per cent has been mapped at high resolution that is needed for detecting important ocean features and informing scientific research. In fact, the surfaces of Mars, the Moon and Venus have been mapped to a higher level of detail than the surface of the Earth’ s ocean.

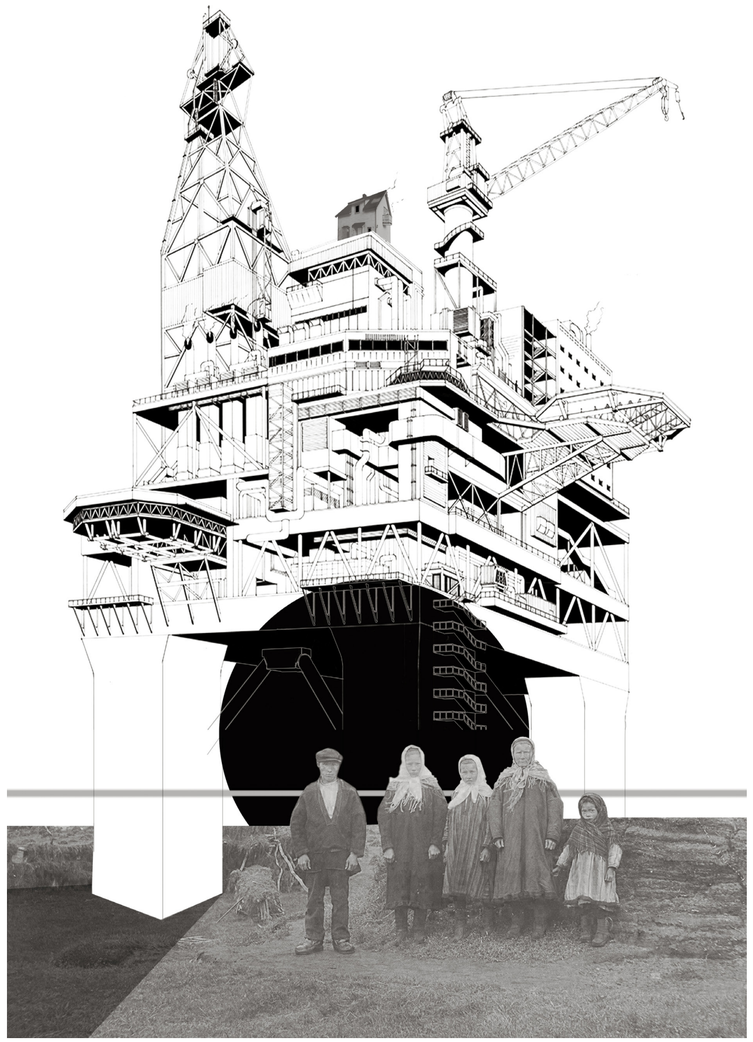
Because the seascape is inherently different from land, terrestrial planning principles cannot be thoughtlessly applied to marine planning. Considering the novelty of marine planning and the amount of marine space that remains unknown, we should face marine planning principles critically and aspire it to be a process that is iterative, flexible and evolving.

The missing layer

MSP operates on three different domains of governance: the environmental, economic and social domain. This becomes evident from the aforementioned purpose of MSP: “[…] to achieve ecological, economic and social objectives” (EC 2014, p.140). Interestingly, of these three domains the social domain is alarmingly underdeveloped (Gissi, Fraschetti, and Micheli 2019; McKinley, Acott, and Stojanovic 2019). The few studies that do adress social dynamics in MSP focus solely on the engagement of stakeholders and their economic interests (Craig, 2012; Mileriene et al. 2014).

Yet, the socio-cultural domain of MSP extends far beyond mere stakeholder analysis. It entails many facets of our society, including local identity, attitudes towards the ocean and cultural ecosystem services. Unfortunately, CES is the most underdeveloped type of ecosystem services in both literature and practice. Studies that do discuss CES usually have a terrestrial focus.

This socio-cultural understanding forms the missing layer (St. Martin and Hall-Arber 2008) of MSP and is neither mapped nor integrated into the planning process (Shucksmith and Kelly 2014).



Right / A coastal Sami family posing proudly before their home in Adamsfjord, Laksefjord, Finnmark in 1909. And an architectural drawing of a typical oil rig.

Edited from: Hanna Resvoll-Holmsen (1909); Julien Nolin (n.d.); Pen RiG Study (n.d.).

PROBLEM STATEMENT 2
Representation

Planning offshore development relies on objective, univocal mapping of an administrative or proprietary nature, which cannot sufficiently represent socio-cultural values, or visualise human-sea relations between Hammerfest and the Barents Sea.

REASON FOR THE GAP
Issues with representation

Fortunately, there does not seem to be a lack of motivation to include socio-cultural values in marine spatial planning. The EU directives specifically state the importance of creating sustainable land-sea relations while considering "economic, social and environmental aspects to support sustainable development and growth in the maritime sector" (EU 2014, p.141). Moreover, many of the marine plans currently in place do make an effort to include cultural ecosystem services. The Norwegian management plan for the Barents Sea devotes a paragraph on cultural ecosystem services acknowledging them as an essential factor for our well-being and quality of life (Norwegian Ministry of the Environment 2011).

Non-monetary values in economic analysis
Although Member States seem willing to include ecosystem services in trade-offs, the qualitative nature of CES makes it challenging to do so. Most of the services refer to public goods that do not have market value, which makes them difficult to compare to other factors in quantitative analysis (Norwegian Ministry of the Environment 2011). As a result, most societal impacts of offshore developments on coastal communities cannot be estimated to inform trade-offs in the planning process.

There have been several attempts to develop tools to describe and translate non-monetary values to economic values (McKinley, Acott, and Stojanovic 2019). For example, recreational value could be measured through the economic contribution of tourism. However, such a method could not measure the influence of recreation on local stress levels. Certainly, the cultural value of the ocean can only be approximated in monetary terms to some extent.

Subject to time and space
Socio-cultural data is subject to variations in time and space. That is to say that these values are different for every community. Even within a community on a certain location values can change with time (Shucksmith and Kelly 2014). Socio-cultural data cannot be generalised for multiple locations and communities. As a result, it becomes near impossible to establish and maintain a complete, up-to-date socio-cultural database.

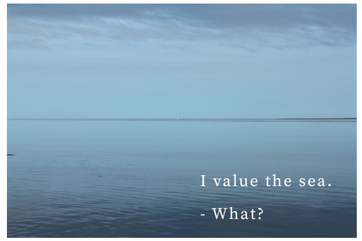
Limitations on capacity
The collection of socio-cultural data is predominantly qualitative and requires intensive labour and time. As opposed to quantitative data, the process of collecting socio-cultural data is largely inductive. The researcher interprets the meaning or quality of the collected data. This approach requires hands on engagement through conversation (e.g. interviews, surveys), workshops or other forms of participatory mapping in the field. Collecting socio-cultural data is limited by the local capacity to provide such engagement.

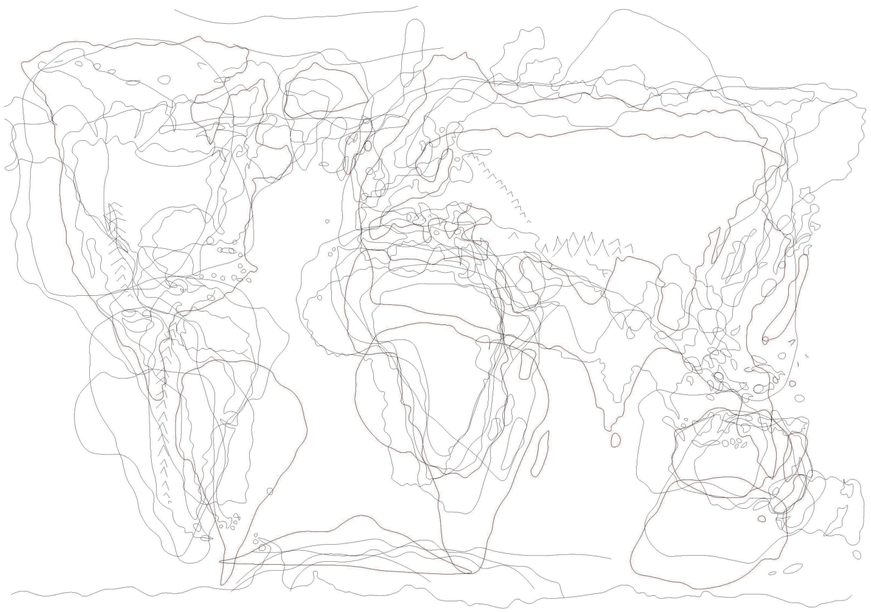
No physical anchors on ocean space
In terrestrial planning, socio-cultural values can be mapped through their attachment to objects in space. For instance, a community might value a local park for its tranquillity, or a monumental tree that has marked the town square for generations. Such objects can easily be highlighted in conventional plans or maps. In contrast to terrestrial landscape, the marine landscape does not provide physical anchors through which socio-cultural values can be located in space. This might be one of the key issues of conventional mapping methods.

Restrictions within planning policy
It becomes increasingly normal to formally validate the quality of datasets and the methods through which they are obtained. In order to be accepted into the decision-making process, datasets need to meet a range of criteria on completeness, methodology, accuracy, level of granulation and objectivity (Shucksmith and Kelly 2014). Considering the abovementioned issues, socio-cultural data can impossibly meet all criteria and will not be accepted into the decision-making process.

Notions of truth
Our society consists of a high variety of audiences that each hold different values, perceptions and beliefs in respect to the ocean (McKinley, Acott, and Stojanovic 2019; Gee 2019). When mapping socio-cultural values, we cannot aim to find one objective truth, because socio-cultural realities are personal (Latour 2017; Berger and Luckmann 1966). The action of mapping should aim to find an understanding of these different realities, by means of representation (Corner 1999). Problematically, the subjective, ambiguous data this type of research would produce is not easily represented through conventional mapping methods.

Ultimately, the qualitative, subjective and changeable nature of socio-cultural data creates considerable difficulties in collecting and representing it within the current policy framework of marine spatial planning. Evidently, MSP policy does not possess the appropriate tools to represent human-sea relations.





Right / The standard world map drawn from memory by ten students of the TU Delft, The Netherlands. The students each have different nationalities. The alterations demonstrate how worldviews are subjective and individual. Source: Atlantis magazine 30.2 (2020).

PROBLEM STATEMENT 3
Offshore urbanism

The current practice of marine spatial planning at the Barents Sea is limited to economic and ecological analysis, lacks design, and is unable to consider socio-cultural risks and opportunities in the organisation of marine uses.

WHAT CAN DESIGN OFFER?

Marine spatial planning as a political proces may not posess the tools to understand and represent socio-cultural valuation of the Barents Sea, but other disciplines do. Surely, the sea is widely represented by many different voices: artists, writers, archaeologists, sociologists, philosphers etc. We have but to listen and accept these voices into marine spatial planning.

Design can offer an interdisciplinary approach to socio-cultural analysis, as it operates at the interface between art and science (Lee 2011). Where science characteristically relies on facts, art relies on the perception of these facts. If we are to understand human-sea relations, we need to reflect on both. Design can do this; it interprets facts as well as perceptions to develop analysis and planning strategies. As such, design is able to embrace subjectivity where MSP policy cannot. Design can be used as a tool to understand (Schama 1995; Lahoud 2016) human-sea relations.

In addition to this, design is able to represent these human-sea relations through cartography (Bryant 2014). Of course, many MSP policy documents use maps as a tool to visualise or localise data. For example, to map marine areas that prohibit fishing. But cartography is so much more than just the spatial visualisation of data. Mapping, as an act of design, has the power to convey meaning. What does it mean to be at sea? What does it mean to be changed by the sea and to change it in return? As James Corner so beautifully phrases it, mapping is “a fantastic cultural project, creating and building the world as much as measuring and describing it.” (Corner 1999, 213). It both uncovers and envisions realities. Mapping is a great design tool to represent the meaning of human-sea relations.

As planners and designers we should open the discourse of urbanism to marine spatial planning. Urbanism is context oriented and location specific (Lee 2011). It acknowledges that socio-cultural values cannot be generalised for multiple locations and communities. Just like MSP, urbanism is a spatial practice. If we research the spatial manifestation of human-sea relations (eg. population density at the coastline) we could learn how the urbanisation of the Barents Sea can accommodate for socio-cultural demands and mitigate negative impacts of offshore development on coastal communities like Hammerfest. By defining the socio-cultural demands of marine space, they can compete with other marine uses in the MSP process.

Moreover, synergetic opportunities with other marine uses can be designed to create more sustainable outcomes. A wonderful example is the project Sandmotor, along the coast of The Netherlands (Rijkswaterstaat and Provincie Zuid Holland 2020). The Sandmotor is an artificial sandbar that protects the dunes from eroding. Without it, the sensitive dune biodiversity would be lost and human settlement behind the dunes would risk flooding. Simultaneously, the project created a unique coastal space, both sea and land, that became a very popular spot for windsurfing. The main purpose was to keep the sea at bay, a fight that has since long been embedded in the Dutch culture. Yet, in a way, the project brought people closer to the ocean as well.

The Sandmotor demonstrates both the challenge and the beauty of offshore urbanism. To create marine space that is both socially and environmentally sustainable. To protect and connect. To understand, represent and employ human-sea relations as driver for positive change. In short, offshore urbanism can offer an interplay between research and design that is key for the sustainable development of the ocean as an urban space and as a social space.

Right / Photographs of kite surfers at the Sandmotor, The Netherlands. Source: Linnartz and De Kurver (2016).

CHAPTER 3.
METHODOLOGY

Image / Mural in Vardø, Norway. Source: Ilona Wisniewska (n.d.).

METHODOLOGY

At the core of any research lies the methodology. Without it, the research is ungrounded or even illegitimate. The same goes for the work before you. This chapter on methodology explains and justifies my research approach while aligning it with the problem statement, research question and the research purpose. All in all, the aim of the methodology chapter is to provide a roadmap of the steps taken in this research, which is transparent and reproduceable.

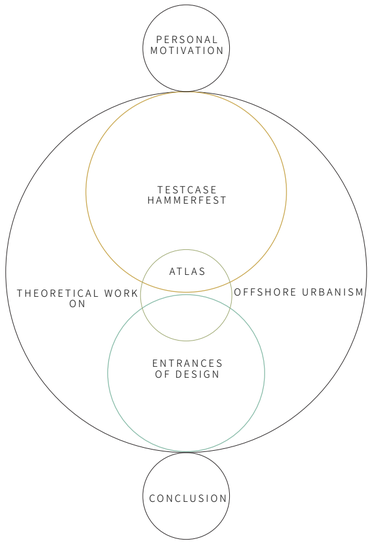
01. Conceptual framework
Provides a quick overview of the problem statements, pressures, socio-economic impacts and the purpose of this thesis as a response to the problematisation. The conceptual framework is a great tool to gain an overview of the research in a glance.

02. Analytical framework
Discusses the scales of influence and relevant domains that the thesis works within. The purpose of the analytical framework is to outline the limits of the thesis.

03. Theoretical framework
Provides an evidence based argumentation for the scientifical relevance of the research and positions it in the current literature. In order to do so, I have mapped the theoretical constellations and literature that substantiate the research and form my frame of reference.

04. Research framework
Presents the overall structure of the research and the actions to take to reach the expected outcomes.

NB.
Before P2, the representation of local voices and socio-cultural values played a fundamental role in the methodology. The project proposed to organise an on-site workshop named ‘Atlas by Hammerfest’ , in which I had hoped to work with inhabitants to produce collaborative mapping. However, due to covid-19 restrictions, I was not able to travel to Norway and plan the workshop. Although the heart of the thesis remained intact, the majority of the methodology had to change. The old methodology chapter can be found in appendix B.



1 / CONCEPTUAL FRAMEWORK

THESIS

1 / PROBLEM STATEMENT Human-sea relations

Problem field

The socio-cultural impacts of marine industrialisation at the Barents Sea on coastal communities remain unmapped and underrepresented in both research and practice.

2 / PROBLEM STATEMENT Representation

The current practice of marine spatial planning at the Barents Sea is limited to economic and ecological analysis, lacks design, and is unable to consider socio-cultural risks and opportunities in the organisation of marine uses.

3 / PROBLEM STATEMENT Design

Planning offshore development relies on objective, univocal mapping of an administrative or proprietary nature, which cannot sufficiently represent socio-cultural values, or visualise human-sea relations between Hammerfest and the Barents Sea.

Pressure

The sea is urbanising in response to global and national demands for resources and economic stability.

Socio-economic impact

Human-sea dependencies and local perceptions on marine industry are not taken into account, leaving coastal **communities vulnerable to change at sea**.

Purpose

Take a **localised approach** to marine spatial planning, that seeks to understand and employ human-sea relations through design.

TESTCASE HAMMERFEST

1 / LOCAL ISSUE Overdependency on oil

Problem field

Hammerfest' s economy of life is overdependent on the petroleum industy offshore.

Pressure

Local petroleum is expected to run out by 2035 after which it moves further seaward or transitions towards a post-oil scenario.

Socio-economic impact

No job security for the majority of the working community, putting **local wellfare at risk**.

The flux of offshore employees coming to Hammerfest reduces, causing both temporal and permanent **population to decline**.

Purpose

Propose pathways of change in which Hammerfest' s economy of life **depends less on offshore petroleum** industry.

2 / LOCAL ISSUE Perceived dependency on oil

Heavy perceived dependence on the petroleum industry as a means of survival.

Collective memory and perception of petroleum as a blessing that saved Hammerfest of severe de-growth around 2002, reviving the town, its population and prospects for a future.

Petroleum has changed the local understanding of growth and causes local **reluctance to move to a post-petrol scenario.**

Strengthen **local sense of ownership and transparancy** of the transition to a larger variety of marine industries besides petroleum, by promoting community-led initiatives and public acces to the offshore environment.

2. ANALYTICAL FRAMEWORK

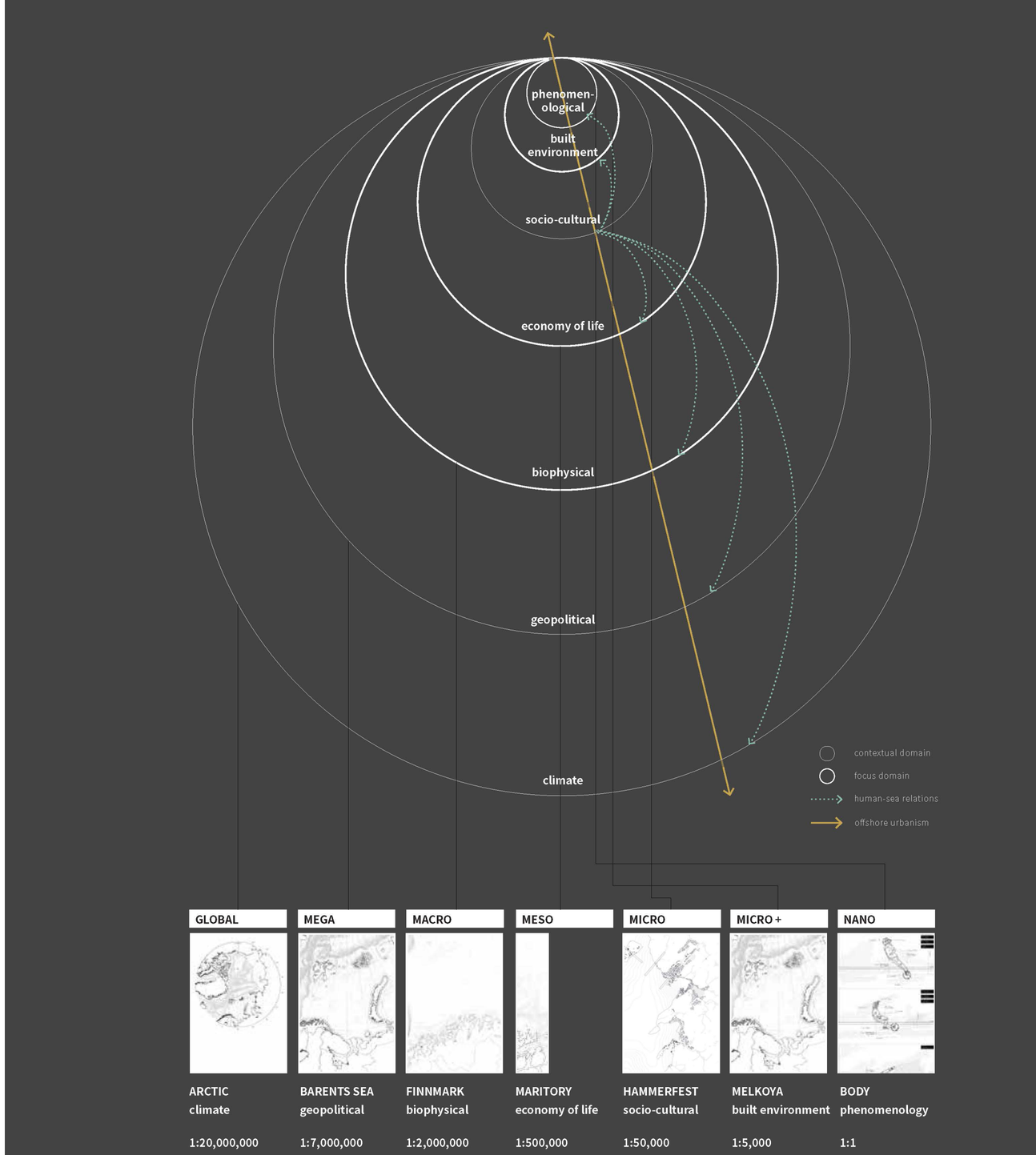
In a nutshell, this thesis studies the socio-cultural relations between the community of Hammerfest and the urban development of the Barents Sea. Hammerfest can be mapped on a scale of 1:50.000 on A3 paper. The entirety of the Barents Sea is mapped on a scale of 1:7.000.000 on the same paper. This massive difference in scale forms one of the key challenges in this thesis. It requires a cross-scalar approach and the acknowledgment that the socio-cultural scale of influence is larger than just Hammerfest.

It is easy to understand that phenomena on every scale (climate change, sea level rise, economic regression, air pollution) can impact society on a socio-cultural scale (UNRISD 2012). But we should not forget, that the reverse is true as well. Is it not us, humans, who cause climate change, sea level rise and air pollution? Is economic regression not also a result of the changing behaviour of consumers? Socio-cultural conditions impact both larger and smaller scales. If we understand the complexity of these relations, the socio-cultural dimension could play an important role in reaching climate objectives.

In line with this idea, the role of urbanism exends across the scales as well, studying urban processes from nano to global: a planetary urbanism (Lefebvre 1970). The ocean, being a part of this urban planet, cannot be left out of urban studies.

Although the relations between climate, economy and society are all interesting and to a certain degree relevant to our case, this thesis will focus on the relations between the built environment, the local economy of life (or livelihood) and the sea as a biophysical system.

The term biophysical may need further explanation. From geography we can take the following definition: A biophysical environment is “the biotic and abiotic surrounding of an organism or population, and consequently includes the factors that have an influence on their survival, development and evolution.” (NWRM 2020). The organisms or populations studied in biophysical research are generally animals. In this research, I look at the Barents Sea as being a biophysical environment for humans or the human population, that consequently includes the factors that have an influence on our survival, development and evolution.



3. THEORETICAL FRAMEWORK

The theoretical framework maps the most important pieces of literature that support this thesis. The theories are mapped within an adaptation of the onion diagram (Czischke 2018). The rings of the onion represent the different scales and domains of the thesis:

- phenomenological,
- built environment,
- socio-cultural,
- socio-economical,
- biophysical,
- geopolitical and
- climate.

The three parts of the onion represent the problem fields of the thesis, which are explained in the first part of this chapter in the conceptual framework:

- human-sea relations,
- representation and
- marine spatial planning.

By mapping the literature in this way, we can visualise to which problem fields they contribute and identify relations and gaps in the current discrouse.

From the map it is clear that the lower right corner of the map is denser than the top right corner. This can be explained by the fact that most sources adressing human-sea relations focus on smaller scales, and sources that adress marine planning tend to focus on larger scales. There seems to be a gap in research that connects human-sea relations to the larger scale of the ocean or climate. With the exemption of Bruno Latour' s work and one edition of Harvard Design Magazine called 'Wet Matter' (2014). Both of these sources build on the importance of human-sea relations as a basis for oceanic or climate research.

Another observation can be made along the axes of the onion. Theories that are located along the axis between 'human-sea relations' and 'representation' would adress the mapping of human-sea relations. Theories that are located along the axis between 'representation' and 'marine spatial planning' would adress the role of cartography in marine planning. The few sources positioned along these axes are of significant importance. Particularly research that links human-sea relations, representation and marine spatial planning together is wanting. The thesis adds to the current discourse by bridging the gap between the three problem fields.

PERSONAL MOTIVATION

To understand a complex system and from this understanding, enable change

PROBLEM FIELDS

Human-sea relations | **Representation** | **Design**

PROBLEM STATEMENTS

The socio-cultural impacts of offshore development at the Barents Sea on coastal communities remain relatively unmapped and unknown.

MSP relies on objective, univocal mapping which cannot represent non-monetary values or visualise human-sea relations.

Marine spatial planning is limited to economic and ecological analysis, and lacks design.

RESEARCH PURPOSE

To actuate urbanists to take a localised approach to marine spatial planning, that seeks to understand, represent and employ human-sea relations through design.

HYPOTHESIS

Offshore urbanism is...

... an act of research: **to understand** human-sea relations

... an act of representation: **to represent** the local dimension in marine spatial planning

... as an act of design **to employ** this understanding in the spatial reorganisation of marine uses at the Barents Sea.

RESEARCH QUESTIONS

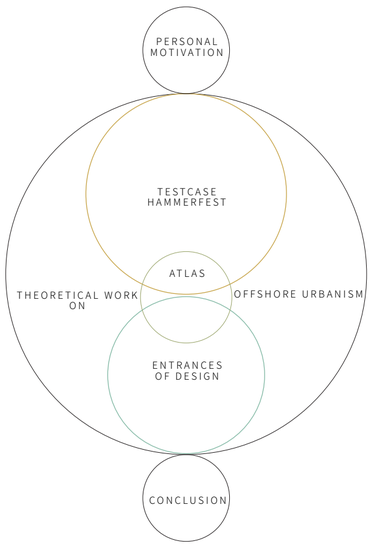
How can human-sea relations be...

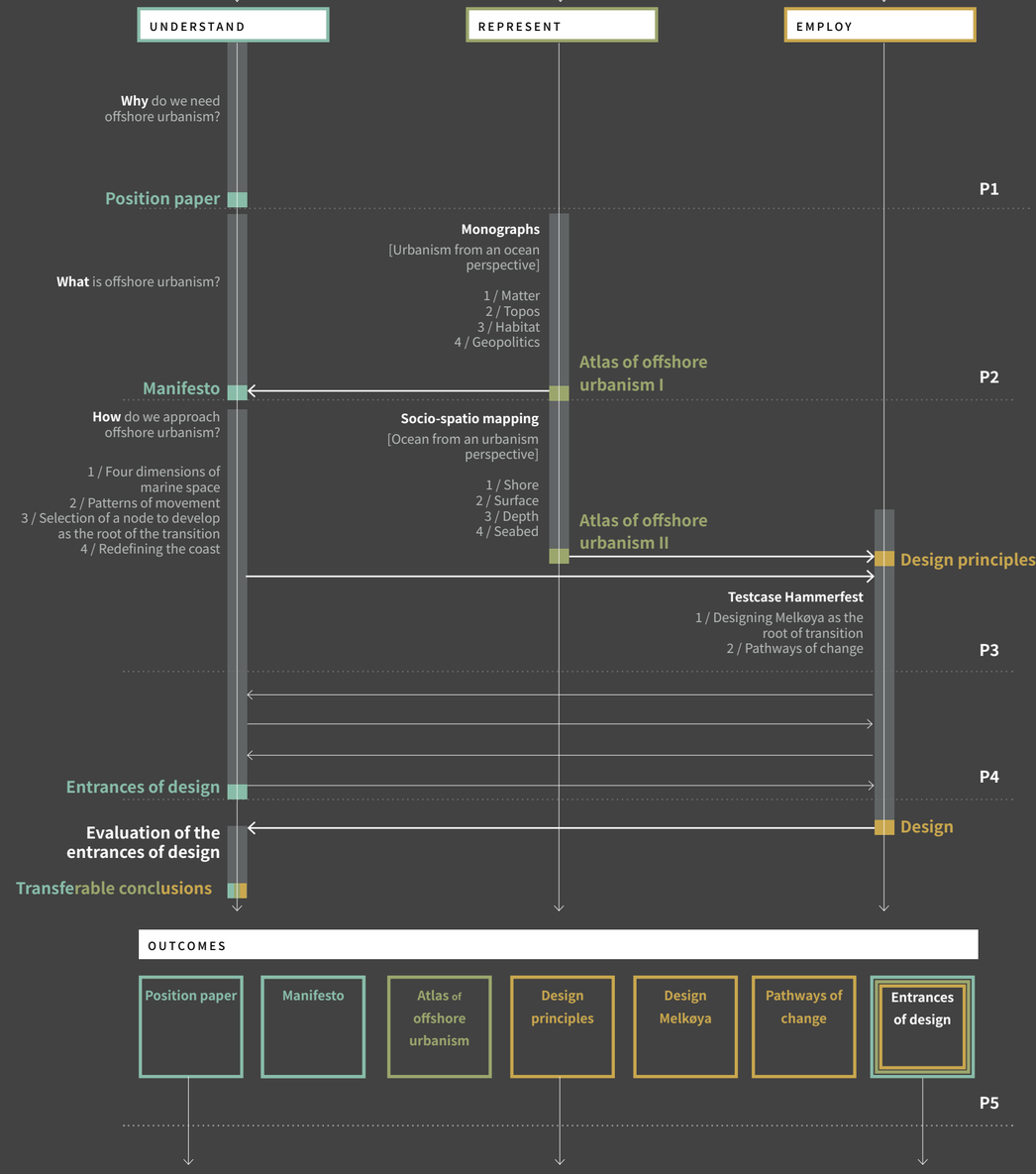
... understood as a component of urban-isation processes in Hammerfest and the Barents Sea?

... represented and visualised through the act of mapping?

... employed to propose pathways of change for the spatial reorganisation of the Barents Sea?

METHODOLOGY





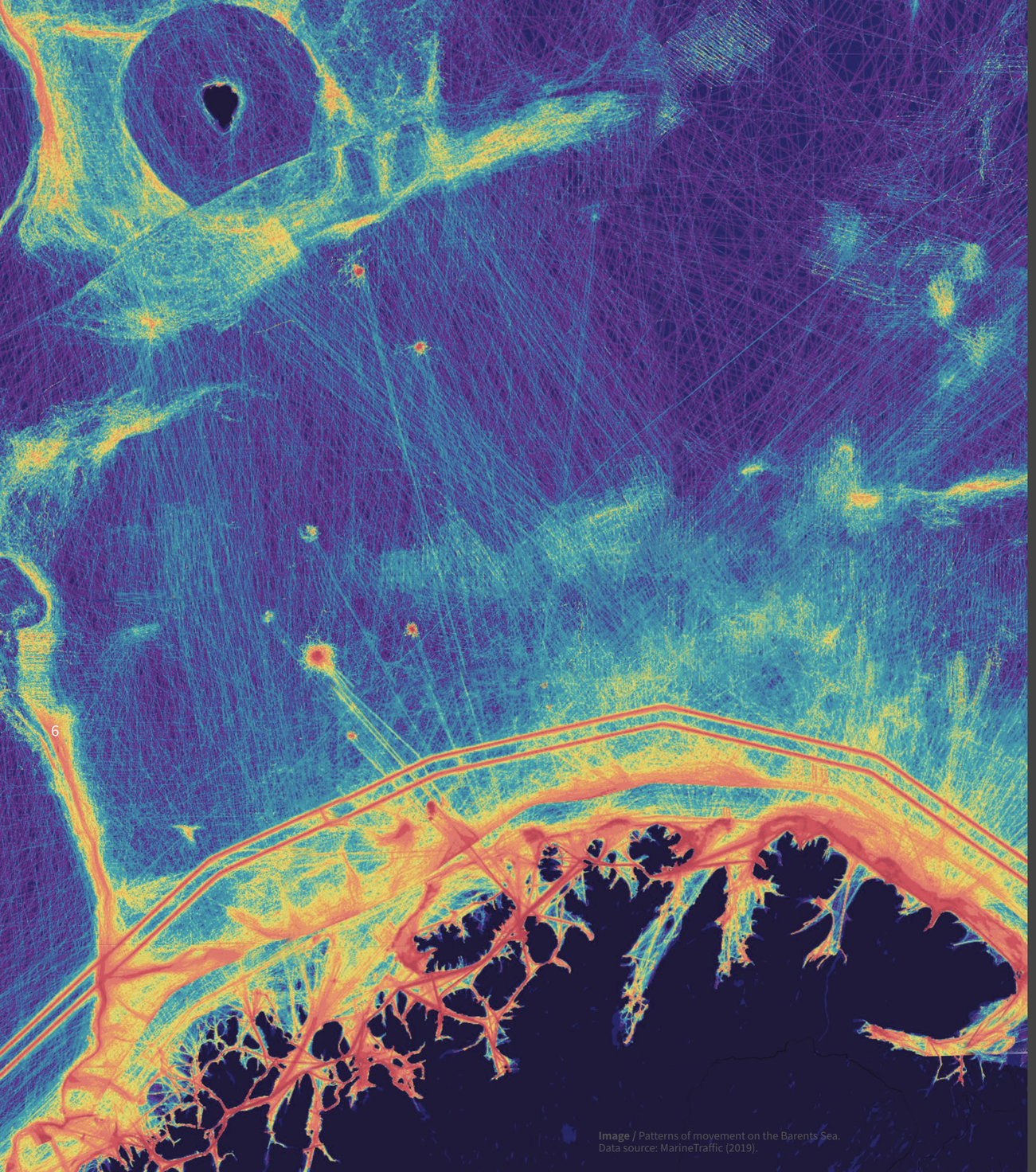


Image / Patterns of movement on the Barents Sea.
Data source: MarineTraffic (2019).

CHAPTER 4.

ENTRANCES OF DESIGN

ENTRANCES OF DESIGN

This chapter explains five entrances of design that provide a theoretical basis from which we can start to approach the offshore urban project. The entrances of design are the result of cartographic exersizes exploring i) urbanism from an ocean perspective [matter, topos, habitat, geopolitics] and ii) the ocean from an urbanism perspective [shore, surface, depth, seabed]. Please refer to the ‘Atlas of Offshore Urbanism’ in appendix C for the cartographic exersizes.

01. Four spaces of design [shore, surface, depth, seabed]

02. Patterns of movement

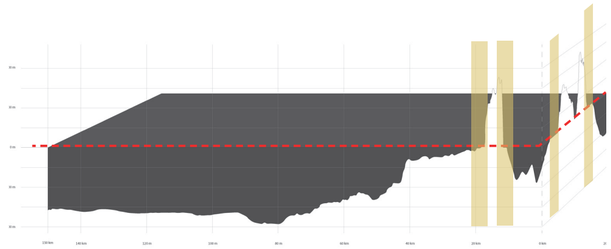
03. Redefining the coast

04. Selecting a node in the network

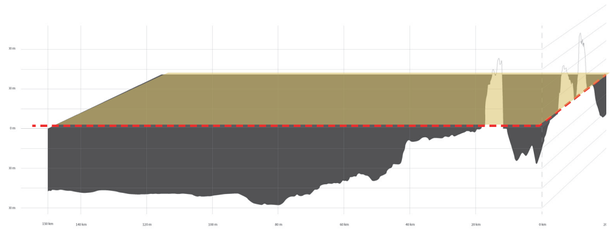
05. Design principles for offshore urbanism

FOUR SPACES OF DESIGN

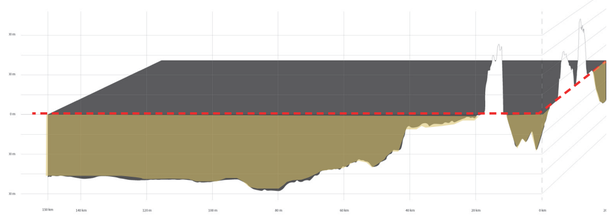
The first entrance is to approach the ocean through four marine spaces of design: Shore, Surface, Depth and Seabed. Comparable to the Dutch layers approach (De Hoog, Sijmons en Verschuuren 1998), Offshore Urbanism should distinguish these four dimensions and study it as an coherent system. “We consider this coherence between the [dimensions] as the domain of spatial planning” (78). Thus, keeping in mind that the conditions of marine space always relate to the other dimensions. For example, maritime access is determined by the depth of the water, sea routes on the surface and the lenght of the shoreline. Maritime access can be improved by dredging the seabed. In short, a condition is never determined by one space alone.



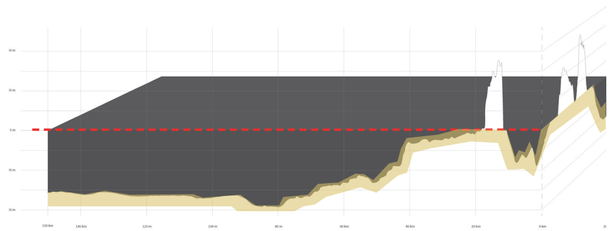
Shore



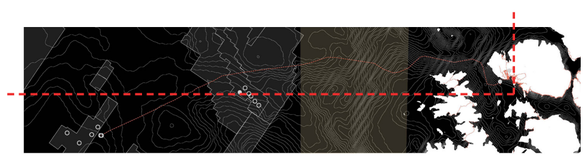
Surface



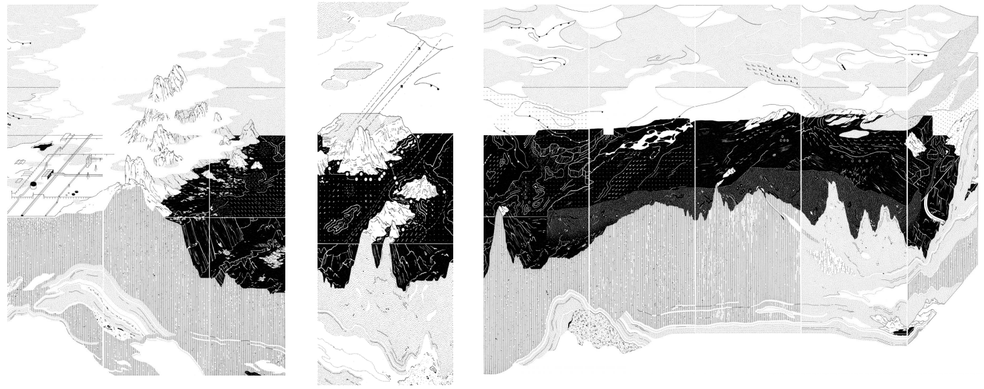
Depth



Seabed



Location sections in plan



Above / Lithosphere, Hydrosphere, Atmosphere. Source: Eva Le Roi (n.d.).

Left / The four dimensions of marine space as an entry point of the maritorial design depicted in transect.

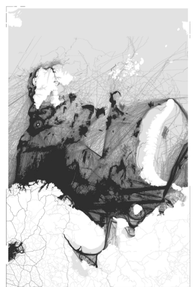
EVERY SHIP AN ISLAND

Trinakria Nesos, is a performance installation off the coast of Norway, made by Luis Callejas and Charlotte Hansson. The metaphorical island is composed of the MSTrollfjord and two search lights forming a large triangular space (perhaps even a place!) at sea. The scale of the triangle and the scale of the ship are linked to the many islands along the coast that the ship passes. As the ships grew larger and larger, the coastal communities remained small. And so, the massive ships faring along the norwegian coast became closer to the notion ‘island’ and more distant from the notion ‘boat’ .

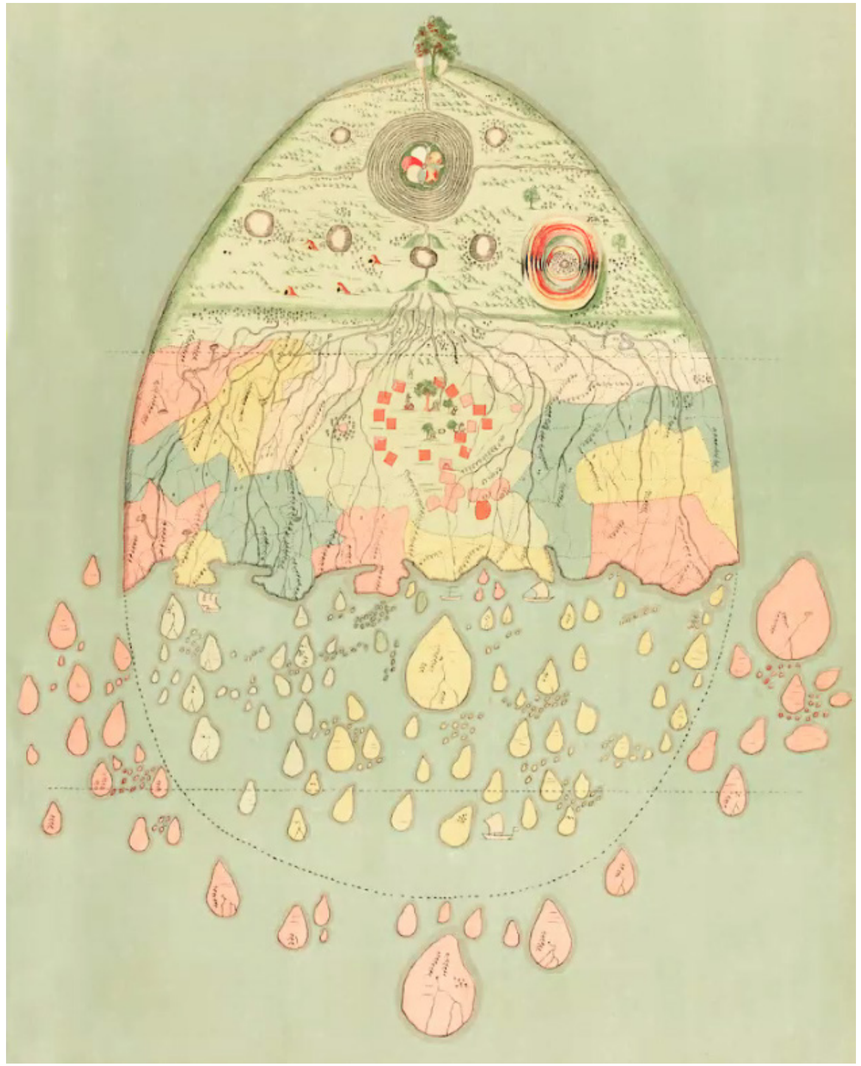
The project regards ships as being islands, moving along the coast, to and form it. As such, they become ‘place’ , rather than mere vessels crossing the ocean space. A place inhabited, occupied and built by humans. An urban node, at sea. In this line of thought, more nodes can be identified:

1. Natural islands (Håja)
2. Man-made islands (Melkøya)
3. Platforms (Goliat)
4. Ships
5. Plastic islands

Thus, offshore urbanism should take a network approach to the ocean as a field of movement. The nodes in the network (ships, islands, platforms) can be seen as nodes of urbanisation that spread the urban territory seaward.

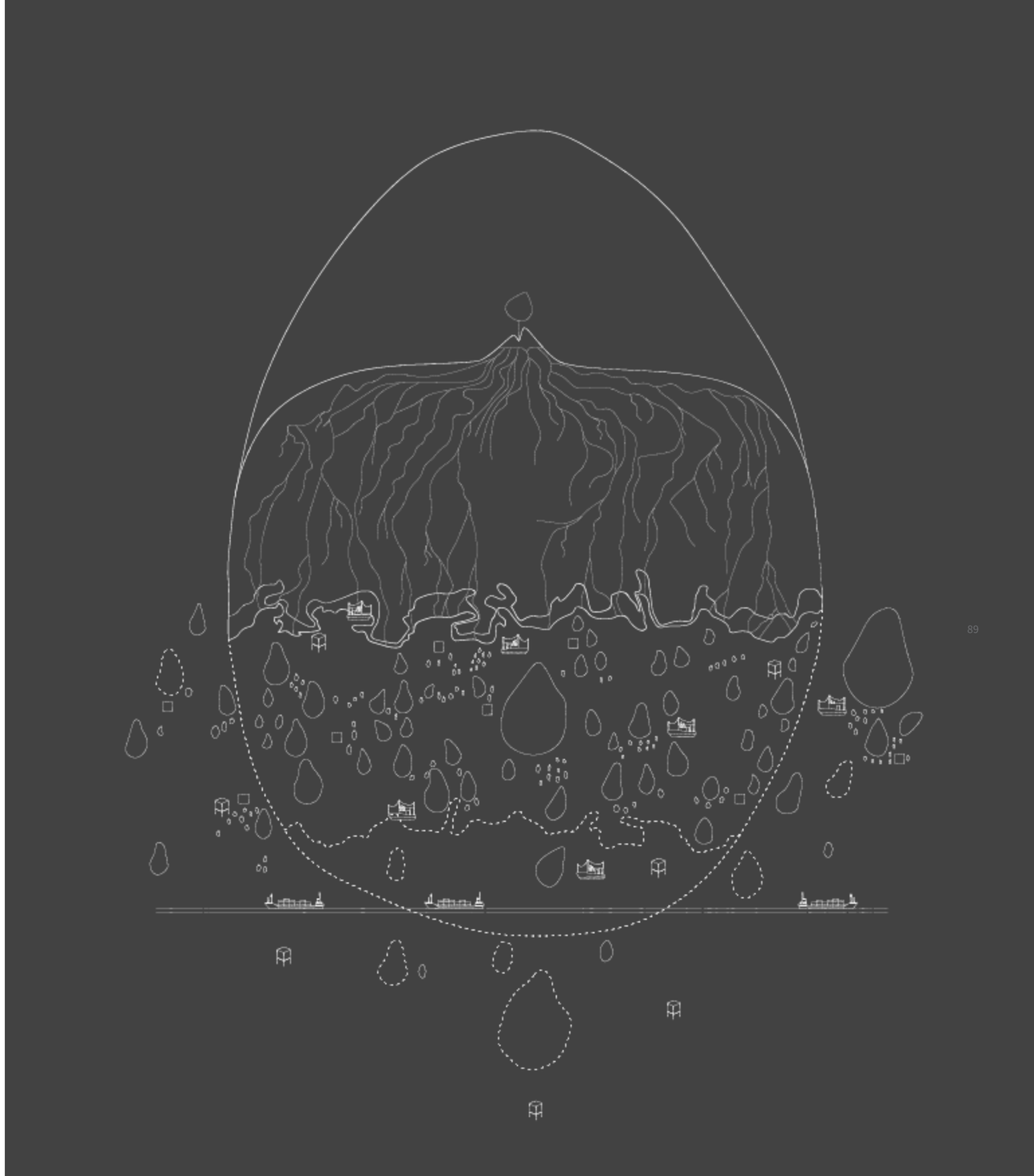


Right / Trinakria Nesos, The Triangular Island. A performance installation off the coast of Norway. Creating a metaphorical island out of a ship and two searching lights at sea. Source: Callejas, Hansson, Kampevold Larsen, and Wiebe (2018).



Above / A Burma Map of the World. Representing the sea as a composition of islands that originate from and relate to the land. Source: unknown.

Right / Adapted version of 'A Burma Map of the World' to my understanding of the Hammerfest Maritory as a composition of urban nodes that originate from and relate to the land.



PATTERNS OF MOVEMENT

By analysing the patterns of movement of these urban nodes at sea, we can read the current organisation of marine uses and their spatial relation to Hammerfest. Global ship tracking data on marine traffic density (MarineTraffic, 2019) can be used to visualise the patterns of movment on the Barents Sea. The map on the right shows the traffic density measured in routes per 0.61km² in the year 2019. In other words, every line represents the course of a single ship. Warm colours (reds), represent a higher density of courses than cold colours (blues). In the Barents Sea, the following patterns can be identified.

1 / Fishing
Cloud pattern: vessels follow the shoals as they move. Conditions: prawning or feeding grounds, season, water temperature, presence of fish, fishing permit, market demand.

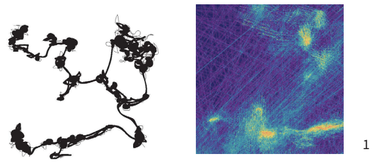
2 / Petroleum industry
Satelite pattern: commute between fixed nodes of urbanisation offshore, such as oil rigs, and a central harbour at shore. Conditions: presence of oil or gas, accessibility of the field (depth field in ocean floor, depth of the ocean itself, distance from shore), extraction permit, market demand, infrastructure.

3 / International transport
Distinct double line: international trading route for cargo ships following agreed upon coordinates. Similar to a highway. Conditions: coordinates, buoys, geopolitical gravitation and position international harbours, safety vulnerable coastal ecosystems, maritime access (depth water and navigateability), economic route (shortest possible).

4 / Legislative border
Edge offset from shore: showing high density traffic along the seaward side and low density traffic along the landward side from a set distance from shore. Could signify the location of administrative borders limiting marine traffic within territorial waters without permission.
Conditions: Maritime access policy, type vessel, nationality vessel, morphology shore, proximity shore.

5 / Local traffic
Harbour to harbour network: vessels taking the shortest possible route from one harbour to another within territorial water. Resulting in a dense network of almost straight lines in between islands and w-shaped patterns along shores. Conditions: economic route (shortest possible), maritime access (depth and navigateability), land access of the harbour.

6 / Continental slope
Cloud-like patern along an edge: at the west edge of the Barents Sea signifying fishing activity. The intermediate Arctic waters of the continental slope provide spawning grounds for fish such as Deep-sea Redfish, Haddock and Greenland Halibut. Conditions: Bathymetry, marine landscape, prawning or feeding grounds, season, water temperature, presence of fish, fishing permit, market demand.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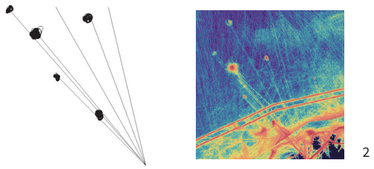
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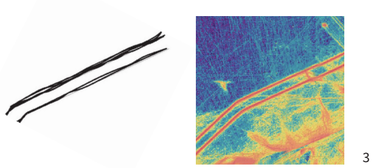
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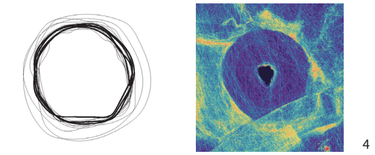
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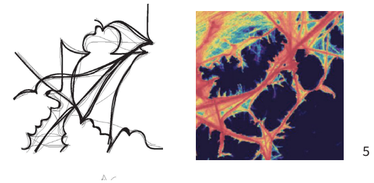
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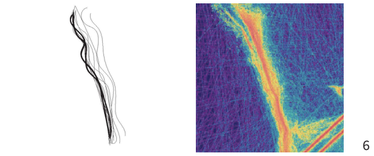
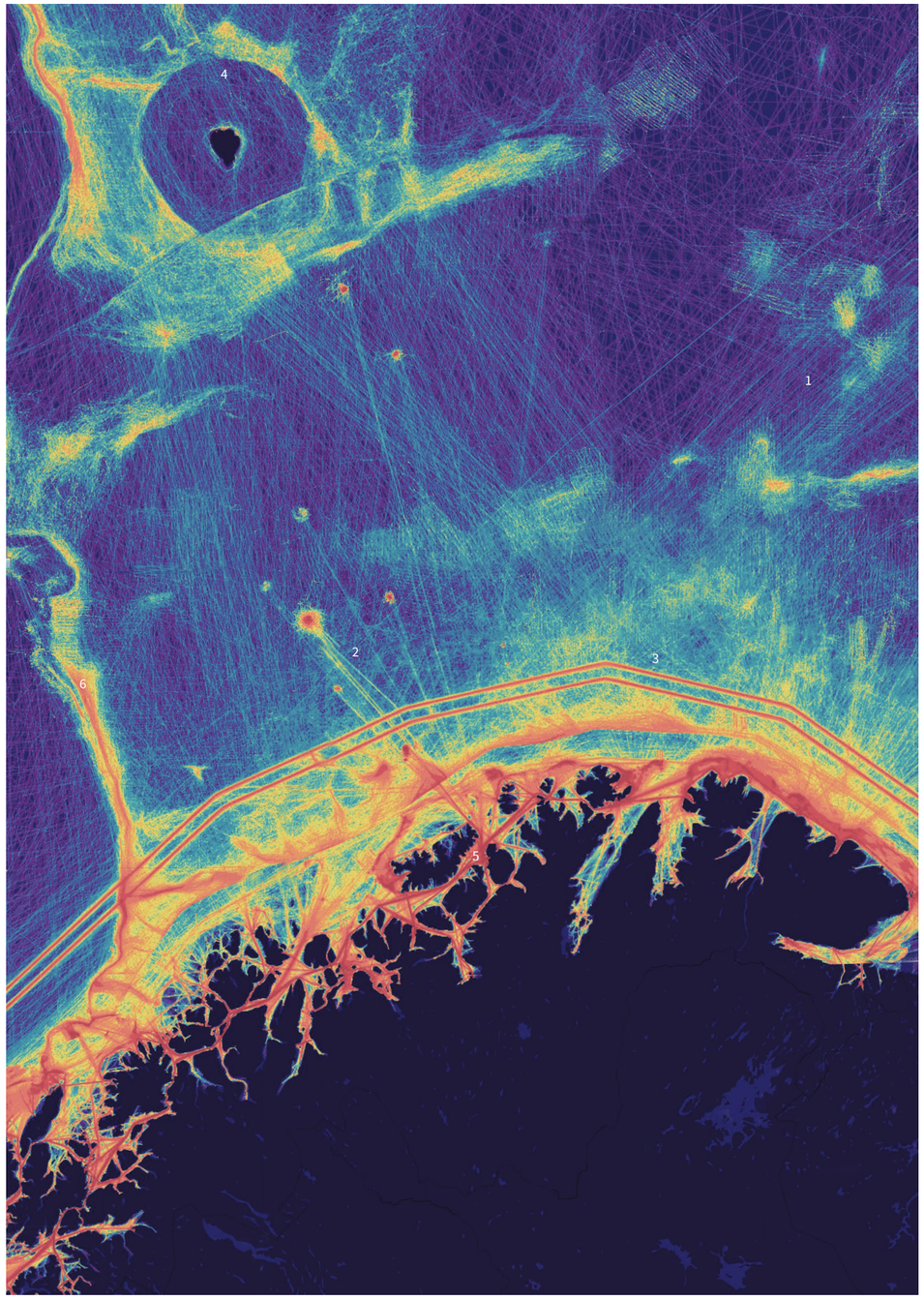

6

Patterns of movement
Source data: MarineTraffic (2019).

719 - 285k routes / year
35 - 114 routes / year
23 - 35 routes / year
1 - 23 routes / year

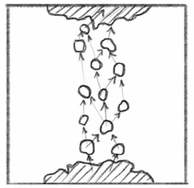
N
0 50 km

Finnmark Scale

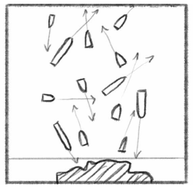


PATTERNS OF MOVEMENT

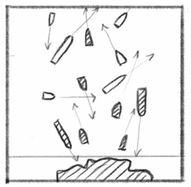
From the patterns of movement we can derive the network composition of the Hammerfest maritory. The understanding of the network forms a key point of entrance for design.



Territorial expansion on land.

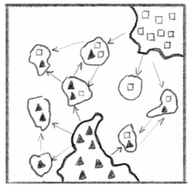


Every ship is an island that could expand the maritory seaward.



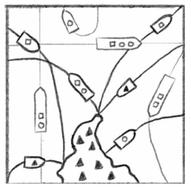
Yet, not all ships that come and go from Hammerfest expand the territory ...

... only those with a reccurent spatial relation to Hammerfest.



Cross-contamination between two populations on land.

No cross-contamination between populations offshore.



Each ship has its own composite community.

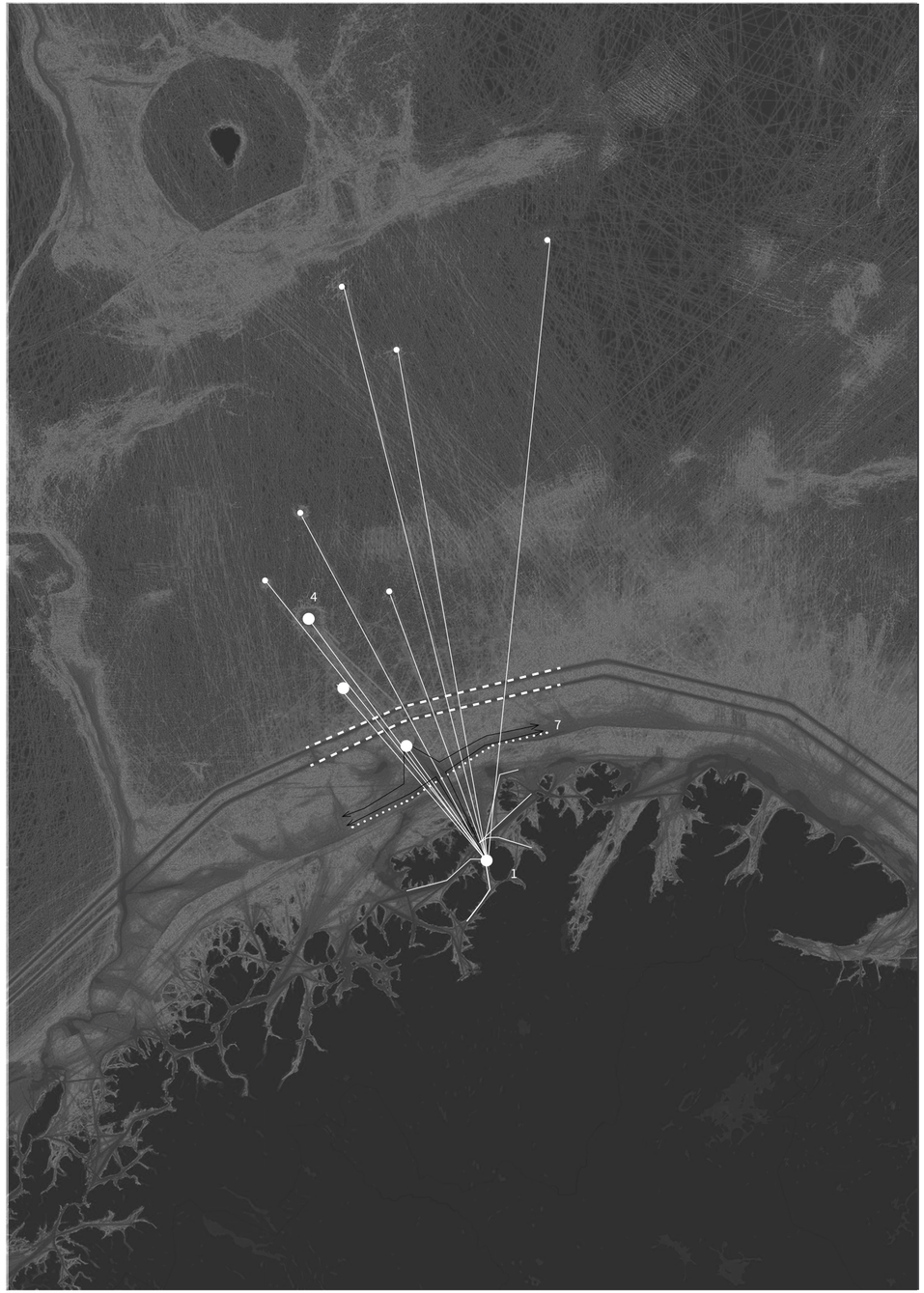
ENTRANCES OF DESIGN

Deriving the network composition

1 / Hammerfest town
2 / Goliat floating oil storage, production and offloading facility (FSPO)
3 / Snøhvit submarine gas extraction facility
4 / Johan Castberg (oil) FSPO under construction until 2023
5 / Exploration wellbore
6 / Northern Sea Passage, international traffic between the global East and West
7 / Concentration of fishing activity along the continental slope, submarine edge between the shallow strandflat and the continental shelf
8 / Border territorial water, falling under local legislation
9 / Local harbour-to-harbour marine traffic
10 / Assumed export course crude oil, from Goliat to market
11 / Assumed export course LNG from Melkøya to market

0 50 km N

Finnmark scale



DEFINING THE EXTENT OF THE MARITORY

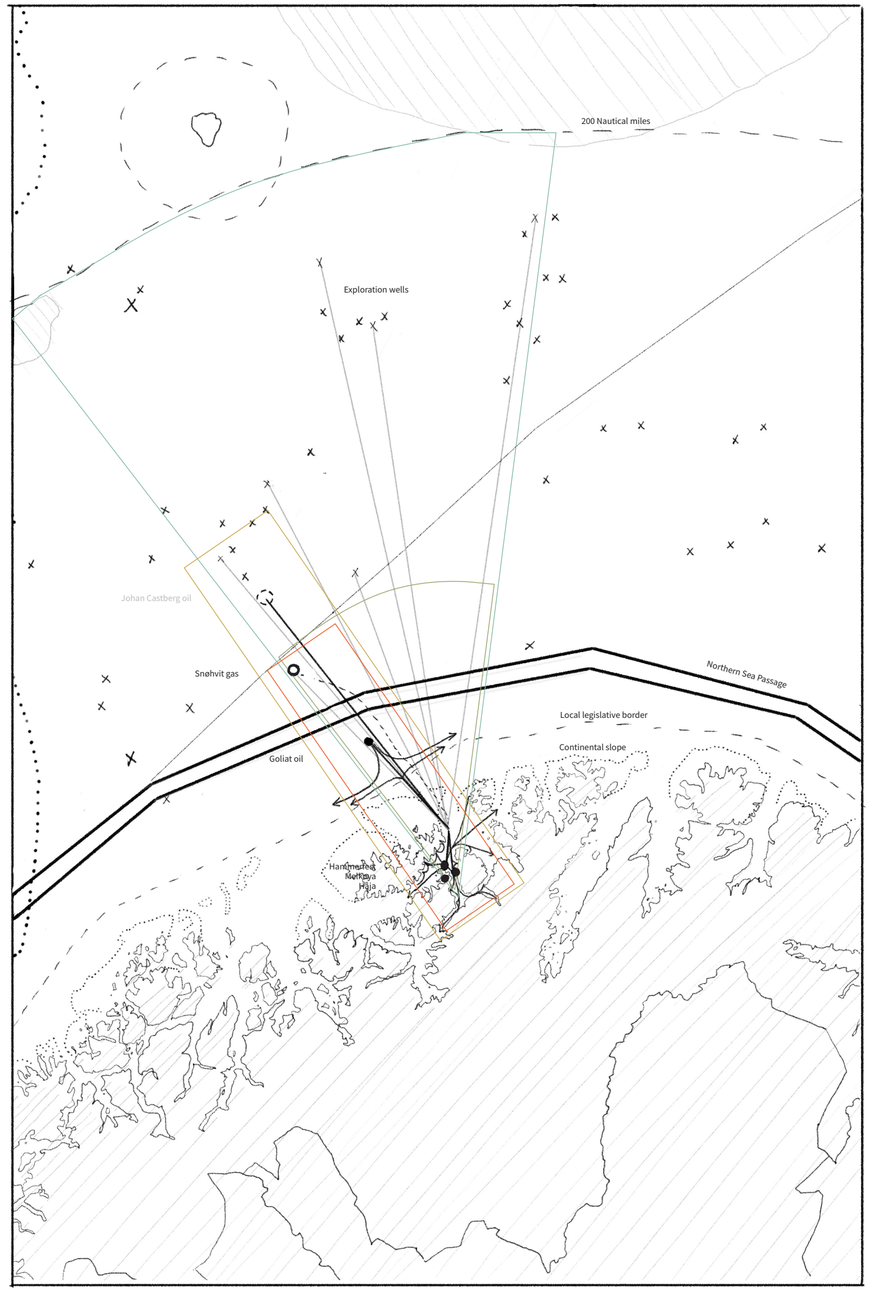
Considering that every ship is an island that expands the maritory as they move across the shore and the patterns of movement represent the extent of this movement, we can use the patterns of movement to define the extent of the maritory.

In the map, the green cone roughly outlines the network of movement related to Hammerfest as shown on the previous page. For a spatial analysis of the maritory in transect, a cone is not ideal. Therefore, a rectangular shape (red) is selected as basis for the maritorial scale.

Other possible factors to determine the extent of the maritory:

- As far as the Exclusive Economical Zone (blue cone). Although an analysis on this scale might provide interesting contextual information, it is too large to provide information valuable to the local scale.

- As far as the furthest fixed extraction facility (yellow rectangle). The furthest extraction facility is Johan Castberg, a floating oil production and offloading platform currently under construction 100 kilometres north of Snøhvit Johan Castberg is expected to start production by 2023. Goods and people are transported via helicopter. Although this outline does contain all petroleum acitivies related to Hammerfest, it is still too large for network analysis that is meaningful on the local scale.



The extent of the Hammerfest maritory

Top / Enlarged cutout of the Hammerfest maritory.
Right / Defining the extent of the Hammerfest maritory.

- Cone: maximum within EEZ
- Cone: corresponding to local patterns of movement
- Transect: as far as the furthest fixed extraction facility
- Transect: corresponding to local patterns of movement

0 | 50 km | N

Finnmark scale

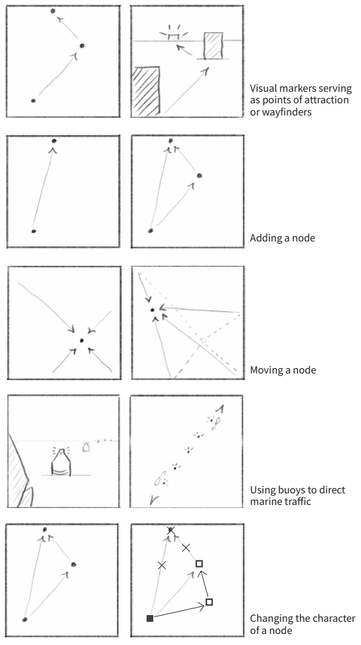
From the patterns of movement we can derive the current network in the Hammerfest maritory. The network is depicted in both plan and transect on the right page.

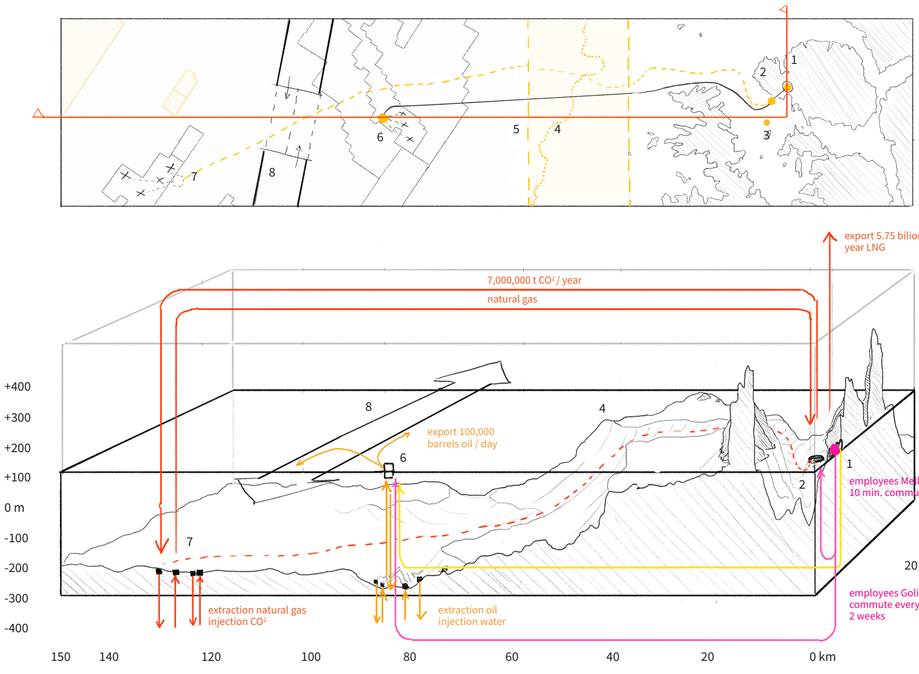
The nodes
1. Hammerfest town
2. Melkøya
3. Håja
4. Continental slope
5. Boundary internal waters
6. FPSO Goliat
7. Snøhvit and pipeline
8. Northern Sea Route

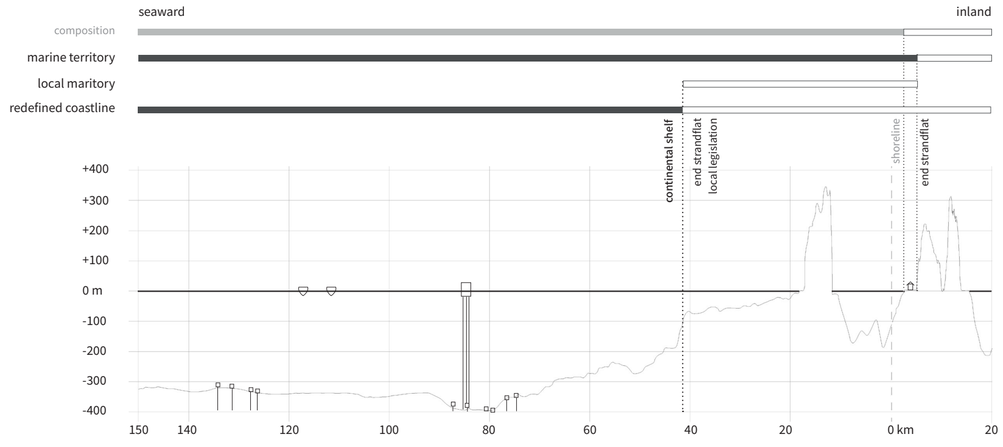
Redefining the coast
The coast must be approached as a zone that is composed of both land and water. The coastline, as border between inland and seaward, is not necessarily positioned at the shoreline (the border between land and water). In the case of Hammerfest, one could position the coastline at the continental slope, about 40 kilometres from shore. Its position is defined by i) the bathymetric edge between the shallow strandflat and the deep continental shelf, ii) the fine grained morphology of islands, fjords and archipelago' s inland and the rigid morphology of extraction plots seawards, and iii) the legislative boundary of territorial water. Thus, the border between what is considered 'local' and 'non-local' shifts seaward.

The redefinition of the coast is important, because it introduces the maritory as a local project. Especially in light of the prospected urbanisation of the ocean and the socio-cultural impact this will have on coastal communities, a localised approach to offshore urbanism is imperative.

Select a node in the current network
The current network composition can be changed in different ways. For example, by adding or moving a node in the network. The most efficient way might be to select and change an existing node in the network. By focussing the design on one node, we are forced to turn back to the local scale, the physicality of the network and the people interacting with it. In this thesis I select the island Melkøya.







Redefining the coast

Above / offshore urbanism principle demonstrating different strategies to change the patterns of movement at sea.
Right / current network composition of the Hammerfest Maritory. Source data: Google Earth (2021).

Oil
Gas
Electricity
Human

0 20 km N

Maritory scale

SURFACE

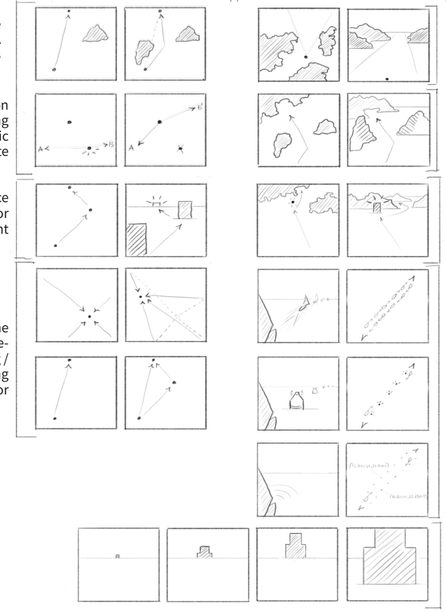
move | perceive

economic route from anchor A to anchor B

strategic position anchor along most economic route

anchor at surface as guide for movement

manipulating the patterns of movement by adding / (re)moving anchor



coulissen

gate

seamark

wayfinding or visibility infrastructure

'ontsluiting' approaching an anchor at sea

SHORE

move | perceive

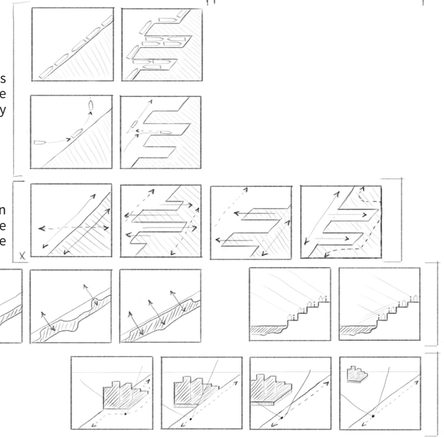
maritime access and shorline morphology

interaction across the shoreline

public access to shore

public visual access to water from shore

position marine industry in relation to shore and visibility

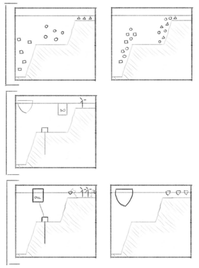


DEPTH

depth and species population

depth and human occupation

depth scale occupation



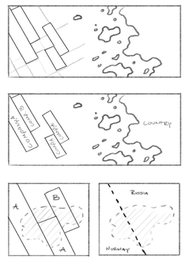
SEABED

resources | biodiversity

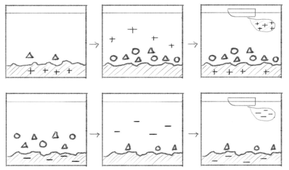
scale and rigidity borders inland and seaward

scales of ownership inland and seawards

discrepancy borders of claim and claimed (resources)



quality seabed, biodiversity and catch



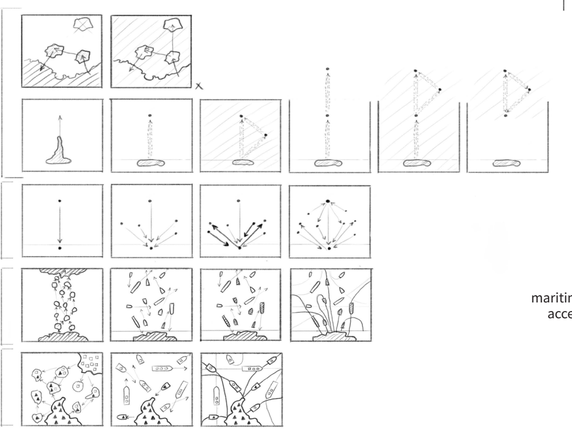
SURFACE+ SHORE

urban growth along infrastructure

dependency

territorial expansion

human population

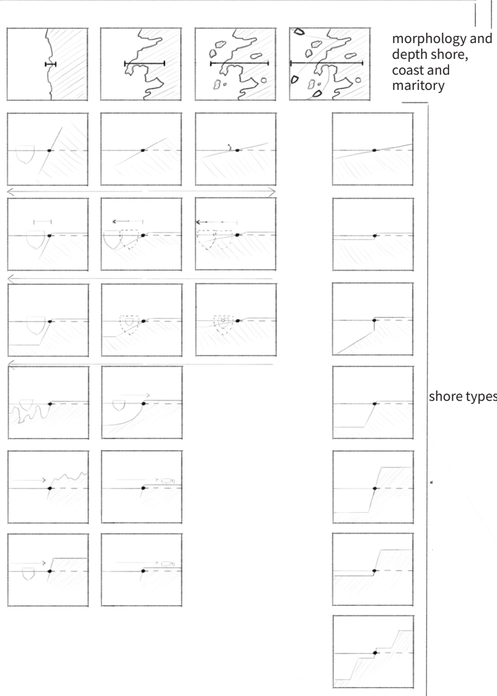


SHORE + DEPTH

maritime access

morphology and depth shore, coast and maritory

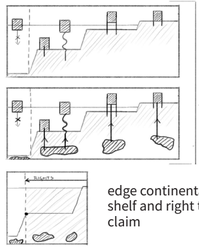
shore types



DEPTH + SEABED

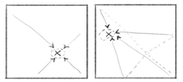
depth and access to seabed and its resources

edge continental shelf and right to claim



SEABED + SURFACE

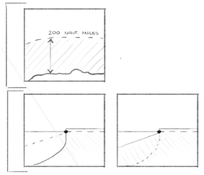
pressence of resources in seabed as anchor for movement on surface



SHORE + DEPTH + SEABED

seaward depth and right to resources

dredging and filling



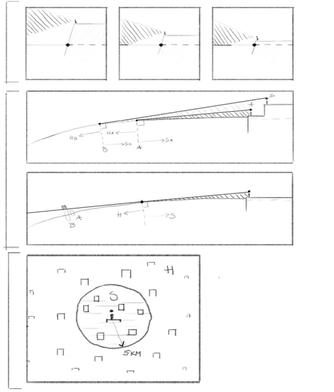
SURFACE + SHORE + DEPTH

height viewer and orientation towards ocean surface or horizon from shore

height viewer andvisible surface and horizon from shore

height object and its visibility from shore

the surface and the horizon



CHAPTER 5.
DESIGNING MELKØYA

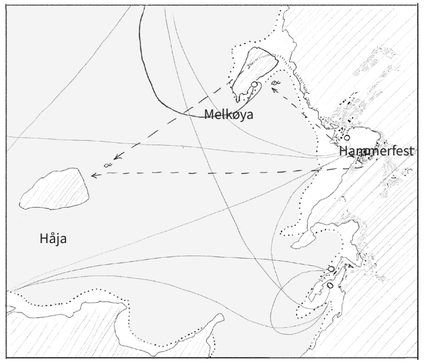
SELECTING MELKØYA

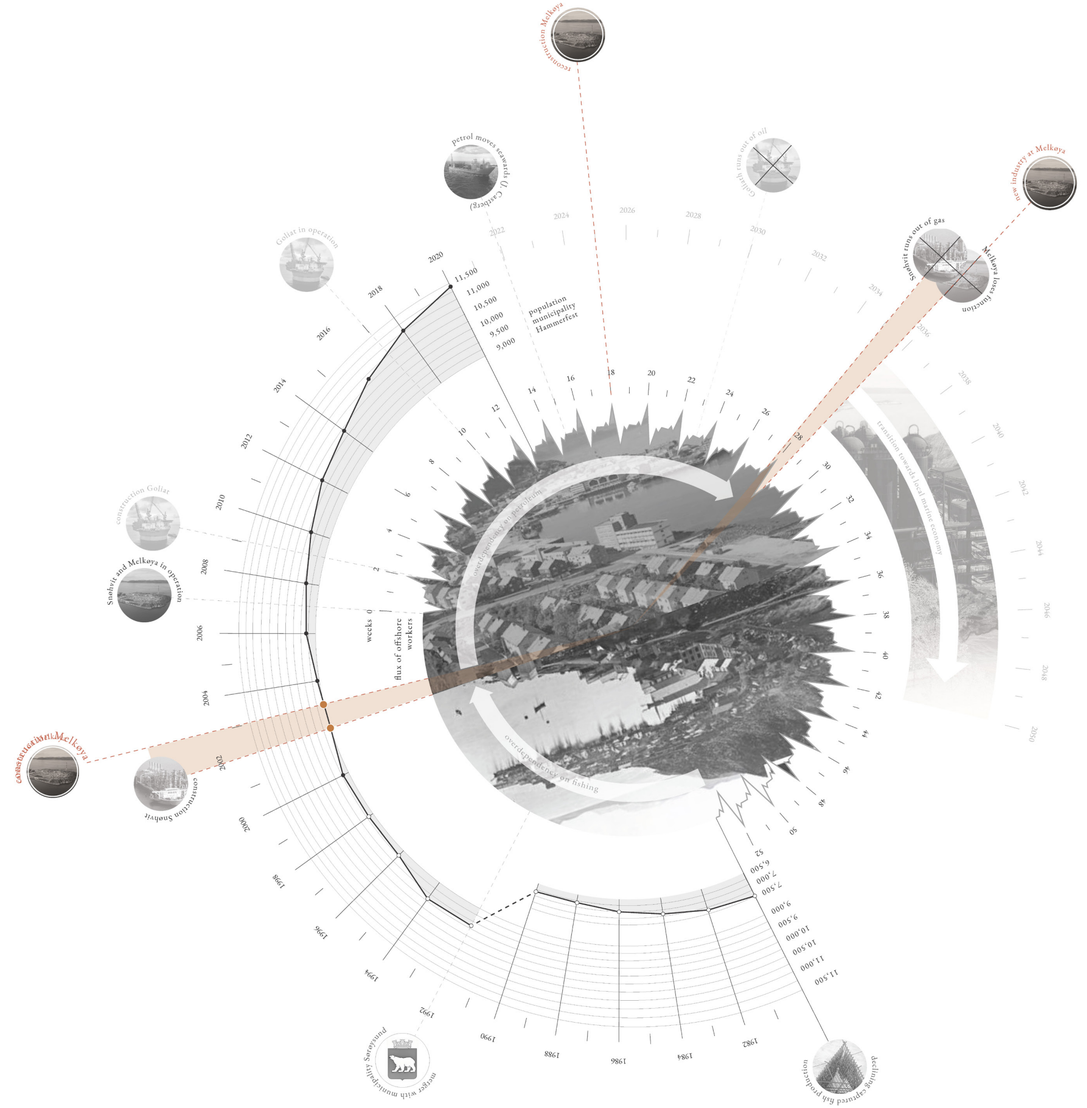
Melkøya is redeveloped as the first step of a transition towards localised marine economy. It is designed to provide access and opportunity for local pioneers in the marine sector, such as community-led mariculture, habitat restoration and mussel farming. In doing so, Hammerfest' s new economy of life will depend on a variety of marine industries and less on petroleum, thus becoming more resilient to prospected changes in the petrol industry.

The heavy perceived dependency on petroleum in Hammerfest stems from the collective memory of a period of severe degrowth. The arrival of petroleum is remembered as a blessing that finally revived the town in 2002, bringing jobs and prospects for a future. This turning point in local history was visibly manifested in the reconstruction of the island Melkøya as gas processing plant. By selecting Melkøya to redevelop as the root of the transition, the island again marks a turning point in time. As such, the design aims to use collective memory to induce acceptance.

Moreover, Melkøya' s close proximity to Hammerfest makes it easy to reach by car or boat and visible from town. Although the island is currently only privately accessible, it has the potential to become a public extension of Hammerfest. The travel distance is less than 10 minutes and thus suitable for public use. The accessibility and visibility of the island strengthens local sense of ownership and transparency of the transition.

When Snøhvit is runs out of production in 2035, Melkøya loses its current function. This provides an ideal opportunity to substitute the petroleum industry with a more localised, durable marine industry. I propose to start redevelopment before the Snøhvit gas field is depleted, to enable a smooth evolution to the new marine economy once petrol departs Melkøya. This strategy mitigates the impact of petroleum 's departure, while gradually introducing a new economy of life to the community.

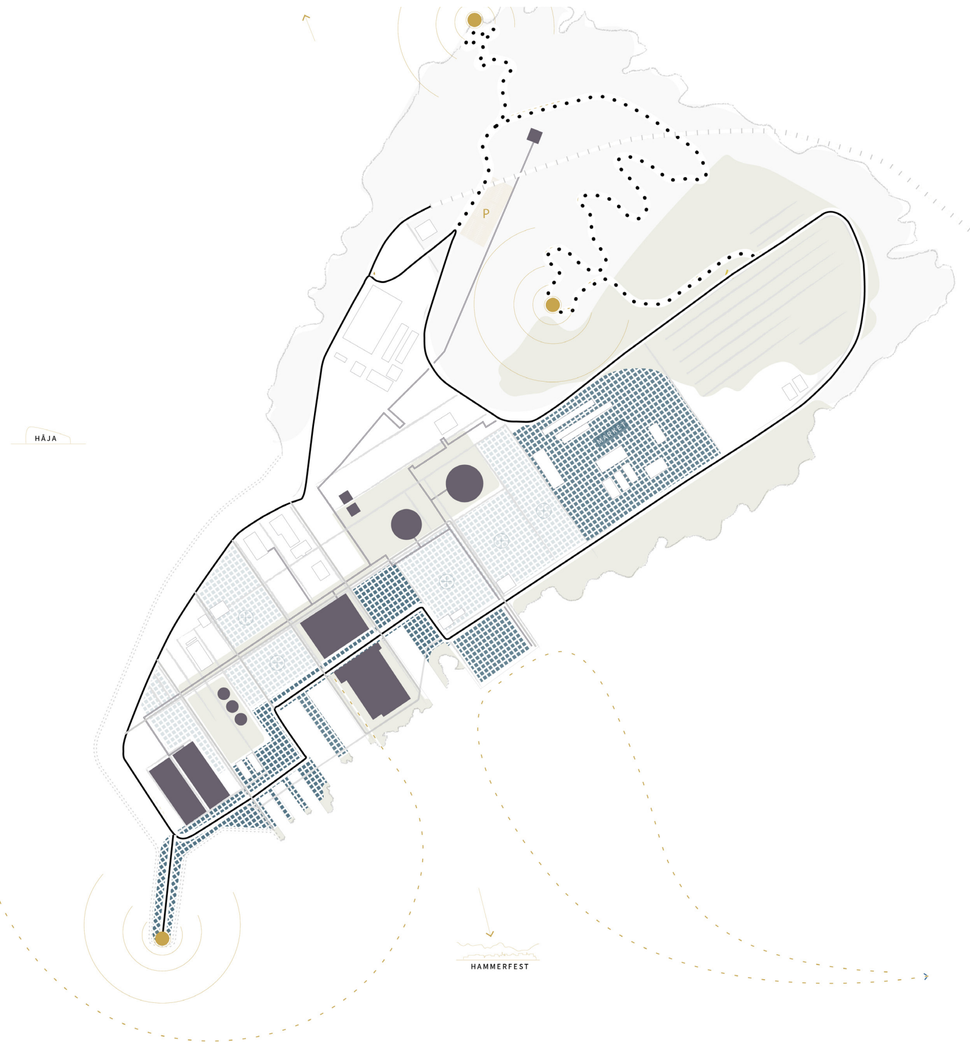




Using collective memory to induce acceptance

Above / Situation Melkøya
Right / Melkøya as a trigger in the timeline

Source data: Statistics Norway (2013, 2020); Loe & Kelman (2016).
Photos by: Axel Lindahl (1889); Oskar Puschmann (2004).



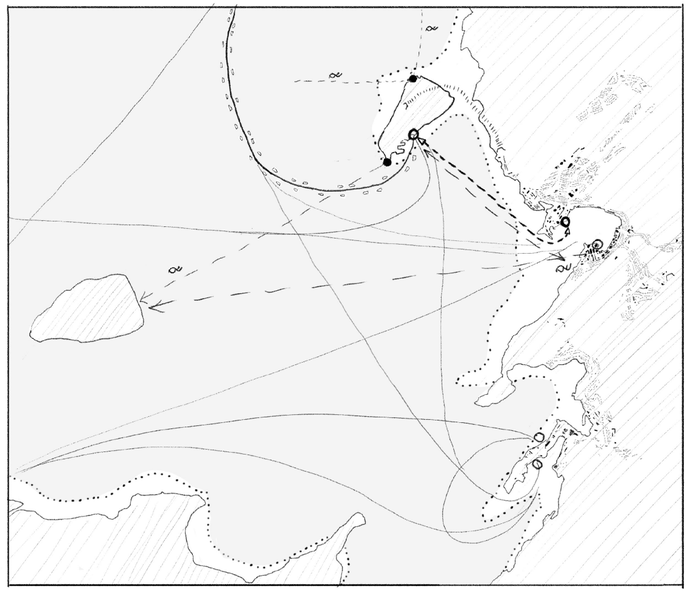
Left / Current situation Melkøya.
Source: Bing Maps (2021). Edited by author.

Right / Proposed redevelopment

N

0 250 m

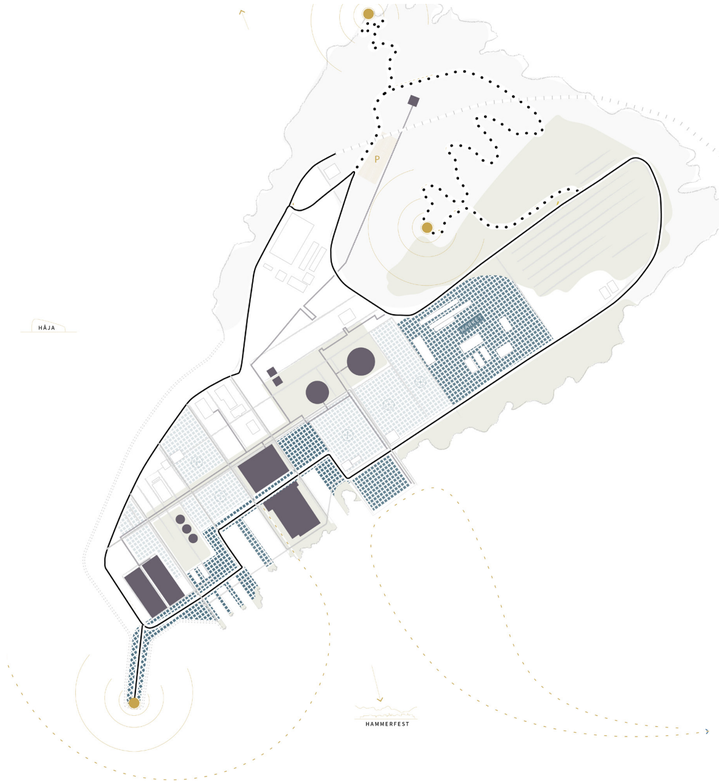
Melkøya scale



New situation / Melkøya is made publicly accessible by car (via the tunnel) or by boat from Hammerfest and other neighbouring towns. A water taxi connection is established between Hammerfest and Melkøya. Marine traffic increases from Melkøya' s harbour seaward.

0 | 1 km | N

Hammerfest scale



Proposed redevelopment / The design aims to provide access and opportunity for public use and the establishment of local businesses pioneering in marine industry. In redevelopment, removal is preferred to the addition of elements. Repurposing and rehabilitation is preferred to deconstruction.

0 | 150 km | N

Melkøya scale

Point of departure

Structure

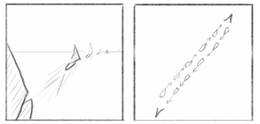
Shoreline

Abandoned industry

Renaturalisation

New industry

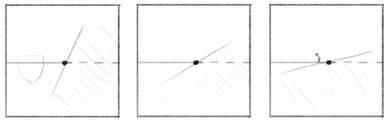
Routing



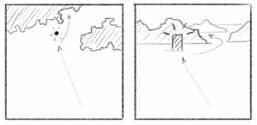
Public access / Allow public use of existing car tunnel, public mooring and water taxi connection to Hammerfest. The island is the main point of arrival and departure in the maritorial network.

Follow existing structure / Develop Melkøya following the existing structure, so that redevelopment can start while gas operation is still in operation.

Maintain natural form / Increase capacity at the existing harbour by removing rather than adding land to maintain the natural form of the island and its relation to Hâja.

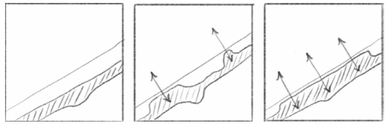


Access shore / Use existing slope variety along the shore to provide for ship access or human acces



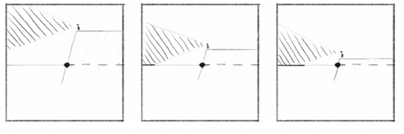
Repurpose, remove, abandon / When gas industry leaves, repurpose buildings where possible and remove unnecessary concretion to make space for the new industry. Where possi maintain distinct structures as post-industrial landscape features and point of recognition.

Renaturalise / Renaturalise shore using dredged rock where possible. Reintroduce local species on the southern hillside. Use phytoremediation plants to decontaminate the most contaminated areas.



Approacheability shore / establish public space at the shore.

Substitute gas / with a new, local marine industry.



Viewpoints / Use existing elevation to make a variety of viewpoints each with a different visual relation to the water surface and horizon.

Layers

01. Structure and shoreline
02. Abandoned industry
03. Renaturalisation
04. New industry
05. Routing
06. Viewpoints

STRUCTURE AND SHORELINE

Layers

To increase harbour capacity at the shoreline, land is removed at the south side of the island to create ports. The removal of land is prefered to adding land as to maintain the natural form of the island and its morphological relation to Håja.

The ports are positioned along the lines of current structure. In doing so, the paths on the island lead pedestrians unobstructed to the end of the piers.

The ports are positioned where there are no gas facilities that have to be removed, so that processing can remain operative throughout the first phases.

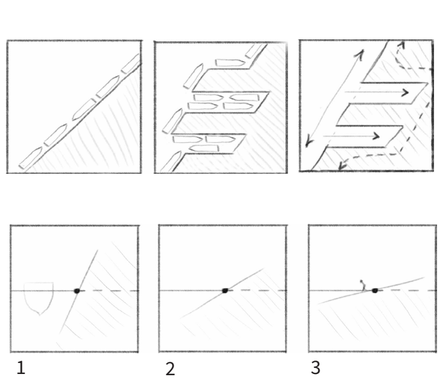
Dredged rock from the digging sites is reused to renaturalise the shoreline where possible, thus bringing back the original character of the island.

I use the existing slope variety along the shore to provide maritime access for ships or people. The typologies are numbered in the map.

1/ Steep quays that allow the mooring of ships.

2/ Wavebreaker consiting of coarse cobblestones allows neither human nor maritime access.

3/ Natural or renaturalised rock formations allow people to approach the water and wade in.



Altering the shoreline

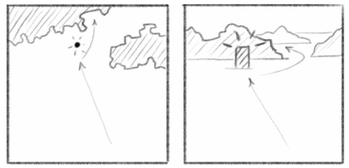
Dredging to -25m depth
Reuse dredged rock for renaturalisation
Maintain offloading platform
Alignment with existing structure

0 150 m N

Melkøya scale

ABANDONED INDUSTRY
Layers

When gas industry leaves, existing buildings are reused by the pioneering marine industries where possible. Some striking gas processing facilities such as the storage tanks (1), the pipelines (2), the processing facility (3) and the chimney (4) remain intact. They serve as point of recognition and landscape elements as a reminder of the old gas industry. Leaving the structures intact instead of deconstructing them is also beneficial financially.



1

2

3

4

Maintain gas structures

- Abandoned gas structure
- Pipeline
- Abandoned building
- Empty lot

N

0 — 150 m

Melkøya scale

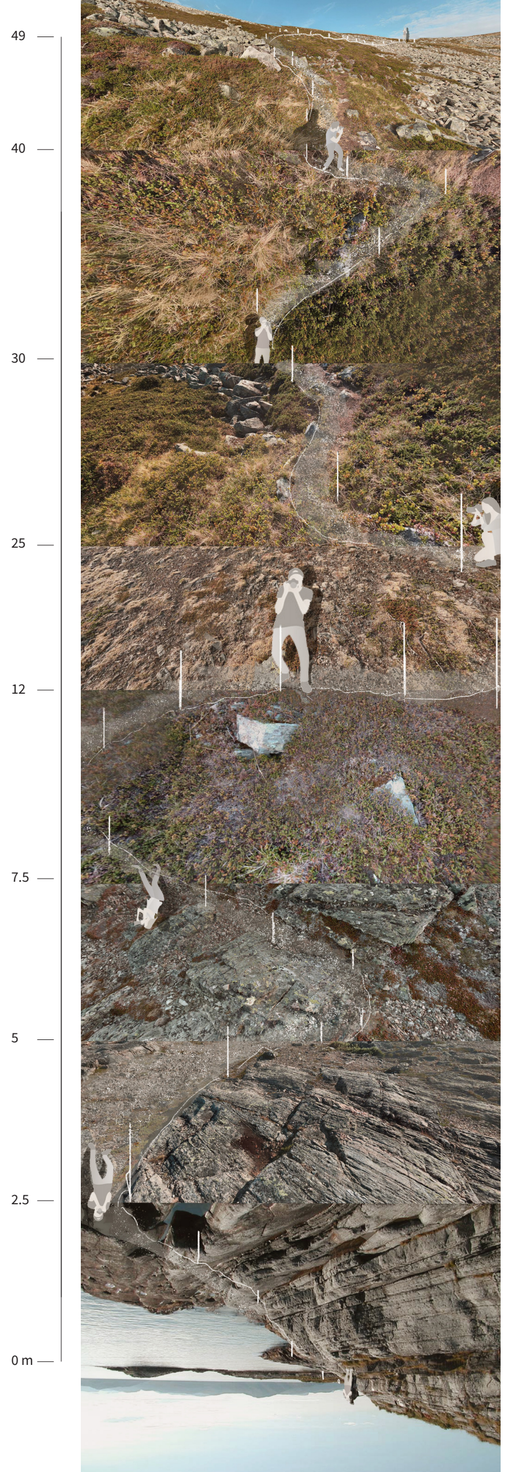
RENATURALISATION
Layers

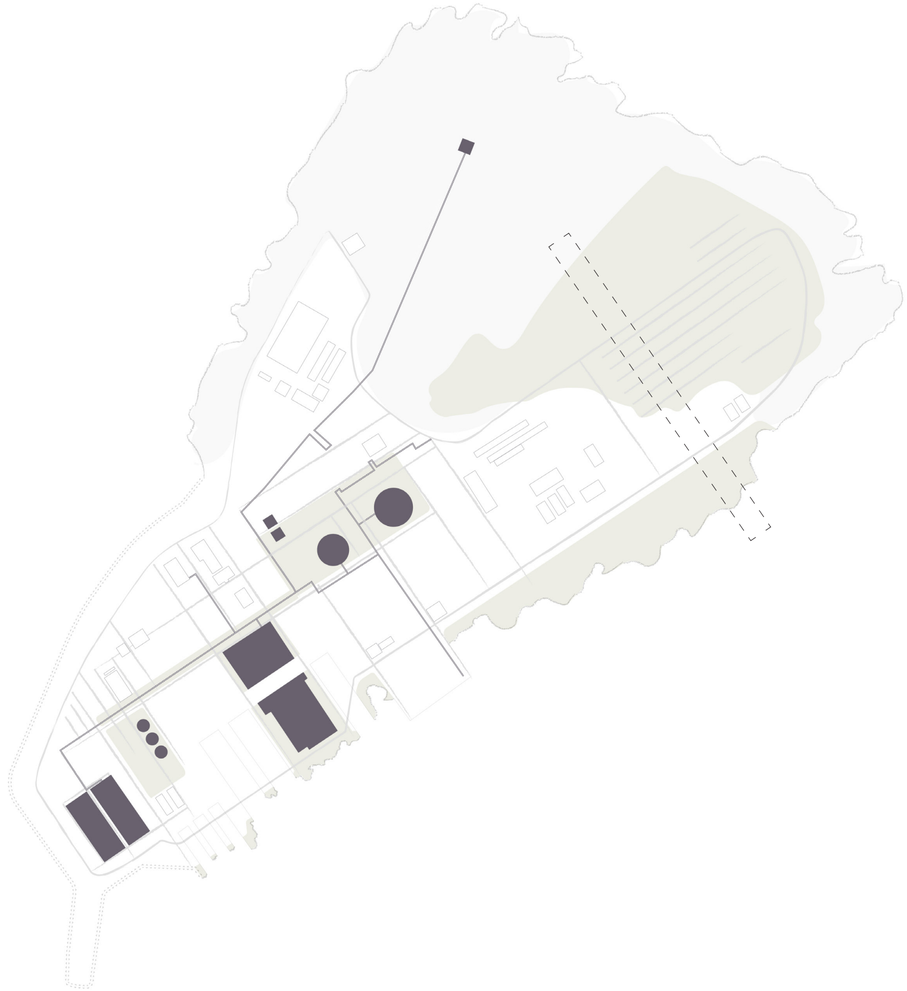
The plots that contain abandoned gas facilities are renaturalised and vegetated with phytoremediating plant species. Plots that are severely contaminated and plots that will host food market or processing functions will be decontaminated artificially.

The shoreline is renaturalised with dreged rock from site, restoring the natural character of the island.

Along the post-industrial pipelines a green corridor is developed.

The buildings on the southern hillside are removed. Their foundations can remain as landscape elements. The hillside is renaturalised by reintroducing native plant species, creating a gradient from shore to the top of the hill.





Renaturalisation

Collage / Source images: Google Earth (2021).

- Abandoned gas structure
- Pipeline
- Abandoned building
- Renaturalisation

0 150 m

N

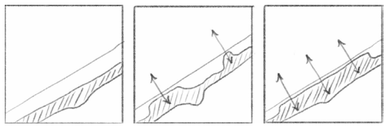
Melkøya scale

NEW INDUSTRY
Layers

The departure of gas industry in 2035 provides an opportunity for a new, durable marine industry to settle on Melkøya. Local pioneers in the marine sector, such as community-led mariculture, habitat restoration and mussel farming can find a place here. Produce from the offshore production fields can be processed and sold in shops, restaurants or on the market place.

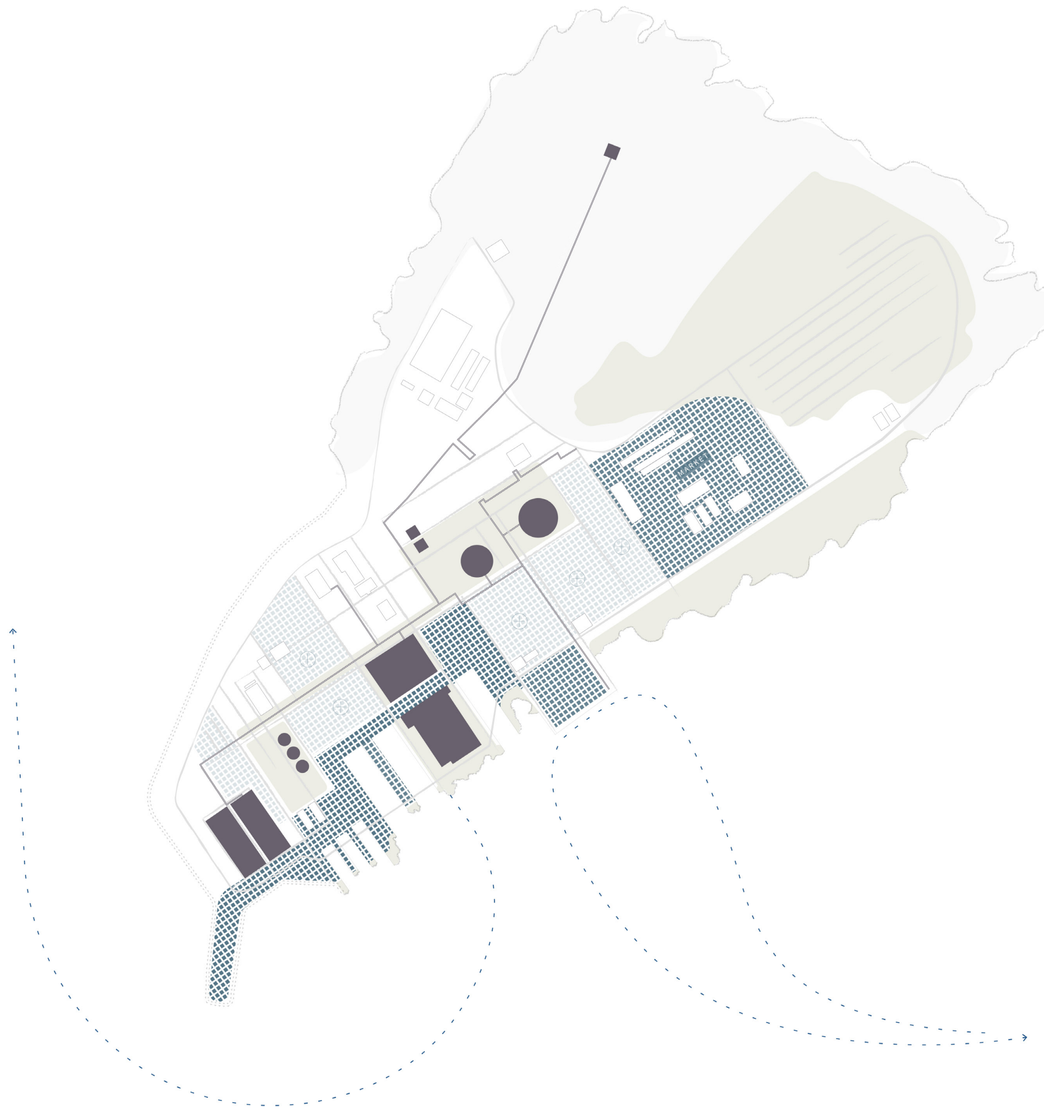
The port is used by the public for temporary mooring. Local business owners are allowed permanent mooring.

Aside from the market place, some public places are established at the shore, strengthening the approacheability of the water. For instance, the pier at the south side of the island is made accesible as a path leading to a viewpoint at the end.



Public space and local marine industry

Top / Gas processing facility before redevelopment and after redevelopment as public market. Source: Preemraff Lysekil (2021).



Melkøya scale

ROUTING
Layers

Along the shore a simple pathway is established re-using concrete from deconstruction on site (black line). The pathway leads the pedestrian through the different landscapes of the island.

1/ Before entering the tunnel to Melkøya, the driver has a clear view of the island in front of them.

2/ The first thing the driver sees when exiting the tunnel is the island Håja.

3/ When the road turns toward the parking lot, the driver turns back towards Hammerfest. From here they can even see the entrance of the tunnel, allowing them to orient themselves in the environment.

4/ The car is parked in the parking lot, which is positioned against the hillside as to not obstruct the view of the water. From here the visitor has a choice. They can take the unpaved route along the north side of the hill or the paved route around the southside of the hill.

5/ The unpaved route consists of a few markers guiding the visitor through the landscape (see reference images from Tudela Culip Restoration project by EMF and Ardevol). The path leads down over the rock formations to the water edge. Here they can approach the water, pick shells between the rocks or wade into the water. The viewpoint looks out towards the sea.

6/ Turning back the visitor follows the path to the north-east side of the island, here there is less wind and the atmosphere is somewhat more secluded by the hills of the neighbouring island Kvaløya. The path leads up meandering to the top of the hill from where, suddenly, the view opens up towards a panorama of the sea and surrounding islands. Again, the visitor sees Håja and Hammerfest. Below, they look down at the post-industrial part of the island, the harbour, the storage tanks, the people walking in between.

7/ Now, walking down the hill, the visitor arrives in the renaturalisation park. Low, native plants are starting to grow between the old foundations of buildings that have been demolished.

8/ Descending even further, the visitor finally arrives at the ground level in the busy marketplace.

9/ The paved route leades through the market, along shore passing the water taxi platform, storage tanks and old gas processing facility towards the harbour.

10/ Leaving the busy harbour behind, path leads to the viewpoint at the end of pier. It is windy. Ships are ariving back from the sea, coursing around the pier towards the harbour. From here the visitor walks back to the parking lot along the northern shore of the island.

The path and viewpoints

Above / Reference images of the markers guiding the visitor through the northern rock formations on the island (black dotted line). Source: Tudela Culip Restoration project by EMF and Ardevol (2010).
Above / And a reference image of the re-used concrete path in the southern part of the island (solid black line).

Primary route
Secondary route
Visual relation
Boat route
Tunnel
Viewpoint

N

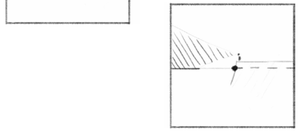
0 150 m

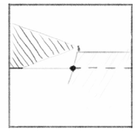
Melkøya scale

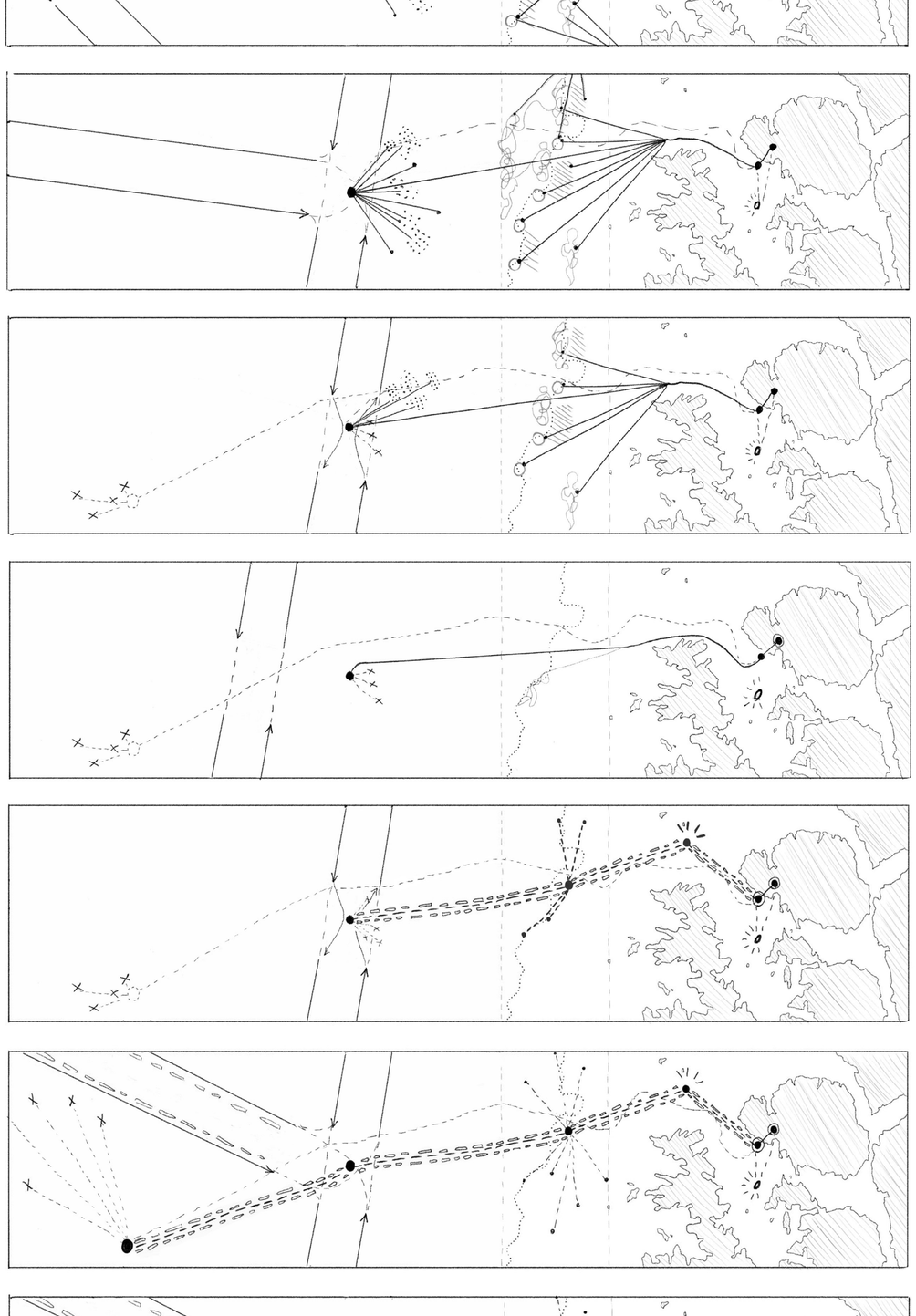
VIEWPOINTS
Layers

The three viewpoints (number 5, 6 and 10) each provide a different experience of the water due to their varying elevation. The viewpoint on top of the hill (6) provides a panoramic view of the surroundings. The eye is oriented towards the horizon. Whereas the viewpoint at the waters edge (5) invites to approach the water, to entry. The eye is oriented down towards the water as matter, the seabed visible below. The viewpoint at the pier (10) allows the visitor to walk away from the island and out into the sea, to be truly surrounded by water.

Left / Viewpoint number 6, looking back to Hammerfest and Håja.
Center / Viewpoint 5, at the rockformations.
Right / Viewpoint 10, at the pier.







CHAPTER 6.
PATHWAYS OF CHANGE

For all network composition drawing in this chapter, the following legend applies.

- Urban node
- Home
- Marine traffic route
- High density marine traffic route
- Global marine traffic (highway)
- Pipeline
- Point of extraction
- Fishing
- Mariculture
- Habitat restoration
- Continental slope

Petrol or no petrol?

For the sake of this case-study, we accept that petroleum is our present and future reality. That is to say: at least untill the year 2100. This is not an unrealistic assumption, considering the continuous societal demand for petroleum, last year's unprecedented number of licences granted for exploration wellbores in the Barents Sea (Barents Observer 2020) and the average lifespan (15-30 years) of a new production field.

The oil (Goliat) and gas (Snøhvit) field that Hammerfest currently depends on are expected to run out in respectively 2031 and 2035. Before then, new extraction facilities will be constructed further North in the Barents Sea - away from the coast.

Hammerfest thus stands before a forked path. Do they follow the petroleum industry seaward, or do they let go and invest in alternative marine industries instead?
The two pathways are as follows:

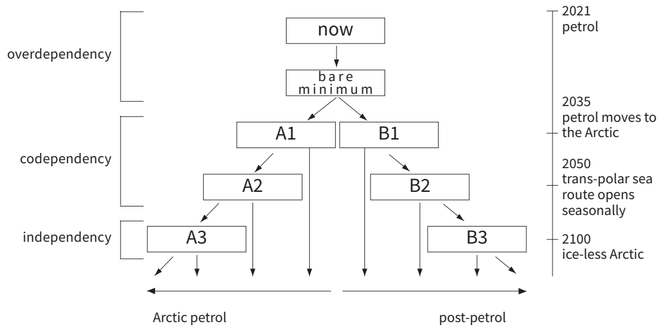
- Pathway A: reaching out, Arctic petrol
- Pathway B: letting go, post-petrol

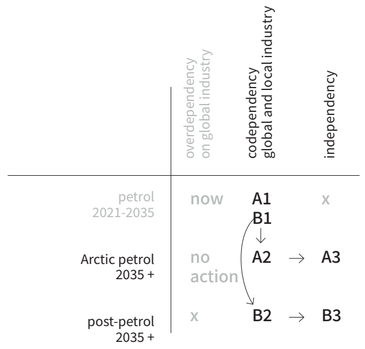
Dependency

Hammerfest current economy of life is overdependent on the global petroleum industry. Other levels of dependency could be imagined. In a codependent system, Hammerfest relies both on global and local marine industry. In an independent system, Hammerfest relies solely on local marine industry.

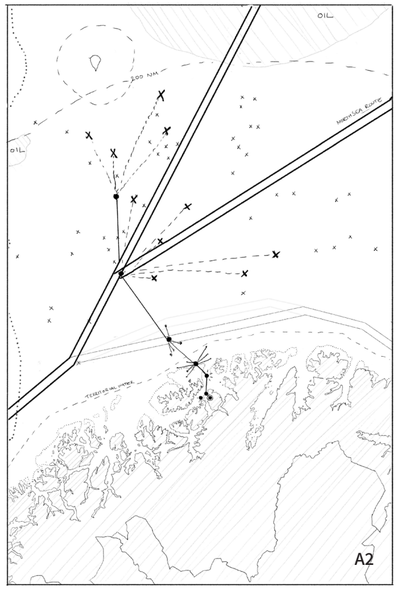
Considering these two factors (level of dependency and response to Arctic petroleum), several network compositions can be imagined. Each of the network compositions respond to a different set of factors. For example, composition B3 is an independent system in a post-petrol scenario. Composition A2 is a codependent system in an Arctic-oil scenario.

The network compositions can transition into eachother (i.e. A1 into A2, B2 into B3). Yet, each of the compositions can be seen as an outcome. In other words, the pathway does not work towards a final destination.

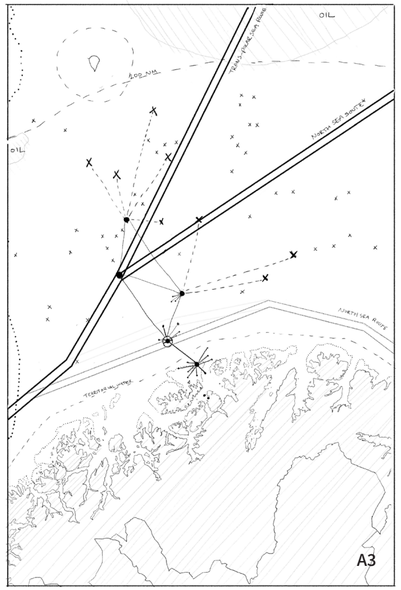




Codependency



Independency

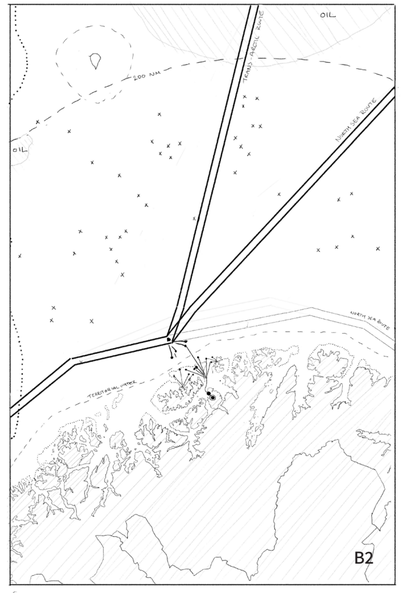


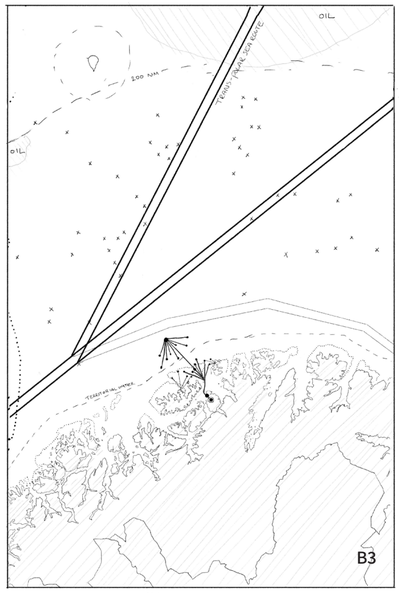
PATHWAY A

Reaching out
Arctic petrol

PATHWAY B

Letting go
Post-petrol





N

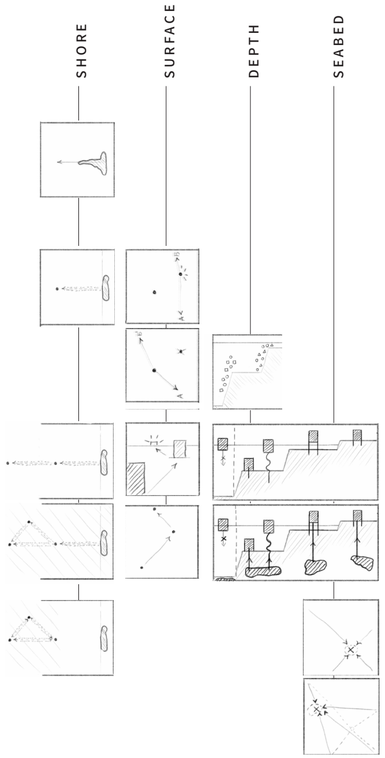
0 | 100 km

Finnmark scale

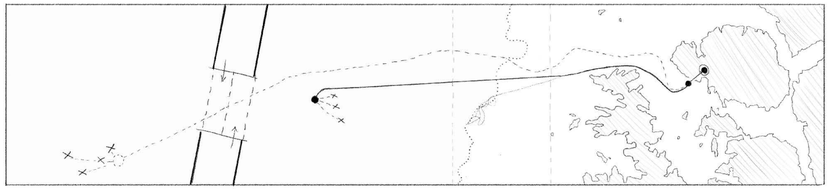
PATHWAY A: REACHING OUT
Choosing Arctic-petroleum

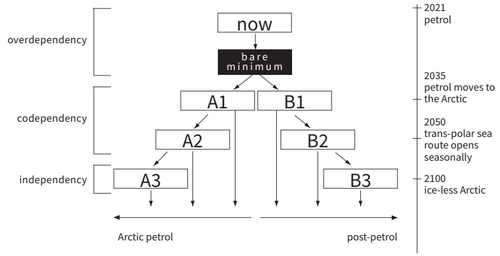
Overview

SHORE
SURFACE
DEPTH
SEABED



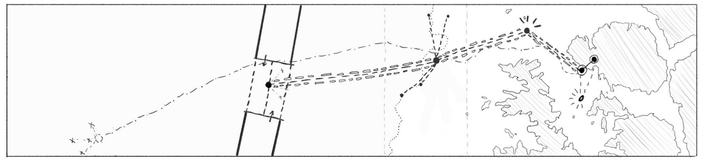
NOW
overependency
petrol





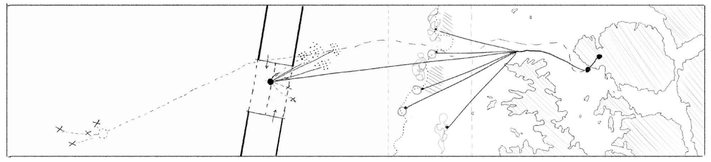
PATHWAY A
reaching out
arctic petrol

A 1
codependency
petrol

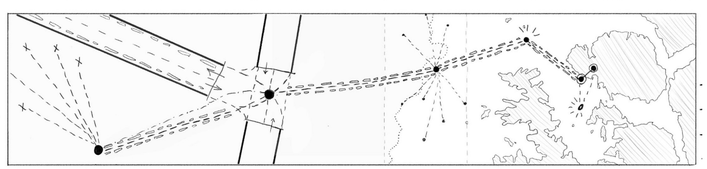


2030 petrol

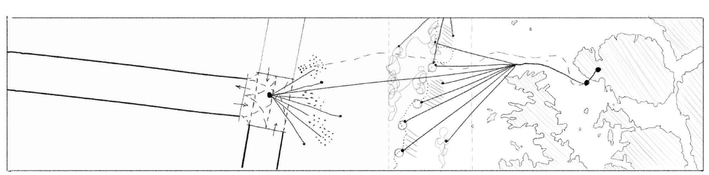
2035 petrol moves to the Arctic



A 2
codependency
arctic-petrol

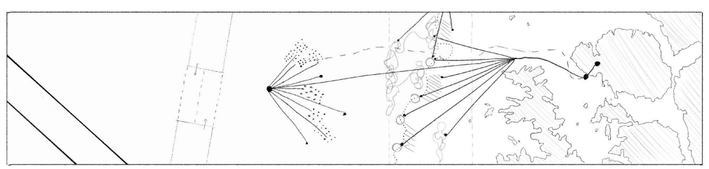


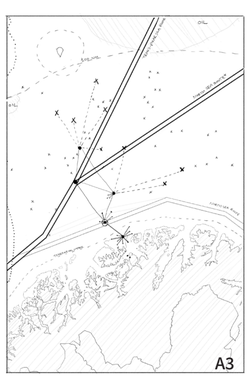
2050 TSR opens seasonally



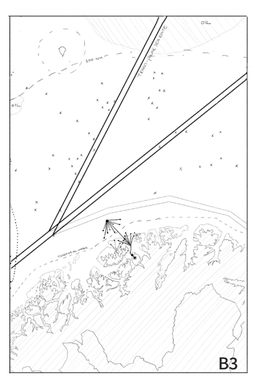
A 3
independency
arctic petrol

2100 ice-less Arctic





An offshore Hammerfest community, that constantly migrates over the ocean reaching for petroleum and other resources. The network is independant from the shore community and closely attached to the international sea network.



Hammerfest community let' s go of the oil industry and invests in local production of alternative marine resources. The network operates independantly from the global network.

Extremity A — Reality — Extremity B

PATHWAY B: LETTING GO
Choosing post-petroleum

Overview

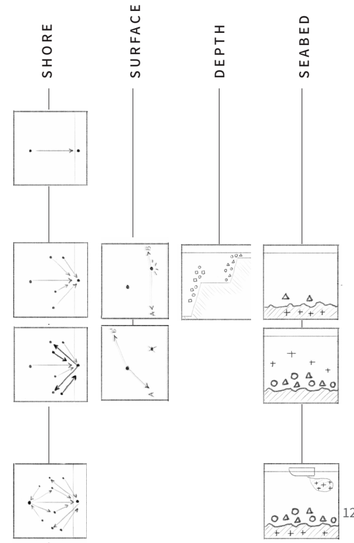
PATHWAY B
letting go
post-petrol

B 1
codependency
petrol

B 2
codependency
post-petrol

B 3
independency
post-petrol

SHORE
SURFACE
DEPTH
SEABED

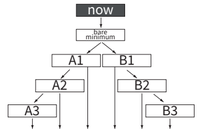


PATHWAY A: REACHING OUT

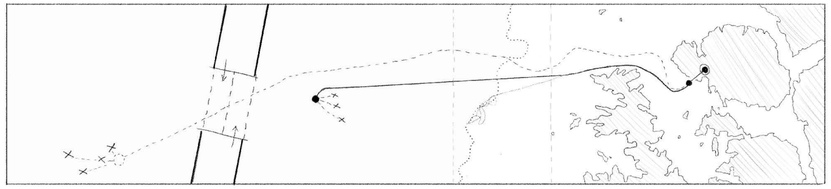
Choosing Arctic-petroleum

Network compositions

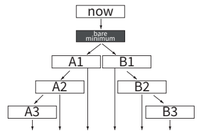
Network compositions transitioning through three phases. For each of the phases, actions are listed that make the composition a physical reality.



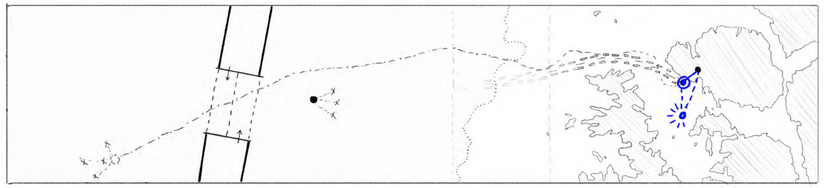
NOW
overependency petrol



2021
NOW

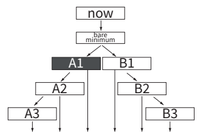


0
bare minimum

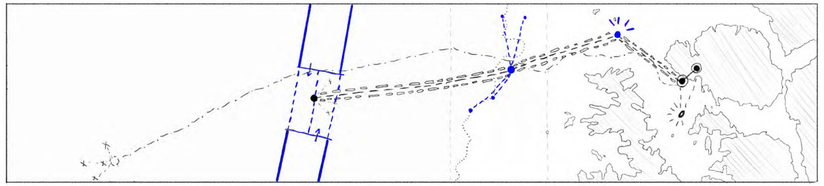


2025
PHASE 0
Melkøya

- Redevelop Melkøya.

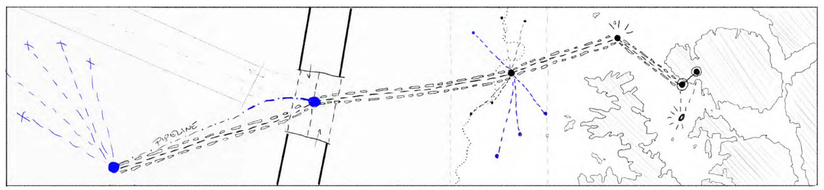


A1
codependency petrol



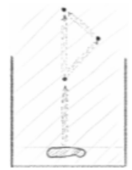
2030
PHASE 1
shifting seaward

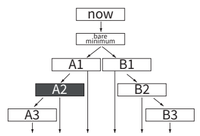
- Start restoration and nourishment of seabed on the edge of the strandflat.
- Allow community-led mariculture to develop on the edge of the strandflat.
- Reposition Northern Sea Route to pass Goliat.



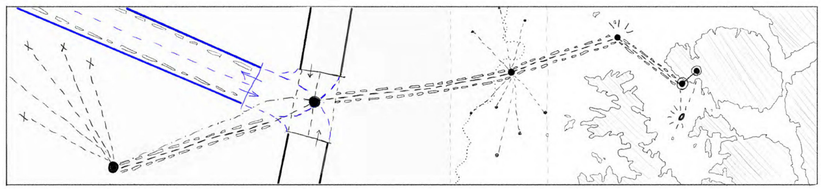
2035
PHASE 1
petrol moves to the arctic

- Repurpose Goliat as offshore harbour.
- Maintain gas/oil storage and offloading facilities.
- Support new marine economy to develop on Melkøya as gas operation decreases towards 2031.
- Petroleum extraction moves north when the operating fields run out.
- Produce from the new extraction facility is transported to Goliat for offloading reusing the pipeline.



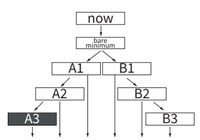


A2
codependency arctic-petrol



2050
PHASE 2
trans-polar sea route open

- Once the sea ice allows seasonal traffic along the Trans-polar Sea Route, connect the route to Goliat and the Northern Sea Route.



A3
independency arctic petrol

2100
PHASE 3
ice-less Arctic

- Redevelop residential quarters in Goliat as permanent residence.
- Petroleum extraction moves north again when the operating field runs out.
- The abandoned extraction facility is activated as renewable energy production field (wind, wave, solar energy).
- Product from local mariculture, petroleum extraction and marine energy production are exported to market from harbour Goliat.

N

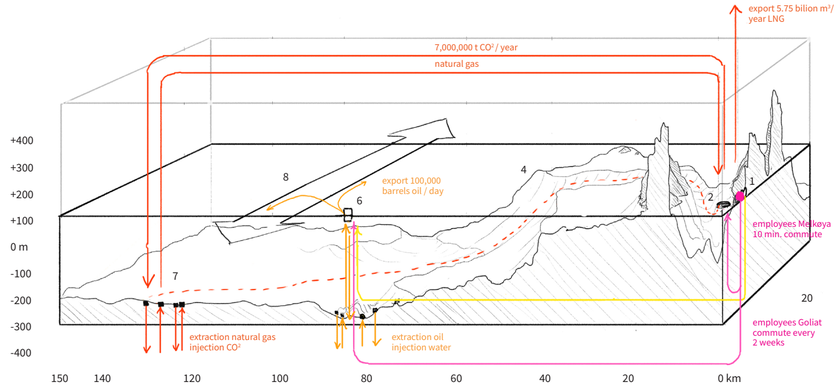
0 | 30 km

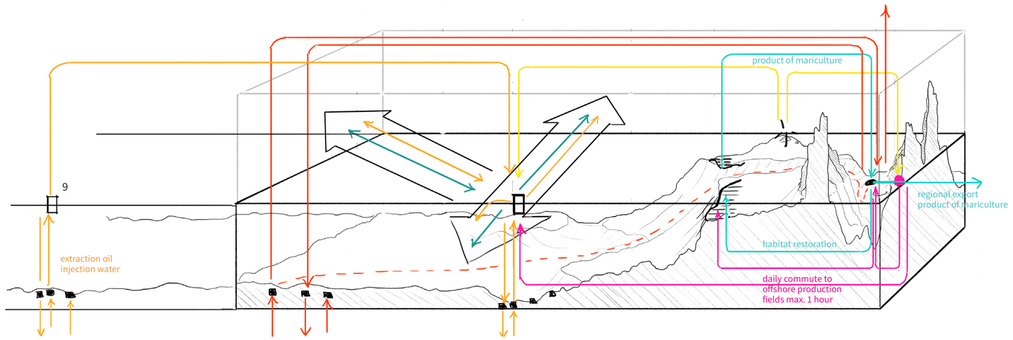
Maritory scale

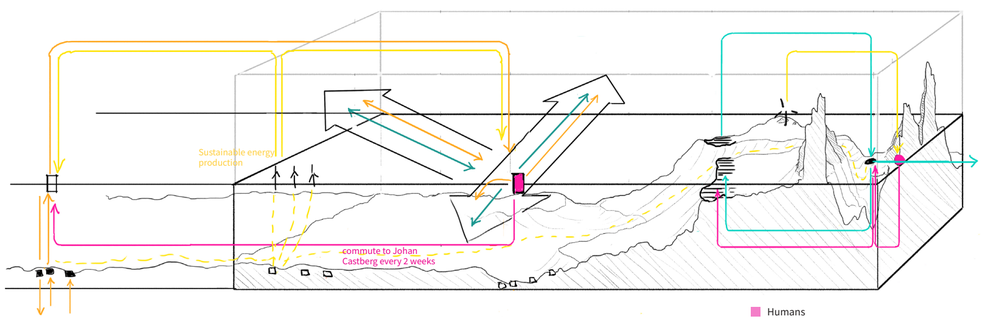
PATHWAY A: REACHING OUT
Choosing Arctic petroleum

Flows

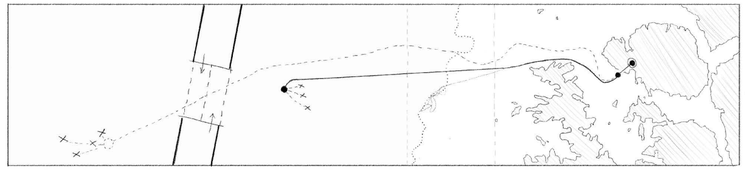
1. Hammerfest town
2. Melkøya
3. Håja
4. Continental slope
5. Boundary internal waters
6. FPSO Goliat
7. Snøhvit and pipeline
8. Northern Sea Route
9. Johan Castberg



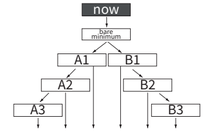


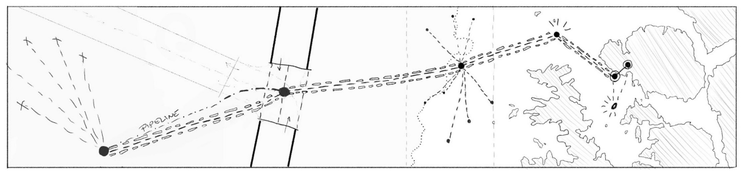


Humans
Gas
Oil
Electricity
Produce mariculture
General cargo

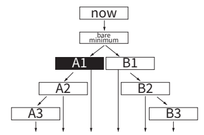


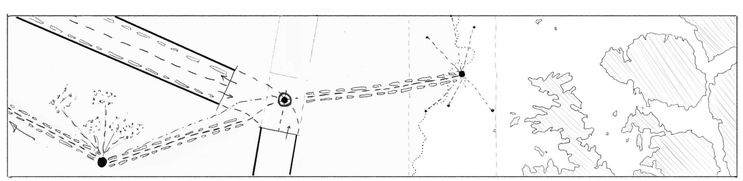
N O W
overependency
petrol



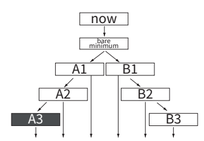


A 1
codependency
petrol





A 3
independency
arctic petrol



N
0
15 km

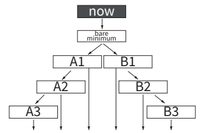
Maritory scale

PATHWAY B: LETTING GO

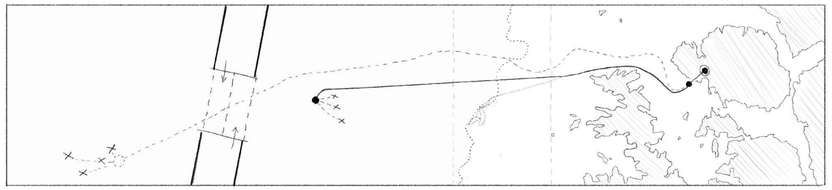
Choosing post-petroleum

Network compositions

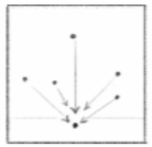
The network compositions of pathway B transitioning through three phases. For each of the phases, actions are listed that make the composition a physical reality.

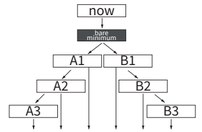


2030
NOW
overependency

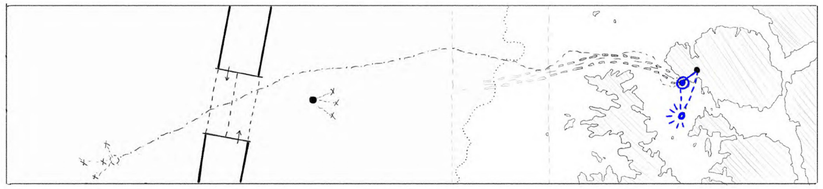


2021
NOW



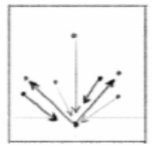


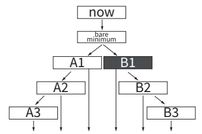
2025
bare minimum



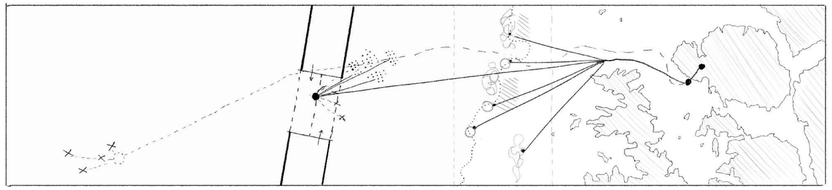
2025
PHASE 0
Melkøya

- Redevelop Melkøya.



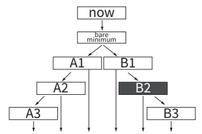


2030
PHASE 1
shifting seaward

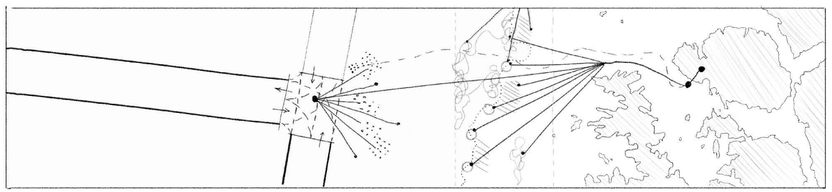


2035
PHASE 1
petrol moves to the arctic

- Start restoration and nourishment of seabed on edge of the strandflat.
- Invest in community-led mariculture to develop along the edge of the strandflat.
- Support new marine economy to develop on Melkøya as gas operation decreases towards 2031.
- Petroleum extraction moves north when the operating fields run out.

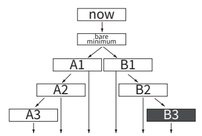


2035
PHASE 2
post-oil

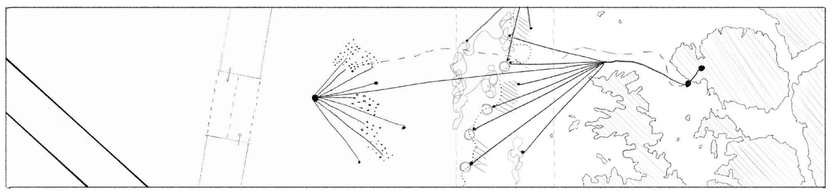


2050
PHASE 2
trans-polar sea route open

- Repurpose Goliat as offshore energy production facility. For example: experimenting with wave energy technology and offshore windfarms.



2050
PHASE 3
trans-polar sea route open



2100
PHASE 3
ice-less Arctic

- As extraction and traffic moves further north, the network becomes independent.
- Other coastal communities in the region invest in local marine industry as well, creating market competition.

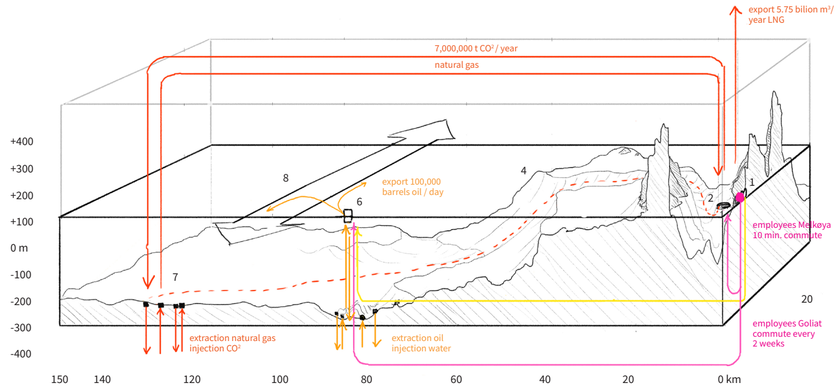
Maritory scale

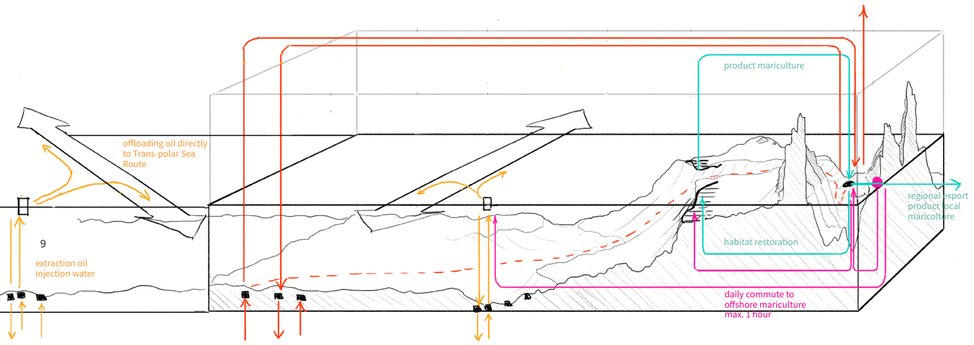
PATHWAY B: LETTING GO

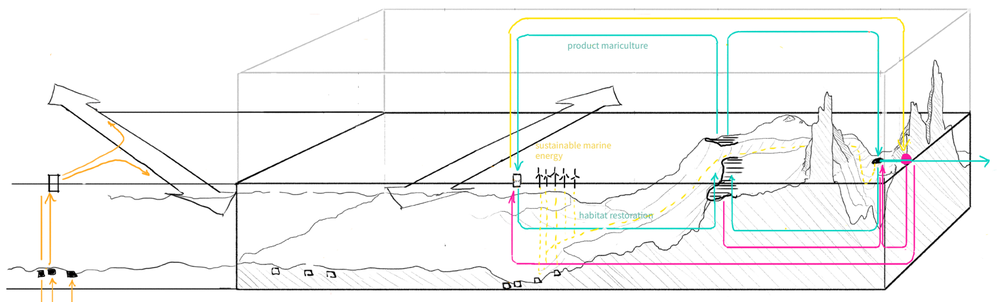
Choosing post-petroleum

Flows

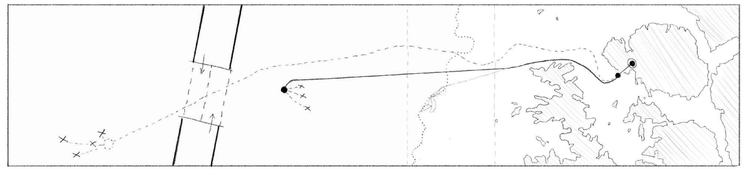
1. Hammerfest town
2. Melkøya
3. Håja
4. Continental slope
5. Boundary internal waters
6. FPSO Goliat
7. Snøhvit and pipeline
8. Northern Sea Route
9. Johan Castberg



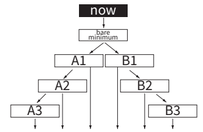


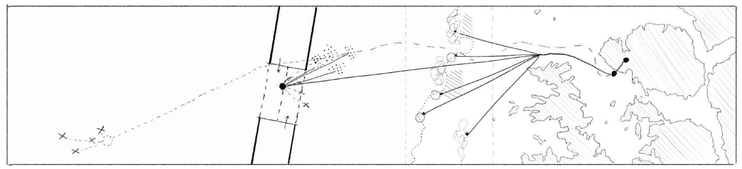


Humans
Gas
Oil
Electricity
Produce mariculture

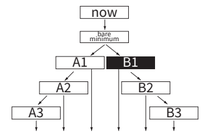


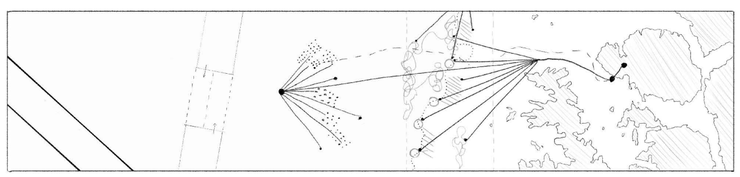
N O W
overependency
petrol



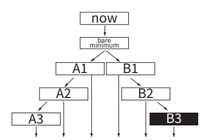


B 1
codependency
petrol



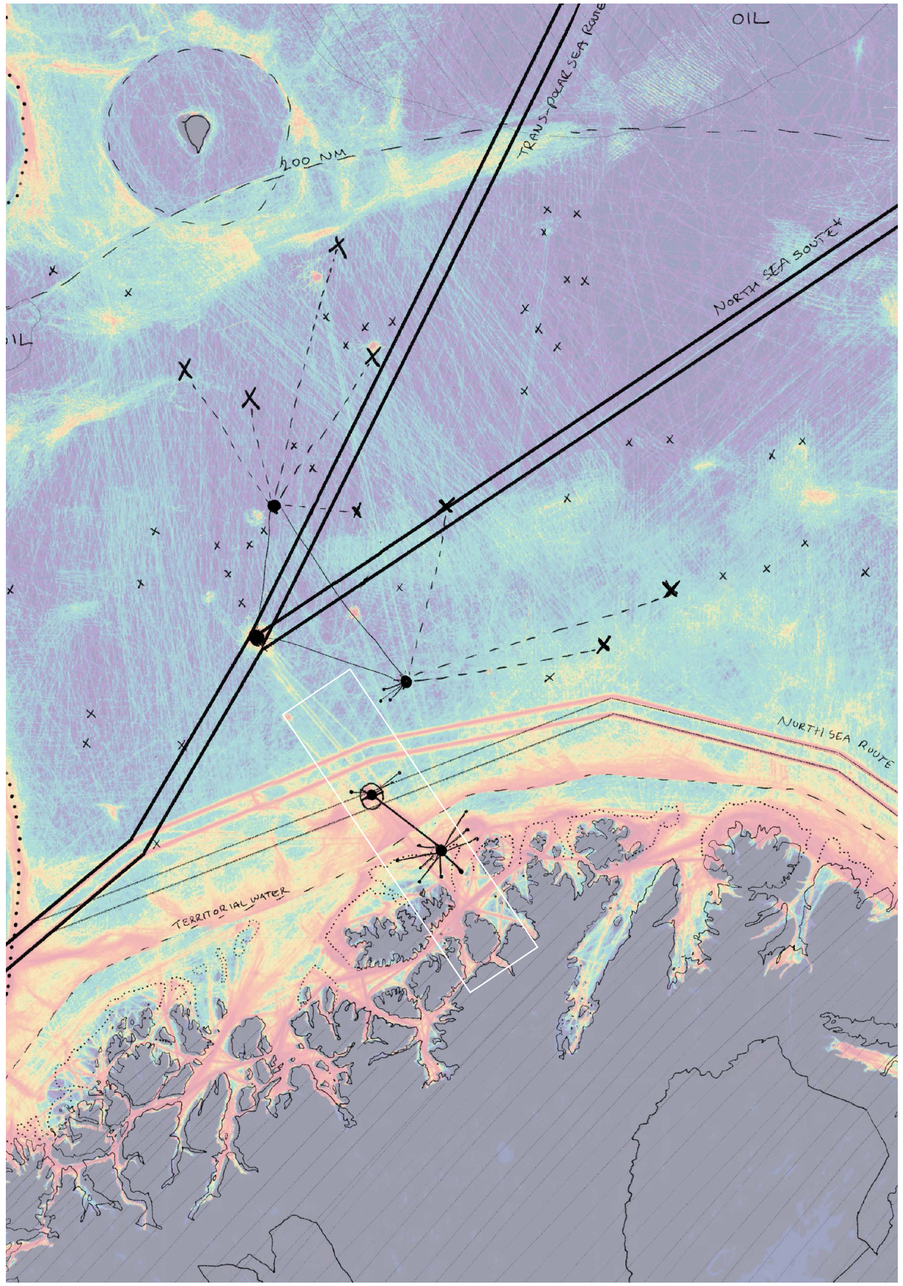


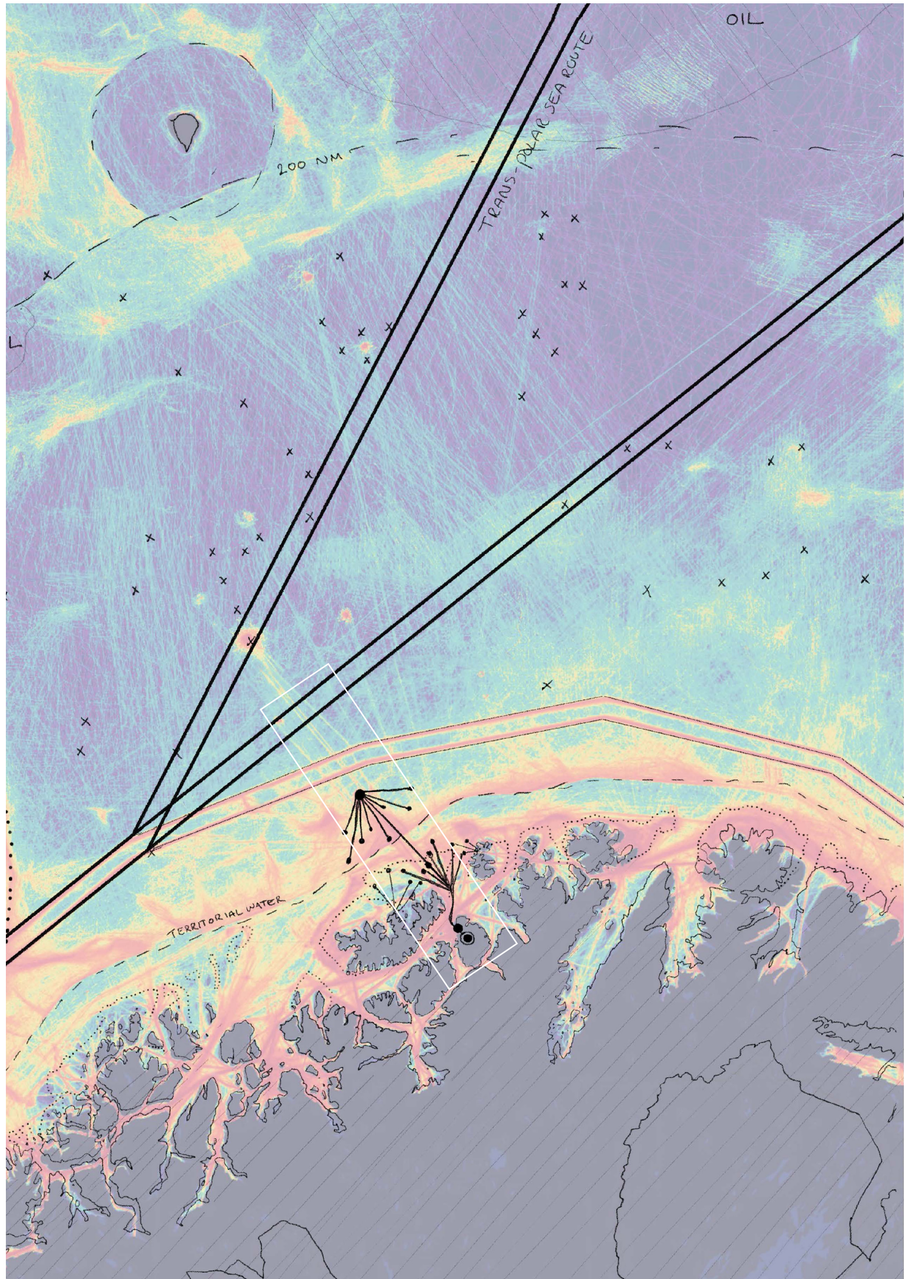
B 3
independency
post-petrol



0 | 15 km | N

Maritory scale

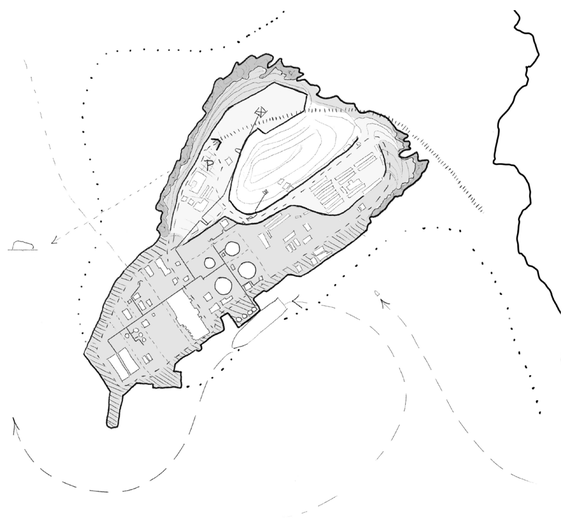


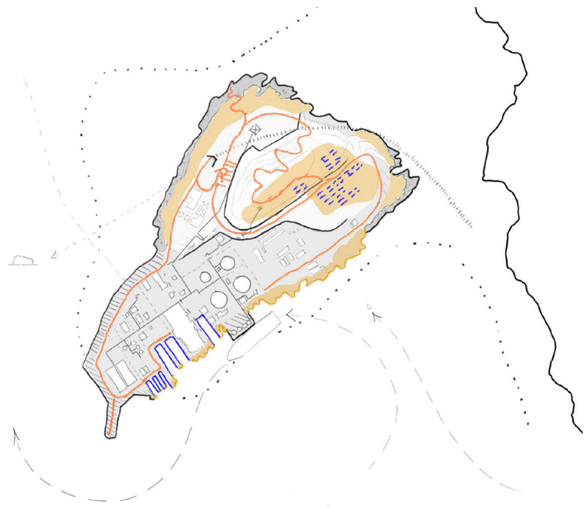


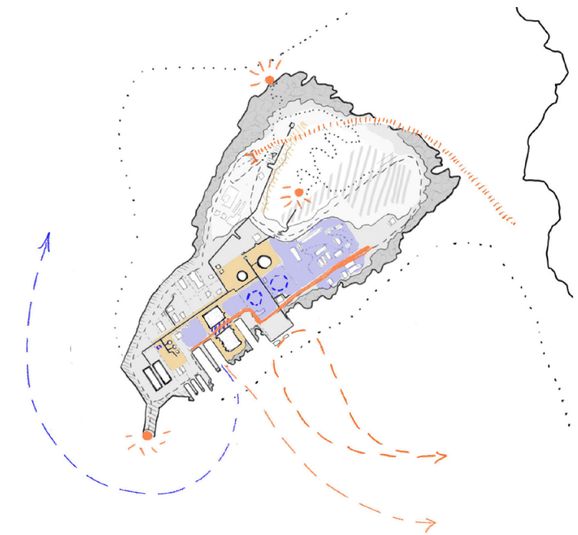
N
0
50 km
Finnmark scale

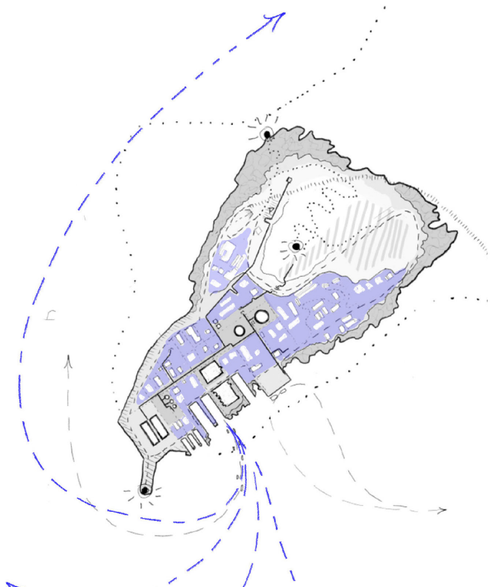
ALIGNMENT WITH MELKØYA

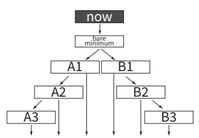
Transition of Melkøya through the phases for pathway A and B. Note that Actions to transform Melkøya are the same for both pathways until 2035- when petrol moves to the arctic. It is then that the two paths split and Melkøya develops accordingly.



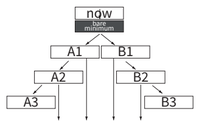








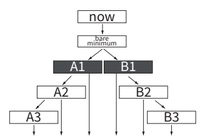
2021
NOW



2025
PHASE 0

Bare minimum

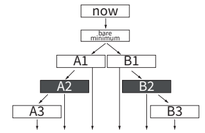
- 1 / Dig out new ports at the southside of the island.
- 2 / Renaturalise shoreline with dredged rock.
- 3 / Remove buildings on the southern hillside.
- 4 / Renaturalise the area using decontaminating plant species.
- 5 / Establish the new paths and parking lot using deconstructed concrete and steel form the site.
- 6 / Gas processsing remains operative.
- 7 / Offloading of LNG continues.
- 8 / Car tunnel is maintained for private use.



2035
PHASE 1

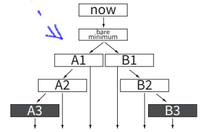
Petrol moves to the Arctic

- 1. Maintain striking gas facilities when petroleum leaves the island.
- 2. Allow temporary public mooring.
- 3. Open tunnel for public use.
- 4. Make offloading platform accessible as water taxi stop.
- 5. Establish the three viewpoints
- 6. Decontaminate and renaturalise the most polluted plots.
- 7. Local pioneers in marine economy settle on the island, reusing the abandoned buildings of the gas industry.



2050
PHASE 2

Trans-polar Sea Route opens seasonally



2035
PHASE 3

Ice-less Arctic

Pathway A: Reaching out

- 1. New industry slowly grows on the island.

Pathway B: Letting go

- 1. Now that petrol has moved away, Hammerfest invests heavily in local marine economy. New marine industry grows rapidly on the island.
- 2. Marine traffic from Melkøya to offshore production and nourishment fields visibly increases.

Pathway A: Reaching out

- 1. Once a part of the community has permanently migrated to sea, the new industry stops growing. A small and local industry remains operative. The community that remains uses the island as recreational space. It has a unique hybrid identity: abandoned industry, local industry and natural growth.

Pathway B: Letting go

- 1. Now completely independent of petroleum, the new industry blooms. The island densifies and gains the characteristics of a new urban center, that is publicly used.
- 2. Melkøya becomes an important node in the regional network, as an export port of local products and as a regional point of attraction.

In what ever way we choose to respond to petroleum industry moving towards the Arctic, the transition cannot happen without a resilient coastal community. That is why both pathways begin with the redevelopment of Melkøya. Even pathway A, where the community chooses to follow petroleum seaward, still primarily relies on Melkøya as a point of departure. From this case-study, the value of a localised approach to offshore urbanism becomes apparent.

The proposed transition of Melkøya from a private gas processing plant, to a public island with local marine industry, embodies a certain mindset. To see the uncertain future of petroleum as an opportunity to invest in alternative marine industries and diversify local job opportunities. Thus, a more resilient coastal community grows; housing a population whose economy of life does not depend on the comings and goings of petrol.

Left / Visualisation of Melkøya in 2050. A combination of naturalised shores, harbour functions and abandoned industry.

CHAPTER 7.
CONCLUSION

Evaluation of the design
How does the design respond to the two identified issues in Hammerfest?

1. Overdependency on petrol
Melkøya is redeveloped as the first step of a transition towards localised marine economy. It is designed to provide access and opportunity for local pioneers in the marine sector, such as community-led mariculture, habitat restoration and mussel farming. In doing so, Hammerfest' s new economy of life will depend on a variety of marine industries. Pathway A proposes a co-dependant network that relies on both global petroleum and local marine industries. Pathway B proposes a network that is independent of the global petrol industry and invests completely in local marine economy. Both of the pathways lead the community to an economy of life that depends less on petroleum than the current system, thus becoming more resilient to prospected changes in the petrol industry.

However, the current working population in Hammerfest that is specifically trained to work in the petroleum sector might not possess the qualifications to work in other marine sectors. Moreover, it would be unjust to presume that they would be willing to change their occupation. We can expect that the departure of petroleum from Hammerfest will still cause a turnover in the population. Although the design does provide the opportunity and incentive for alternative marine industries to grow, the success of the transition remains partially reliant on the resilience of the community.

2. Perceived overdependency on petrol
The heavy perceived dependency on petroleum in Hammerfest stems from the collective memory of a period of severe degrowth. The arrival of petroleum is remembered as a blessing that finally revived the town in 2002, bringing jobs and prospects for a future. This turning point in local history was visibly manifested in the reconstruction of the island Melkøya as gas processing plant. By selecting Melkøya to redevelop as the root of proposed transition, the island again marks a turning point in time. As such, the design aims to use collective memory to induce acceptance.

Melkøya' s close proximity to Hammerfest makes it easy to reach by car or boat and visible from town. From the first stages of redevelopment, the island is made accessible for public use. The accessibility and visibility of the island strengthens local sense of ownership and transparency of the transition. I propose to start redevelopment before the Snøhvit gas field is depleted, to enable a smooth evolution to the new marine economy once petrol departs Melkøya. This strategy mitigates the impact of petroleum 's departure, while gradually introducing a new economy of life to the community.

Evaluation of the entrances of design
This thesis is in the first place a theoretical work that aims to develop entrances of design for offshore urbanism from a socio-cultural perspective. The entrances of design are the product of theoretical research (see position paper in appendix A and bibliography) and cartography (see 'Atlas of Offshore Urbanism' in appendix C). The design (Melkøya and the pathways of change) functions as a testcase in which I apply the entrances of design. The testcase helps to evaluate the entrances of design and form conclusions that are transferable to other urban designers.

The first entrance is to approach the ocean through four marine spaces of design: Shore, Surface, Depth and Seabed. In my effort to compose a set of design principles for each of these spaces, I found that the most interesting principles applied to a combination of spaces (i.e. Shore + Depth, or Surface + Seabed). Comparable to the Dutch layers approach (De Hoog, Sijmons en Verschuuren 1998), Offshore Urbanism could distinguish four dimensions: Shore, Surface, Depth and Seabed, that should be studied as an coherent system. "We consider this coherence between the [dimensions] as the domain of spatial planning" (78).

Validation of this statement can be found in the comparison of network drawing methods applied in this thesis. In retrospect, the transects provided more valuable information on the workings of the network than the compositions drawn in plan view. Transects have the capacity to represent submarine nodes, pipelines and the system' s relation to bathymetry. This confirms the importance of conducting network analysis throughout the four dimensions.

The second entrance is to approach the ocean as a space of movement. Network analysis of marine traffic density data has proven to be a valuable tool to distinguish patterns of movement offshore. From the patterns we can derive the current network composition of the Hammerfest maritory and identify dependencies and missing links. The patterns of movement can also be used to project the impact of certain interventions (i.e. moving or changing the function of a node) on the network as a system.

A disadvantage of using patterns of movement as a design entrance is its two-dimensional nature. For example, seabed conditions find very little representation in the patterns of movement. With an exemption to the presence of resources (gas and oil), which is clearly legible from the satellite patterns that indicate extraction activity. High variations in depth clearly do affect the patterns of movement, since we can read the position of the continental slopes from the density of fishing activity along its edge. Yet, smaller variations in depth cannot be read from the patterns. The impact of shore conditions (i.e. maritime access and morphology) on the patterns of movement have not been studied in this thesis, but could provide an interesting topic for follow-up research.

Although conditions of depth, shore and seabed can be derived from the 'patterns of movement analysis' to a certain extent, it focusses too much on 'surface' and too little on the other three dimensions of marine space.

In short, the patterns of movement have the potential to inform offshore urbanism on the current organisation of marine uses and their spatial relation to a coastal community. However, the analysis has to be supported by nodal data: position of pipelines, type of extraction (i.e. oil, gas), type of node (submarine, FSPO, wellbore), type of matter transported (i.e. LNG, CO2, NG). Together, patterns of movement and nodal data can provide a network understanding of the urban morphology offshore.

The third entrance is to select one node in the current maritorial network and proactively redevelop it as the root of the proposed transition. This guideline has proven to be a valuable tool to materialise the proposed network transition in the built environment - to land it on earth. By focussing the design on one node, we are forced to turn back to the local scale, the physicality of the network and the people interacting with it. This is imperative for offshore urbanism from a socio-cultural perspective.

The fourth and last entrance is the redefinition of the coast. The coast must be approached as a zone that is composed of both land and water. The coastline, as border between inland and seaward, is not necessarily positioned at the shoreline (the border between land and water). In the case of Hammerfest, one could position the coastline at the continental slope, about 40 kilometres from shore. Its position is defined by i) the bathymetric edge between the shallow strandflat and the deep continental shelf, ii) the fine grained morphology of islands, fjords and archipelago' s inland and the rigid morphology of extraction plots seawards, and iii) the legislative boundary of territorial water. Thus, the border between what is considered 'local' and 'non-local' shifts seaward.

The redefinition of the coast is important, because it introduces the maritory as a local project. Especially in light of the prospected urbanisation of the ocean and the socio-cultural impact this will have on coastal communities, a localised approach to offshore urbanism is imperative.

Answer to the research question
How can human-sea relations be...

- **understood** as a component of urbanisation processes in Hammerfest and the Barents Sea?
- **represented** through the act of mapping?
- **employed** to design pathways of change for the spatial reorganisation of the Barents Sea?

Understand
i) Approach the sea as an urban and local project. ii) Approach the sea as a field of movement composed of populated urban nodes (boats, islands, platforms, etc.) that extend the urban territory across the coast.

Represent
i) Consider socio-spatial conditions of the ocean as precipice of design. ii) Consider the four dimensions of marine space (Shore, Surface, Depth and Seabed) as a coherent system. iii) Use collective memory and perceived dependency on marine industries to induce acceptance and a sense of ownership over the transition.

Employ
i) Analyse the patterns of movement to derive the organisation of marine uses and their spatial relation to the coastal community. ii) Derive the current network compositions revealing local dependency on marine conditions. iii) Proactively transform a node of the existing network as the root of the transition. iv) Propose alternative network compositions that can grow from this point of intervention.

Abovementioned conclusions form possible guidelines to offshore urbanism from a socio-cultural perspective. Although they have proven to be applicable in design, more iterations of research and design are necessary to further develop the discipline. This requires academics, educators and urbanists to use design as a means to inform and inspire Marine Spatial Planning and engage in the discourse of offshore urbanism.

Scientific relevance

I started building my graduation project on the proposition that the ocean is transitioning to become a highly urbanized space. In doing so, the thesis expands the notion of 'the built environment' into the Barents Sea and approaches it as an urban project. The thesis argues the need for design to provide a socio-cultural perspective on marine urbanization. As an interplay between art and science, facts and interpretations, urbanism is able to understand human-sea relations and employ this understanding in a design, where the current (political) practice of Marine Spatial Planning (MSP) cannot. The thesis proposes 'offshore urbanism' to bridge the socio-cultural gap in MSP.

The starting point of the Transitional Territories studio is the colonization of nature and the radical reorganization of water, land and society in the face of climate extremes. Each student studies a different coastal zone, redefining the notion 'coast' and formulating a new and surprising gaze on the issues in place. In my case: the study of the coastal community of Hammerfest, and the reimagination of the Barents Sea as an urban and social space.

Societal relevance

The aim of this thesis is to understand the human-sea relations between Hammerfest and the Barents Sea and questions how marine urbanisation can accommodate for local demands allowing them to compete (and comply) with global or economic demands. In this light, the thesis approaches the ocean as a local project. The design adresses the coastal community of Hammerfest, whose economy and livelihood heavily depend on the petroleum industry. It proposes different pathways of change towards a future where the Hammerfest's economy of life does not solely depend on the global industry of petroleum. In doing so, the community becomes more resilient to changes in the petrol industry. Particularily when the current fields run out in 2035 and extraction moves seaward- away from Hammerfest.

Professional relevance

During my education at the TU Delft as an Urbanism student, it had never occurred to me to apply the knowledge of my discipline to marine space. In this thesis I argue that the application of offshore urbanism is not only needed to ensure sustainable marine development, it also provides a unique opportunity to further develop our discipline. The study of offshore urbanism could provide a new area of research we can engage in and learn from. Alongside scientific research, the role of education systems is equally important. Universities can contribute by including the study of marine space in the design curriculum and engaging both students and academics in the offshore urbanism discourse.

Even so, a socio-cultural understanding of the ocean cannot be achieved by academics alone. It is essential that marine citizens understand the ocean's impacts on society and the impact society has on the ocean. Education systems should aim to achieve public ocean literacy that induces informed and responsible behaviour towards ocean resources, leading to more ocean-sustainable societies.

On process and methodology

The concept of Offshore Urbanism is quite novel. Aside from a small pile of research on marine spatial planning that calls for the development of a socio-cultural approach, the topic is severely underrepresented in theory and practice.

It might be because of this, that I borrowed many constructs, methods and theory from other disciplines. Where I could not find the necessary knowledge in urbanism, I found them in arts, sociology, philosophy, maritime technique, landscape ecology and policy.

More so than achieving successful outcomes, the aim of this thesis is to reimagine, to understand and to try. In other words, it is a theoretical work that aims to develop entrances of design for offshore urbanism from a socio-cultural perspective. The entrances of design are the product of theoretical research and cartographic exersizes. The design functions as a testcase in which I apply the entrances of design. The testcase helps to evaluate the entrances of design and form conclusions that are transferable to other urban designers.

Before P2, the representation of local voices and socio-cultural values played a fundamental role in the methodology. Socio-cultural values are inherently subjective, location specific and changeable. Therefore, data is preferably collected through observation or collaboration with the community. Considering this, the project proposed to organise an on-site workshop named 'Atlas by Hammerfest', in which I hoped to work with inhabitants to produce collaborative mapping that represents local voices. However, due to covid-19 restrictions, I was not able to travel to Norway and plan the workshop. As a result, the project methodology had to change. At P2, the purpose of the thesis was threefold: i) to understand, ii) represent and iii) employ human-sea relations in the reorganisation of the Barents Sea. But without the collaborative mapping workshop, a third of the purpose fell away. If I cannot speak to the inhabitants and listen to their stories, what voices am I representing?

I compensated for this lack of on-site data by using alternative sources. I dived deeper into the history of the Hammerfest community. I read about the fires, wars and fish crisis that drove the people away, and respectively, the innovations of electricity, post-war architecture and petroleum industry that brought them back. The history of Hammerfest teaches us the resilience of its people, the role of the church as a pinnacle of reconstruction and marine industry as a means of survival. The interviews conducted by Loe and Kelman (2016) provided insights in local attitudes towards oil and the socio-cultural changes since petroleum came to Hammerfest, underlining the perceived dependency on oil. Furthermore, Alan Sekula's Fish Story (1995) portrayed the human scale of marine industries through a photographic documentary. His work provided phenomenological data, approaching the globalisation of the ocean from the perspective of the human body.

Although the abovementioned sources provide valuable data for the thesis, they do not sufficiently provide cartographic representation in the same way the workshop would have done. As a result, all cartographic material in this thesis remains a spatial translation of collected socio-cultural data. A translation that is facilitated - and thereby biased - by my disciplinary knowledge and frame of reference.

Fortunately, the new methodology has some advantages as well. The new methodology reflects a more realistic design scenario. It has pushed me to find a way to ensure socio-cultural representation in offshore design without having the benefit of on-site data. This is important, because in practice data collection through collaborative workshops and conversation is not always feasible. It requires intensive labour and time and is thus preferably omitted.

Ethical issues

- *In research:* The representation of local voices has been of concern throughout the research process. Questions that continued to lead my project are: Who/ what am I representing? Why do they need to be heard? How does the project improve socio-cultural representation in marine spatial planning?

- *In design:* My first visit to the Arctic University of Tromsø in MSc2 has shaped my personal motivation for this thesis. When discussing our design proposals with the Norwegian students I was struck by the delicacy of their proposals. In comparison, the lines of our territorial designs seemed to strike through the map without any consideration of the value, the reality of the places trampled underneath. This thesis aims to be sensitive to place and people, while at the same time responding to issues on a territorial scale.
- *In general*: I can understand that some would resist the idea of offshore urbanization. Perhaps an implementation of the design (seaward migration of people and economy) would, in fact, contribute to the human colonisation

of nature. But, I would prefer to see the design as a means of exploration of what offshore urbanism informed by socio-cultural considerations could entail. Considering the fact that urbanisation at sea is only expected to increase in the future, the thesis merely proposes that this process be guided by socio-cultural considerations and local demands as well as global and economic demands.

Bare minimum

One of the first parts of advice that the studio mentors gave us, is to aim for the 'bare minimum'. Although the phrase might not immediately raise a positive note, I learned to interpret this as 'to aim for simplicity and elegance'. It means to understand a complex system (its qualities, conditions and dependencies) and to intervene ever so slightly at exactly the right spot. To nudge, not impose. It is a beautiful, yet tough ambition.

Personally, I enjoy designing towards extremities. To play with reconceptualisation as a means of projection and, perhaps, provocation. To ask "what if?". I have tried to bring these two approaches together in the design, instead of choosing one. The design proposes a seawards migration of economy and people of Hammerfest, reaching up to 150km into the Barents Sea: an extreme scenario. Yet, the physicality of the design comes down to the redevelopment of one island (0,69km^2). The island, Melkøya, forms the root of the proposed transition. From it, a new economy of life is allowed to grow seawards. In principle, the redevelopment of Melkøya prefers removal to the addition of elements. Repurposing and rehabilitation is preferred to deconstruction. Primarily, the design aims to provide access and opportunity for public use and the establishment of local businesses pioneering in marine industry. Still, a question that has continued to guide my thesis lingers: "Can I do less?".

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OFFSHORE URBANISM

A design perspective on the representation of socio-cultural data in marine spatial planning

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Abstract
This paper builds on the proposition that the ocean is both an urban space and a social space. Therefore, marine planning needs to consider socio-cultural demands, risks and opportunities in order to be deemed sustainable. In fact, if we understand the complexity of human-sea relations and purposely employ them in marine planning, they could even play an important role in reaching climate objectives. However, socio-cultural data is underrepresented in Marine Spatial Planning. As a result, the socio-cultural impacts of offshore development on communities on shore remain unmapped and unknown. The essay adresses the nature of socio-cultural data and the issues that complicate its representation in MSP decision-making.

As an interplay between research and design, urbanism can offer the necessary tools to understand, represent and employ human-sea relations where MSP cannot. The purpose of this essay is to actuate planners and designers to open the discourse of offshore urbanism as a means to inform and inspire MSP; and to bridge the gap towards offshore development that is both environmentally and socially sustainable.

Keywords
Marine spatial planning; socio-cultural data; offshore planning; offshore urbanism; social sustainability

1. Introduction

Since the first rafts embarked onto the sea, the ocean has been subject to the Anthropocene. As the population is growing, so is our hunger for habitable land and resources, causing urban territory to expand far beyond the coastline. Already, a variety of industries compete for marine space and resources. Oil and gas extraction, fishing, renewable energy production, transport and tourism are expected to crowd the seascape in the future (Dafforn et al. 2015). Traces of this offshore urbanisation can be found in both fixed forms (e.g. oil platforms, wind farms, piping) and in flows (e.g. transportation of goods and people). As a consequence, ocean ecosystems, already at a tipping point by the ongoing effects of climate change, face overuse and ecological degradation (Santos et al. 2018; Halpern et al. 2008).

The increasing spatial demand of marine uses and the risks that come with it triggered the first applications of marine spatial planning (MSP) in 2005 (Ehler 2020), a political planning process adopted by countries across the globe to ensure sustainable development at sea. However, recent studies have pointed out the lack of socio-cultural considerations in the MSP process, suggesting that MSP does not possess the appropriate tools to represent non-monetary values (McKinley, Acott, and Stojanovic 2019; St. Martin and Hall-Arber 2008; Shucksmith and Kelly 2014). As a result, the impacts of offshore development on communities on shore remain alarmingly unmapped and unknown.

Approaching the problem from a design perspective, this paper proposes that urbanism can offer the necessary tools to understand, represent and employ socio-cultural human-sea relations, where MSP cannot. Building on the proposition that the ocean is both an urban space and a social space, the paper provides an argumentation of i) why a socio-cultural perspective in MSP is imperative for sustainable development, ii) why terrestrial planning and design principles cannot be thoughtlessly applied, iii) the issues with the representation of socio-cultural data that complicate its inclusion in MSP, and finally iv) what urbanism can offer as an addition to MSP.

The purpose of this essay is to actuate planners and designers to open the discourse of offshore urbanism as a means to inform and inspire MSP; and to bridge the gap towards offshore development that is both environmentally and socially sustainable.

2. The ocean is urban

What is urban?
On the contrary to popular belief, the urban territory is not limited to land. The term urban, descendant from the Latin conjugation urbanus (meaning: of the city), is most simply defined as: relating to the city. Urban territory is characteristically inhabited by humans and occupied by humans functions. Both inhabitation and occupation manifest physically in the form of architectural elements like houses, highways, factories. Or in other words: the human settlement. We can find human occupation, settlement and inhabitation not only on land, but also on sea.

Human occupation of the sea
When we stand on shore, looking out over the water to the horizon, we might not expect human occupation of the sea to be very extensive, but it is. In fact, due to the many resources that the ocean supplies, marine uses are numerous and wide spread (Ehler and Douvere 2006). Mostly, marine use is related to resource extraction, including fishing, sand mining and oil and gas extraction (table 1). But there are also commercial, recreational, environmental, scientific and military uses.

Aside from resource extraction, the ocean has always been a medium for transport. In the past, man crossed the ocean to claim new land, a trend particularly evident in the 15th century during the western colonization. Now, marine transportation mostly concerns the trade of goods. According to the 2020 review of maritime transport (United Nations 2020), an average of 80 per cent of the volume of international transportation of goods is carried overseas. This number is even higher in most developing countries. The world fleet consists of bulk carriers, oil tankers, container ships, ferries, passenger ships, fishing vessels and more. Marine transportation has been increasing steadily in the last years (fig. 1), especially the transportation of gas and oil.

Table 1
Examples of human marine uses and their spatial manifestation. Adapted from: (Ehler et al. 2007).

	Marine use	Spatial manifestation
Extraction	Fishing	Fishing zones
	Oil and gas exploration and extraction	Drilling platforms
	Sand and gravel mining	Dredge ships
	Dredged material disposal	Disposal piles, Dredge ships
Commercial	Food production	Aquaculture
	Tourism	Diving sites
	Trade	Offshore harbours
Renewable energy	Wind energy	Wind farms
	Tidal and wave energy	Buoys, generators
Transportation	Transportation	Container ship
		Cables, pipelines
Recreation	Recreational fishing	Open fishing zones
Environmental	Natural conservation	Natura 2000 areas
	Habitat restoration	Artificial reefs
Military	Military activities	Airports, training grounds
Science	Climate research	Weather stations

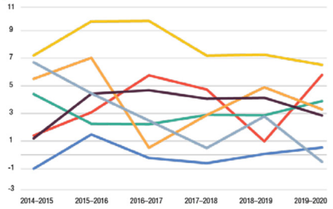

Fig. 1

Growth of world fleet by vessel type 2014-2020. On the y-axis: percentage of growth in repspect to the previous year. Note the high growth of Gas carriers (yellow line) and Oil tankers (red line).

Source: United Nations. 2020. “Review of Maritime Transport 2020.” In United Nations Conference on Trade and Development. Geneva.

The increasing transportation of gas and oil tankers are both a cause and a result of climate change. The production and transportation of petrol is a major source of CO2 emission contributing to climate change and global temperature rise (UNCTD 2020; Staalesen 2019). High temperatures in the Arctic cause the regression of sea ice and leave the Arctic Sea more accessible to transport and resource extraction every year (Overland et al. 2017; Schütz 2018). As a result, oil production in the Barents sea alone is expected to increase to 115 million standard cubic meters. That is the size of 23.000 soccer fields and a 40 percent increase from 2019 (Staalesen 2019). A vicious circle indeed.

Fortunately, the production of renewable energy is emerging as marine use. Wind energy is starting to become a key player in the marine energy sector. The technology is readily available and large scale wind farms can find more space and social acceptance on sea than on land (Sijmons, Hugtenburg, and Veul 2017). In addition to wind energy, the experimentation of other renewables such as wave energy and algae harvesting introduce new sustainable marine uses to the ocean space (IOC 2006).

Although the abovementioned marine uses vary in sustainability, none of them are risk free. Oil spills, overfishing and pollution are never far away (United Nations 2017). Even the construction of wind farms can easily disturb the delicate ecosystem of the sea floor (Halpern et al. 2008; Santos et al. 2018). As marine uses increase in variety and number, so do the risks.

Human settlement on sea

The spatial manifestation of marine uses can be found in both fixed forms, such as oil rigs and windfarms, and in flows, such as shipping routes, vessels, piping and cables. Aside from these more obvious forms of settlement other unconventional forms can be imagined too. For instance, offshore housing. In The Netherlands, the concept of boathouses is already quite common, although on a small scale. On a larger scale, designers and civil engineers experiment with offshore housing and land reclamation. In this line of thought, Venice could even be seen as an offshore settlement. The foundations of the city were constructed on wooden piles and platforms driven into the lagoon around 450 AD (Avventure Bellissime 2020). Because the structure has been submerged in water, the wooden piles have not eroded and continued to support the city ever since. Thus Venice earned its nickname: Floating City .

Just like on terrestrial settlement, the architecture and construction of marine settlement varies for different depths, soil types and functions. Offshore construction requires a knowledge of marine dynamics and environment. If offshore construction is approached from a design perspective, it could be possible to design structures to be multifunctional. For instance, wave breakers protecting the shore from erosion can simultaneously be designed as artificial reefs (Dafforn et al. 2015). The design of human settlement has the opportunity to create synergetic solutions to marine issues.

Human inhabitation of the sea

People constantly move across the coast (fig. 2). The captain of a ferry might arrive at and depart from the coast more than twenty times per day, whereas a technician working on an oil rig spends two full weeks off-shore after every three weeks on land. At any given time hundreds if not thousands of people reside at sea (MarineTraffic 2020).

The question remains, when we go offshore and leave our terrestrial houses, what happens to the home? Does it remain, or does it travel with us when we traverse the sea. Let us propose the latter. In that case, human habitat is not stationary, but mobile. With every raft we push onto the ocean, with every ship we board, we take a part of our habitat and sail it away from shore. In this sense, human inhabitation is not confined to land at all. If a house can be a home, why not a boat or an oil rig?

The most densely inhabited part of the ocean is the coast. Perhaps this statement seems strange, as we are used to think of coastal communities as the inhabitants of land. However, I argue that coastal communities are just as much inhabitants of the sea, because the coast forms the threshold between both domains. Certainly, coastal communities often rely heavily on marine resources (Gee 2019) and are sensitive to changes in both their terrestrial and their marine hinterland.

In 2017, nearly 2.4 billion people live within 100 km of the coast, which is about 40 per cent of the world’ s population (United Nations 2017).

Considering the extensive occupation, settlement and inhabitation of the ocean, we can conclude that the scope of the city reaches far beyond the coastline into the maritime space. The ocean is an urban space. The increasing urbanisation of the ocean pressures the marine ecosystems on which so much of the human population relies. Therefore, we need a spatial planning process to organise marine uses and ensure sustainable development offshore.

3. The ocean is a social space

If the ocean is an urban space, including a population density, then it is inevitably a social space as well (Gee 2019). Since historic settlement, coastal communities have relied heavily on the ocean for food, trade, transport and livelihood. Human-sea relations have developed since then, embedding into local culture. The dependency of humans on the ocean ecosystem can be described by means of ecosystem services. Ecosystem services, first defined by the Millennium Ecosystem Assessment board in 2003, are the benefits people derive from nature. Four types of services are identified: provisioning (e.g. food, water), regulating (e.g. floods, drought), supporting (e.g. nutrient cycle, photosynthesis) and cultural services (Millennium Ecosystem Assesment 2003). For now we focus on the latter. Cultural ecosystem services (CES) include non-material benefits, such as aesthetic, recreational, religious or spiritual values. CES may also refer to mental well-being, sense of belonging, identity and heritage (Millennium Ecosystem Assesment 2003). Just like the landscape, the seascape is built out as many layers of soil as of layers of memory (Schama 1995). It should come as no surprise that the ocean forms a popular stage for folklore and myths.

The ocean impacts the people

In this respect, it can be expected that offshore developments will have a certain socio-cultural impact on coastal communities. An example of such impacts can be found in Hammerfest, a small town (approx. 10,500 inhabitants) at the northern coast of Norway. According to Loe and Kelman (2016), Hammerfest owes its current prosperity to offshore oil and gas industries. Up until 1984, the towns economy could offer little livelihood prospects and unvaried job opportunities. This lead to severe depopulation and unemployment. The arrival of oil industry revived Hammerfest, creating job opportunities and cultural development which attracted a new, younger population. Local interviewees describe the offshore petrol development as “a blessing” (Loe and Kelman 2016).

The socio-economic benefits of the oil industry in Hammerfest are easy to measure, but the offshore developments did more than just increase local job opportunities. According to the interviewees it also changed the mindset and lifestyle of the inhabitants. Transitioning from a culture where neighbours, family and ‘soft’ values were important to a society that emphasises status and income (Loe and Kelman 2016).

The people impact the ocean

It is clear that changing conditions at sea impact us, but we should not forget that the reverse is true as well. Is it not us, humans, who cause climate change, sea level rise and water pollution? Is the increasing petrol industry at the Barents Sea not also a result of consumer behaviour (Staalesen 2019), of the cars we drive and the furnaces we cook on? Socio-cultural conditions impact the ocean as a biophysical system. If we understand the complexity of these relations and employ them in marine planning and design, they could play an important role in reaching climate objectives (UNRISD 2012).

Marine spatial planning should acknowledge coastal communities as a group of people that strongly relates to the ocean and is sensitive to its alterations. As agreed upon in 2015 during the UN sustainable development summit in New York, sustainable development should consider the relationship between society and the natural world (UN 2015). To achieve sustainable oceans, social sustainability cannot be forgotten.

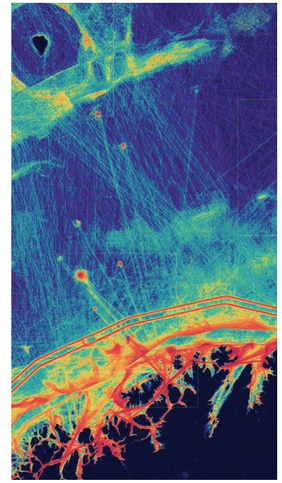

Fig. 2

Mapped marine traffic density in the Atlantic Ocean in 2019 and snapshot of vessels at sea on December 3rd of January 2021 at 14:02. Red areas mark high traffic density over 1.800.000 routes / 40 km2 in 2019.

Source: MarineTraffic 2020

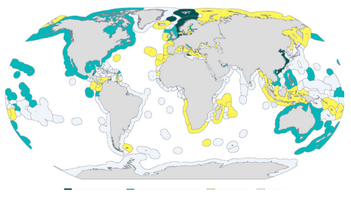

Fig. 3
Exclusive economic zones (EEZ) marking the application of MSP. In Black: MSP approved for the entire national space; Green: MSP approval only for a part of the national space; Yellow: MSP underway.

Source: Santos et al. 2018

1.
Although EEZ now mostly entails the rights to extract resources, the initial purpose of Mare Clausum was defence (Gee 2019). Nations were allowed to deny access to foreign ships, keeping them at a minimum distance of 200 nautical miles which was, at the time, the furthest distance a canon was able to shoot.

4. Why we cannot apply terrestrial principles

More so than land, the ocean is dynamic and everchanging. Maps and planning documents falsely represent the ocean as a static surface, obscuring the constant movement of water (Gee 2019). In spatial terms this provides some difficulties, as no particle of water stays ever in the same place. Due to its mobility, water cannot be bound by administrative borders and can thus not truly belong to a nation. According to Hugo Grotius, a Dutch jurist and philosopher, private or public ownership of the sea is therefore impossible if not immoral. A free ocean, Mare Libirum (Grotius 1609), is an ocean that owns itself ("Embassy of the North Sea" 2020). This attitude creates some difficulties for marine planning. How can we represent the constant movement of the ocean in planning, how can we locate anything on sea, and how do we plan for an ocean that we do not own?

Opposing the construct Mare Libirum stands Mare Clausum, a doctrine developed by John Seldon in 1635. In principle, Mare Clausum, the enclosed sea, allowed nations to have the right to resources and jurisdiction over their neighbouring waters up to 200 nautical miles[1] from the coastline. These borders are still applied today to enclose the Exclusive Economic Zones (fig. 3).

However, these borders still cannot contain the water itself; nor fish populations, or spilled oil. There is but one continuous ocean (fig.4), which we all share (Santoro et al. 2017). More so than terrestrial planning, marine planning should look beyond national borders.

Novelty

The topic of marine planning is quite new, especially compared with terrestrial planning, which has been an object of study for centuries in urbanism, city planning, architecture, social studies and philosophy. The principles that currently guide terrestrial planning have been formed over years of research, trial and error. Marine spatial planning, being roughly 20 years old, does not enjoy this advantage.

In addition to this, the majority of the ocean space remains unmapped and unknown (Santoro et al. 2017). Although the whole ocean floor has been mapped at a 5 km resolution, less than 0.05 per cent has been mapped at high resolution that is needed for detecting important ocean features and informing scientific research. In fact, the surface of Mars, the Moon, or Venus has been mapped to a higher level of detail than the surface of the Earth' s ocean.

Because the seascape is inherently different from land, terrestrial planning principles cannot be thoughtlessly applied to marine planning. Considering the novelty of marine planning and the amount of marine space that remains unknown, we should face marine planning principles critically and aspire it to be a process that is iterative, flexible and evolving.

5. Marine Spatial Planning

Definition and intentions

The increasing demand of marine uses and the risks that come with it triggered the first applications of marine spatial planning (MSP) in 2005 (Ehler 2020). Many definitions of MSP coexist, but the most commonly agreed upon is "a public process of analysing and allocating the spatial and temporal distribution of human activities in marine areas to achieve ecological, economic and social objectives that have been specified through a political process" (IOC 2006). An easier definition might be: the political process of spatial organisation of marine uses. In order to guide this process, the European Committee developed an MSP framework providing directives for decision-makers for the planning of sustainable marine space and development (EC 2014).

Member States are expected to establish their marine spatial plans before the end of March 2021. Although MSP initiatives can be found in numerous countries across the globe, only the Netherlands, Belgium, Germany and Norway have been so far committed to a long-term planning process and have published revisions of their first plans (Ehler 2020).

The missing layer

MSP operates on three different domains of governance: the environmental, economic and social domain. This becomes evident from the aforementioned purpose of MSP: "[…] to achieve ecological, economic and social objectives" (EC 2014, p.140). Interestingly, of these three domains the social domain is alarmingly underdeveloped (Gissi, Fraschetti, and Micheli 2019; McKinley, Acott, and Stojanovic 2019). The few studies that do adress social dynamics in MSP focus solely on the engagement of stakeholders and their economic interests (Craig, 2012; Mileriene et al. 2014).

Yet, the socio-cultural domain of MSP extends far beyond mere stakeholder analysis. It entails many facets of our society, including local identity, attitudes towards the ocean and cultural ecosystem services. Unfortunately, CES is the most underdeveloped type of ecosystem services in both literature and practice. Studies that do discuss CES usually have a terrestrial focus.

This socio-cultural understanding forms the missing layer (St. Martin and Hall-Arber 2008) of MSP and is neither mapped nor integrated into the planning process (Shucksmith and Kelly 2014).

6. Issues with socio-cultural data

Fortunately, there does not seem to be a lack of motivation to include socio-cultural data in marine spatial planning. The EU Directives specifically state the importance of creating sustainable land-sea relations while considering "economic, social and environmental aspects to support sustainable development and growth in the maritime sector" (EU 2014, p.141). Moreover, many of the marine plans currently in place do make an effort to include CES. The Norwegian management plan for the Barents Sea, for example, devotes a whole paragraph on cultural ecosystem services acknowledging them as an essential factor for our well-being and quality of life (Norwegian Ministry of the Environment 2011).

Non-monetary values in economic analysis

Although Member States seem willing to include ecosystem services in trade-offs, the qualitative nature of CES makes it challenging to do so. Most of the services refer to public goods that do not have market value, which makes them difficult to compare to other factors in quantitative analysis (Norwegian Ministry of the Environment 2011). As a result, most societal impacts of offshore developments on coastal communities cannot be estimated to inform trade-offs in the planning process.

There have been several attempts to develop tools to describe and translate non-monetary values to economic values (McKinley, Acott, and Stojanovic 2019). For example, recreational value could be measured through the economic contribution of tourism. However, such a method could not measure the influence of recreation on local stress levels. Certainly, the cultural value of the ocean can only be approximated in monetary terms to some extent.

Subject to time and space

Socio-cultural data is subject to variations in time and space. That is to say that these values are different for every community. Even within a community on a certain location values can change with time (Shucksmith and Kelly 2014). Socio-cultural data cannot be generalised for multiple locations and communities. As a result, it becomes near impossible to establish and maintain a complete, up-to-date socio-cultural database.

Limitations on capacity

The collection of socio-cultural data is predominantly qualitative and requires intensive labour and time. As opposed to quantitative data, the process of collecting socio-cultural data is largely inductive. The researcher interprets the meaning or quality of the collected data. This approach requires hands on engagement through conversation (e.g. interviews, surveys), workshops or other forms of participatory mapping in the field. Collecting socio-cultural data is limited by the local capacity to provide such engagement.

No physical anchors on ocean space

In terrestrial planning, socio-cultural values can be mapped through their attachment to objects in space. For instance, a community might value a local park for its tranquillity, or a monumental tree that has marked the town square for generations. Such objects can easily be highlighted in conventional plans or maps. In contrast to terrestrial landscape, the marine landscape does not provide physical anchors through which socio-cultural values

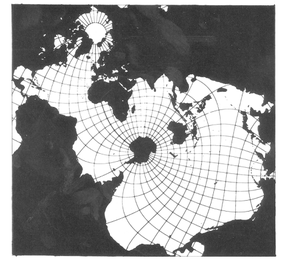

Fig. 4
The Spilhaus projection of the one continuous ocean. The ocean, and human impacts on the ocean are shared by all.

Source: Spilhaus 1942

can be located in space. This might be one of the key issues of conventional mapping methods.

Notions of truth

Our society consists of a high variety of audiences that each hold different values, perceptions and beliefs in respect to the ocean (McKinley, Acott, and Stojanovic 2019; Gee 2019). When mapping socio-cultural values, we cannot aim to find one objective truth, because socio-cultural realities are personal (Latour 2017; Berger and Luckmann 1966). The action of mapping should aim to find an understanding of these different realities, by means of representation (Corner 1999). Problematically, the subjective, ambiguous data this type of research would produce is not easily represented through conventional mapping methods.

Restrictions within planning policy

It becomes increasingly normal to formally validate the quality of datasets and the methods through which they are obtained. In order to be accepted into the decision-making process, datasets need to meet a range of criteria on completeness, methodology, accuracy, level of granulation and objectivity (Shucksmith and Kelly 2014). Considering the abovementioned issues, socio-cultural data can impossibly meet all criteria and will not be accepted into the decision-making process.

Ultimately, the qualitative, subjective and changeable nature of socio-cultural data creates considerable difficulties in collecting and representing it within the current policy framework of marine spatial planning. You could say that we have been treating the MSP policy framework as Maslow' s Hammer2 . Evidently, MSP policy does not possess the appropriate tools to understand and employ human-sea relations.

7. What can design offer?

A solution to this problem can be found through an interdisciplinary approach. Where MSP lacks in socio-cultural knowledge, we can find it in sociology, arts, philosophy, geopolitics, archaeology, landscape architecture and urbanism. These disciplines are not bound by the same restrictions as MSP for collecting data and can provide valuable insights and methods.

Particularly, design can offer an interdisciplinary approach to socio-cultural analysis, as it operates at the interface between art and science (Lee 2011). Where science characteristically relies on facts, art relies on the perception of these facts. If we are to understand human-sea relations, we need to reflect on both. Design can do this; it interprets facts as well as perceptions to develop analysis and planning strategies. As such, design is able to embrace subjectivity where MSP policy cannot. Design can be used as a tool to understand (Schama 1995; Lahoud 2016) human-sea relations.

In addition to this, design is able to represent these human-sea relations through cartography (Bryant 2014). Of course, many MSP policy documents use maps as a tool to visualise or localise data. For example, to map marine areas that prohibit fishing. But cartography is so much more than just the spatial visualisation of data. Mapping, as an act of design, has the power to convey meaning. What does it mean to be at sea? What does it mean to be changed by the sea and to change it in return? As James Corner so beautifully phrases it, mapping is "a fantastic cultural project, creating and building the world as much as measuring and describing it." (Corner 1999, 213). It both uncovers and envisions realities. Mapping is a great design tool to represent the meaning of human-sea relations.

As planners and designers we should open the discourse of urbanism to marine spatial planning. Urbanism is context oriented and location specific (Lee 2011). It acknowledges that socio-cultural values cannot be generalised for multiple locations and communities. Just like MSP, urbanism is a spatial practice. If we research the spatial manifestation of human-sea relations (eg. population density at the coastline) we could learn how the urbanisation of the ocean can accommodate for socio-cultural demands and mitigate negative impacts of offshore development on coastal communities. By defining the socio-cultural demands of marine space, they can compete with other marine uses in the MSP process.

Moreover, synergetic opportunities with other marine uses can be designed to create more sustainable outcomes. A wonderful example is the project Sandmotor, along the coast of The Netherlands (Rijkswaterstaat and Provincie Zuid Holland 2020). The Sandmotor is an artificial sandbar that protects the dunes from eroding. Without it, the sensitive dune biodiversity would be lost and human settlement behind the dunes would risk flooding. Simultaneously, the project created a unique coastal space, both sea and land, that became a very popular spot for windsurfing. The main purpose was to keep the sea at bay, a fight that has since long been embedded in the Dutch culture. Yet, in a way, the project brought people closer to the ocean as well.

The Sandmotor demonstrates both the challenge and the beauty of offshore urbanism. To create marine space that is both socially and environmentally sustainable. To protect and connect. To understand, represent and employ human-sea relations as driver for positive change. In short, offshore urbanism can offer an interplay between research and design that is key for the sustainable development of the ocean as an urban space and as a social space.

8. Conclusion

Owing to the extensive occupation, settlement and inhabitation, we can conclude that the ocean is an urban space. The increasing demand of marine uses pressure the ocean ecosystem, which is already at a tipping point, and require spatial planning. Because the seascape is inherently different from land, terrestrial planning principles cannot be thoughtlessly applied to marine planning. A new discourse of spatial planning specific for the marine environment is needed. We should face marine planning principles critically and aspire it to be a process that is iterative, flexible and evolving.

Marine Spatial Planning (MSP) makes an effort to organise marine uses and ensure sustainable offshore development, but the discourse on MSP is young and evolving. Especially the socio-cultural domain remains alarmingly underdeveloped, forming the missing layer of MSP. Although there does not seem to be a lack of motivation to include socio-cultural data in MSP, its subjective and changeable nature complicate its incorporation in trade-offs. As a result, socio-cultural impacts of offshore developments on communities on shore remain unmapped and unknown.

If we consider the ocean a social space as well as an urban space an understanding of human-sea relations is imperative. This implies to acknowledge coastal communities as a group of people that strongly relates to the ocean and is sensitive to its alterations. Offshore urbanism needs to consider socio-cultural demands, risks and opportunities in order for it to be socially sustainable. Moreover, if we understand the impact socio-cultural conditions have on the ocean as a biophysical system, they could play a key role in reaching climate objectives.

Due to restrictions in data collection MSP policy does not possess the appropriate tools to represent human-sea relations, but design does. Firstly, design operates at the interface between art and science, it uses both facts and interpretations. As such, design can embrace subjectivity. Secondly, design can offer a spatial understanding of socio-cultural demands, allowing it to compete with other marine uses in MSP trade-offs. In addition to this, design is able to visualise the meaning of human-sea relations through cartography. Finally, urbanism can offer interplay between research and design that is key for sustainable development of marine space. As a conclusion, marine spatial planning should aim to understand, represent and employ human-sea relations as driver for positive change; and open the discourse to offshore urbanism.

Implications

If we are to use urbanism as an addition to marine spatial planning, more scientific knowledge on ocean dynamics is needed. Our understanding of the ocean and its contribution to sustainable offshore development largely depends on our capacity to conduct scientific research. Taking into account that the majority of the earth' s ocean remains unmapped, this implies providing necessary funding and infrastructure to do so.

As an undeniable element of offshore urbanism, at least a part of marine research should focus on understanding human-sea relations and socio-cultural impacts. Although

the application of cultural ecosystem services theory in offshore urbanism is promising, it is still too underdeveloped to properly inform either marine urbanism or spatial planning. Recommended lines of inquiry could be the translation of socio-cultural demands in terms of marine space, the visual representation of local values, or synergetic opportunities of combining socio-cultural demands with other marine uses to create positive outcomes.

Alongside scientific research, the role of education systems is equally important. Universities can contribute by including the study of marine space in the design curriculum and engaging both students and academics in the offshore urbanism discourse. Even so, a socio-cultural understanding of the ocean cannot be achieved by academics alone. It is essential that marine citizens understand the ocean' s impacts on society and the impact society has on the ocean. Education systems should aim to achieve public ocean literacy that induces informed and responsible behaviour towards ocean resources, leading to more ocean-sustainable societies.

Limitations

This paper focused on the lack of socio-cultural considerations in marine spatial planning and the potency of design to bridge that gap. Naturally, the topic of offshore urbanism could also be approached from many other perspectives. For instance, the issues of cross-border marine planning, the role of the marine environment in climate change, geopolitical conflicts in international waters, participatory marine planning, alternative forms of subjective mapping, local attitudes towards marine issues or ocean ontologies. Each of these topics deserve in-depth attention, but within the limitations of this paper, I could just present a small tip of the iceberg that is offshore urbanism. To go in depth for all of them would be to write a book, or perhaps a thesis.

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METHODOLOGY CHAPTER P2

At the core of any research lies the methodology. Without it, the research is ungrounded or even illegitimate. The same goes for the work before you. This chapter on methodology explains and justifies my research approach while aligning it with the problem statement, research question and the research purpose. All in all, the aim of the methodology chapter is to provide a roadmap of the steps taken in this research, which is transparent and reproduceable. It is a rationale that both critiques and validates the choices made along the road.

WHAT?

1. Conceptual framework
   Provides a quick overview of the research concept. It uncovers the problem fields and paradigms through which I position myself in the relevant discourse and the constructs used to tackle the research question. The conceptual framework is a great tool to gain an understanding of what this thesis intends to research in a glance.

2. Analytical framework
   Discusses the scales of influence and relevant domains that the thesis works within. The purpose of the analytical framework is to outline the limits of the thesis.

HOW?

3. Theoretical framework
   Provides an evidence based argumentation for the scientifical relevance of the research and positions it in the current literature. In order to do so, I will map the theoretical constellations and literature that substantiate the research and form my frame of reference.

4. Research framework
   Presents the overall structure of the research and the actions to take to reach the expected outcomes. The research framework also contains a list of research and design methods I expect to apply throughout the research.

1. CONCEPTUAL FRAMEWORK

We start to draw our roadmap with the conceptual framework. This framework does not include all theories, constructs and methods that are a part of this thesis. It just means to provide a quick overview of the base concept from which the rest of the research will ramify. The trunk of the tree, if you will.

The conceptual framework is devided by three parts, as you can see in figure 1 below. The left side of the framework describes the problem fields, problem statements and paradigms that lead me to define the research purpose. The right side of the framework poses some key constructs that help me approach the research question. The central part of the framework shows the expected outcomes of this thesis. We start at the left side of the conceptual framework, by defining the problem fields

1.1 Problem fields

As you can see in the framework (figure 2) the problem fields consist of three topics: human-sea relations, representation and offshore urbanism. Together, these topics form a red line throughout the methodology.

Human-sea relations

The Barents Sea is subject to heavy marine industrialisation and large scale developments. The increase of oil industry at the sea endangers the subtle balance of marine ecosystems, changes the character of the coast, pushes harbour capacity beyond its limits, and stresses a climate that is already at a tipping point.

As a reaction to this development, academics from all over the world have researched the impacts of offshore industrialisation on the ocean ecosystem, marine economy, and climate. However, the socio-cultural impacts of these offshore developments on coastal communities remain unmapped and alarmingly underrepresented in research and practice (McKinley 2019).

Offshore urbanism

The same issue is reflected in the current marine spatial planning (MSP) documents that organise marine uses at the Barents Sea (Norwegian Governemnt 2011). Although the purpose of MSP is to ensure sustainable offshore development (EU 2014), the decision-making proces does not regard socio-cultural impacts and is thus ignorant to the risks and opportunities of this domain. It could be questioned if any development that does not regard societal impacts can be deemed sustainable.

A promising theory that adresses human-ecosystem relations and impacts is CES (Cultural Ecosystem Services). CES regards the non-material benefits people derive from nature. Unfortunately, it remains the most underdeveloped form of ES in both theory and practice (McKinley 2019). The research that does adress CES is mostly confined to terrestrial planning.

The marine spatial plan for the Barents Sea does briefly adress CES, but they were unable to include socio-cultural data in the trade-off assessments, because these assessments are of an economic nature. Most cultural ecosystem services are non-monetary and are difficult to translate to economic values.

Representation

This problem can be traced back to the current methods of data collection and cartography used in marine spatial planning. Large scale offshore development generally relies on mapping through dominant power structures. Conventional mapping methods focus on objective, mostly quantitative data of an administrative or proprietary nature. These conventional ways of mapping are not able to represent socio-cultural values, or visualise human-sea relations.

1.2 Positioning

The problem statements help me to take a position in the current discourse. The positioning argues what should be done, why it should be done in the case of the Barent Sea and a first idea of how it can be acchieved.

- What? Visualise the potential role of the socio-cultural dimension in offshore urbanism.
- Why here? To ensure offshore industrialisation at the Barents Sea that is socially sustainable on shore.
- How? By the means of non-conventional mapping methods that represent socio-cultural relations to the sea.

In my positioning I am inevitably biased by my own worldview, my ontology. I find that my worldview is aligned with the logic of constructivism. Constructivism builds on the belief that reality is personal, subjective. It takes shape and exists only through the perceiver. Therefore, there is no one truth and research should not persue to find it. Instead, research should aim to find an understanding. Through the eyes of this philosophy, the use of subjective data and local knowledge is of high value in research. This statement is supported by the Sustainable Development Goals (UN 2015; UNRISD 2012). Specifically goal number 11, which states: “Ensure sustainable cities and communities”, which seems to acknowledge the importance of social factors for sustainable development.

- Why anywhere? Multitude of local worldviews are valuable for sustainable urban planning, also at sea.

1.3 Purpose

The purpose of this research is to visualise the potential role of the socio-cultural dimension in offshore urbansim through mapping, and in doing so, to open a pathway towards socially sustainable development at the Barents Sea.

1.4 Constructs

The right side of the conceptual framework starts with posing a selection of constructs which have the power to help me approach the research question. Each of the constructs in the conceptual framework are outlined in a certain colour, that corresponds with one of the three problem fields: human-sea relations, representation, and offshore urbanism. I will provide a brief discription of these constructs and indicate how they can be applied in the research.

Ocean literacy

A knowledge or understanding of the influence people have on the ocean and vice versa (UNESCO 2020; National Marine Educators Association 2019). Ocean literacy is about education and awareness. It recognises seven principles:

- the earth has one big ocean (fig.3),
- the ocean and life on the ocean shape the features on earth,
- the ocean is a major influence on wheather and climate,
- the ocean makes the earth habitable,
- the ocean supports a great diversity of life and ecosystems,
- the ocean and humans are inextricably interconnected,
- the ocean is largely unexplored.

Application: the principles of ocean literacy should form the basis of marine urbanism, an ocean ontology which this thesis will expand and build on.
Power: TO UNDERSTAND

Marine citizenship

Understanding the rights and responsibilities people have towards the ocean. Marine citizens display an awarenes of and concern for marine issues, and the impact people have on the marine environment.

Application: Researching the degree of marine citizenship in Hammerfest can provide an understanding of local human-sea relations.
Power: TO UNDERSTAND

Storytelling

A story is a sequence of words creating a narrative or account of imaginary or real events, people and places. It often contains a representation of the speakers identity, experience or opinions. The same story told by different storytellers can communicate different meanings and emotions, even whenit is reproduced word for word. Similarly, a book can convey different messages to different readers, even though the book itself does not change. In this light, storytelling is never free from subjectivity.

Application: I will use storytelling in particular in the writing of the manifesto.
Power: TO COMMUNICATE

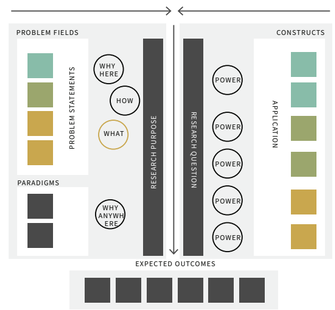

Fig. 1
How to read the conceptual framework

Fig. 2 (next page)
The conceptual framework.

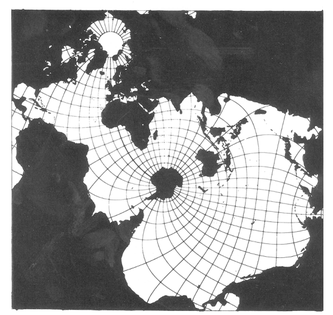

Fig. 3
Spilhaus Projection of the one continuous ocean.
Source: Spilhaus, 1942.

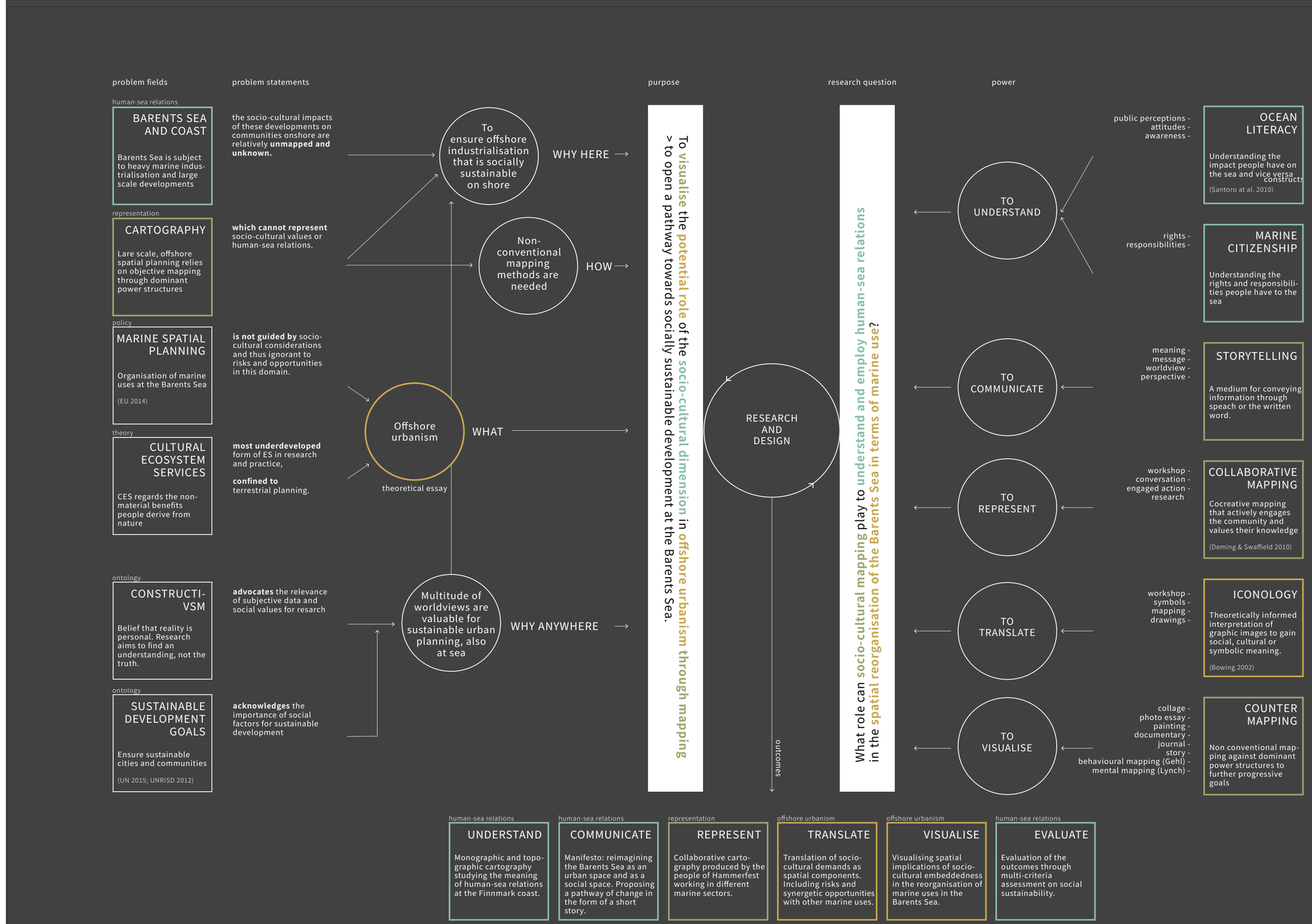

Fig. 2

The conceptual framework. A diagram of the research concept, providing a quick overview of the problem fields, problem statements, purpose, constructs and research question.

Source: by author

Fig. 4
Migration of Salt Mother. Exposed in the A:shiwi A:wan Museum & Heritage Center in New Mexico, USA. Source: Larson Gasper, 2009.

Collaborative mapping
Cocreative mapping that actively engages the loal community to produce cartography. Engaged action research embraces subjectivity off all experience. It is not merely an action of emancipation, engaged action research really values the knowledge and worldviews of the community and intends to treat the gathered data with importance. It is strategic rather than procedural (Deming & Swaffield 2010).

Application: I will use collaborative mapping to represent socio-cultural values during the workshop 'Atlas by Hammerfest' .
Power: TO REPRESENT

Countermapping
"More land has been lost to mapping than to conflict" (Emergence Magazine 2018). These are the words of Jim Enote, a traditional Zuni farmer and director of the A:shiwi A:wan Museum & Heritage Center in New Mexcio, USA. It shook me to hear these words, because I realised the truth in them. Conventional mapping is proprietal. The base of all our maps are the administrative borders of nations, regions, municipalities. The maps I make are no exeption (see the base maps in figure 7).

Conventional mapping is based on claimation of land and sea, it is a geopolitical act. Perhaps the root of this problem origines from the days of colonisation, when men crossed the ocean to find new land. In 1770, Lt James Cook sailed along the Australian coast and declared the land he 'discovered' to be empty, a terra nullius: land belonging to no one. In doing so he justified British occupation without treaty or payment to the more than 400 different aboriginal nations that were in fact living on the Australian land (Aboriginal Heritage Office 2020). As a result of the brutal colonisation that followed, much of the land, its people and its culture was lost. If it is not on the map, it is not there, it has no rights.

Jim Enote works with Zuni artists to create alternative maps of the native American land (see fig. 4). These maps "bring an indigenous voice and perspective back to the land, countering Western notions of place [...] and challenging the arbitrary borders imposed on the Zuni world" (Emergence Magazine 2018). He is creating counter mappings.

Counter mapping opposes dominant power structures to further progressive goals. It can take many forms, including photography, paintings and collages. The maps are not bound to scale and can combine sections, plans, symbols and text to convey a certain message. Mostly, countermapping aims to convey the meaning, memory or quality of a place. But it is also possible to visualise quantitative data through counter mapping, like Jamers Corner does beautifully in Taking Measures Across the American Landscape (1996) (see fig. 5).

Counter mapping can also be used as an analytical tool. For example, Jan Gehl' s behavioural mapping documents objects in space influence the movement of individuals in public space. And Kevin Lynch' s mental mapping documents the city through memorable landmarks, paths, edges, nodes and areas as they are experienced by the pedestrian. Similarily, Lehman-Frisch investigated gentrification of Paris neighbourhoods through its childrens eyes (Lehman-Frisch 2012). She asked local children to draw their neighbourhood from memory, in an attempt to reveal what spatial elements children consider important. Such as, a road with fast driving cars, a friends house, a park with tree to climb in (see fig. 6).

Application: The workshop 'Atlas by Hammerfest' engages the community to produce counter maps of the Barents Sea and coast.
Power: TO VISUALISE

Iconology
Theoretically informed interpretation of graphic representations to gain social, cultural meaning or significance (Bowing 2002).

Application: I will use iconology to interpret the counter maps produced in the workshop through collaborative mapping.
Power: TO TRANSLATE

1.5 Research question
The constructs help me to define more precisely the research question: What role can socio-cultural mapping play to understand and employ human-sea relations in the spatial reorganisation of the Barents Sea in terms of marine use?

1.6 Hypothesis
Socio-cultural mapping can be used

- as an act of research: to understand and visualise human-sea relations,
- as an act of design: to employ and embed these relations in the spatial reorganisation of marine uses,
- as a driver for positive change in the Barents Sea.

1.7 Expected outcomes
In line with the research question, the outcomes of this thesis will have to demonstrate the role and power of socio-cultural mapping in offshore urbanism. Beneath, the expected outcomes are stated ordered by type of power.

TO UNDERSTAND
Monographic and topographic cartography studying the meaning of human-sea relations at the Finnmark coast.

TO COMMUNICATE
Manifesto: reimagining the Barents Sea as an urban space and as a social space. Proposing a pathway of change in the form of a short story.

TO REPRESENT
Collaborative cartography produced by the people of Hammerfest working in different marine sectors in workshop 'Atlas by Hammerfest' .

TO TRANSLATE
Translation of socio-cultural demands as spatial components. Including risks and synergetic opportunities with other marine uses.

TO VISUALISE
Visualising spatial implications of socio-cultural embeddedness in the reorganisation of marine uses in the Barents Sea

TO EVALUATE
Evaluation of the outcomes through multi-criteria assessment on social sustainability.

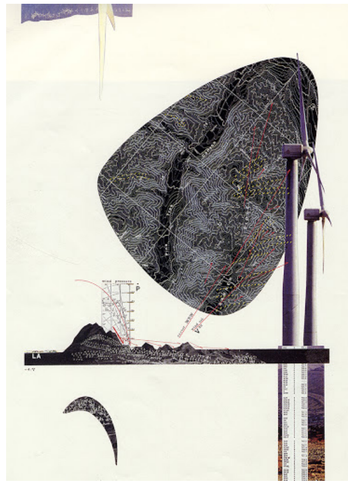

Fig. 5
Taking Measures Across the American Landscape. Source: James Corner, 1996.

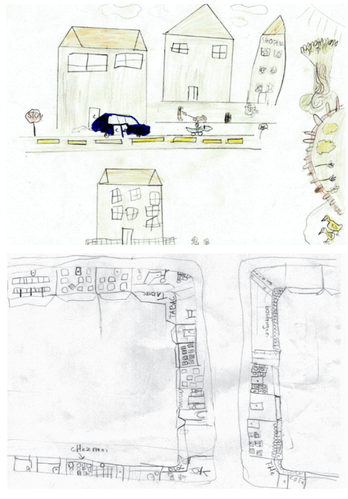

Fig. 6
Top: Oliver' s neighbourhood, drawn by Oliver.
Bottom: Lilian' s neighbourhood, drawn by Lilian.
Source: Lehman-Frisch, 2012

2. ANALYTICAL FRAMEWORK

In a nutshell, this thesis studies the socio-cultural relations between the community of Hammerfest and the urban development of the Barents Sea. Hammerfest can be mapped on a scale of 1:50.000 on A3 paper. The entirety of the Barents Sea is mapped on a scale of 1:7.000.000 on the same paper. This massive difference in scale forms one of the key challenges in the thesis. It requires a cross-scalar approach and the acknowledgment that the socio-cultural scale of influence is larger than just Hammerfest.

It is easy to understand that phenomena on every scale (climate change, sea level rise, economic regression, air pollution) can impact society on a socio-cultural scale (UNRISD 2012). But we should not forget, that the reverse is true as well. Is it not us, humans, who cause climate change, sea level rise and air pollution? Is economic regression not also a result of the changing behaviour of consumers? Socio-cultural conditions impact both larger and smaller scales. If we understand the complexity of these relations, the socio-cultural dimension could play an important role in reaching climate objectives.

In line with this idea, the role of urbanism exends across the scales as well, studying urban processes from nano to global: a planetary urbanism (Lefebvre 1970). The ocean, being a part of this urban planet, cannot be left out of urban studies.

Although the relations between climate, industry (economy) and society are all interesting and to a certain degree relevant to our case, this thesis will focus on the relations between society and the sea. Or: socio-cultural and biophysical scale.

The term biophysical may need further explanation. From geography we can take the following definition: A biophysical environment is “the biotic and abiotic surrounding of an organism or population, and consequently includes the factors that have an influence on their survival, development and evolution.” (NWRM 2020). The organisms or populations studied in biophysical research are generally animals. In this research, I look at the Barents Sea as being a biophysical environment for humans or the human population, that consequently includes the factors that have an influence on our survival, development and evolution.

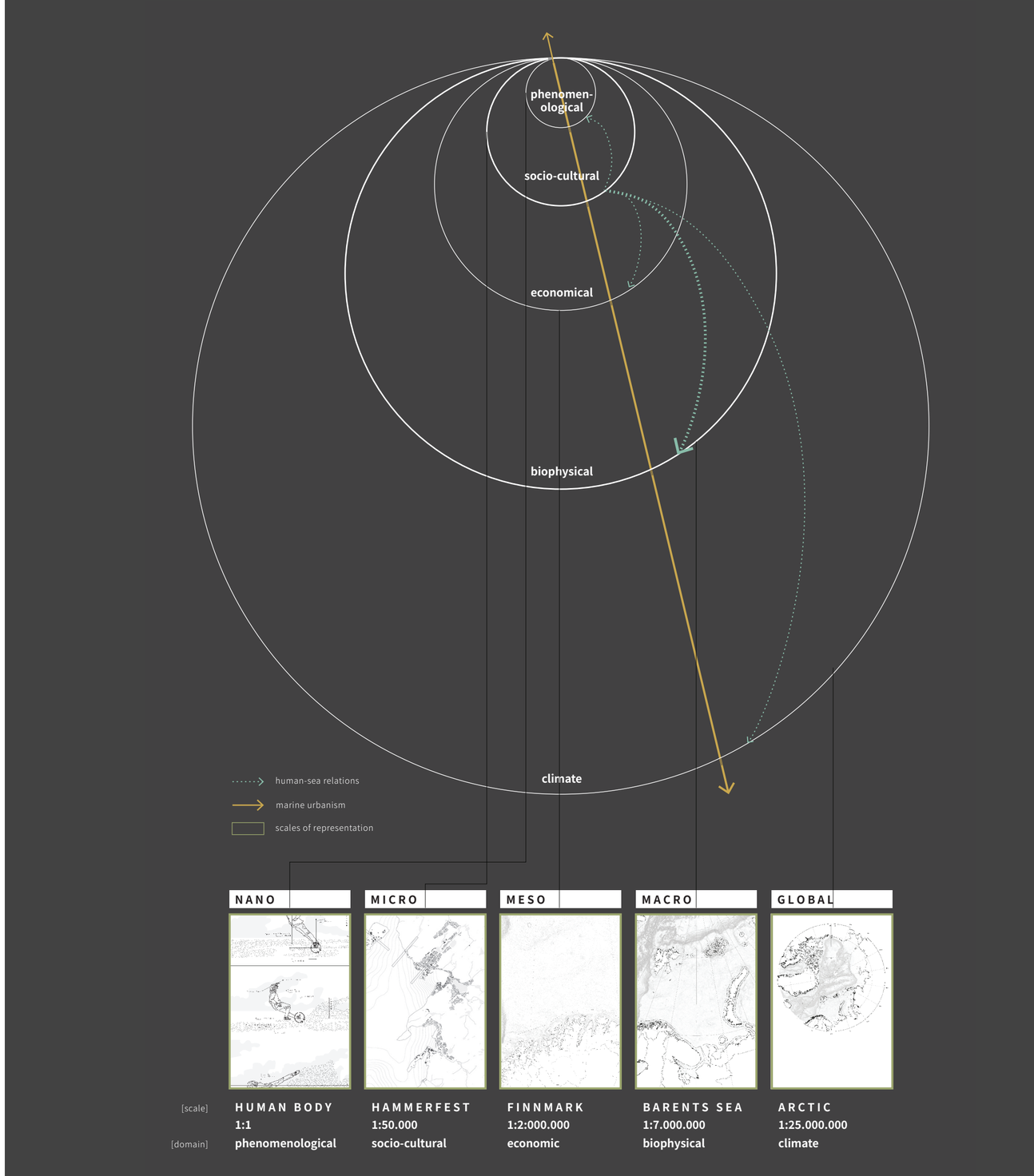

Fig. 7 right
The analytical framework, scales of influence and domains. Source: by author.

3. THEORETICAL FRAMEWORK

The theoretical framework maps the most important pieces of literature that support this thesis. The theories are mapped within an adaptation of the onion diagram (Czischke 2018) also visable in the analytical framework in figure 7. The rings of the onion represent the different scales and domains of the thesis:

- phenomenological,
- socio-cultural,
- economic,
- biophysical,
- climate.

The three parts of the onion represent the problem fields of the thesis, which are explained in the first part of this chapter in the conceptual framework:

- human-sea relations,
- representation,
- offshore urbanism.

By mapping the literature in this way, we can visualise to which problem fields they contribute and identify relations between them. In doing so a constellation frame of reference is created, on which we can reflect.

It is clear that the left-bottom of the map is denser than the top-right side. This can be explained by the fact that most sources adressing human-sea relations focus on smaller scales. Similarily, sources that adress marine planning focus on the larger scales. There seems to be a gap in research that connects human-sea relations to the larger scale of the ocean or climate. With the exemption of Bruno Latour' s work and one edition of Harvard Design Magazine called 'Wet Matter' (2014). Both of these sources build on the importance of human-sea relations as a basis for oceanic or climate research.

Another observation can be made along the axes of the onion. Theories that are located along the axis between 'human sea relations' and 'representation' would adress the mapping of human-sea relations. Theories that are located along the axis between 'representation' and 'offshore urbanism' would adress the role of mapping in marine planning. These sources are of significant importance. Unfortunately, I have not disovered many of such sources.

The thesis adds to the current discourse by bridging the gap between the three problem fields and by approaching the research from an urbanism perspective.

Please note that this map contains just a small part of the actual amount of literature available. The map serves as a visualisation of the theories that so far informed my research. As such, the conclusions as drawn above might be premature. Nevertheless, the current theoretical framework provides a useful tool to reflect on the current discourse and the theories informing my research as I continue to discover and elaborate it in the next six months.

Fig. 8 right
The theoretical framework, a constellation frame of reference. Source: by author.

4.1 RESEARCH FRAMEWORK

In the previous paragraphs, we have stated the problem fields, problem statements, research purpose, research question, expected outcomes, key constructs and theories. The research framework will go further into detail as to the step by step structure that I will follow to arive at the expected outcomes.

Breaking down the research question into subquestions serves as a guide to. Each of the subquestions are highlighted with a colour corresponding to one of the three problem fields that they contribute to most.

Research question
What role can socio-cultural mapping play to understand and employ human-sea relations in the spatial reorganisation of the Barents Sea in terms of marine use?

Subquestion

SQ1. What are human-sea relations?

SQ 2. What human-sea relations can be observed between Hammerfest and the Barents Sea?

SQ 3. What is the position of these relations as a socio-cultural layer within the complex system of the ocean?

SQ 4. How can we understand and represent human-sea relations through the act of mapping?

SQ 5. How can we describe the socio-cultural demand for marine space?

SQ 6. What synergetic opportunities and can be identified between socio-cultural uses and other marine uses?

SQ 7. What are the spatial implications of reorganising human uses on the Barents Sea, when socio-cultural demand for space is taken into account?

SQ 8. (How) will the human-sea relations change as a result of this reorganisation?

SQ 9. How can we evaluate the outcomes of reorganisation on social sustainability?

Reading the framework
The backbone of the research framework are the phases (fig. 9). The structure of these phases is derived from Levi R. Bryant' s onto-cartography (2014) and follows the sequence: Cartography, Deconstruction, Terraforming. Or in other words: Inquiry, Strategy, Design (Deming & Swaffield 2010). It might be good to clarify that the Cartographic phase refers to the first inquiry or inventorisation of data. The act of mapping will be an important component througout all of the phases.

Every phase contains a number of actions and subactions that apply a selection of methods to gain a certain output. The output of every phase triggers and informs the next phase. Each of the outputs is once again highlighted in the colour that corresponds to one of the three problem fields and the subquestions that they contribute to most.

Phase 1. Cartography
The research starts with monographic mapping of the site throughout the different scales. The monographs follow four lines of inquiry, which observe and explore human sea relations at the Barents sea:

- matter: to be at sea,
- topos: to be changed by the sea,
- habitat: to change the sea,
- geopolitics: the right to the sea.

The monographic research will help to inform the next step: topographic mapping, which will map position of the human-sea relations as a socio-cultural layer within the complex system of the ocean.

Phase 2. Deconstruction
The monographic work of all graduation students of the Transitional Territories studio will be publicly presented during a Symposium. Due to present conditions of the Covid-19 crisis, it is not possible to organise the symposium in the faculty as was done previous years. Instead, the symposium will take form online. The work will be on display on an interactive website and will be presented to the audience by the students through an online streaming service. Due to these unusual circumstances it might be challenging to curate the work in a way that stimulates interaction and informal discussions between the students and the audience.

The aim of the symposium is to review and organise the produced monographs to form a narrative that communicates the main conclusions to the audience and engage them to think and reflect on the produced work.

Curating the symposium is done in collaboration with fellow students. As we analyse eachother' s work and seek alignments within them, we find a new gaze on the world and can propose a line of action, that is necessary, albeit uncomfortable.

Phase 3. Terraforming
The symposium helped me to formulate a personal worldview, I will communicate this worldview by means of a short story: a manifesto. A story often contains a representation of the speakers identity, experience or opinions. The same story told by different storytellers can communicate different meanings and emotions, even when it is reproduced word for word. Similarly, a book can convey different messages to different readers, even though the book itself does not change. In this light, storytelling is never free from subjectivity. The aim of the manifesto is threefold:

- to worldbuild, a term borrowed from creative writing, that means to describe the world or 'what is' ,
- to pose ethical considerations on 'what should be' ,
- to propose a design as a response to this unfamiliar world: 'what could be' .

The manifesto sets the stage for my research, design and action. It uses a constructivist ontology and leads to the conclusion that a multitude of worldviews coexist, aside my own. Local worldviews represent local realities, therefor, they are valuable. This thesis is located far from my home, The Netherlands. Although my worldview is a relevant and inescapable base of the thesis, it should not stand alone. Local worldviews and voices are just as (if not more) valuable and need to be represented. If so, the thesis will gain both in honesty and succes.

Phase 4. Cartography
As a response to the conclusions of phase 3, phase 4 starts again with Cartography, but this time the data is collected and mapped by the inhabitants of Hammerfest themselves. During a workshop, the participants map the coastline by means of engaged action research (Deming & Swaffield 2010), or: collaborative mapping. The workshop intends to collect local knowledge, based on personal perspectives, embracing subjectivity.

The precise mapping excersize is yet to be designed. This is also largely dependent on the development of the Covid-19 crisis and travel registrations to Norway. If I cannot go to Norway myself to guide the workshops, other methods like zoom might be necessary which impact the format of the excersize. It will also influence de degree of my depency on local institutions, such as the Oslo School of Architecture or the Arctic University of Norway in Tromsø.

An additional element to the workshop is portrait photography. It would be wonderful to photograph some of the participants that are willing to sit for a portrait. The portraits intend to give a face to the persons, the source of the data. It provides context to the data while emphasising its subjective nature.

Ofcourse, the portraits themselves contain biographies, worldviews and identities that remain untold, but speak from the photograph nonetheless. I will not try to describe these portraits or the biographies of the people in it any more than is absolutely necessary. In doing so, the portraits remain open for interpretation by the readers of this thesis: you. Your interpretation of those portrayed will enrich mine of the mappings they produced. Together, the portraits and the mappings form the 'Atlas by Hammerfest' .

Phase 5. Deconstruction
The next step is to interpret the mappings produced in the workshop to gain usable data and conclusions by means of Iconology (Bowing 2002). The aim of this phase is to translate the workshop data to formulate socio-cultural demands in terms of space. This step is necessary, because it enables the socio-cultural demands to compete with

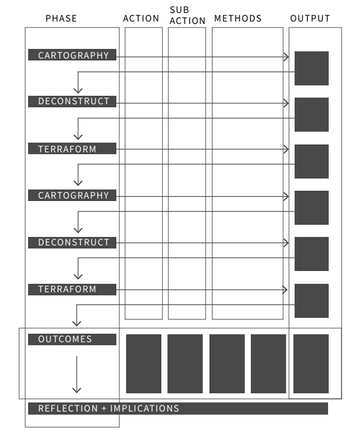

Fig. 9
How to read the research framework, visible in fig. 10 on the next page. Source: by author.

economic, political and ecological demands for marine space. The next step is to identify socio-cultural risks (be it perceived or 'real') and synergetic opportunities with other marine uses.

Plese note that the specifications of this phase still require some development as they are entirely dependent on the results of the workshop. Once I have designed the workshop excersises in more detail, the development of this phase will follow.

Phase 6. Terraforming

Now we have the spatial components and we can start to fit them into marine spatial planning of the Barents Sea. By means of modal mapping (Bryant 2014), I will visualise the spatial outcomes of the reorganisation of marine uses, while taking socio-cultural demands, risks and opportunities into account. Three modal maps visualise the outcomes of three degrees of socio-cultural imposition in the organisation proces.

- no socio-cultural imposition
- moderate socio-cultural imposition
- high socio-cultural imposition

It is possible that this phase requires more knowlegde on the spatial demands of other marine uses (economic, industrial etc.), which might prove to be whole research an sich. Whith the scope of this thesis in mind, it would be necessary to limit the spatial reorganisasion to just one other marine use: the petrol industry.

Conclusion phase

The modal maps allow me to reflect and evaluate the possible outcomes of reorganisation. The outcomes will be evaluated on their alignment with the proposed line of action in the manifesto in phase 3, on its potenty for acchieving the research purpose and on social sustainability through multi-criteria assessment.

In particular the social sustainability assessment might prove a challenge, as the current discourse lacks a commonly agreed upon assessment method as of yet (UNSRISD 2012). Most researches use multi-criteria assessments, but each decide on different criteria that fit the case or site of the project. Further literature review is needed from my side to decide on criteria for this evaluation.

Based on the results of the evaluation and critical reflection on the research, I can formulate a conclusion and answer the research question.

4.2 List of methods

Monographic mapping

POWER :	explorative, understanding
AIM:	to expolore human-sea relations between Hammerfest and the Barents Sea
SCALE:	all
DOMAIN:	socio-cultural
DATA TYPE:	mixed
NATURE:	objective

Topographic mapping

POWER:	understanding
AIM:	to map human-sea relations as a socio-cultural layer in the complex system of the Barent Sea
SCALE:	Barents Sea
DOMAIN:	biophysical
DATA TYPE:	mixed
NATURE:	objective
THEORY:	(Bryant 2014)

Literature review

POWER:	supportive
AIM:	to substantiate research or to gain knowledge from predecessors
DOMAIN:	all
DATA TYPE:	mixed
NATURE:	mixed
ACTORS:	academics from different professions: artists, philosophers scientists, geologists
THEORY:	see theoretical framework

Curating

POWER:	communicative
AIM:	to organise the work as a display that conveys found conclusions to the public and stimulates reflection and engagement
DATA TYPE:	mixed
NATURE:	subjective
ACTORS:	tutors and fellow students of the Transitional Territories Studio, symposium attendants

Storytelling

POWER:	communicative
AIM:	to convey information, meaning, or emotions expressed in speech or the written word, used in the manifesto and symposium
DATA TYPE:	mixed
NATURE:	subjective
ACTORS:	storytelling as a transaction can only exist in the pressence of both speaker and listener, writer and reader

Vision building

POWER:	directive, inspirational
AIM:	to visualise a future that is different, or better than the future which will be if we do not change
SCALE:	Barents Sea
DOMAIN:	biophysical
DATA TYPE:	qualitative
NATURE:	mixed
ACTORS:	the people of Hammerfest and myself

Portrait photography

POWER:	communicative, representative
AIM:	to portray the participants of the workshop, humans of Hammerfest
SCALE:	human body
DOMAIN:	socio-cultural
DATA TYPE:	qualitative
NATURE:	mixed
ACTORS:	workshop participants, and the photographer

Collaborative mapping

POWER:	representative
AIM:	to gain local subjective knowledge from personal experiences and worldviews in the 'Atlas by Hammerfest' workshop
SCALE:	t.b.d.
DOMAIN:	socio-cultural
DATA TYPE:	qualitative
NATURE:	subjective
ACTORS:	workshop participants, possibly local institutions (Oslo University of Architecture, Arctic University of Design)
THEORY:	Engaged action research (Deming & Swaffield 2010)

Iconology

POWER:	interpretive
AIM:	to interpret produced counter maps in the workshop to gain meaning and conclusions that can be used in the design proces
SCALE:	t.b.d.
DOMAIN:	socio-cultural, biophysical
DATA TYPE:	mixed
NATURE:	subjective
THEORY:	(Bowing 2002)

SWOT-analysis

POWER:	analytical
AIM:	to identify socio-cultural strengths, weaknesses, opportunities and risks in urbanisation of the Barents Sea
SCALE:	Hammerfest, Barents Sea, Arctic
DOMAIN:	socio-cultural, biophysical, climate
DATA TYPE:	qualitative
NATURE:	objective

Modal mapping

POWER:	projective, visualisation
AIM:	to visualise the spatial outcomes of socio-cultural imposition in the reorganisation of the Barents Sea in terms of marine use
SCALE:	Barents Sea
DOMAIN:	biophysical
DATA TYPE:	mixed
THEORY:	(Bryant 2014)

Multi-criteria assessment

POWER:	evaluative
AIM:	to evaluate the outcomes of socio-cultural imposition in the reorganisation of the Barents Sea in terms of marine use on social sustainability
SCALE:	Hammerfest, Barents Sea
DOMAIN:	Socio-cultural
DATA TYPE:	qualitative
NATURE:	objective
THEORY:	(UNRISD 2012)

Reflection

POWER:	reflective
AIM:	to review the proces and outcomes of the research as it develops to inform actions and conclusions

MOTIVATION
To understand, and from this understanding enable change

PROBLEM FIELDS
i. Human-sea relations
ii. Representation
iii. Offshore urbanism

PROBLEM STATEMENTS
The socio-cultural impacts of offshore development at the Barents Sea on communities onshore are relatively unmapped and unknown.

The mapping of socio-cultural values requires unconventional forms of cartography that are not lead by dominant power structures.

Organisation of human uses at the Barents Sea is not guided by socio-cultural considerations and thus ignorant to risks and opportunities in this domain.

RESEARCH PURPOSE
To visualise the potential role of the socio-cultural dimension in offshore urbanism through mapping
› to open a pathway towards social sustainable development at the Barents Sea.

HYPOTHESIS
Socio-cultural mapping can be used ...
› **as an act of research:** to understand and visualise human-sea relations,
› **as an act of design:** to employ and embed these relations in the spatial reorganisation of marine uses
› **as a driver for positive change** in the Barents Sea.

RESEARCH QUESTION
What role can **socio-cultural mapping** play to **understand and employ human-sea relations** In the **spatial reorganisation of the Barents Sea in terms of marine use**?

SQ 1. What are human-sea relations?
SQ 2. What human-sea relations can be observed between Hammerfest and the Barents Sea?
SQ 3. What is the position of these relations as a socio-cultural layer within the complex system of the ocean?
SQ 4. How can we understand and represent human-sea relations through the act of mapping?
SQ 5. How can we describe the socio-cultural demand for marine space?
SQ 6. What synergetic opportunities can be identified between socio-cultural uses and other marine uses? And what risks?
SQ 7. What are the spatial implications of reorganising human uses on the Barents Sea, when socio-cultural demand for space is taken into account?
SQ 8. (How) will the human-sea relations change as a result of this reorganisation?
SQ 9. How can we evaluate the outcomes of reorganisation on social sustainability?

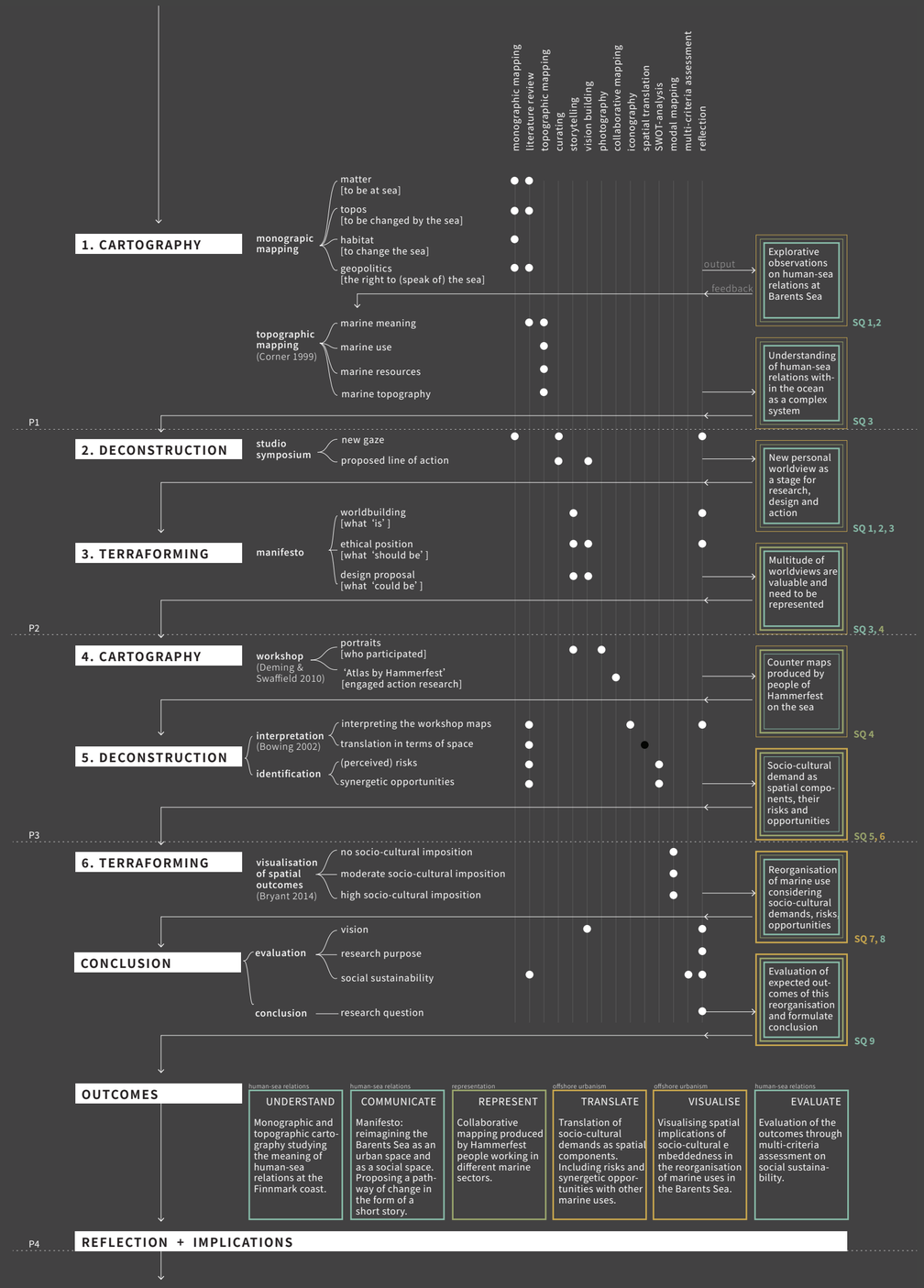

Fig. 10

The research framework. A step by step roadmap of the research leading from the research question to the expected outcomes.

Source: by author

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