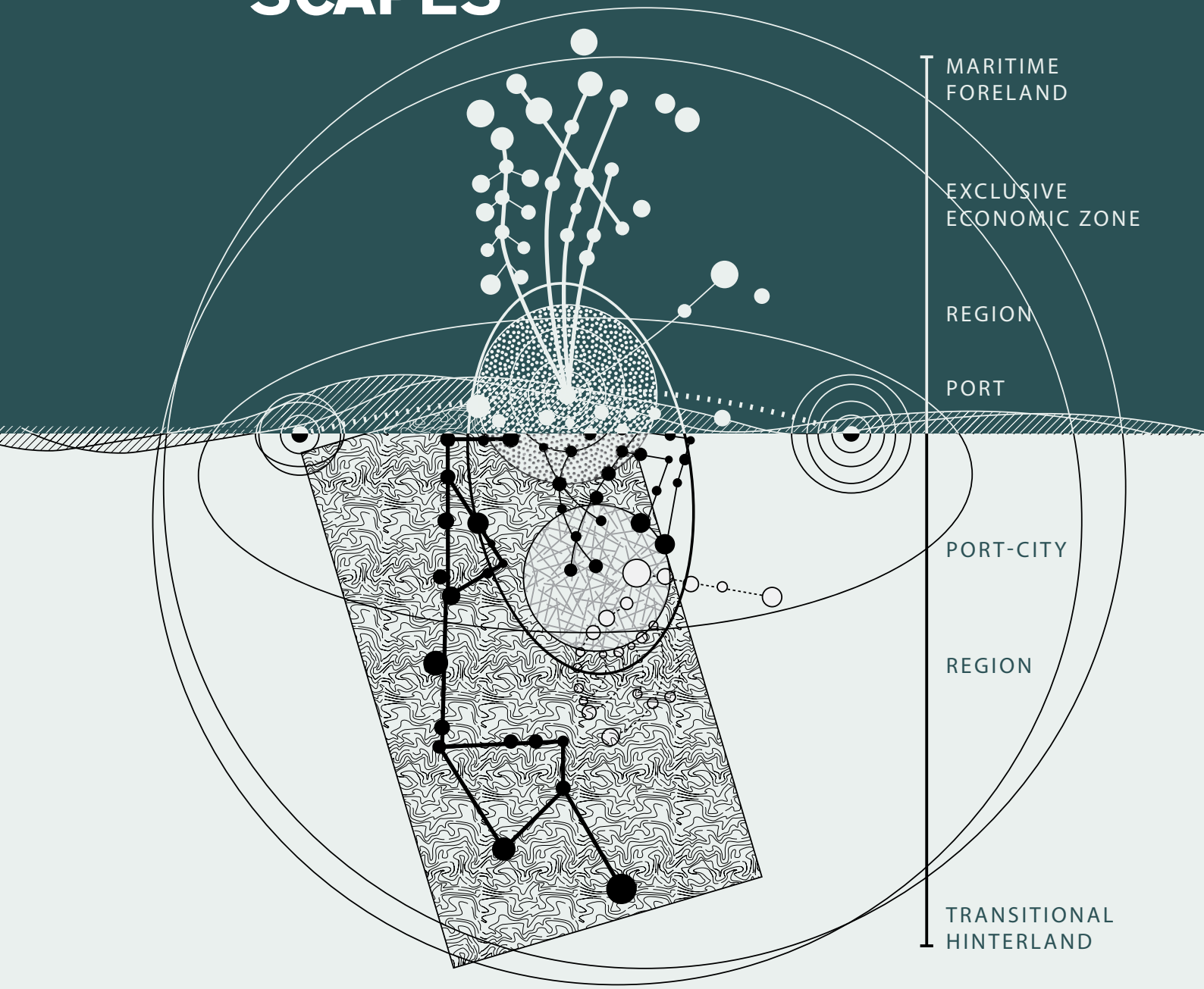
DYNAMIC PORT-CITY SCAPES



» From Liminal "Non-Places" to Imaginative and Synergistic Adaptive Ecosystems «

COLOPHON

DYNAMIC PORT-CITY SCAPES

» From Liminal "Non-Places" to Imaginative and Synergistic Adaptive Ecosystems «

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Transitional Territories Studio

P5 Report
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CONTENT

MOTIVATION

I want to start my thesis by explaining the very first idea of the cover illustration. The sketch is based on Pablo Picasso´s illustration in Honoré de Balzac's novel "Le Chef-d'œuvre inconnu (English: The Unknown Masterpiece)," in which Picasso used dots and lines to create his own re-imagination of the night sky constellation. Re-imagining urbanized, operational landscapes, in this case, ports, port-cities, and their terrestrial for- and aquatic hinterland, will be an essential topic in times of worldwide urbani-zation, territorialization, economic development, and climate change. To be able to understand the complex world we live in today, but also to be able to create alternative realities, which emerge oppor-tunities instead of negative externalities, imaging and articulating, which are essential to start the pro-cess of negotiation and planning, are the urbanist´s most essential and crucial tools.

For me, the essential fact about urbanism is that it is not only closely related to the field of civil engi-neering and architecture but also acts as an important, cross-disciplinary communicator between as well as beyond social science (Akkerman, 2012). The fact that today´s uncertain problems (ecological, economic, and societal) will and cannot be solved with simple and modern solutions, which call for in-terdisciplinary and visionary approaches within our built but also unbuilt environment.

Seeing urbanism as the linkage between different professions as well as perceiving the chance to gather knowledge within all those fields and to open me towards a spectrum of various and exciting opportunities to tackle contemporary and future problems, is my personal driver for graduating as an urbanist.

As part of my fourth-quarter project, I intensively investigated the cumulative impacts of climate change and infrastructural development in the city of Houston. As one of the most flood-prone delta-metropolis worldwide, Houston was an interesting and fascinating case to learn about water-sensitive design and the implementation of green-blue structures in urban developments. Coming from a landscape-architectural background, I´m inquisitive about urban concepts like Planning with Nature (McHarg), Landscape as Infrastructure (Belanger), or Flowscapes (Nijhuis & Jauslin). Especially the in-terdisciplinary work with students from "Transport, Infrastructure, and Logistics," the investigation of different urban flows (mobility, urban ecology and flood-management), as well as the final collaborative project about the combination of nature-based solutions within urban infrastructures, made me decide to choose Transitional Territories as my graduation studio and also influenced the choice of my personal master thesis.

INTRODUCTION

With over 70%, water covers the largest amount of surface on our planet, whereas the coastal zone occupies only 8%. Nonetheless, almost 65% of cities with populations above 1.3 million and, therefore, half the world's population lives within 100 km of water (Barragán & de Andrés, 2015; Geldof & Janssens, 2014). Especially those coastal/delta areas face enormous impacts today, as well as in the near future. On the one hand, the challenges of global warming, e.g., sea-level rise and extreme weather scenarios, affect humans but also whole ecosystems around the world. Port-cities and urban waterfronts are at
the forefront of these changes (Hein, 2016). On the other hand, the rising population, the "need" for more land and the economic benefits result in a persistent territorialization and exploitation of resources within coastal areas, e.g., land reclamations, off-shore activities, resource extraction, and infrastructural development (Geldof & Janssens, 2014).

Ports, occupying the liminal* space inbetween land and sea as well as the territorial and urban scale, function as gateways to global trade and as such they create local identity and culture, giving rise to numerous port-cities in the past, present, and future. Ports, as well as the international networks they created, have shaped the cities' built and non-built environments through many transformation processes, emerging a multi-layered palimpsest of historical, economic, social, cultural, and environmental characteristics (Sanchez, 2018). Changes in the maritime network, e.g., the introduction of containerization and a shift in the spatial distribution of industrial and economical port activities towards a regional/global scale, have an increased influence on ports and, therefore, on the port-city relationship (Ducret, 2011; OECD, 2014; Hesse, 2017). Within times, where centers of economic importance accumulate into patterns of inter-metropolitan networks and nodes, which are strongly relying on large scale infrastructures, contemporary port-city relationships increasingly suffer from spatial and institutional separation. After the introduction of the term "Port-City Interface" by Hayuth in 1982, which since then can be seen as the conflict- but also co-operation-zone (Hoyle, 1989) between the two (sub)-systems, port, and city, many different professions, e.g., sociologists, economists, geographers, engineers, planners, architects as well as historians showing their different interests with-in this field of research (Hein, 2016), seem to have lost a relational view on the port-city. We can see port-cities more and more embedded in and interdependent on larger, global associations and networks (Hesse, 2017).

On the one hand, ports are mainly focusing on their economic efficiency, rather than the impact of the port operation on the surrounding environment (del Saz-Salazar, García-Menéndez, & Merk, 2013). On the other hand, urban planners, stakeholders, and decision-makers within the city´s realm see port activities as a growing risk and spatial constraint for achieving a sustainable urban environment. Globalization, technologization, and deregulation within the economic logistics sector, but also the increased risks of extreme weather events, the loss of biodiversity, ecosystems´ functions, and the interrelated impact on society and culture call for rethinking the port-city on different spatial and temporal scales.

*__Liminality__ *(from the Latin word limen, meaning "a threshold") is the quality of ambiguity of time, space, human-beings or whole societal groups and therefore a betixt or inbetween state while shifting from one to the other state. Within the concept of Port-Cities, the liminality of a Port-City Scape can be seen as the threshold or border-scape between port and city in which the transition from one to the other creates multiple liminal conditions and connotations of e.g. function, culture and identity.*

▼ *Figure / 01* **Arctic as Sciene Fiction /** *Höller*

Climate Change Impacts

Climate change is seen as the main driver for the increased frequency of risks extreme weather events affecting societies worldwide. The awareness for climate change and urbanization is growing, especially in coastal areas. As stated before, around 40% of the world`s population lives within 100 km distance to the coast.

As Hanson et al. investigated, more than 40 million people living in port-cities are exposed to a 1 in 100-year flooding event. This amount of exposed population will grow tenfold by 2070 (Hanson et al., 2010 in Tsatsou, 2015, p. 1593).
Another reason why climate change has an enormous impact on port-cities is because of their role within global trade networks. As 90% of the world`s trade is by maritime traffic (Hein, Wiese, Hall & Jacobs, 2013), climate adaption within those critical nodes

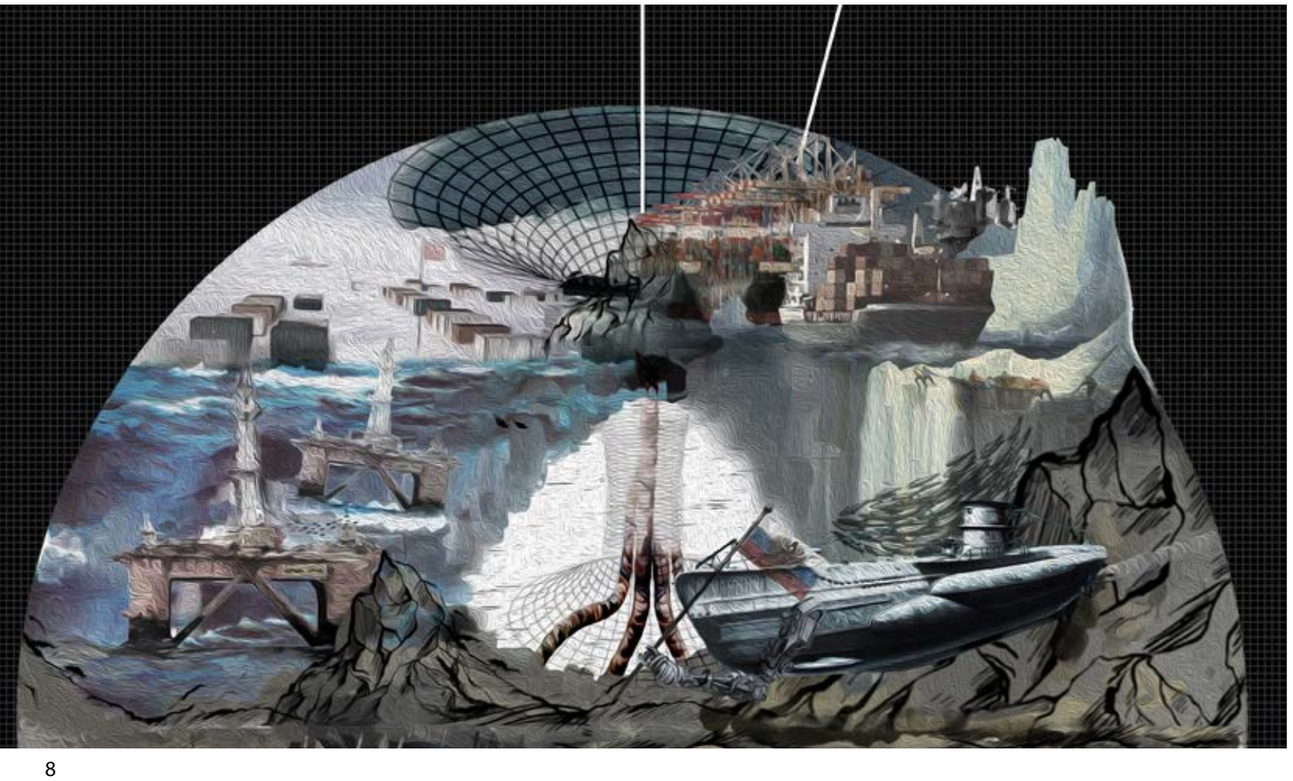
» *In the last century, capital and power became more important than land.* «

BÉLANGER, 2009, P. 79

of the global supply chain network is essential.
However, not only extreme events and increasing disturbance, e.g., due to storms and floodings occur more often, also functions essential for the human being, provided by the biotic and abiotic ecosystem alter and disappear. Global analysis of climate change impacts shows that already 60% of those so-called ecosystems´ functions interrelated to societal well-being have been diminished by human activities during the past 50 years. Changes in rainfall and temperature affect biotic systems, like plant communities and animals, that are essential, for example, food production and, therefore, socio-economic stability (Mooney et al. 2009).

Furthermore, other, less obvious aspects like culture and identity are exposed to hazards and disruptions as well. Losses of public goods such as community and place are not easily compensated by economically rational adjustments to risk (Adger & Arnella & Tompkins, 2013) and primarily affects communities

But what is with water...?



and non-institutional stakeholders, whose social stability is already affected by globalization processes, op-pression by global economic power or exclusion by political institutions, when it comes to a decision- mak-ing.

Economic Pressure

There is an ongoing trend of implementing neoliberal structures such as privatization and deregulation within vital economic sectors resulting in multiple impacts on all spatial scales of urbanization. Continuous economic growth creates capital, enabled by constant upscaling and improved efficiency of economic processes and flows. One can recognize an une-ven spatial development, where densifying and imploding urbanization processes go hand in hand with ex-plosive transformations of territorialized landscapes and environments on local, regional, and global scales (Brenner & Schmid, 2015). Centers of economic power shift into spreading patterns of inter-metropolitan networks and nodes, which are strongly relying on large scale infrastructures, to secure their economic resilience and to please the needs of their growing number of inhabitants. However, not only urban areas, defined by population, and the built environment are getting denser but also their hinterlands where green-fields transform into territorialized spaces and operational landscapes accompanied by the "infrastructura-lization" of vast areas to facilitate our demand for resources. These developments are humans´ capacity to amplify their force to change the natural environment "(…), leading to a sense of empowerment, overco-ming and controlling natural processes" (Edwards, 2002, p. 7). Furthermore, infrastructures possess the power to shape social and cultural structures persistently, leaving a sense of them being beyond (most) human and natural control, creating a dialectic between infrastructure and society/culture as well as infra-structure and nature. On the one hand, due to this complete urbanization of our world (Henri Lefebvre 1979 in Brenner 2016), unlimited economic growth, and rapidly progressing developments, "we find ours-elves faced with an extraordinary, little-noticed phenomenon: the explosion of spaces. Neither capitalism nor the state can maintain the chaotic, contradictory space they have produced . . ." (Henri Lefebvre 1979 in Brenner 2016).

On the other hand, we can observe the phenomena of former local places getting transformed into non-places reduced to their utilitarian use, crushing the sense of individual identification, societal relationships, and cultural identity. The complexity of those territories, their growing "entangledness" within networks and the resulting chaotic spaces let emerge multi-layered palimpsests of historical, economic, social, cultu-ral, and environmental characteristics. The dynamic and multiscalar web of interrelated processes and flows shows that this transformation as a multidimensional phenomenon "(…) is as much about space, place, ecology, and culture as is about pipes, wires, and concrete" (Steel & Legacy, 2017, p. 3). Nonethel-ess, even in times of climate change impacts, growing threats and uncertainties, the implementation of monofunctional infrastructures, supporting the extraction and transformation of "common goods" into commodities and the transformation of cultural landscapes into operational ones, satisfying the idea of the generation of capital, is still an ongoing process. As a result, social, cultural, and environmental structures often change persistent in areas of modern industrialization, where territorialization overgrows the local by prioritizing economic growth.

Designers and Planners are left to decide:
Should they approach those landscapes to be able to generate the maximum amount of capital, or should they understand the interrelated dynamics, flows to gaining operative forces in envisioning places that facilitate a balance between economic, social, and ecological interactions?

◄ *Figure / 02* **Arctic as Reality /** *Höller*

PROBLEM FIELD
INTRODUCTION

Port-Cities, their aquatic for- and terrestrial hinterland are such operational landscapes for which new forms of investigati-on and design need to be developed, to encounter the growing conflict between economic developments within the territorial and the local scale as well as to adapt to climatic changes worldwi-de. Within the following chapter, the two main problem fields of the thesis are introduced.

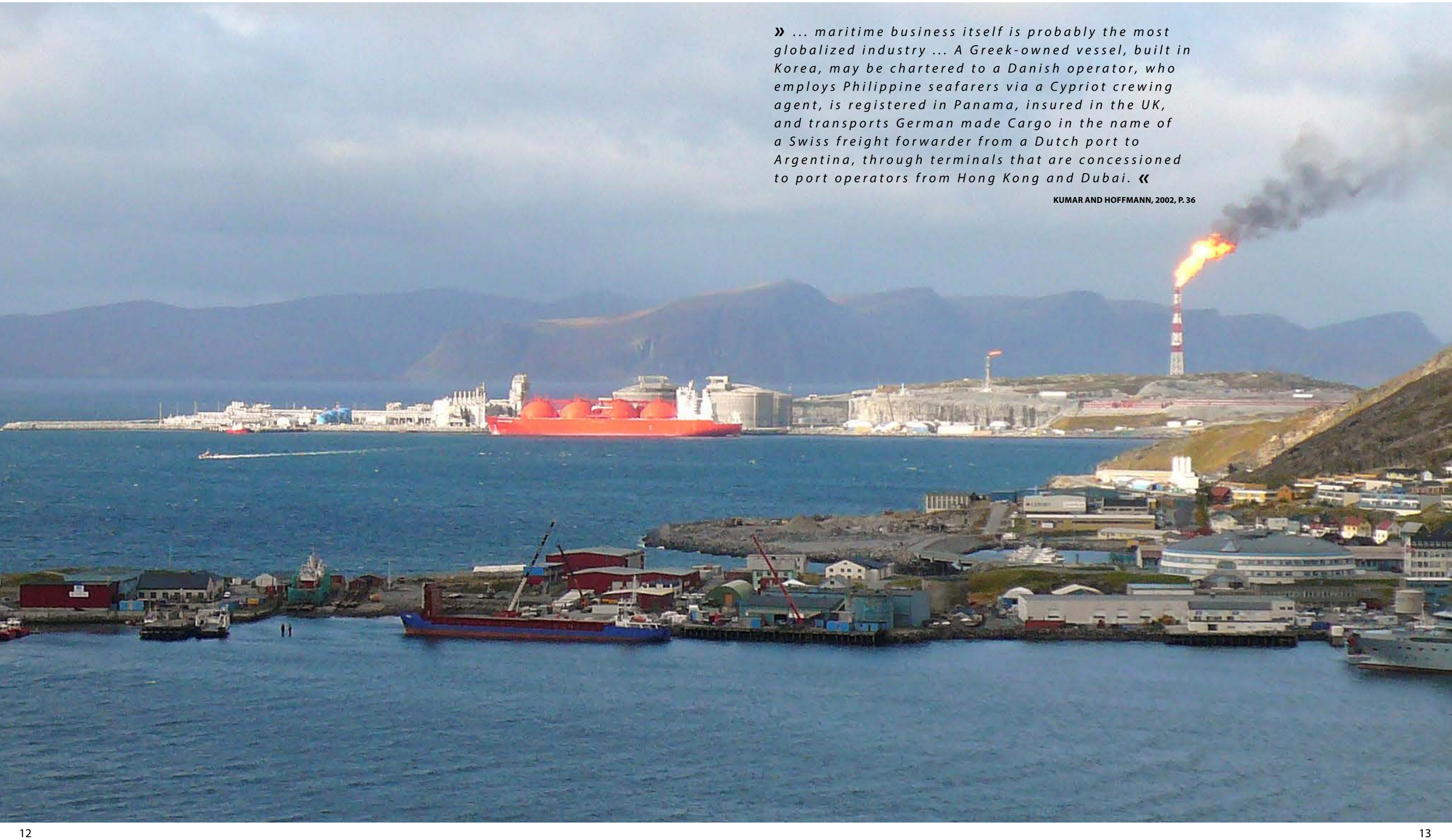
The first part of this chapter gives an overview of the highly debated and essential field of the port-city relationship. It in-vestigates on current scientific approaches on port-cities and identifies the gaps and the necessity for changes, additions, and adaptions within the conceptualization, the research, and design of the Port-City being the liminal and ambiguous space between the local specificity of the city and the maritime and territorial characteristics of the port. Since the ongoing post-industrialization processes of port cities in the 1960s, the spatial, as well as institutional embeddedness of the port-milieu within the urban environment, decreases. Due to the physical and mental separation of port and city, the growing imperative of economic values is overshadowing equally important cultural and societal values, like the inclusion of all sta-keholders within the port-city development. Furthermore, it slows down the process of natural participation, essential for the evolvement of a state of balance between social, economic, environmental, and institutional sustainability and resi-lience, where people, planet, and prosperity are aligned systems. Current academic research on the port-city relationship from a reduced, positivistic, as well as a universal economic modeling approach, needs to be completed by an integrative, locally-driven, spatial, and synergistic one.

The second part of this chapter introduces to the specific problem field within the area of interest and connects it to the overall topic of port-cities. Driven and strengthened by climatic changes, economic developments are impacting Arctic regions due to the increasing opportunities for the extraction industry but also from a maritime logistics point of view.
Melting ice, the opening of faster sea-routes and the availability of newly discovered and valuable resources like oil, gas and metals increase the interest for strategic port developments within Arctic territories. The often remote and natural sta-te of those regions is endangered by a dyadic, a two-sided, impact of natural and anthropogenic activities, cumulatively increasing each other. Similar to the problem within many port-cities, a growing mismatch between local and global needs sets the often fragile natural as well as the societal system of the North under pressure. Many urban areas above the Arctic Circle are trapped within a loop of path-dependencies due to a long history of heavy industry, mining, or forestry, unable to reach a critical juncture for new sustainable and resilient change. New perspectives for nature and humans need to be offe-red in such regions to sustain the natural qualities on the one hand, and the societal/cultural well-being of its inhabitants on the other hand. Therefore a rethinking of several processes, like ongoing territorialization and industrialization, needs to take place.
By putting the attempt for a re-conceptualization of the port-city relationship into the extreme context of the remote, na-tural and unique Arctic environment, the research aims for new creative and experimental outcomes.

The high contrast between the diversity of natural and human actors, the need for economic development and the necessi-ty for climate change adaptation can help to shift the perception away from a static, zone-like interface of port and city towards dynamic and pluralistic interrelation-scapes between port, the city their various actors and values in order to find new port-city synergies.

01 PROBLEM FIELD
PORT-CITY

▼ *Photo / 01* **Port of Hammerfest, oil- and gas terminal**



» *... maritime business itself is probably the most globalized industry ... A Greek-owned vessel, built in Korea, may be chartered to a Danish operator, who employs Philippine seafarers via a Cypriot crewing agent, is registered in Panama, insured in the UK, and transports German made Cargo in the name of a Swiss freight forwarder from a Dutch port to Argentina, through terminals that are concessioned to port operators from Hong Kong and Dubai.* «

KUMAR AND HOFFMANN, 2002, P. 36

PORT-CITY **INTERFACE**

TTalking about port-cities is talking about a specific and particular form of urban environment. For many cities around the globe, water-related activities such as transportation and trade and, therefore the relationship between urbanity and mari-time mindset have been pivotal for their formation but also for increasing their importance in competition with other cities within the hinterland.

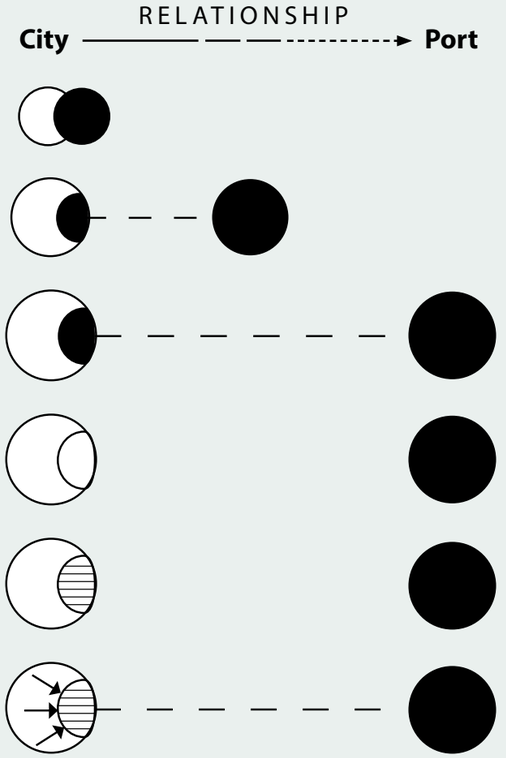
Often starting as a post for trade, ports supported urban development and economic growth of their hosting cities. Local conditions like climate, geology, political, economic, social, and cultural, as well as the foresight and connectedness of many actors and institutions, have always been important factors for the success of port-cities (Hein, 2011).
The land-sea intersection, as well as their interconnectedness with other port-cities via trade and thus the former insepara-ble and seamless character of the two entities port and city, is imprinted within the faces of many historical examples.

Still, until today ports play an essential role in our society. Around 90% of world trade operated by maritime transport and their land-based equivalent of port logistics (Wiese & Hein & Hall & Jacobs, 2013), ports, the gates to the global economy are the spatial manifestation of the latter. According to Moretti (2020), the port-city "(…) is a result of two territories and two entities: its very definition depends on the intensity of this linkage and the degree of intimacy, or conflict that the two sides have established over the years."

Transitions and the Port-City Interface

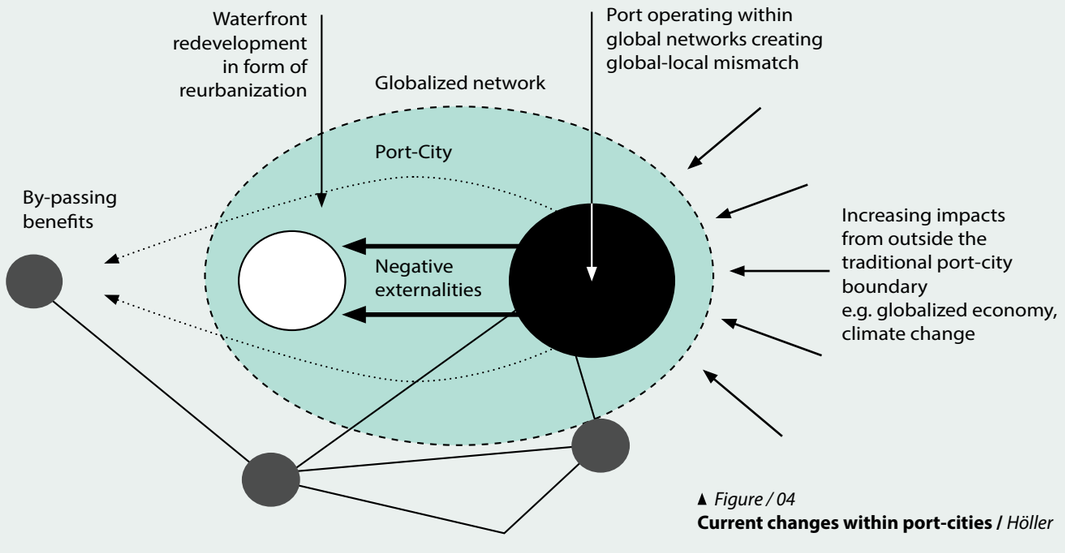
From the 1960s onwards, ports and port-cities experienced vast transformation processes. Innovations in cargo handling, like containerization, growing ship sizes due to growing demands of goods and materials, technologization of infrastruc-tures, lead to the transition of new and already existing port structures and facilities to the outskirts of cities. City govern-ments and port authorities started to plan on new waterlines, longer quays, deep-water berths with giant cranes, and large, sealed areas for container storage, connected with transport infrastructure to serve the growing hinterland demand (Daamen & van Gils, 2006; Hein, 2016; Pinheiro & Henk, 2011).

One of the main driver that drastically affects the negative association between the port and the city is the increasing local-global mismatch of local negative impacts of ports on cities and their surrounding ecosystems (pollution, land-use change noise) and by-passing benefits, such as employment and added economic value, which is relocated beyond the traditional boundaries of the port-city, due to regionalization and globalization processes of the port and logistic system (Ferrari & Merk & Bottasso & Conti & Tei, 2012). Even though the direct causal relationship between ports and economic growth (e.g., increase in container throughput related to the additional employment of jobs) are still valid, the by-passing of direct as well as most of the indirect economic benefits (more than 90%) and the increase of local negative externalities, intensi-fies the separation of port and city (OECD, 2014). Only a few ports have been able to accommodate growing facilities and ships. Their hosting cities and the location they have been embedded have restrained most ports in expanding their territory essential to handle the growing amount of cargo in the form of bulks and containers.



- Primitive Port, Ancient-19th century: Close spatial and fucntional association between city and port
- Expanding port-city, 19th -early 20th century: Rapid commercial/industrial growth, port goes byond city, linear quays/break bulk industries
- Modern/industrial port-city, mid - 20th century: Industrial growth (oil), containerisation, growing spatial demand
- Retreat from waterfront, 1960s - 1980s: Changes in maritime technology, growth of maritime industrial areas, port construction on extra-urban locations
- Redevelopment waterfront, 1970s - 1990s: Large-scale modern port consumes large areas land/water, urban renewal of obsolete port structures at core location
- Globalisation and intermodalism transform port: 1980s- now, urban waterfront redevelopment, port-city association renewed?

▲ *Figure / 03* **The port-city relationship model in Hoyle (2000), modified version from Hoyle (1989, p. 432)**



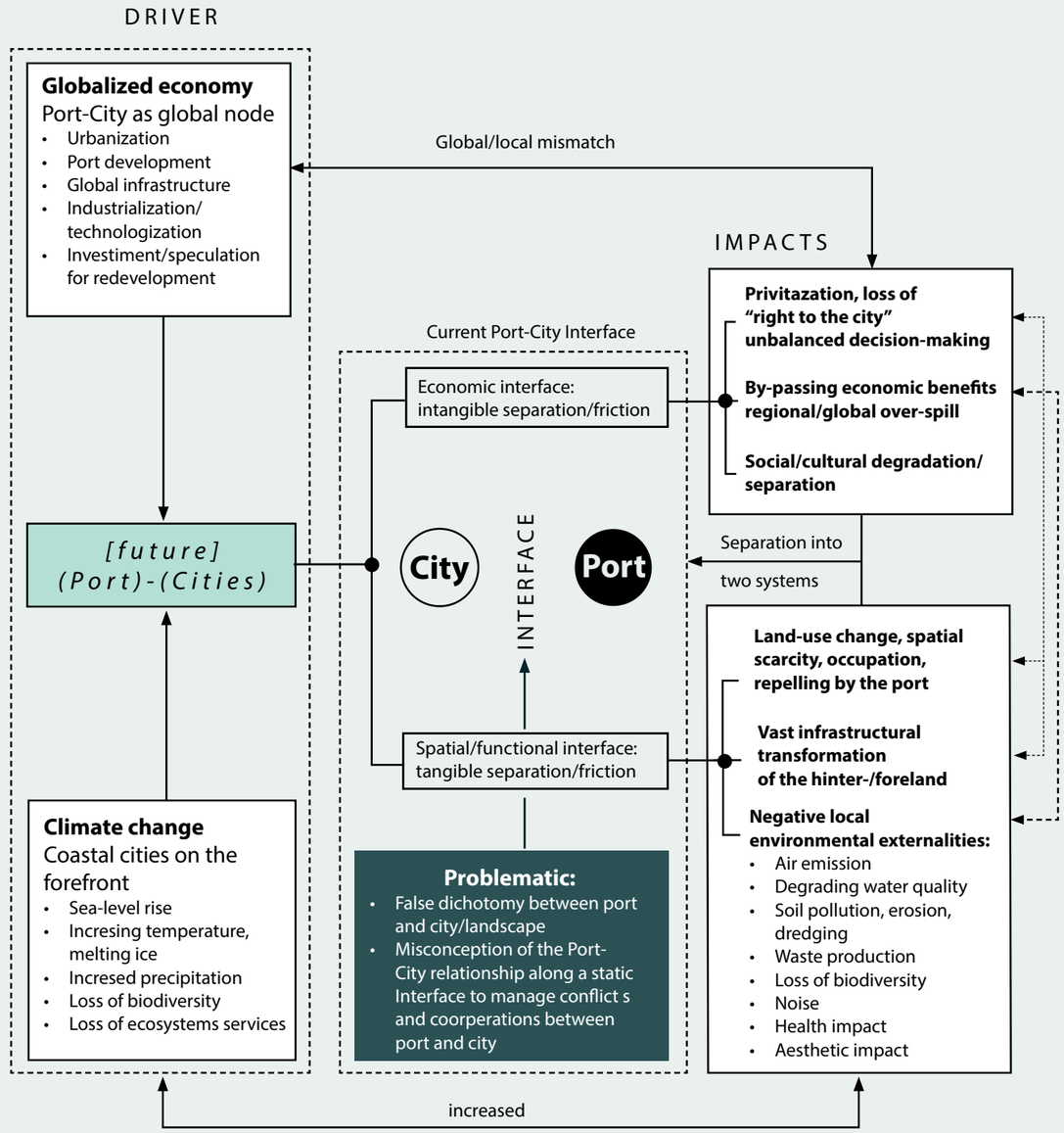
▲ *Figure / 04*
Current changes within port-cities / *Höller*

Those restraints made them move towards extra-urban locations, creating the first of many steps towards a deteriorated port-city relationship. This transition process and the resulting dynamics of shifting port mileus towards the outside of port-cities as well as the accompanying institution separation of port and city were conceptualized by Hoyle in 1989 and 2000. Based on Bird´s "Anyport" model (1963), who first investigated on those transitions, Hoyle structured the spatial separation of ports and cities as it is illustrated on the next page. The transforming Port-City Interface, changed in political, economic, and social conditions, the evolving of trading networks and containerization transformed and affected the port and the city persistently. Furthermore, it also brought institutional changes related to decision-making, depicting the steadily increasing conflict between technological changes, social and ecological restraints, maritime perspectives, and urban planning processes (Hoyle, 1989, p. 434), mostly within the favor of the port´s territorial and economic interests. The relationship between port and city therefore was seen as an interface zone (physical and non-physical) which becomes the source of managing problems marking the specific and localized border of a complex agglomeration of port and city spaces, e.g. operating facilities, urban commercial and office areas, brownfields and greenspaces.

Critic on the Port-City Interface and the Waterfront Paradigm

The ideal-typical evolution of a port by Bird and Hoyle leads to similar transformation processes of port-cities worldwide. As investigated by many economic geographers, the implementation of positivistic-driven developments, e.g., infrastruc-ture transshipment methods, large-scale industrial functions, but also the separation of the port institution from the city evolved similar elements as well as still drives contemporary developments in port-cities worldwide. As Moretti (2020) de-scribes, these analogues evolutionary phases make the territorial development of the port in combination with the specific-ity of the local and urban, a place that is simultaneously specific and generic. Operating ports create tensions from the ur-ban perspective. Also, redevelopment projects of obsolete post-industrial port-sites within the city, e.g., the Royal Albert Dock in London, are currently being turned into a business-district hosting mainly office spaces for Chinese multi-nationals (Wiig & Silver, 2019b), create socio-economic frictions and pressures on the urban system. As César Ducruet (2010 in Ng, Ducruet, Jacobs, Monios, Notteboom, Rodrigue, Slack, Tam, Wilmsmeier, 2014) states, the ongoing dismantling and re-structuring of obsolete port-structures within the city's environment during the 20th century and, therefore, the paradigm of the waterfront redevelopment helped the city to reconnect to the sea but continued the development and transition of port and city as separated spatial and institutional entities. Daamen & Louw investigated that only a small amount of wa-terfront projects worldwide can be seen as economically beneficial and socially just at the same time (Daamen & Louw, 2016, p. 642). Similar to Hesse´s critic of the contemporary waterfront paradigm as the most critical zone for establishing a renewed port-city relationship, consisting mainly of flag-ship buildings, "starchitecture," and contemporary urban design (Hesse, 2017, p. 221), aiming for capital production on the regional real estate market.

▼ *Figure / 05* **Problem scheme port-cities /** *Höller*



PORT-CITY
RELATIONAL APPROACH

Relational Approach / Strategic Coupling

Another way of analyzing port-city regions is the relational approach on port-cities from an economic geography´s point of view (Beaverstock et al. 2002, Coe et al. 2004; Dicken et al. 2001, Ducruet, 2005, 2018; Ducruet and Lee, 2006; Hesse 2018; Jacobs & Lagendijk, 2014; Lagendijk and Boekema 2008; Van den Berghe & Jacobs & Boelens, 2018).

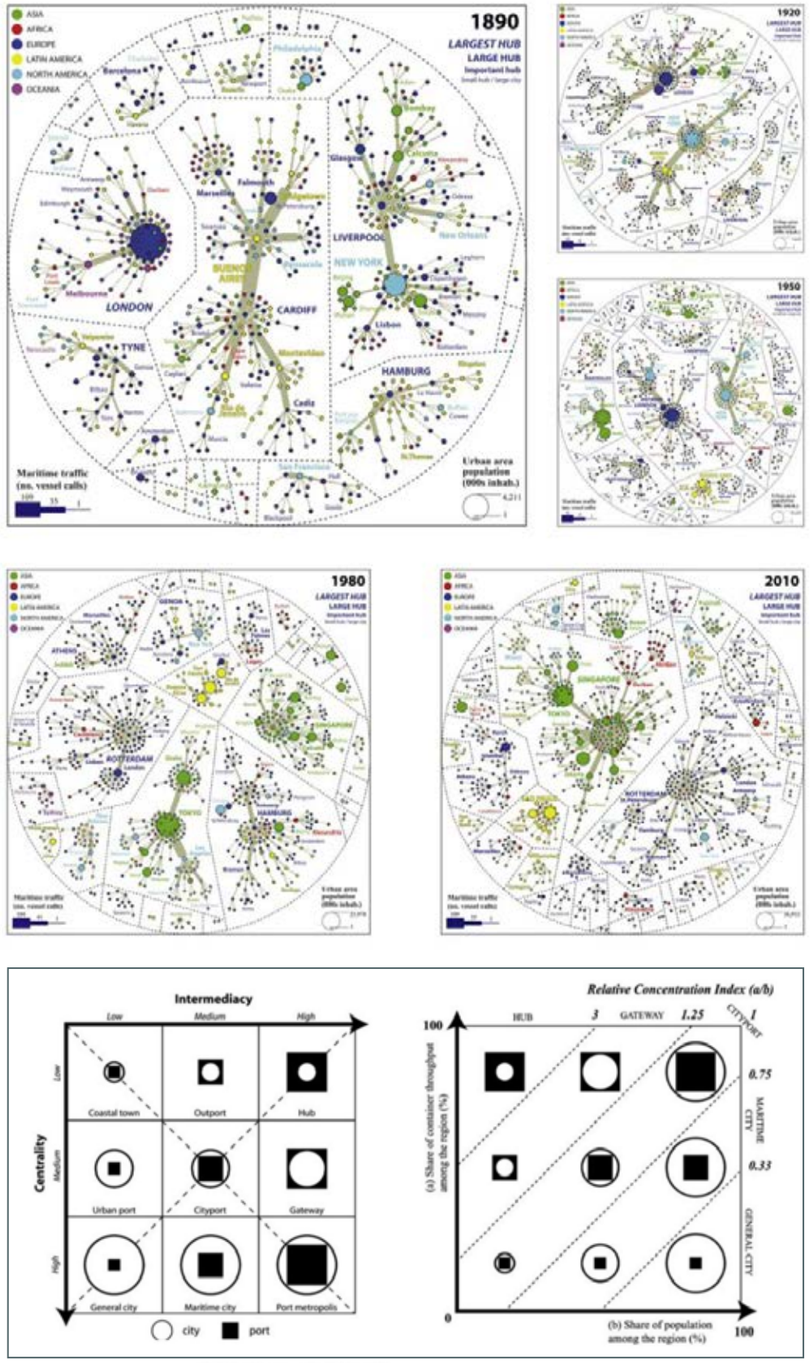
Relational thinking - focusing on linking local developments and assets with regional and global influences and impacts, either beneficial and/or critical for the port-city - can be seen as an encounter to the rising degree of external connectivity shaping the port-city and its region (Hesse, 2017, p. 210). Similar to the analysis on challenges in the port-city within this essay, also Hesse concluded that "(…) ties and tensions between global flows and the local place provide a rather mixed bag for both port and city, with risks and benefits offered simultaneously." (2017, p. 219).

Looking for a new perception on the port-city, Hesse describes the interface as a "(…) strategic platform for integration and contestation between port and city, economy and territory (…)" instead of a pre-given and clearly defined territory (2017, p. 211). This point of view can be compared with Hoyel´s perspective on the Port-City Interface as being an interactive eco-nomic system of openness and connectivity, creating ties and constraints for both port and city (Hoyle, 1989, p. 429).

Based on Jacobs´ and Lagendijk´s framework of strategic coupling, Hesse further investigates on the interconnectedness of fixities and flows, which represents the fundamental relationship between port and city (Hesse, 2017, p. 212), and related processes between the same or different institutional (e.g., port or city) and geographical scales. Strategic coupling in its original meaning suggests a dynamic interplay between the local and regional and tries to interconnect mutually dependent and basic processes involving shared interests and cooperation between two or more groups of actors, eventually not working together to reach a common strategic goal. Therefore, it enables actors and institutions to link territorial dynamics at a local/regional scale with network dynamics at a global one (Jacobs & Lagendijk, 2014, p.47).

According to Jacobs and Lagendijk, the outcome of such strategic coupling is the active and intentional formation of tem-poral coalitions between local and global agents interacting within three different levels. The first one is called the "struc-ture of provision." In the context of the port-city, the provision contains the physical as well the institutional dimension to facilitate and organize local assets like infrastructure. The other two levels are described as "space of dependence" and "space of engagement." While the latter defines on which scale they engage with other agents, the other one describes the range of multiple identities shaped by interactions between agents' operations and by social and material conditions and constraints (Jacobs & Lagendijk, 2014, p. 54-59).

Even though Hesse, Jacobs & Lagendijk, and other authors within the field of economic geography, mainly focusing on the coupling of local assets (material and institutional) within the context of global circuits of production, capital, and decision-making, the core-concept or idea of shifting the Port-City Interface from a solely local and spatial perception towards a strategic platform for coupling possible interrelated dynamics, fixities and flows within the port-city is something to build on from an urbanism point of view.



▲ *Figure / 06* **Visualizations of the port-city relationship /** *(Ducruet, 2005, Ducruet and Lee, 2006 in Hein & Mil, 2019, p. 5)* **and shipping networks in relation to ports and city locations /** *1890–2010 (Ducruet et al 2018 in Mil & Hein, 2019, p. 5).*

▼ *photo / 02* **Nuclear icebreaker Arktika (LK-60Ya-class lead ship) under construction in St. Petersburg**

PORT-CITY
PROBLEMS

The problems, which have been investigated and explained, can be synthesized into five primary outcomes:

1. Port-cities are increasingly affected by influences that are extending the port-city limits. Climate change impacts and economic pressures create global-local mismatches as well as equally shared burdens for the port and the city. Nonethe-less, their contradicting character disables the port-city to adapt to those threats in its full potentials.

2. Conceptualizations of port-cities universalize the transformation processes of the interface and reduce it towards the local functional and spatial cross-section between port and city. The port-city´s port being embedded within a global eco-nomic network and the urban system being regionalized (Bélanger, 2009, p.90) creates the urgency to question the tradi-tional boundaries of the port-city as a sheer territorial overlap of port and city as it is now (Hesse, 2017).

3. Research is mainly focusing on rather than on flows (e.g., value chains, materials, knowledge, migration), which are cre-ating a dynamic, multi-scalar and complex web of interconnected elements, able to make the port-city more than the sum of its elements (Ducret, 2011; Hein, 2016; Hesse, 2017).

4. The false dichotomy between port and city and between foreland-port-city-hinterland as separated systems in a spatial and functional understanding, but also from an institutional, actor and decision-making, theoretical and practical point of view, often restricts actors, decision-makers, and planners from seeing alternative relations and, therefore, possibilities within this web of complexity.

5. Space-based approaches, taking local specificities of culture, society, and nature within the context of port-city relation-ship into account, need to be added to the often quantitative and economy-based research modelings of economic geog-raphers.

02 PROBLEM FIELD
ARCTIC EXPANSION

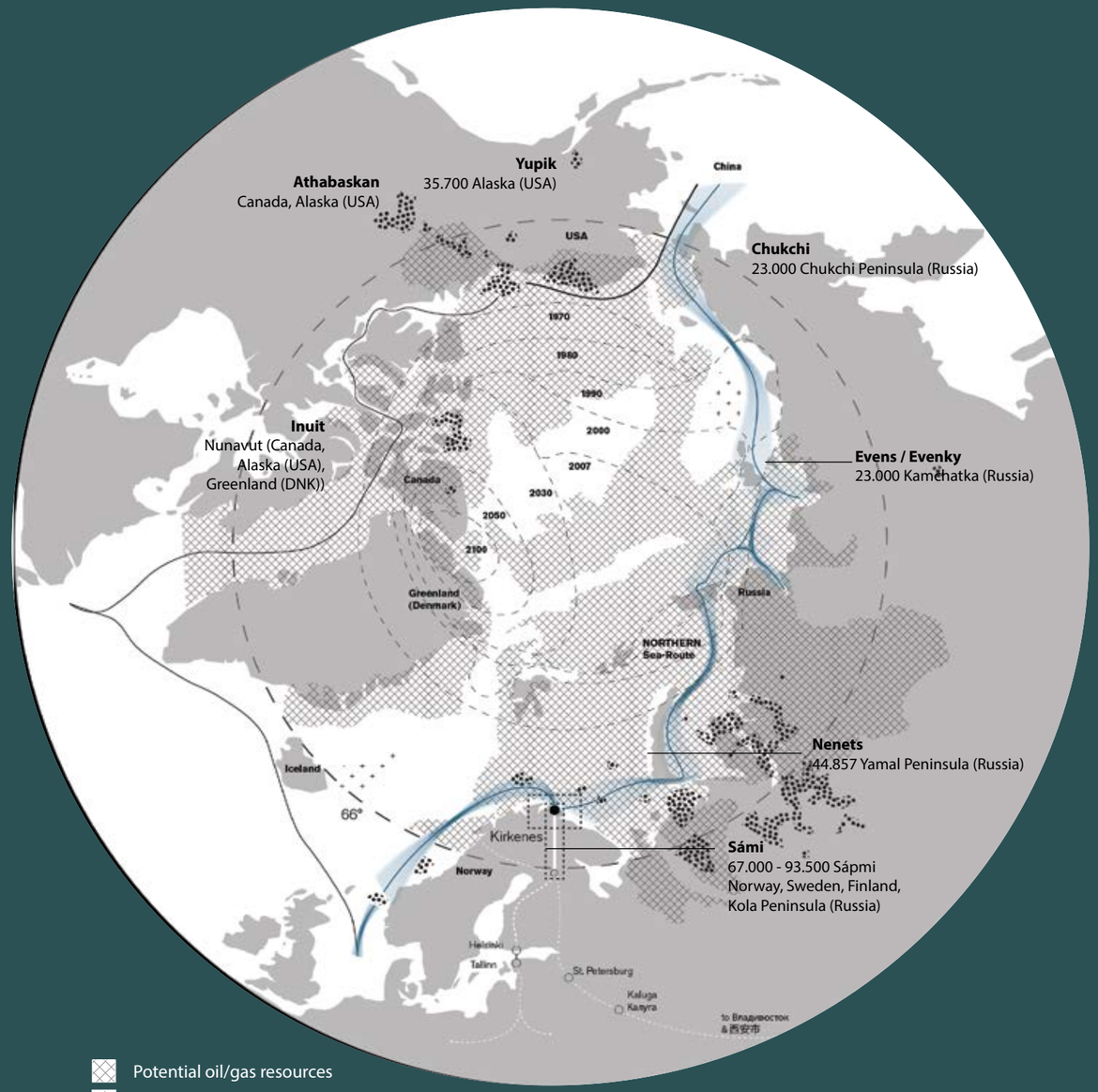
▼ *Photo / 03* **The Northern Sea-Route**

» *The Arctic situation now goes beyond its original inter-Arctic States or regional nature, having a vital bearing on the interests of States outside the region and the interests of the international community as a whole, as well as on the survival, the development, and the shared future for mankind. It is an issue with global implications and inter-national impacts.* «

STATE COUNCIL INFORMATION OFFICE OF THE PEOPLE'S REPUBLIC OF CHINA , 2018, N.P.

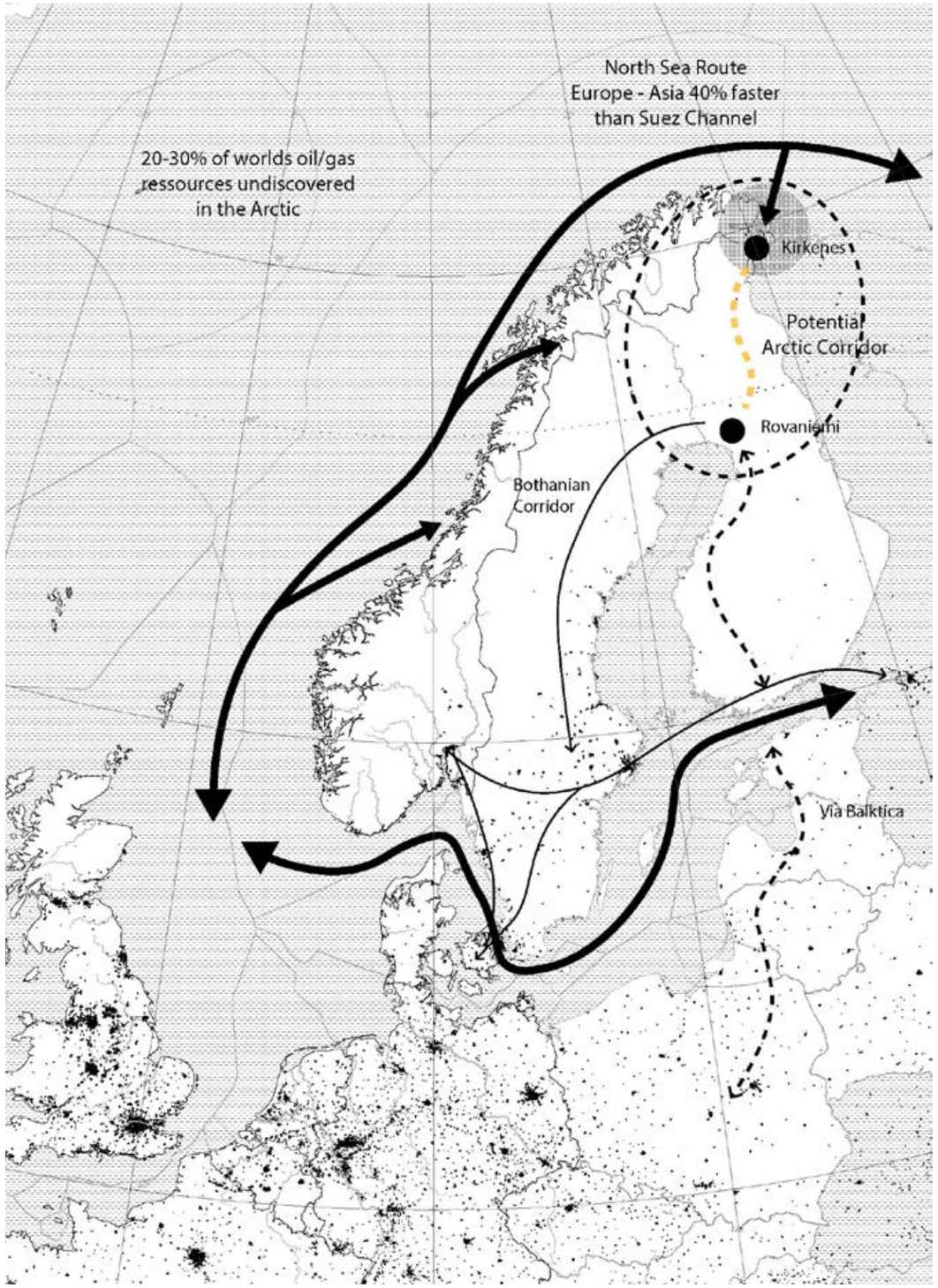
ARCTIC
CHANGES

This map shows the ongoing changes within the Arctic region, related to the melting of the ice, potential undiscoverd oil and gas resources as well as potential new maritme trade routes, bringing infrastructural development in form of strategic ports with it.

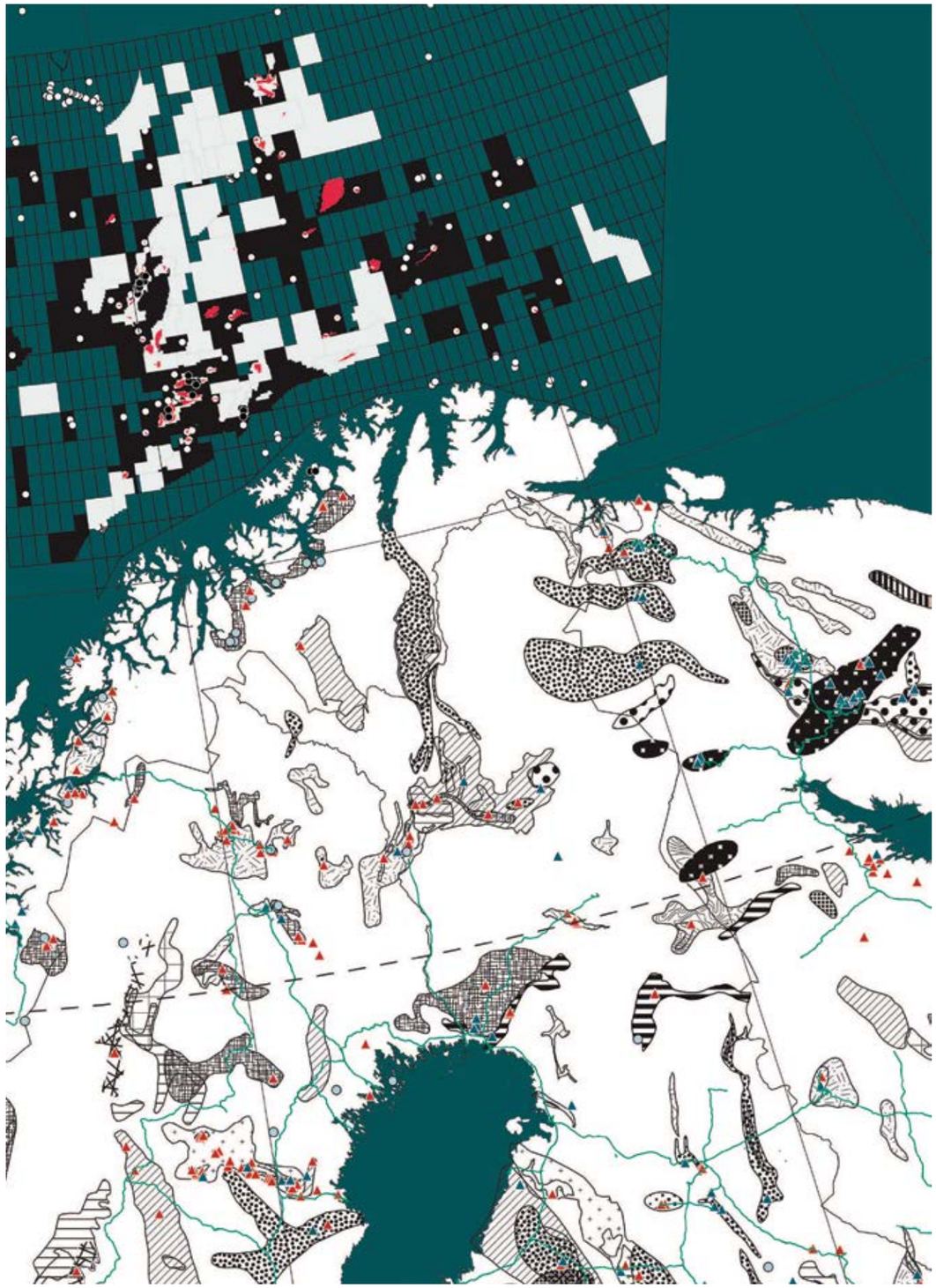


▲ *Map / 01* **Arctic changes** */ Höller*

▼ *Map / 02* **The Northern Sea-Route and the proposed Arctic corridor from Kirkenes to Rovaniemi** */ Höller*

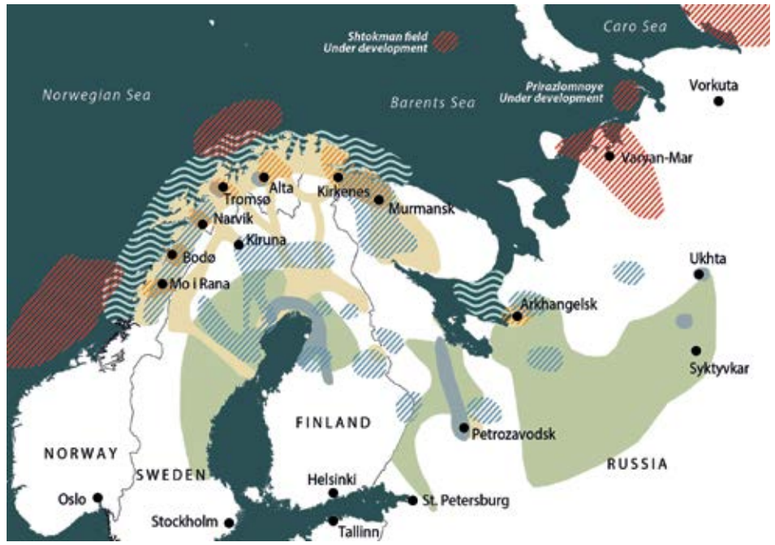


▼ *Map / 03* **Infrastructure following the extraction industry** */ Höller*



HIGH NORTH CONTEXT
SOCIETY AND ECONOMY

On the one hand, Arctic regions and locations in the High North are rich in natural resources, like metals, ores, oil, and gas. Due to the melting ice, driven and benefited by climate changes, those regions always have and will, even more, be im-pacted by econom-ic growth and industrial development.



◄ *Map / 04*
Rough illustration of raw materials and main industries in different parts of the Barents Region

- Oil/Gas producing area
- Service for oil/gas industry
- Mining industry
- Metal industry
- Seafood industry
- Forest industry
- Tourism

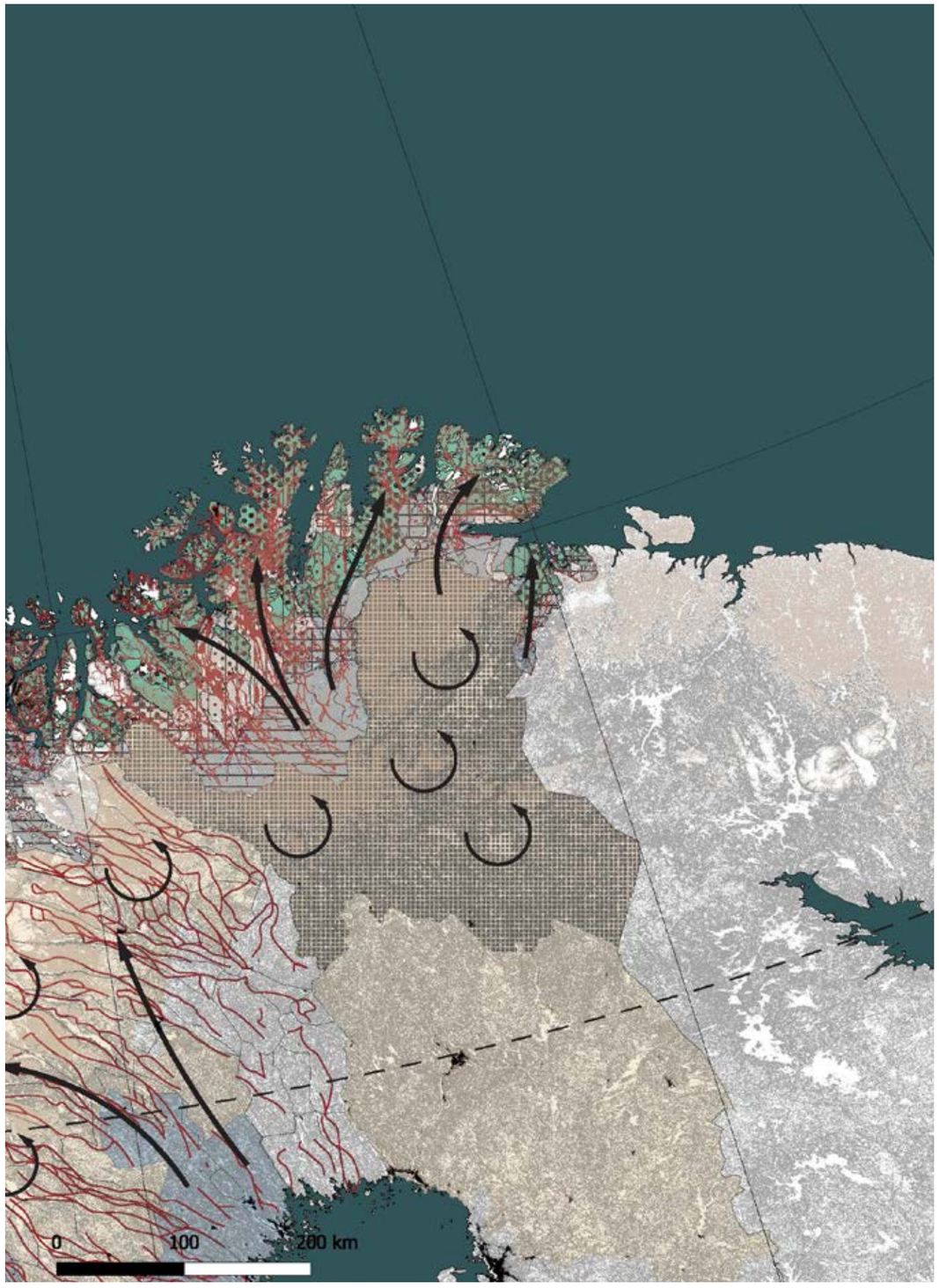
◄ *Map / 05*
Cargo turnover in ports, Barents Region

20
10 Million tonnes (2012)
5

- Port
- Port under construction
- Main sea route
- Inland port

- Railway lines
- Active mining
- Shut-down mining (can be reactivated)
- Historic mining

▼ *Map / 06* **Traditional reindeer heerding** */ Höller*



HIGH NORTH CONTEXT
SOCIETY AND ECOLOGY

On the other hand, Arctic communities have a close relation to their natural environment due to the remote geography they live in. Especially the Sámi, Europes only and the world's most northern indigenous culture is relying on traditional life-styles, cultural, socioeconomic patterns, and socio-ecological relationships. Their reindeer-based economy and their no-madic habits are one of many characteristics of the ecosystem benefits the Artic community is relying on.

The map shows the reindeer herding areas of Fennoscandia as well as the dynamic movements between the different graz-ing areas depending on the seasons. Long before the first western colonies arrived within the Arctic territory, the indige-nous Sámi followed their semi-domesticated reindeer herds, which provided them with food, materials for clothing and therefore became an inseparable part of their culture until today. Even though technologies like snowmobiles and helicop-ters make the herding for the Sámi community seemingly easier than a hundred years ago, economic accessibility of Arctic territories and the interrelated development of infrastructures, and the exploit of earth´s resources have increasing impacts on this traditional and nature-based livelihood. Furthermore, climate change additionally raises the risks for reindeers and their herders.

- Finnish border of the Sámi homeland
- Pasture / winter grazing
- Pasture / summer grazing
- Pasture / spring grazing
- Pasture / autumn grazing
- Pasture / autumn-winter grazing
- Reindeer migration route
- Reindeer spring-migration routes
- Reindeer year-round migration routes
- Southern border of Sapmi (Sámi territory)

▲ *Photo / 04* **Nenets are preparing their travel by the Erkura river, in southern Yamal. Here they travel with sledges across the Tundra landscapes.**

▲ *Map / 07* **New industries planned around the Barents Region**

- Projects in development
- Reindeer heerding area
- Concession reindeer heerding area
- Municipalities that recognize the Sámi languages as official languages

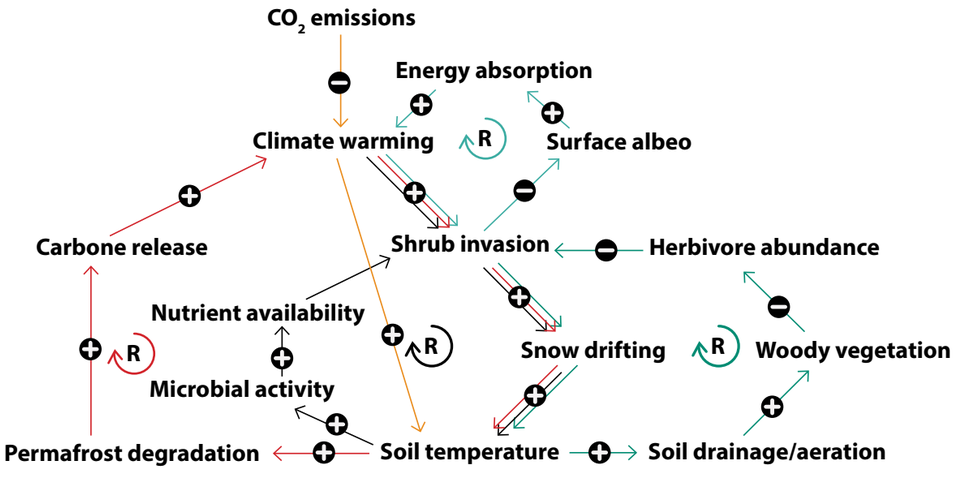
GLOBAL CONTEXT
CLIMATE CHANGE

The process of global warming is about twice as fast in Arctic regions compared to the global average. The main cause is the so-called Albedo-Effect, where melting snow and ice starts to expose darker surfaces, like rock and soil. This results in the faster absorption of solar energy within those areas.

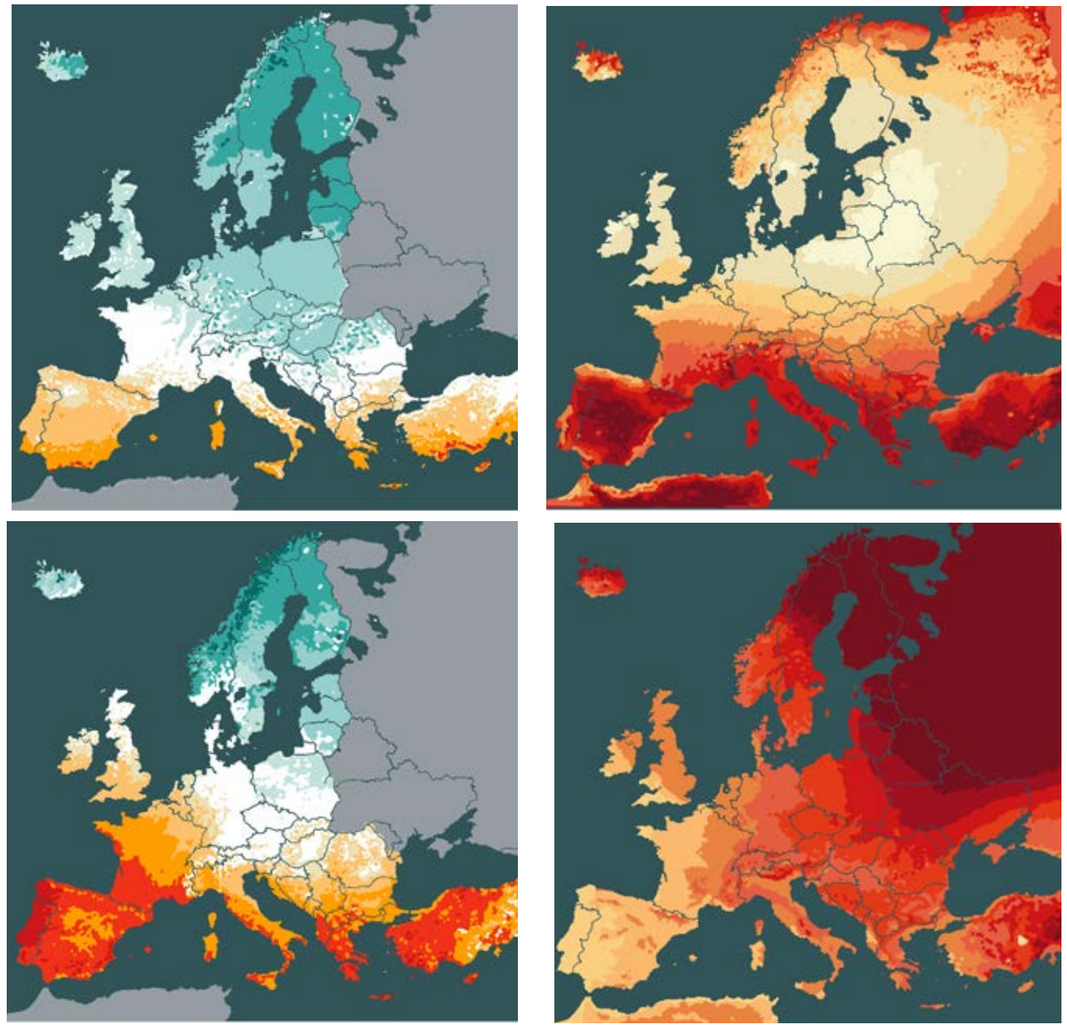
Furthermore, this process is fastened by the greening or browning of the Tundra biome due to shifting boreal forests fur-ther into northern regions. This irreversible process can only be slowed by the abundance of herbivores, counteracting the growth of trees and shrubs (Marine Mammal Report, 2012).

Projections expect a temperature increase of 1 Degree Celsius in Norwegian coastal areas and at least 1,5-2.0 Degrees Cel-sius in the eastern parts of Finnmark by 2050 in which the project region is located. At the end of the century, an increase of even 2,5-3,0 Degrees Celsius is simulated and especially affects the regions of Varanger and the inner parts of Finnmark in the North.

Next to the warming of the climate, an increase of precipitation is expected to hit the Arctic in a much larger percentage as the global average as well.
Until the end of the century, an increase by 20-30% of precipitation, more frequently in the form of rain instead of snow, for the most northern regions of Norway and the Arctic is expected (Norwegian Polar Institute, n.d.).



▲ *Figure / 07* **The main regime shift feedback mechanism /** *adapted by Höller*



▲ *Map / 08-09* **Projected change in annual and summer precipitation, 2071 - 2100**

- < -40 %
- -40 to -30 %
- -30 to -20 %
- -20 to -10 %
- -10 to -5 %
- -5 to 5 %
- 5 to 10 %
- 10 to 20 %
- 20 to 30 %
- > 30 %

▲ *Map / 10-11* **Projected change in annual, summer and winter temperature for the forcing scenarios RCP 8.5**

- 1.5 to 2.0 °C
- 2.0 to 2.5 °C
- 2.5 to 3.0 °C
- 3.0 to 3.5 °C
- 3.5 to 4.0 °C
- 4.0 to 4.5 °C
- 4.5 to 5.0 °C
- 5.0 to 5.5 °C
- 5.5 to 6.0 °C
- > 6.0 °C

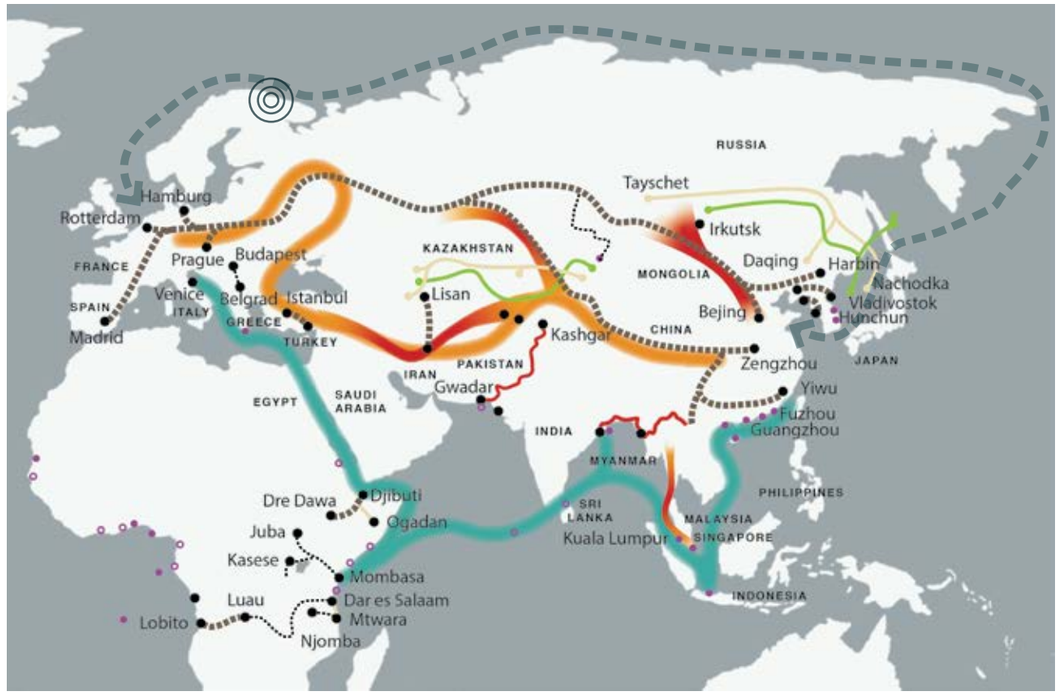
GLOBAL CONTEXT
SILK ROAD URBANISM

The "Belt and Road Initiative" (BRI) or construction of the 21st century Silk Road, announced by the Chinese Government in 2013, is one of the main drivers for the deployment of global infrastructure in current times, designed to facilitate trade, increase transport efficiency, and in some cases, bypass geopolitical deadlocks. As understood by Sassen, global infrastruc-tures are logistical clusters of nodes connected through corridors "(…) being the connective systems, technological net-works, and spaces that support global capitalism´s everyday operations, a system that today largely is organized through operational nodes in cities." (Sassen, 2011 in Wiig & Silver, 2019b, p. 913).

With an investment of around $1trn., the BRI is the country´s most impacting international ambition to inter-connect eco-nomic development around the world, covering many regions and strategic locations in Asia, Europe, Africa, and the Arctic (Huang, 2016).

Currently, the BRI connects over 16 European countries and more than 50 cities to almost 60 different Chinese destina-tions. While there is already a large amount of research about the economic and political impact of the Belt and Road Initi-ative (e.g., L. K. Cheng, 2016; Djankov & Miner, 2016; Y., Huang, 2016; Yu, 2017, Blanchard & Flint, 2017; Y. Cheng, Song, & Huang, 2017; Ferdinand, 2016; Liu & Dunford, 2016), research about the BRI within the field of urbanism only recently emerged. The so-called field of "Silk Road Urbanism" (Wiig, 2019, Wiig & Silver, 2019a) is investigating the deployment of global infrastructure as a driver for the (re)shaping and creation of (new) urban development and the possible interrelated socio-economic, cultural, spatial and environmental impacts. Current research points out that the benefits for the Chinese Government as well as for the countries involved in this large-scale infrastructural transformation are uncertain; nonethe-less, there are concerns about the potential colonialization of territories and countries to create one-sided benefits for China. Port-cities as strategically essential nodes within the development and deployment of global infrastructure, undergo drastic spatial, socio-economic, and environmental changes.

In 2017 China added the "Polar Silk Road" to its ambitious Belt and Road initiative. Driven by climate change and melting ice in the Arctic region, the so-called "Arctic Boom" creates a race for undiscovered resources and economic benefits. Through the development of a globalized economy and regional integration, the Arctic becomes more and more significant for its strategic and economic values. This ongoing process will result in many different, often negative transformations of the biophysical system on sea as well as on land. Next to Norway, Russia, and lately the U.S., also China is a key player when it comes to future developments based on these conditions.



▼ *Map / 12* **Showing the projects subsumed under One Belt, One Road**

▼ *Photo / 05* **Gazprom will work with Russian Railways on the construction of a railroad running to the new Arctic Port of Sabetta**

METHODOLOGY
INTRODUCTION

The following chapter focuses on the methodological framework behind this thesis. It is structured into three consecutive parts.

The first part introduces general theories and concepts around the terms of sustainability, resilience and adaptivity, which will be set into the context of port-cities and their need to achieve multiple forms of resilience and balance to follow a path towards a long-term adaptive future.

The second part deals with the conceptual framework and the rethinking process of the relationship between port and city as well as questions, how spatial planning and designing can increase its operative force by the emergence of a third di-mension of synergistic spaces in-between port and city. This will help to refocus on a spatial, actors- and values-based ap-proach, adding cultural, societal, and environmental aspects to the economic perspective of port-city research.

As a third part, it will be explained how the theorie and concept of nature-participation and ecosystem functions can help to become a design tool for the sensemaking on the port-city in-between scapes, thus synergistic cooperations can emerge.

03 METHODOLOGICAL **FRAMEWORK**

▼ *Photo / 06* **Lichen** */ Höller*

» *Unlike the treelike, hierarchical structures of traditional cities, the contemporary metropolis functions more like a spreading rhizome, dispersed and diffuse, but at the same time infinitely enabling new types of pluralistic relations - thinking in multiple dimensions, in all dimensions, possible* «

ANGÉLIL IN HAUTZ, 2018, P. 218

RESEARCH
QUESTION

RESEARCH STATEMENTS

In spatial planning and design, the port, city, and ecology should be considered agents within one ecosystem.

The Port-City Scape ecosystem is a synergistic and adaptive ecosystem in which the needs of the port, city, and ecology are united and together create synergies between multiple agents (global-local, economy-ecology-society) through their inter-related flows of values and needs.

Spatial planning and its holistic concepts can help to complement the research and design of port-cities and can function as a mediator between the two institutions as well as between the multiple and often contradicting values and needs. Thus spatial planning can create the stage for potential coexistence of local specificities of the city and territorial generics of the port, which turn into synergies, creating a whole (Port-City Ecosystem), which is bigger than the sum of its single parts.

RQ: How to **re-integrate the currently not aligned systems** of people, planet and prosperity in a **Port-City Scape** to create an **adaptive and sustainable ecosystem?**

SQ 1: How to **conceptualize city and port as different but complementary realities** and how to make sense of the **inescapable liminality** of the port-city milieu being **in-between local and territorial as well as in-between contradictions and synergies**?

SQ 2: How can the concept of **ecosystem-participation** help to **research and design** the Port-City Scapes to be able to use it as a **strategic tool** to drive a **sustainable/resilient development** of the Port-City Scapes?

SQ 3: How can the **concept of Design Fiction** help to research on the **performance** of Port-City Scapes and what **forms of synergy and coexistence** those Port-City Scapes can emerge to be able to **create overall social, economic, environmental and institutional** sustainability/resilience?

RESEARCH
AIM

The goal of the research is the re-conceptualization of the port-city relationship away from a static, zone-like interface of port and city towards dynamic and pluralistic interrelation-scapes in-between port, city, and region.

Scapes or milieus of multiple liminalities (liminality of port and city, liminality of center and periphery, liminality of paradox and synergy) between port and city and, therefore, the emergence of an additional dimension in-between the territorial economic force of the port and local urbanity and culture can help to explain the relationship of port and city and its char-acteristics. The encounters or border-scapes between port, city and region, which are filled with the heterogeneity and in-comparability of different values and stakeholders and their often oppositional and competitive interactions, create the challenge but also the actual richness of port-cities.

The embeddedness of the port milieu within the urban environment and, the side by side of urban and territorial, people-planet-prosperity, local specificities and global ge-nerics, contains the actual port-city culture as being a constant interplay between paradox and synergy of all of the above and distinguishes the port-city from other cities or separated ports and cities.

It is essential to understand the necessity for resetting the port and its broad territorial context into connection with the local specificities driven by the urban society, surrounding nature and regional cultures and values.

By shifting the approach on the port-city from a positivistic or quantitative one towards an analysis/synthesis of spatial and cultural patterns of interrelation can help to emerge a port-city relationship, where interests and conflicts of different stakeholders of port and city, but also the human and natural sphere can strategically be adapted into synergies. Therefore an experimental approach of using design fiction aims for identifying additional tools and strategies that can help to reflect on the reconnection of port and city institutions as well as stakeholders by emerging a new space in-between port and city which creates more than its single parts alone through the coexistence of shared and combined val-ues.

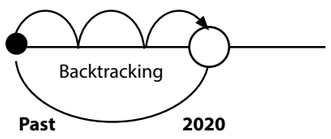
The fictional/utopian design, therefore, assures the potential for long-term sustainability and resilience of both interrelated entities of port and city, instead of short-term economic benefits on the cost of an imbalanced power-relations within the port-city.

Such an imaginative and experimental approach, rather than a technocratic one, can have the possibility to perceive the Port-City Scape as a dynamic space of flows, which is widening the perspective beyond the physical waterfront into the “scape” where the physical reality of human and natural life takes place.

PROJECT
APPROACH

As stated within the research aim, the goal is to find tools for and methods of researching and designing port-cities with a focus on balance between people, planet and prosperity where the local specificities of the city and its region become the driver for measuring and designing sustainability and resilience within the port-city milieu.

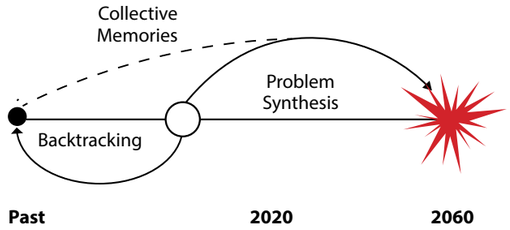
1. Scoping / Scape Mapping



As a first step, a historic geospatial analysis of the region of interest will be done. The so-called backtracking can help to identify cultural patterns and societal logic behind quantitative characteristics.This can help to explain the status quo of the area by looking into past decision-making processes, which might in-fluence the physical/spatial layout but also mental characteristics of the area until today.
Furthermore, such a historical analysis might give answers on potential future scenarios and decision-making processes that are biased by certain path-dependencies and collective memories.

Secondly, a spatial analysis and mapping of the current built and the unbuilt environment will take place.
On the one hand, the focus will be set at the very center, where port and city create the unique interac-tion-zone between the economic force of the port/harbor and the local specificity of the city.
Analyzing the current port, the proposed port development, its infrastructure and dynamics to understand the current and future rationality of the port.
On the other hand and to encounter the economic dominance within the research of port-city, mapping of the societal and ecological system and its interrelated dynamics in and around Kirkenes and Sør-Varanger will help to acknowledge also the spatial, environmental and cultural factors.

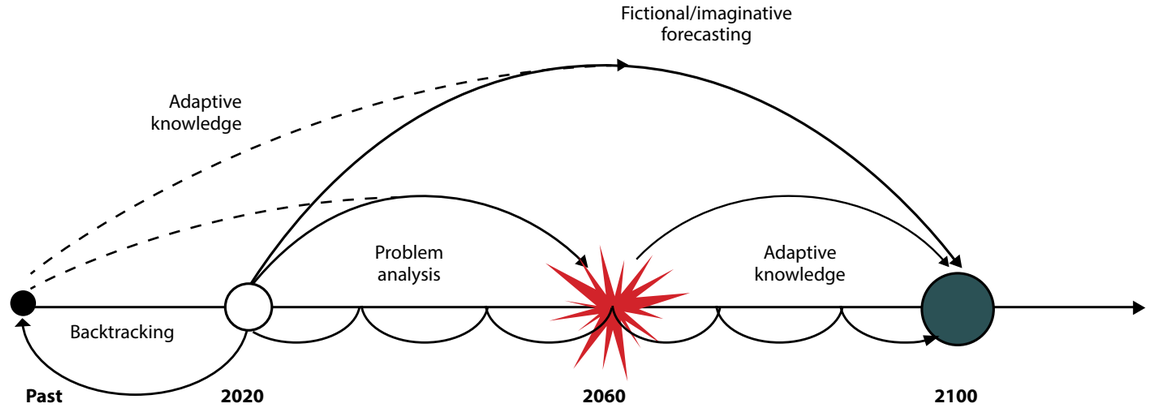
2. Port-City Relationship Mapping



After the Scoping and Scape Mapping was done, the relationship between port and city will be analyzed, mapped, and synthesized. The exploration of potential future conflicts and risks for nature and society co-ming from the proposed port development, possible future economic changes, and global warming im-pacts within the port-city region will help to understand the contradictions and unaligned values of port and city. The imbalance of the economic dominance within the port-city milieu reduces the chance for evolving and reaching shared and combined goals/values. By identifying and synthesizing interrelations, contradictions and stretch uncertainties, risks, and question proposed developments and decisions, the forecasting will work as an informative future projection for the fictional design stage.

INFORMATIVE FUTURE PROJECTION:

Boom-Bust Future
- Overlaying of territorial, economic and logistic logics of the port ontop of local culture, identity and ecology
- Seperated port and city entities without spatail embededness or institutional or cultural connectedness
- Future climate change impacts the ecological, societal and economic system
- Socio-economic impacts and pressures due to failing monofunctional and linear industries
- Socio-ecological impacts (e.g. Loss of Sámi culture and reindeer-Heerding, decrease of local fishery)



Forecasting, Backtracking, Backcasting
(Van den Dobbelsteen et. Al. 2006, in Hooimeijer et Al., 2016, p. 5)

3. Synergy Mapping through Design Fiction

After the analysis of the current/proposed state of the port development and the synthesis of the changing interrelations and emergence of potential states of conflicts between port and city the following step will use a utopian approach using design fiction, which will allow for rethinking, but also question the future development of Kirkenes and its region as a port-city.
This imaginative, rather than technocratic approach emerges creative thinking and innovative synergy fin-ding through the spatial redesigning of observed inter-connections
The Synergistic Loop, which will be developed within the conceptual framework, can work as a tool to identify the current but also changing interrelations and emerging synergies between the different natural and human participants based on the proposed implementations of the design fiction.

4. Design Steps and Strategies

As the last step, the translation of the Design Fiction into stepwise implementation strategies allow for a transitional and adaptive development of the future Port-City Scape of Kirkenes.

Spatial planning pushes the emergence of encounter-scapes of port and city with its unique, incomparable, and manifold goals, values, and potentials and sets the stage for a stepwise development of synergistic relationships within the port-city scapes.

The Synergistic Loop Tool can, therefore, help to identify and connect the interrelated institutional and non-institutional stakeholders, which need to need to interact with each other in order to achieve a balanced and renewed port-city governance.

SYNERGISTIC DESIGN FICTION:

Synergistic Adaptive Port-City Scapes:
- Imaginative and Fictional Design Innovation
- High grade of synergy between port development and ecosystems
- Local specifictiy as a driver for a unique cultural and spatial identity of the Port-City Scapes

▼ *Photo / 07* **Reminder for the need for a resilient future in Kirkenes /** *Höller*

» *(...) historical resilience of port cities is embedded in a maritime mindset or port city culture based on a strong and dedicated collaboration among diverse groups of public and private actors from different backgrounds around shared values.* «

HEIN, 2020

METHODOLOGY
THEORIES AND CONCEPTS

The following part of this chapter introduces theories and concepts of

- Sustainability
- Resilience
- Adaptivity, Adaptive Capacity and Adaptive Cylce

that will be used to find an aswer the overall research question of:

How to **re-integrate the currently not alligned systems** of people, planet and prosperity in a **Port-City Scape** to create an **adaptive and sustainable ecosystem?**

As a first step, those concepts will be introduced and secondly be set into the context of port-cities. To emerge resilience and sustainability for a long-term adaptive future of port-cities, it is crucial to create a balance between all values and needs of local and global stakeholders. Institutional resilience and a balan-ced power-relationship between the interrelated stakeholders is crucial for the collaboration on such a highly needed co-beneficial development.

METHODOLOGY
THEORIES AND CONCEPTS

Sustainability

According to the Brundtland report, there are two key concepts of sustainable development:

1. "The concept of "needs" in particular the essential needs of the world's poorest people, to which they should be given overriding priority.
2. The idea of limitations which is imposed by the state of technology and social organisation on the environment's ability to meet both present and future needs." (Brundtland, 1987)

According to the second concept of limitations, sustainability therefore needs to be a balance between all the needs of the engaging but often not alligned systems of society/culture (people), ecology (planet) and economy (prosperity).

People: The positive and negative impacts, desicions and developments have on different stakeholders of the societal realm.

Planet: The positive and negative impacts, desicions and developments have on the natural environment.

Prosperity: The positive and negative impacts, desicions and developments have on the local, national and international economy

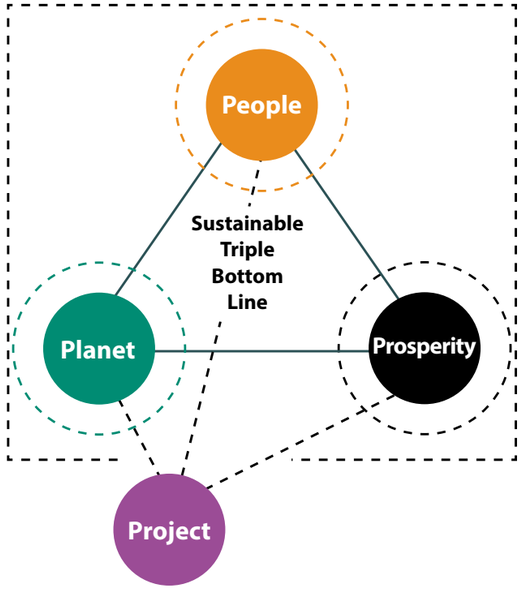
The three Ps meet within the 4th P which is called **Project** and determines the spatio-temporal dynamics and interrelations between People, Planet, and Prosperity and depicts the urge to investigate on spatial conflicts, but also balance or even synergize the three Ps within one spatial entity.
(Van Dorst & Duijvestein, 2006)

Last but not least sustainability within and between People-, Planet- and Prosperity-needs can emerge when an equilibrium within one synergistic adaptive ecosystem is achieved.

Roggema´s (2017) concept of sustainability is based on the three pillars of complexity, society, and landscape.
These three pillars arrive from the fact that we have to deal with a triplet of uncertainties (climate change, development/transition of economy and exposure of society towards risks). Therefore sustainable design is society-based (society as co-designers), complexity-led (city as a complex system) and landscape-driven (building on the natural richness of the environment as true sustainability), which can lead to six overall design and planning principles: closing cycles, innovative designs, create space for the unknown, anti-fragility and flexibility, people's engagement, and taking the landscape as basis for design.

▼ *Figure / 08* **Triple Bottom Line /** *Lukas Höller*

Alligned Triple Bottom Line within the Project



Resilience

According to Chapin III & Kofinas & Folke (2009) "resilience depends on (1) adaptive capacity (see above); (2) biophysical and social legacies that contribute to diversity and provide proven pathways for rebuilding; (3) the capacity of people to plan for the long term within the context of uncertainty and change; (4) a balance between stabilizing feedbacks that buffer the system against stresses and disturbance and innovation that creates opportunities for change; and (5) the capacity to adjust governance structures to meet changing needs" (p.16).

As defined by Gunnerson & Holling (1995), resilience is the essential ability of ecosystems to recover from risk impacts. Even though the main principles of a system are restored, resilient systems do not return fully into the same situation as they have been before the risk impact. City systems are resilient when they can withstand and tolerate risks, e.g. climate change impacts, by specific structures or components that lower the impact by reducing or counteract disturbances.

According to De Brujin (2004), there are two types of resilience: Elasticity and Transition.
On the one hand, elasticity describes the reorganization process of a system, which was impacted by a hazard, back into its former state of equilibrium.
Here, the amount of change in the form of risk that the system can undergo without changing its original forms of functions and structures is measured.
Transition, on the other hand, describes the capability of a system to self (re)organize itself to accommodate external changes and risks and is therefore measured by the magnitude of disturbance a system can tolerate before it has to redefine its structures.
There is a difference between resilience (fixing the current system) and transformation (seeking for a new potentially more desirable state) (Chapin III, Kofinas, Folke, 2009). Different from De Bruijn, who argues that the system tries to maintain its main structures after it recovered from the impact, Wardekker et al. implicates the chance of a reconfiguration of the system into a new structure as well (Wardekker et al., 2010).

METHODOLOGY
THEORIES AND CONCEPTS

Adaptivity

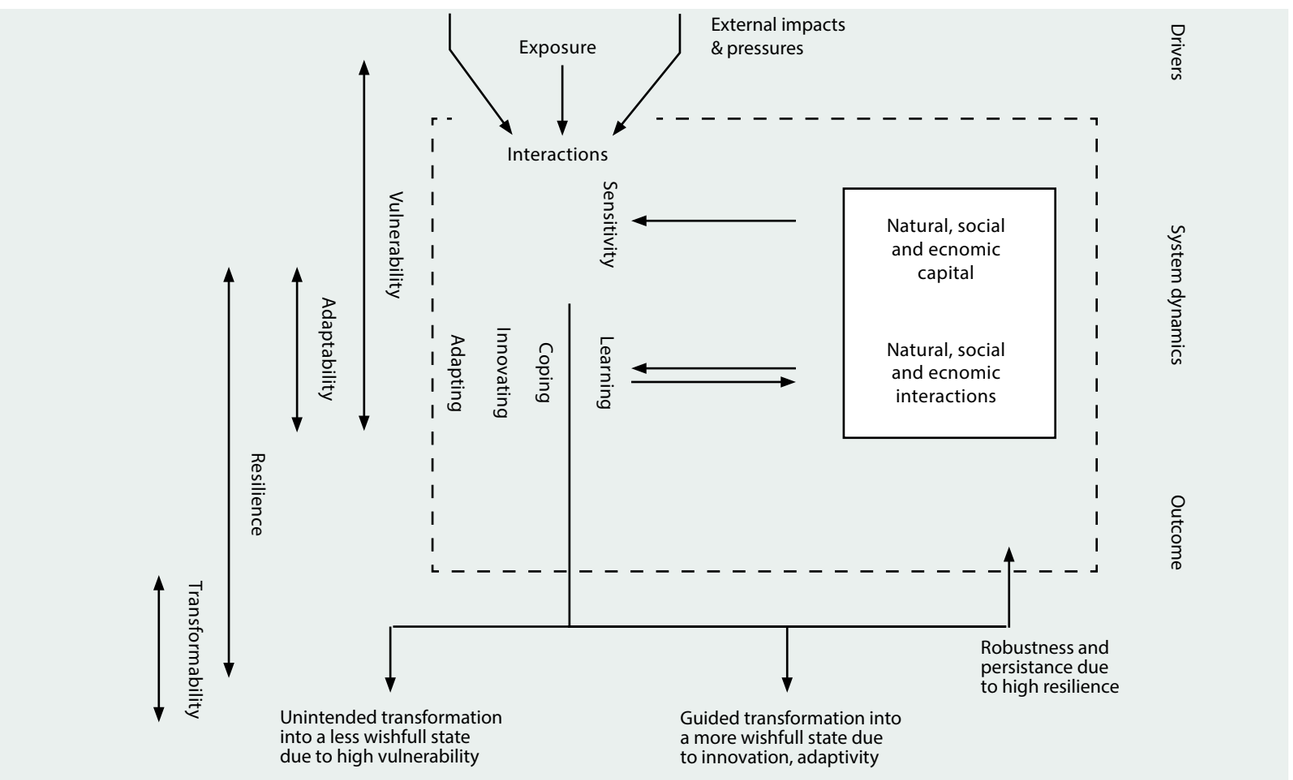
Systems react differently to disturbance or shock by hazards: they can either be persistant through resilience, actively transform their state towards a new, more beneficial one through transformation or transform towards an often degraded stated due to vulnerability.
The sensitivity of a system depends on its exposure to risk. Different to mitigation (reduction of impact on e.g. climate) adaption creates a transformation and therefore reduces or ends the vulnerability to certain perturbations in growing or living conditions or shocks brought on by climate change (Holling, 2001; Chapin III, Kofinas, Folke, 2009).

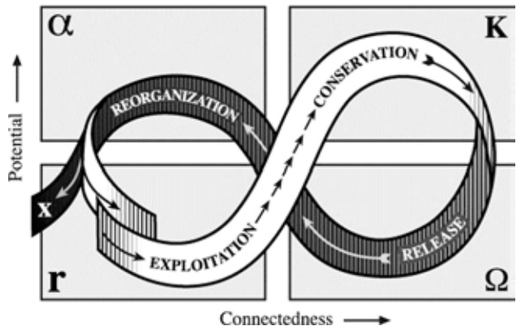
Adaptive Capacity

Adaptive capacity can be described as the amount of capability and effectiveness of a system (social, functional, or biophysical) to respond to specific hazards or disruptions. This capacity is often depending on the amount and diversity of social, economic, physical, and natural capital, as well as how it is used, distributed, and influenced by the individual, social networks, and institutions.

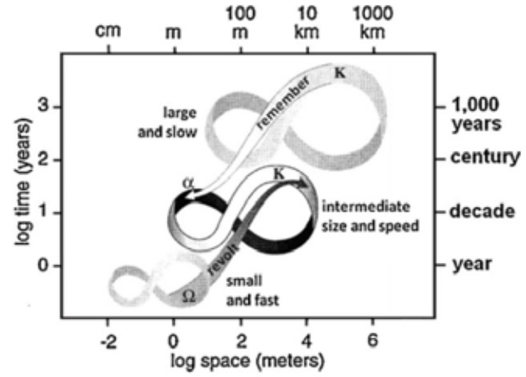
Fostering biological, economic, and cultural diversity, fostering social learning experimenting and innovate to test understanding and selecting, communicating, and implementing appropriate solutions are therefore key-factors for building up adaptive capacities, that reduce the vulnerability and the exposure to dynamic climate and socio-economic pressures
(Holling, 2001; Chapin III, Kofinas, Folke, 2009).

▼ *Figure / 09* **Conceptual framework linking human adaptive capacity, vulnerability, resilience and transformability**





▲ *Figure / 10* **Adaptive cycle**



▲ *Figure / 11* **Panarchy, complex adaptive systems**

The Adaptive Cycle derives from studying Dynamics within Ecosystems

The adaptive cycle alternates between long periods of aggregation and cumulation of resources (r: exploitation phase and k: conservation phase) and fast periods that create the opportunity for innovation (omega: release or collapse or release phase and alpha: reorganization phase) (Resilliance, n.d.; Holling and Gunderson, 2002).

The adaptive cycle is meant as a tool for rethinking. It refers to the conflict between resilience and transformation, setting the focus on the processes of destruction and reorganization, which are often neglected for growth and conservation (especially within our socio-economic society), even though they provide the possibility to shift towards a more desirable structure or state of the system.

The concept of Panarchy, as Holling and Gunderson (2002) proposed, explains the nature of complex adaptive systems. Smaller and faster cycles are interlinked to an intermediate and bigger scale through their revolt. Larger and slower scales stabilize the intermediate system through remembrance. Such complex adaptive systems respond to medium term environmental shifts and transitions and can be seen as a metaphor for a biological/natural system (e.g. ecological resilience) (Ravetz,2013, p. 5102).

Nonetheless, Holling's apporach can also be linked to social-ecological systems or human-nature systems, linking adaptive cycles to growth, accumulation, restructuring and renewal (Holling, 2001 in Hooimeijer et al., 2020, p. 113).

METHODOLOGY
THEORIES AND CONCEPTS

Suastainability, Resilience and Adaptability in Port-Cities

Even though port and city nowadays are parts of different separated entities (territorial and local), they coexist within the same space as well as share challenges of economic transformation, societal instability, climatic changes, and other forms of transitions. Port-cities need to accommodate a growing port as well as space and functions for the expanding city and region. The risk of the port imprinting its 24/7 economic dynamics and activities over those of the city and its inhabitants create another challenge for the co-habitation of within the port-city region (Hein, 2019a). Since geographic modeling has done a lot of re-search on investigating and comparing the economic perspective of the port-city relationship world-wide, the socio-spatial dimension, the impacts and possibilities for a collaborative coexistence of port and city, within the frame of emerging a sustainable, resilient and adaptive port-city region, is still underinvestigated (Hein, 2020). The spatial, as well as the spatiotemporal/dynamic aspects of port-cities, need to be shifted into the foreground to achieve sustainability and a balance between different needs (ecological, socie-tal/ cultural and economic). Approaches on port-cities from a holistic urban planning point of view need to address not only technological or economic drivers but rather set a focus on spatial, institutional, social and environmental resilience as well.

Spatial planning needs to focus on the design of spaces for co-creation, where the maritime- or port-city mindset can emerge as well as where cooperations between institutional and non-institutional stakehol-ders of port and city and from the global and local sphere invest in spatial and technological innovations to ensure environmental, economic, institutional and social resilience for a long-term sustainable future. The question is, how planners and designers can emerge a renewed governance between the multiple needs and wishes of the port-citie´s stakeholders, maybe even towards nature-inclusive approach?

The AIVP (Association Internationale Villes Ports or International Association of Port-Cities) relesead their Agenda 2030 for Sustainable port-cities.
Based on the United Nations Agenda 2030 for Sustainable Development and the resulting SDGs (Sustainable Development Goals) AIVPs Agenda 2030 aims for a framework within the context of port-cities, helping ports, stakeholders, planners and other cooperative partners to prepare projects and give guidelines for decision-making. To follow an holistic approach, 10 goals with 46 measures for sustainable port-city devlopment have been released (AIVP, 2018)

This thesis also uses the guidelines as a broad overview of possible solutions and goals for a sustainable and synergistic development and balance between people, planet and prosperity.

The following is a listing of the goals and the related measures based on the AIVP Agenda 2030. Furthermore additions, aiming for a sustainable and resilient ecosystem participation have been made by the author.

Climate Change Adaptations:
1. Including joint port-city measures to prevent inundation and flooding of the port, connecting infrastructures *and the city**
2. Promoting the renaturalization of riverbanks and coastlines to erosion and climate change impacts
3. Introducing warning systems and *other climate information systems** to reduce human, economic and *environmental impacts**
4. Considering other climate change impacts, such as temperature, precipitation not only on port systems, supply chains and labor but also on *environmental participants* as well as the urban environment**
5. Making resilient and carbon neutrality a priority

Energy Transition, Circular Economy and *General Circularity*:
1. Promoting cooperation between socio-economic, *societal/ cultural and ecological/natural stakeholders** to bring their activities together and identify potential synergies
2. Give priority to circular economy and *circularity in general** to promote and investigate exchange or recycling of materials, energies *and other potential, natural or humanmade flows**
3. Commiting the port-city region to achieve a low carbon, low ressource society (e.g through renewable energies)

Sustainable Mobility:
1. Development of soft, multimodal and collaborative mobility esp. for commuting
2. Develop soft solutions for proximity based logistics (e.g use of waterways)
3. Promote waterways, railways and other non-fossile modes of transport and mobility for shipping goods *and urban mobility**

Renewed Governance:
1. Guarantee better representation for all stakeholder needs, esp. civil society and *natural participants** in decision-making
2. Committing to continuous, long term consultation across port-city region
3. Guarantee transparent management and open information systems
4. Developing collaborative approaches, drawing on scientific, technological, *cultural and natural* knowledge* from scientific community, civil society *and indigenous or alternative societies**
5. Adopting a land and *sea** management policy that strikes balance between urban use, port activity and *environmental use**

Investing in Human Capital:
1. Mobilizing private and public stakeholders in port-city sectors to promote professional training and personal development for citizen
2. Mix of profiles and promote skills transfer to improve flexibility and move beyond the sector-based approach
3. Provide training in preperation and *re-education possibilities**
4. Promote interactions and projects between schools, *universities**, training institutions and the professional world
5. Create *(Makers District)** collaborative space for experimentation, co-working spaces, learning and education facilities, port centers, cultural centers for interaction and new projects

Port-Culture and Identity:
1. Developing all types of open spaces within Port-City Spaces to promote developments and activities
2. Integrate spaces and functions open to everyone into port facilities, enhancing the visibility of port activities
3. Port-Center
4. News and social media for port-city
5. Organizing temporary and permanent cultural events in port-city areas

Food Security and Quality Food:
1. Develop smart sytems for monitoring and controlling maritime and terrestrial food resources
2. Combating food waste by improving storage capacities or *circular reuse approaches**
3. Promote fair trade, organinc and local (special) productions
4. Port areas as dedicated zones for commercial fishing and encourage innovative food research and production projects into port-city regions

Promoting Living, Recreation and Cultural Amenities in Port-City Interface *and Region*:
1. Incorporate measures and designs to reduce port nuisances into urban environment
2. Revising the status of port-city region heritage and refelect the sites historical development
3. Develop public spaces, recreational and cultural amenities, *promote accessibility (local use, before commodification for touristic use*) of cultural built heritage, both new, recycled and obsolete as well as natural port-city heritage both old and new**
4. Promote architectural and landscape integration of port facilities

Healthy and attractive living conditions for residents, *temporary visitors (e.g. fishermen, shipping crews) and other members of the society*:
1. Independent, transparent measurements of air, water, soil quality, noise impacts, light pollution
2. Optimizing the use of water (fresh and sea water)
3. Promote green port facilities
4. Regulate cruise ship stepover based on port-city region capacity *but also environmental capacity (esp. eco-tourism)** without compromising equilibrium and appeal of local, *natural** area
5. *Healthy port-city environment through healthy nature**

Biodiversity and Natural Capacity:
1. Improving and maintaining water quality
2. Regual survey of biodiversity in port-city regions
3. Prevention of destroying sensitive natural habitats when developing on and offshore spaces
4. Supporting civil society and indigenous/alternative societies to protect, s*trengthen or even include natural participants**
5. Restoring and developing biodiversity *beyond protection towards integration** in the port-city region

▼ *Photo / 08* **Polarlights near Kirkenes /** *Höller*

» *Only a design project taking into account this bigger landscape picture is able to deliver a realistic fundament for a city development under the conditions of precariousness.* «

L. DIEDRICH, 2013, P. 3

METHODOLOGY
CONCEPTUAL FRAMEWORK

After discussing the essential theories of sustainability, resilience and adaptivity as well as setting them into the context of port cities, the following part investigates on the changing perception on port-cities from a spatial planning point of view, and how a renewed concept of the relationship can help to achieve the goal of a sustainable, resilient and cooperative port-city scape.
After decades of separated planning activities and decision-making processes of the two entities port and city, the question arises, how spatial planning and design, as a holistic and interdisciplinary profession can become the mediator between the two institutions and their stakeholders´needs and values?

To begin with, it is important to state that new approaches to port-cities need to be imaginative instead of only technocratic when it comes to the designing and planning of the port-city (Hein, 2019a). This state-ment is based on the separated view on port and city, where the port became a positivistic-driven infra-structural realm of economic dominance. Furthermore, the renewed concept of port-cities should be ba-sed on the problematics of currently used conceptualizations of the port-city relationship such as the inter-face, which, on the one hand, strengthens the idea of the separation and, on the other hand, mainly focu-ses on the waterfront as the ultimate design and planning paradigm.

To answer the question of:

How to **conceptualize city and port as different but complementary realities** and how to make sense of the **inescapable liminality** of the port-city milieu being **inbetween local and territorial as well as inbetween contradictions and synergies**?

this part focuses on the concepts of

- Infrastructure
- „Scapes“

and introduces to the idea of

- Parado[x/s]ynergy

as a third dimension of encounter-scape, where the contradictions of port and city intertwine and can be formerd into a synergistic adaptive ecosystem

METHODOLOGY
THEORIES AND CONCEPTS

Port-Cities and Infrastructure

As defined by Persi (2006) in Nijhuis and Jauslin (2015), infrastructure can be defined as all constructed facilities as well as natural features that support and serve human activities. Ports started being co-products of urban development along maritime and coastal location. As stated before, talking about port-cities, is talking about a specific form of cities, in which the specific mindset, driven by maritime activities, has most often been essential for the economic prosperity, social cohesion and cultural identity. During the 20th century and the ongoing industrial and technological revolution, the logic of the port shifted towards a territorial logic of transport, logistics and economy. Positivistic approaches propose, that, if a certain type and amount of infrastructure is rationally located within a port, economic and quantitative elements like throughput of imported and exported goods, the number of transported people and other economic factors, will be reached. Similar to that Hoyle describes the port-city relationship as an interactive economic system of openness and connectivity. Nonetheless, when taking a look at current uncertainties and the increasing risks of economic instability and global warming, it is important to rethink the infrastructural approach of ports to regain a new form of port-city relationship. Essential for this thesis is the addition Steele and Legacy (2017) give to critical infrastructure, as "a multidimensional and lived phenomenon is as much about space, place, ecology, and culture, as it is about pipes, scaffolding, wire, and concrete" (p. 3). This adds not only the essence of the site-specificity, but also the importance of everyday-life, ecology, and culture for the discussion about port-cities. Therefore it is essential to know and understand infrastructure and the interrelation it has with other infrastructures and systems. To reach resilience and adaptivity within port-cities (economic, social, cultural and ecological) experimenting with alternative forms of those infrastructures can help to reach a new comprehension.

Port-Cities and Scapes

Due to the infrastructuralization and territorialization of the port, serving as a node within a global economic network as well as the accompanied expansion of this network towards the maritime foreland and the regional hinterland, shifts the focus of the port-city relation away from the traditional waterfront towards the notion of "scape".
As Waldheim (2008) explains in Moretti (2020), ports are the clearest example of infrastructural landscapes as they accept, redirect and stream the contemporary flow of consumer goods and its transitions bears distinct implications of the landscape medium.

Urban Landscape Infrastructure*

The framework of "Flowscapes" combines the field of Infrastructure as Landscape and Landscape as Infrastructure to enable planners to address the complex web of global-local interrelations and dualities constituting today´s urban (local) space of place (Nijhuis & Jauslin, 2015). Also the Port-City Scape is a system of networks with multiple levels of organization and dynamics, where the port-city can be seen as the synthesis of global-local flows and interactions. Infrastructure can be defined as all constructed facilities and natural features that support human activities (e.g. buildings, communications, energy generation and distribution, green spaces, transportation of all modes, water resources, and waste treatment and management). Landscape is defined as perceived by humans as an area of (inter)actions between natural and human-made processes. From such a point of view infrastructure is the human´s force to shape and change the natural environment (Nijhuis & Jauslin, 2015, p. 18).

Similar to Roggema in his concept about sustainable urbanism, where he proposes a landscape-driven approach, where building on the natural richness of the environment is seen as true sustainability (Roggema, 2017), also within this concept coupling landscape and infrastructure, Landscape as Infrastructure can serve multiple ends (functional, social-ecological) in a multipurpose way.

On the one hand, the concept of "Flowscapes" introduces us to the field of "Infrastructure as Landscape," where infrastructure becomes the interdisciplinary object for design interventions (e.g., green corridors, roads, dikes, port structures).

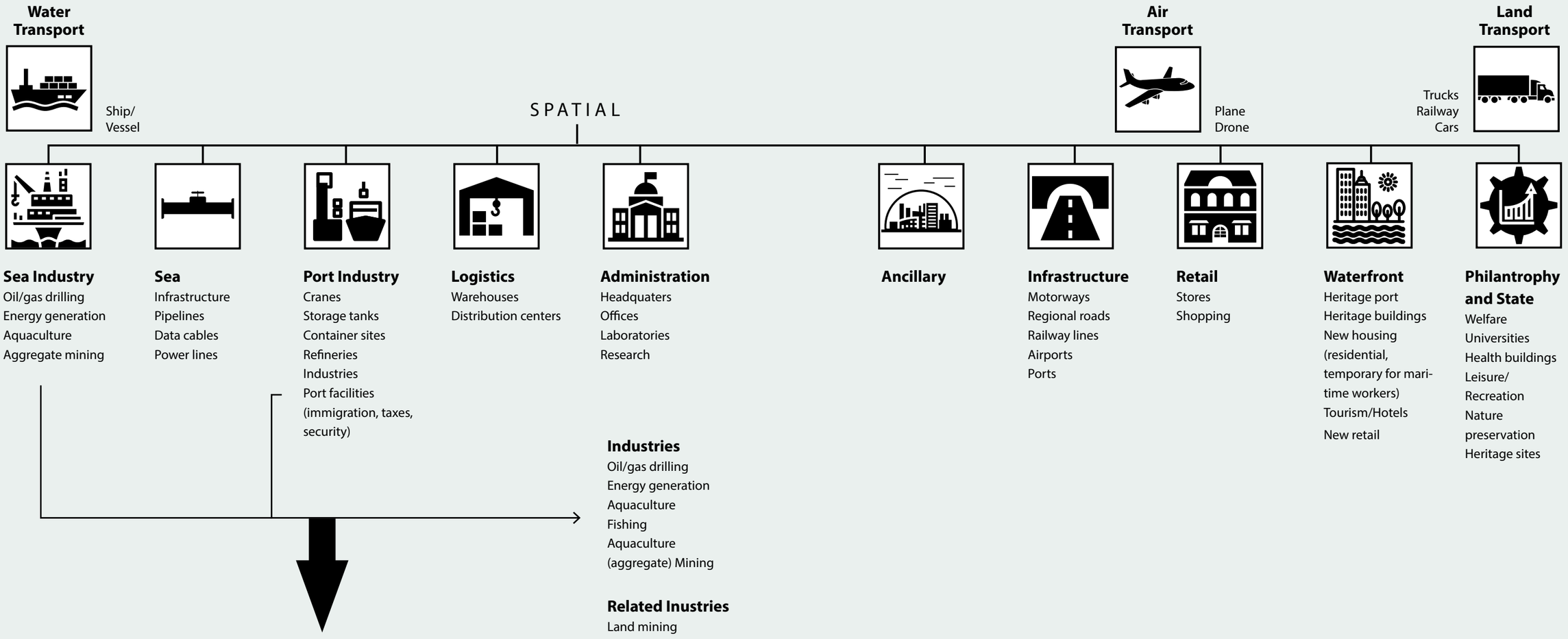
On the other hand, a "Landscape as Infrastructure" approach focuses on the aim of sustaining and improving economic and ecological processes. Here landscape becomes the medium through which solutions implemented into infrastructure are formulated to address multiple pressing urgencies and the need for more multi-functionality within a still economically viable utilitarian system (Nijhuis & Jauslin, 2015, p. 18-23). "Flowscapes" therefore propose a combination of the object-oriented (Infrastructure as Landscape) and goal-oriented (Landscape as Infrastructure) approach and overcome the limited views on either fixities or flows of the two concepts it unites. The focus is set on the integration rather than reduction and the relationship between the social, economic, and natural systems from a spatio-temporal multi-scalar and interdisciplinary perspective.

Port-City Scapes

The space between port, "(...) where the city becomes landscape" (Moretti 2020) of territorial logics and city, where the logic of local culture, society and characteristics of the placespecific meet, become liminal scapes of those contradicting, paradoxical, incomparable logics. The relationship can evolve physical and mental spheres of the port outside the original port-city boundaries. Decision within the port-institution can have regional/global relations, creating physical and mental in-between scapes of port and city/or region distant from the actual waterfront. Due to the local, regional and global op-erational scale of port and port-institutions, but also the local, regional and global scale of institutions steering urban de-velopments, values and the interrelated power of the stakeholders from outside the original port-city entity can be ac-countable for spatial, technological- but also cultural and societal changes within the port-city and therefore have an im-pact on their relationship.

Therefore, Port-City Scapes become heterogenic and ambiguous in-between-spaces where flows and interrelations of insti-tutional - non-institutional, societal - economic - environmental values and their related powers accumulate. As complicat-ed webs of interrelations and flows between port and city, Port-City Scapes shift the perception away from a static Port-City Interface, where managing the needs of and conflicts between port and city as separated antagonists is the priority. The relationship shifts towards dynamic and pluralistic encounter- or border scapes in-between port and city, which are filled with the heterogeneity and incomparability of different values and stakeholders and their often oppositional and competitive interactions, which, nonetheless, create the challenge but also the actual richness of port-cities.

METHODOLOGY
THEORIES AND CONCEPTS



▲ *Figure / 12* **C. Hein, 2019, p.4, Port-City Scape** / *adapted by Höller*

METHODOLOGY
CONCEPTUAL FRAMEWORK

Paradoxsynergy as third dimension inbetween port and city

As stated before, complex systems show the interactions within a web of interrelated flows on different scales and how they affect or stabilize each other. Also, port-city regions need a high grade of adaptive capacity to overcome the changes and dynamics they are exposed to. As hubs for economic activities but also as urban environment for its residents and natu-ral ecosystem on the aquatic foreland, port-city and terrestrial hinterland, they need to accommodate solutions to many different pressures and uncertainties. The Port-City relationship being a paradox scape only exists due to the interrelation of the two systems and the contradiction and conflict of values of one-another. The existence of many different values and goals as well as the process of finding consense, collaboration and solution create the burdens but also the potential rich-ness of the port-city. Focusing on those encounter-scapes of coexistence in-between port and city, which are formed due to multiple liminalities (port and city, center and periphery, paradox and synergy), aims for the emergence of an additional dimension in-between the territorial economic force of the port and local urbanity and culture of the city, which can help to renew the relationship of port and city and its characteristics.

This spatial, actors- and values-based approach uses the richness of heterogeneity within those in-between scapes, where the global generic and the local specific intertwine. The aim for a healthy and two-sided relationship of port and city is the emergence of shared visions within those encounter-scapes, but the assumption that we can break society into parts, with distinct functions, that when properly aligned, can reach equilibrium is not working in reality. The theory that all one needs to do is optimize the system, neglects how our societies often do not, in fact, fit neatly together (Littlejohn, 2020)

Therefore, spatial design as a holistic and interdisciplinary profession can make sense of those paradoxical, ambiguous and confusing spaces and turn them into scapes of coexistence and synergistic interrelations.

Designing coexistence of the territorial and local sets both port- and city-scapes institutionally and spatially into play and is characterized by heterogeneity, incomparability, duality and alterity.

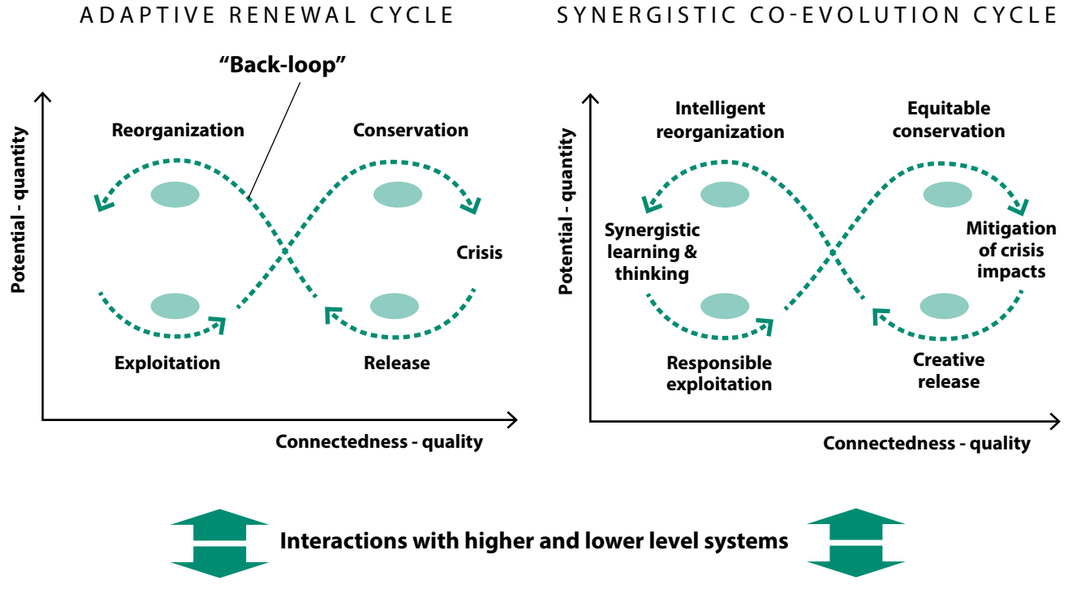
As Warsewa (2017) states, port-cities don't follow a purely adaptive logic, which would make the impact of the global dy-namics of the port main driver for change. Different to a sheer functional adaptive system, which response to short term pressures through economic and technological innovation, but also different to a complex adaptive system, as Holling pro-poses, a synergistic adaptive system, taking local specificities, characteristics of the societies and the strength of local cul-ture and nature into account, can be a driver for sustainable port-city region development. According to Ravetz (2013), a synergistic adaptive system is „[...] driven more by human qualities of thinking, learning, questioning, creativity, strategy and reflexive awareness (a metaphor of a human system involving cognitive deliberation and personal development). The concept of resilience here focuses on these human qualities and their capacity not just to adapt, but to synthesise wider societal goals." Thus, Paradoxsynergy Scapes, a third dimension in-between port and city emerge, in which spatial planning has the operative force to become the mediator between port and city during their encounter.

Paradox-Scapes

Scapes (Land and Sea), representing the contradiction and duality between both legitimate institutions of port and city as well as their surrounding due to their encounter, holding within itself two or more contra-dicting, different values/ideas, none of which excluding each other, and their interrelated power-state, resulting in current and/or potential spatial/technological and institutional differentiation. The accumula-tion of incomparable, heterogenous, dual, contradicting and altering values of port, city and their envi-ronment in a physical or mental form within the port-city scape creates and emerge the character and form of the Paradox-Scape.

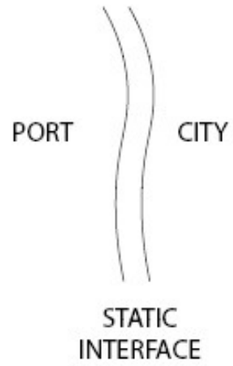
Synergy-Scape

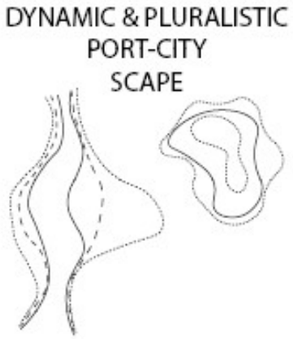
Paradox research has emphasized that the cognitive ability to accept the coexistence of contradictory elements sets the stage for using the tensions between those elements as an opportunity for creativity and the emergence of cognitive ca-pacity.
The transition of the Paradox-Scape into a Synergy-Scape can follow through sensemaking between the different, contra-dicting values and actors of port and city by finding combined and shared values and emerges the opportunity of coexist-ence of different stakeholders due to one or multiple synergizing effects, which create a port-city ecosystem as a whole within those scapes of encounter, which is bigger than its single parts alone.



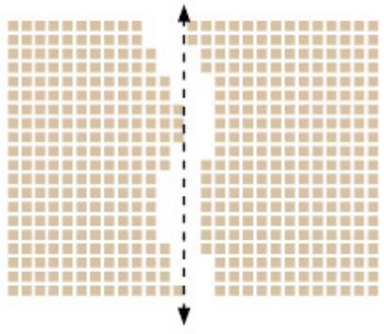
▲ *Figure / 13* **Adaptive and synergistic cycles**

METHODOLOGY
CONCEPTUAL FRAMEWORK





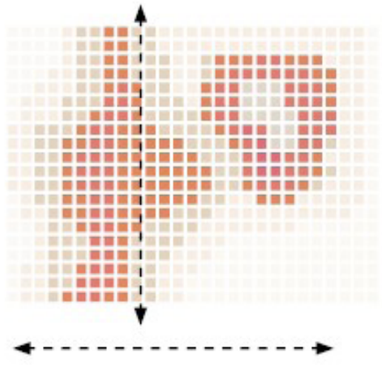
SPEPARATION OF TWO HOMOGENOUS ENTITIES, DIFFERENT VALUES AND INSTITUTIONS



WATERFRONT

2 DIMENSIONS WITH INTERFACE BETWEEN PORT AND CITY

ENCOUNTER AND ACCUMULATION OF HETEROGENOUS, CONTRADICTING, PARADOXICAL, AMBIGUOUS VALUES AND ACTORS

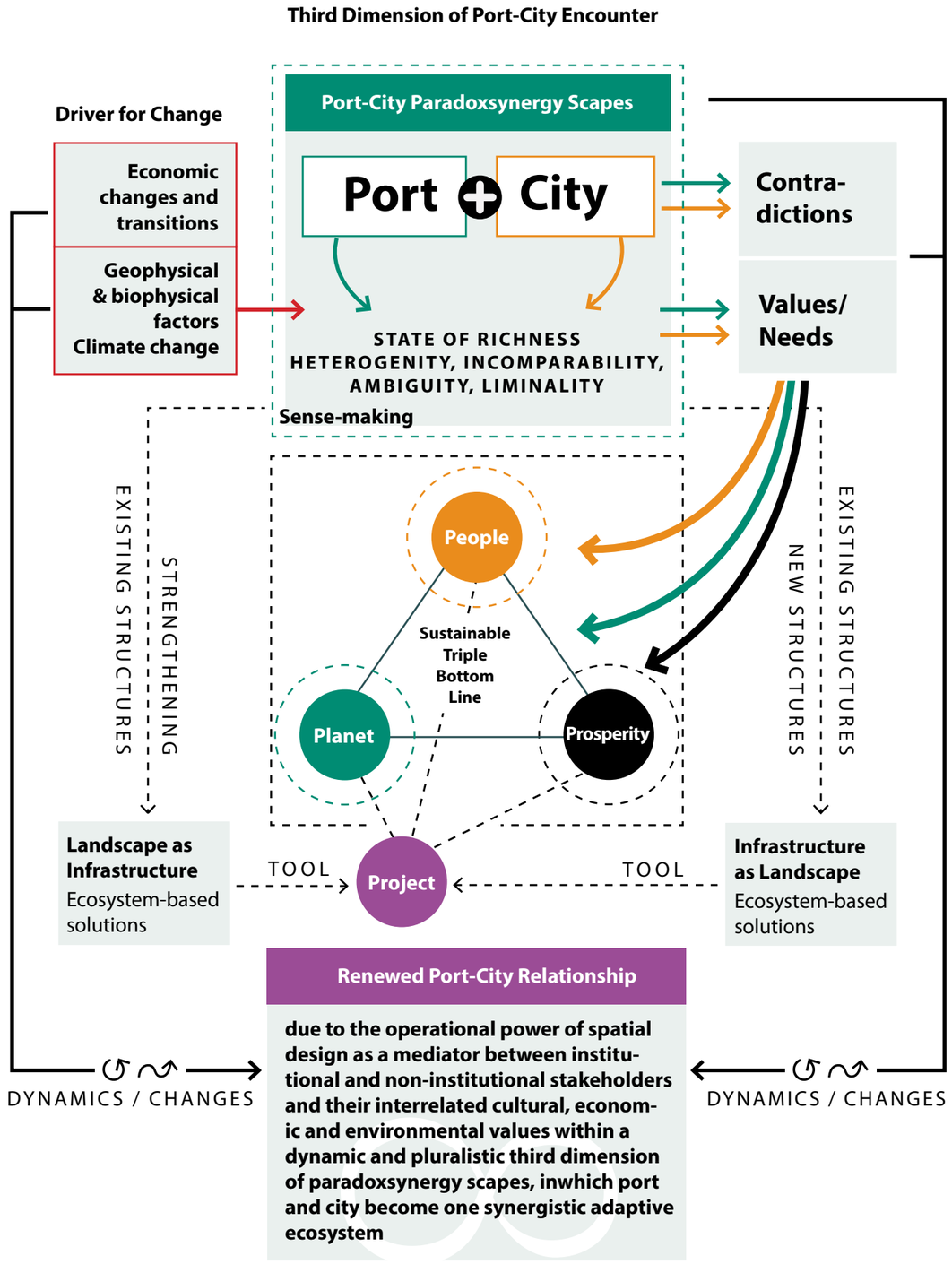


AQUATIC FORELAND | WATERFRONT | TERRESTRIAL HINTERLAND

EMERGENCE OF A 3rd DIMENSION BETWIXT AND IN-BETWEEN PORT AND CITY

Port-City Parado[x s]ynergy

Low *High*



▲ *Figure / 14* **Conceptual Framework** / *Höller*

▼ *Photo / 09* **Landscape around Kirkenes /** *Höller*

»Synergistics'—the science of synergy, or how things work together'«

J. RAVETZ, 2013, P. 5

METHODOLOGY
STRATEGIC SYNERGISTIC LOOP

Las but not least, this part of the chapter investigates on the question of:

How can the concept of **ecosystem-participation** help to **research and design** the Port-City Scapes to be able to use it as a **strategic tool** to drive a **sustainable/resilient development** of the Port-City Scapes?

Learning from the valuation of ecosystem functions and their benefits for humans as well as other natural participants through backflows is therefore essential. The separation in provisioning, regulating, support-ing, and cultural flows can be adapted to port-cities and their infrastructures and the built environment. To shift the perception away from only hard values
Like economic and technological innovation and solutions, seeing the port-city region and their infrastruc-ture/built environment from an ecosystem function`s perspective aims for the focus on soft-values like spatial qualities, cultural and societal values, renewed governance, and other non-material or profit flows.

The combination of the idea of how ecosystem functions work in multiple sustainable ways and the idea of port-cities as synergistic adaptive ecosystems can emerge a tool for the design of the encounter-scapes of port and city.

METHODOLOGY
STRATEGIC SYNERGISTIC LOOP

Ecosystem Functions and Ecosystem Based Solutions

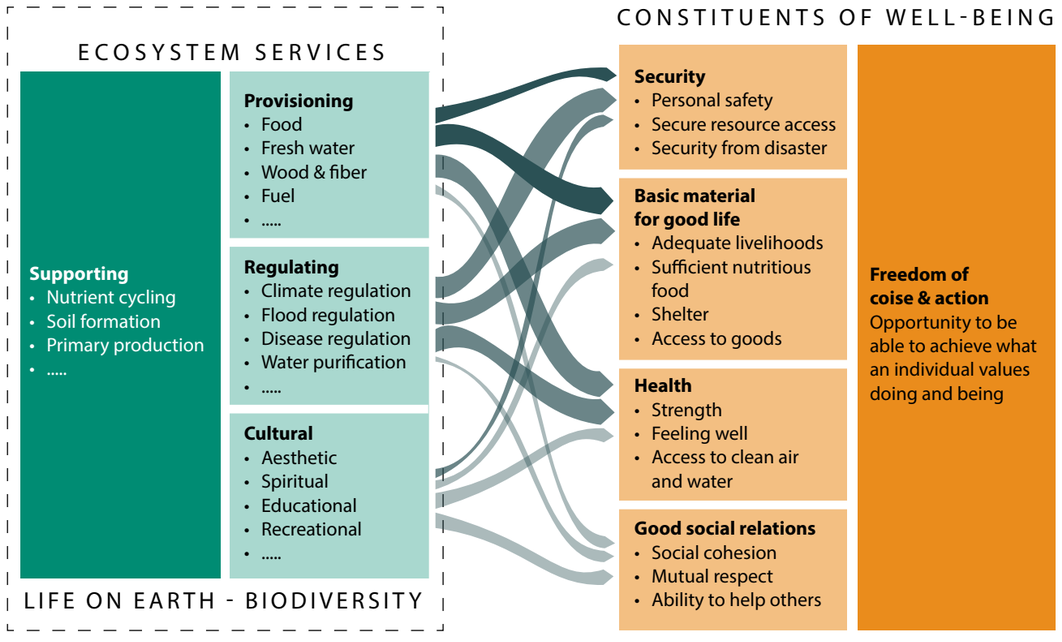
Ecosystem-based solutions to adaptation are multi-purpose ways to increase the capacity of natural capital and, therefore the adaptive capacity of human societies against various impacts of climate change. This happens through the delivery of ecosystem functions and services for humans, which reduce exposure to negative impacts. Generally, ecosystem services can be defined as benefits humans derive direct or indirect from ecosystem functions *(Constanza et al. 1999; MEA, 2005)*.

Besides providing additional adaptive capacity, ecosystem services can also have social, economic and cultural benefits. They can create a win-win situation for the biophysical, social and economic system, by:

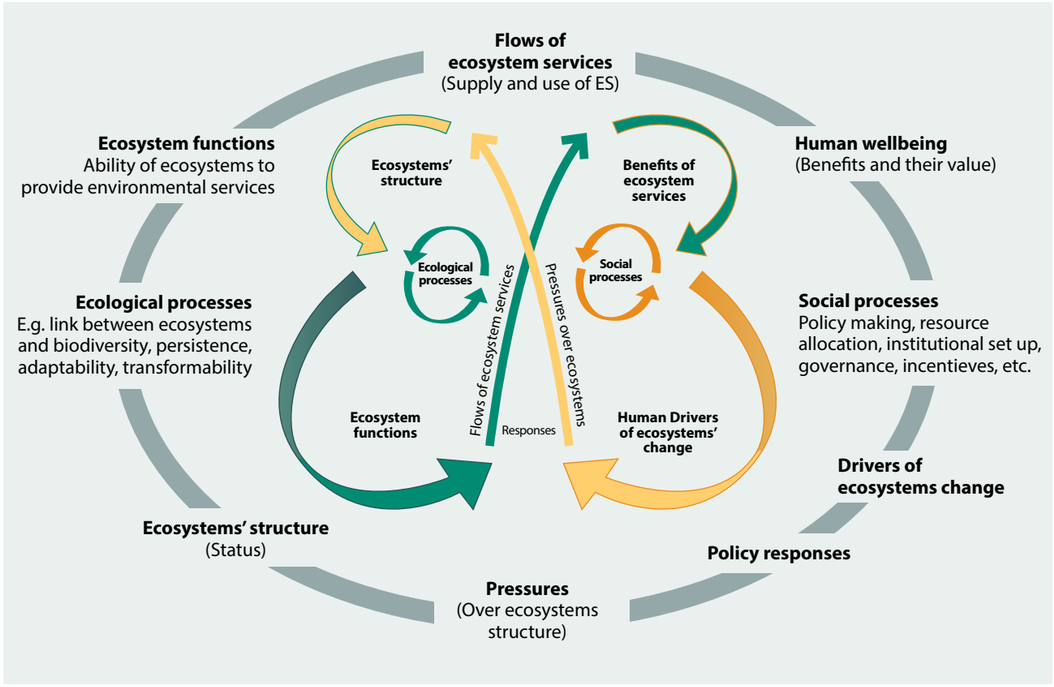
- Climate change adaptation and mitigation;
- Additional socio-economic development;
- Environmental protection and biodiversity conservation
- Contributing to sustainable economic development

(Munang et al., 2013).

The value of ecosystem services can be divided into regulating services, **provisioning services, supporting services, and cultural services.** Within this project ecosystem services and their creation of benefits for all three investigated systems (biophysical, societal, economic) will play an important role to create not only additional adaptive capacity against climate change impacts but also create new opportunities and win-win solutions.



▲ *Figure / 15* **Ecosystem services valuation**

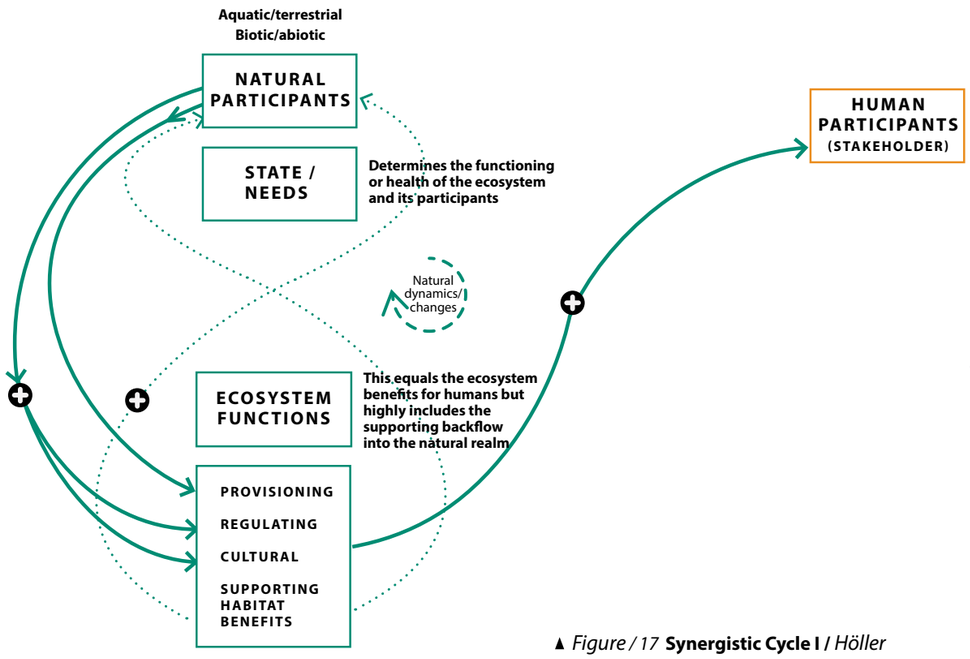


▲ *Figure / 16* **Flows, processes and pressures of ecosystem services**

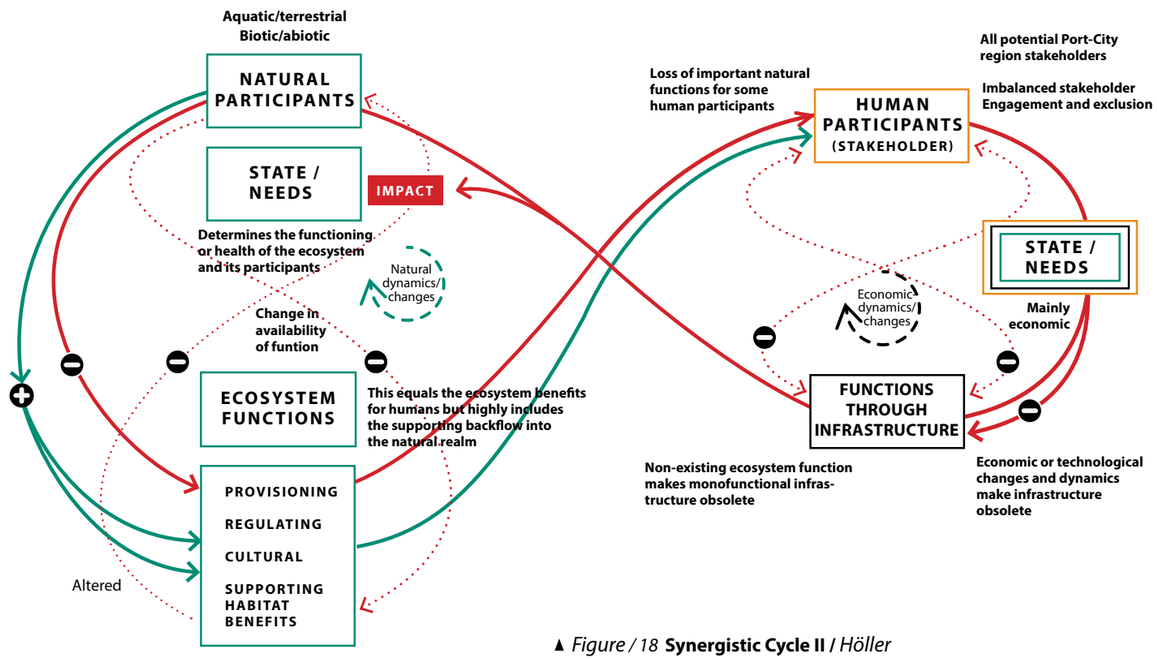
Within this thesis it is important to point out the use of ecosystem`s functions for the proposed desing and planning strategies. The danger of using ecosystem services as a part of the framework is the risk of observing them from a reductionist and very human-centered point of view. As a result unsustainable trade-off decisions are the case, leading to the over exploitation of some services and the lost function of others due to heavy impacts on the ecosystems structure/state.

Instead, this projects aims for nature inclusion, trying to intergrate natural participants as kind of stakeholders and their needs into the decision-making processes. This observation from a holistic point of view still aims for benefits for people living and economies producing in port-city regions, nonetheless, the synergistic approach aims for creating a living port-city ecosystem in which all parts work together and complement each other. The focus is on a synergistic design where natural and human participants co-benefit from each other creating a balance between economic, societal/cultural and environmental needs.

METHODOLOGY
STRATEGIC SYNERGISTIC LOOP



▲ *Figure / 17* **Synergistic Cycle I** / *Höller*



▲ *Figure / 18* **Synergistic Cycle II** / *Höller*

TThe next step of this framework is to find a way to integrate the proposed concepts of sustainability and balance between people, planet, prosperity, adaptivity, ecosystem functions and infrastructure to emerge the creation of one big „Port-City Scape as Synergistic Adaptive Ecosystem“through the inclusion of natu-ral ecosystem participants and a for- and backflow system between the different participants and needs. On the one hand, we have the natural participants (aquatic/terrestrial, biotic and abiotic) providing func-tions, and therefore human benefits, when their current state (the functioning or the health) of the ecosys-tem and the single participants allows it.

Examples for the different types of functions within port-cities could be:

Provision: natural resources and products that a society gets from ecosystems.
This could be for example, material flows like fish or other food, the provision of mobility by waterways, when looking at the aquatic system. On the terrestrial or coastal side also different food, but also building materials or abiotic minerals can be found and used by humans.

Regulation: benefits that emerge by „how a system regulates processes, resources and its own properties. “
This could be for example: regulation of the air quality, coastal flood protection or protection and reduc-tion of other climate change impacts.

Cultural: non-material benefits, for example recreational activites, research and education possibilities but also cultural identity values.

Support: processes that keep the state of the whole ecosystem intact. Those are flows between natural participants, like food web flows, habitat and shelter functions or the regeneration processes of soil.

From a wider perspective it could be possible to categorize the different functions of the ecosystem into **people**/societal or/and cultural flows, **prosperity** or economic flows and **planet** flows which are both, regulating flows creating adaptive natural capacity against climate change impacts and supporting flows directly looping back into the natural system to ensure a healthy and functioning ecosystem.

On the other hand, there is the port-city or port-city region system. As part of both, depending on the bio-physical sphere which provides resources and other services as well as being part of the technosphere, where infrastructure provides functions to satisfy the needs within the port-city.

As already analyzed within the chapter about port-cities, economy is still seen as the main development driver for port-city regions, either supporting shipping logistics, mineral extraction or natural resources like fish creating impacts on the surrounding natural ecosystem´s state. Furthermore the economic imperative and the focus on hard values creates an imbalance within the needs of all port-city stakeholders, e.g. the civil society or indigenous/alternative societies. Such an imbalanced governance system and stakeholder engagement can lead to a huge loss of adaptive capacities, when economic but also natural changes and dynamics impact the port-city.

Nonetheless we could identify that infrastructures are the technosphere´s equivalent to the ecosystem functions of the biophysical sphere.

Biophysical Sphere		Technosphere
ECOSYSTEM FUNCTIONS	=	FUNCTIONS THROUGH INFRASTRUCTURE

METHODOLOGY
STRATEGIC SYNERGISTIC LOOP

Integrating the valuation of ecosystem functions into the functions of port-city infrastructures can be a helpful design and planning tool to achieve a balance between people, planet and prosperity needs to reach real prosperity/sustainability within the synergistic adaptive system.

As stated earlier in this chapter, the thesis is oriented on the AIVP Agenda 2030 and its sustainability goals.
Each existing, new or redeveloped implementation within the Port-City Scape should integrate all three needs and find the working synergies so multifunctionality as well as adaptivity over time can emerge.

Provisioning: next to the provisioning flows and functions of ecosystems, also the infrastruture/the processes within port-city regions can have provisioning functions. Next to the provision for maritime industries, e.g. container shipping, bulk shipping, logistics, economic growth and jobs, there are alternative provisioning flows which lead to a sustainable port-city region.

Sustainable mobility infrastructure provides the function of moving, comfortably, sustainable and efficient within the port city. One way of synergy could be the use of natural modes, like waterways or the inclusion of nature supporting implementations, that help to adapt natural participants to changes and impacts. Goal here is synergy beyond protection or mitigation, but rather adaptive measures for as many natural and human stakeholders as possible.

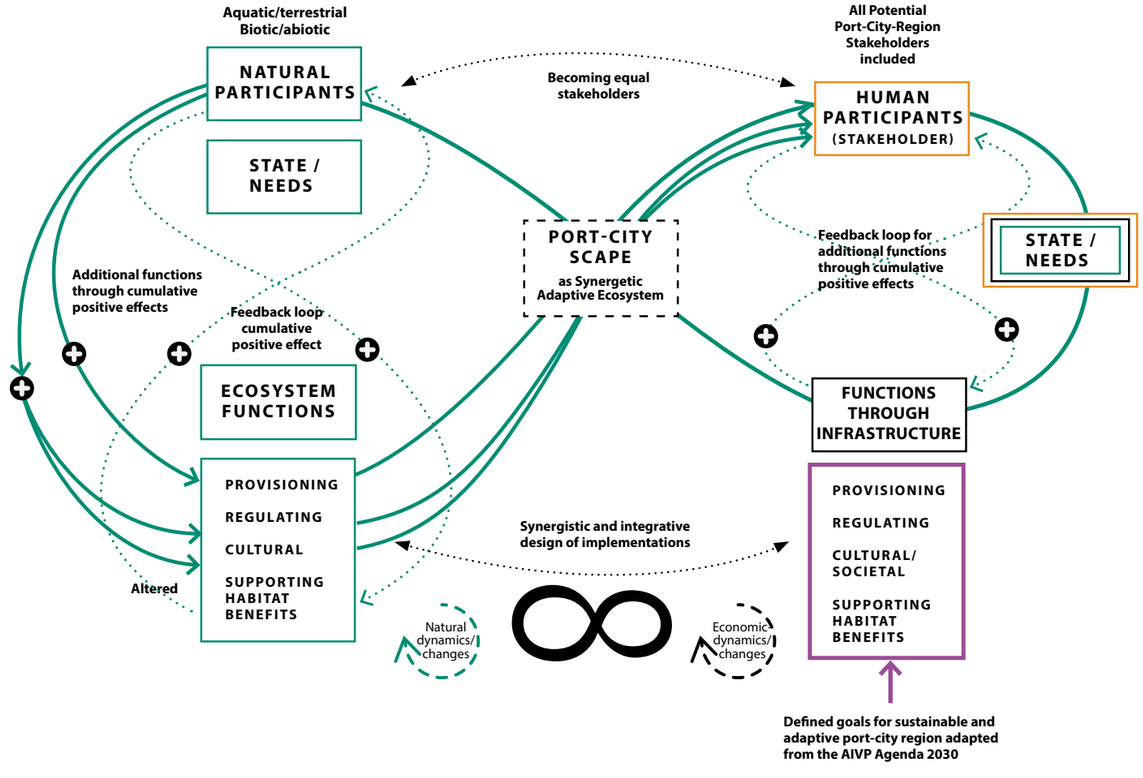
Energy transition and Circularity can find synergistic flows between the two systems of biophysical and technosphere, e.g using biological processes for energy production or reuse human made waste products for the support of essential natural participants (from nature to human to nature). Also human, especially maritime waste products can be upcycled and reused within the port-city environment. This creates not only new economic benefits and cooperations or mitigates environmental impacts due to storage or dumping but can emerge new cultural and societal values aswell.

Food Security and Quality Food: Food itself comes as function for humans from the biophysical sphere. Nonetheless the provision of quality food, due to specific sustainable and local production characteristics emerges from the realm of the port-city. A combination between natural well-being and the economic or cultural promotion of such products shows possible synergistic implementations.

Regulating: Regulating flows can be seen as planet oriented flows eventhough they also have a huge impact into the planet and profit flow aswell.
Going away from a human centered point of view, regulating functions like healthy environments, biodiversity and climate change adaptations should not be separated into only human or natural needs but should be integrated so all implementations and actions taken in the design and planning process aims for an overall healthy and liveable ecosystem for all participants, secured from impacts and risks. Therefore a combination of natural functions regulating environmental characterisitcs for itself or the human realm but also additional implementations within the port-city infrastructure providing assistance and support for natural participants are required.

Last but not least cultural and societal services or people flows like investments in the human capital, port-city culture, and promoting living, recreation and culture within the Port-City Scape can create synergetic benefits between humans and na-ture. On the one hand, research, new job and income opportunities and other human investments can emerge through the integration of nature within the Port-City Scape. On the other hand, also indigenous societies, like in this thesis the Sámi, have a huge cultural profit and securing their livelihood due to the integration of reindeer wellbeing into port and city oper-ations and infrastructures. As a backflow, a culture based on nature can again provide educational and touristic values, re-specting the co-beneficial living of different types of societies within one Port-City Scape.

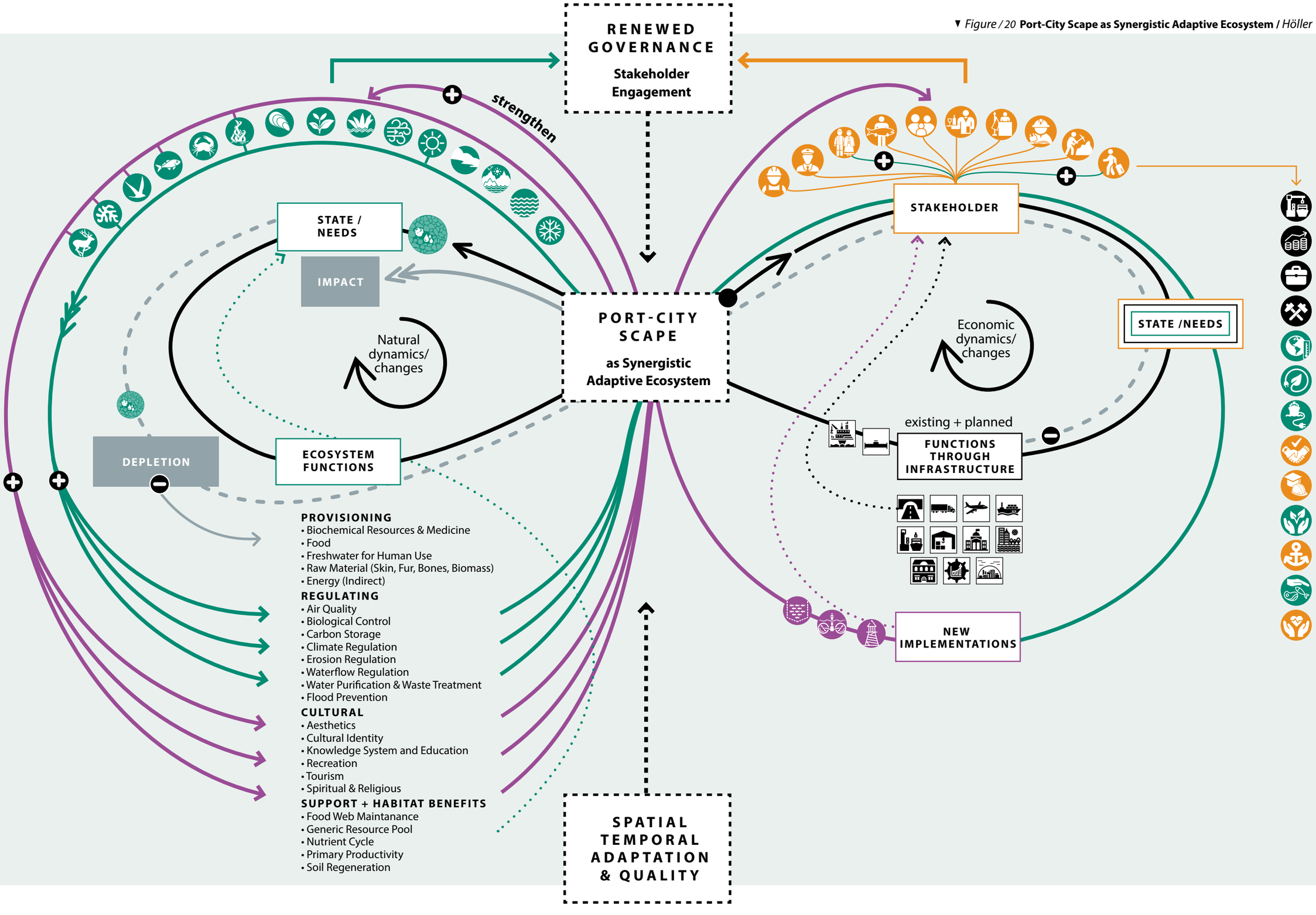
Port Culture and Identity can not only be based on economic and built relicts, or monuments but also on natural values. Build and obsolete cultural port-city heritage can provide many services for natural participants or can be re-functioned for sustainable activities strengthening economy, culture and environmental needs.
Therefore all functions of either biosphere or technosphere become supporting functions for itself and each other so the Port-City Scapes as Synergistic Adaptive Ecosystems becomes a zone of permanent creative destruction and creative exper-iments in transition.



▲ *Figure / 19* **Synergistic Cycle III** / *Höller*

METHODOLOGY
STRATEGIC SYNERGISTIC LOOP

▼ *Figure / 20* **Port-City Scape as Synergistic Adaptive Ecosystem** / *Höller*



ANALYSIS
INTRODUCTION

The following chapter of the analysis consists of three parts:

The first part focuses on a historical spatial investigation on the city, the region, the existing port and introduces the propo-sed development of a new port-facility outside the city. The reason for a historical analysis is to identify patterns of decisi-on-making driven by path-dependencies and collective memories of the mining history of the region. This will be important for further investigation on current and possible future developments and how those are directed or influenced by such shared mindsets within the region.
The second part investigates the surrounding ecosystem as an essential part of the local urban- and indigenous society. By setting the focus on the local specificities for the emergence of possible coexistence between port and city, it is vital to gather such information about the region in order to understand cultural, societal and ecological dynamics as important values and actors within the development of a sustainable and resilient port-city ecosystem.
Last but not least, the third part elaborates on the problems and impacts, driven by economic developments and climatic changes, on the port-city of Kirkenes. The part is divided into two segments. The first one investigates on current problems which e.g. the current disconnected relationship of Kirkenes and the maritime environment and discusses the sheer econo-mic relationship with the port. Furthermore, the current power structure of the local and global stakeholders will be inves-tigated.
The second step takes a look into future cumulative problems driven by climatic changes and the negative externalities on the local environment the proposed port-development can bring with.

As a last step, the summaries in-between the three different parts will be merged and used to conclude the analysis chapter and to lead towards the design-part of this thesis.

04 KIRKENES
HISTORY AND PATH DEPENDENCY

▼ *Photo / 10* **Kirkenes, Northnorway /** *Höller*

» *...to direct and realize the transformation of CityPorts as a sustainable combination of port functions, city functions and living functions...* «

and » *...to interrelate the actors, not only the port and city, but also private companies, knowledge institutes and inhabitants...* «

VAN GILS AND DAAMEN IN DESFOR, LAIDLEY, STEVENS & SCHUBERT, 2011, P. 88

KIRKENES
LOCATION

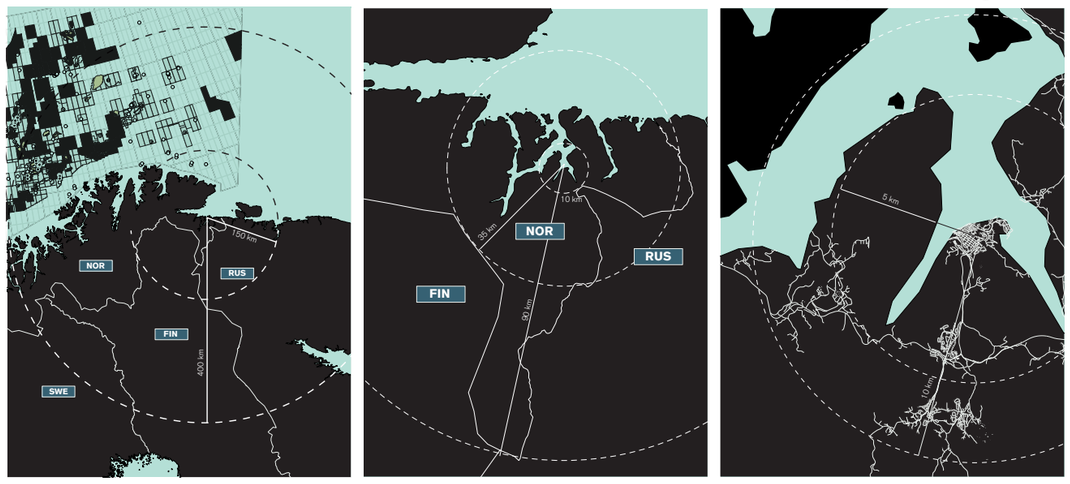
Northern Norway, connected to the Barents Sea, is one of the main areas expected to change due to economic developments benefited by a changing climate, increased navigability, and reachability of resources. As Europe's most northern part, this region will become Europe's gate for future resource extraction but also a new logistic node interrelated to the soon ice-free Northern Sea-Route, creating a 40% faster trading-route with Asia (Ministry of Transport and Communications 2019, p. 4).

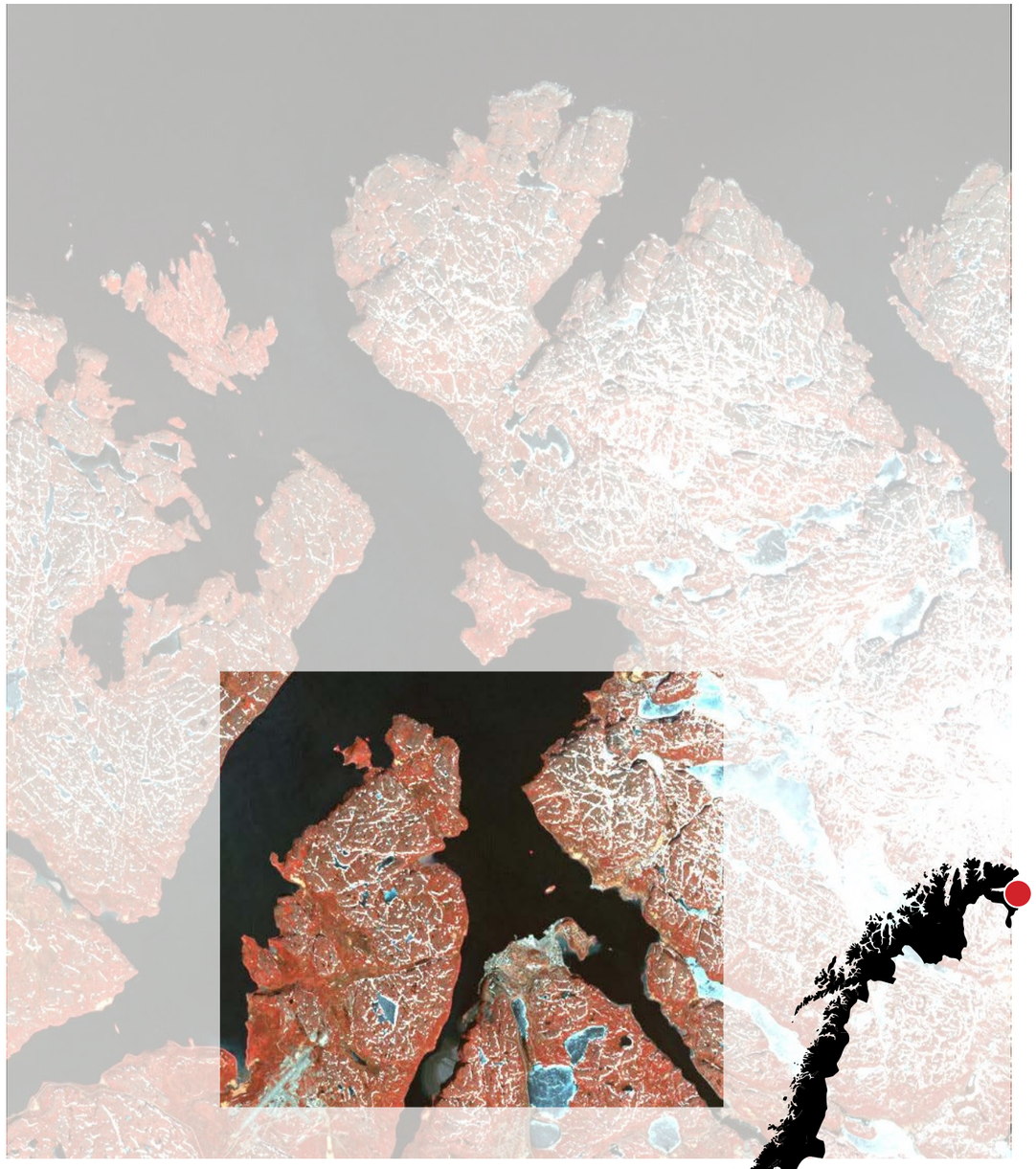
In Kirkenes, Finmark, founded in 1905, as a harbour-town for the transshipment of iron ore from mines a few miles inland (Viken, 2008), new port development is planned, serving as a potential strategic part for Chinas "Polar Silk Road" initiative. The proposed port development located on the neighbouring Tømmerneset Peninsula will transform the currently small to medium-sized Port of Kirkenes into one of Scandinavia´s biggest container ports.

One of the main drivers that drastically affects the well-being of the Arctic community in Kirkenes is the increasing local-global mismatch, such globally driven economic developments bring with them. On the one hand, local negative impacts of ports on cities and their surrounding ecosystems (pollution, land-use change, noise) and on the other hand, bypassing economic benefits, such as local employment and added economic value to the city, which are relocated beyond the traditional boundaries of the port-city, due to regionalization and globalization processes of the port and logistic systems can bring frictions (Ferrari & Merk & Bottasso & Conti & Tei, 2012).

Furthermore, logistical and supportive railway development in the form of the "Arctic Railway" that connects the proposed port development in Kirkenes with the Finnish town Rovaniemi will create access to trade flows towards the Baltic Regions and Western Europe. This is the territory of the Sámi, the most northern and only indigenous people of Europe. The Norwegian Tundra all reflects Sámi history, heritage, and life today. Relying on traditional lifestyles, cultural, socio-economic patterns, and socio-ecological relationships, the Sámi will be profoundly affected by those ongoing processes within the region. This vast transformation and infrastructural development will endanger their reindeer-based economy and their nomadic habits. Furthermore, climate change impacts (global warming double as intense in Arctic regions) already not only alter their traditional routes and patterns and forces them to adapt, but also have an impact on other humans on a local, regional as well as global scale.

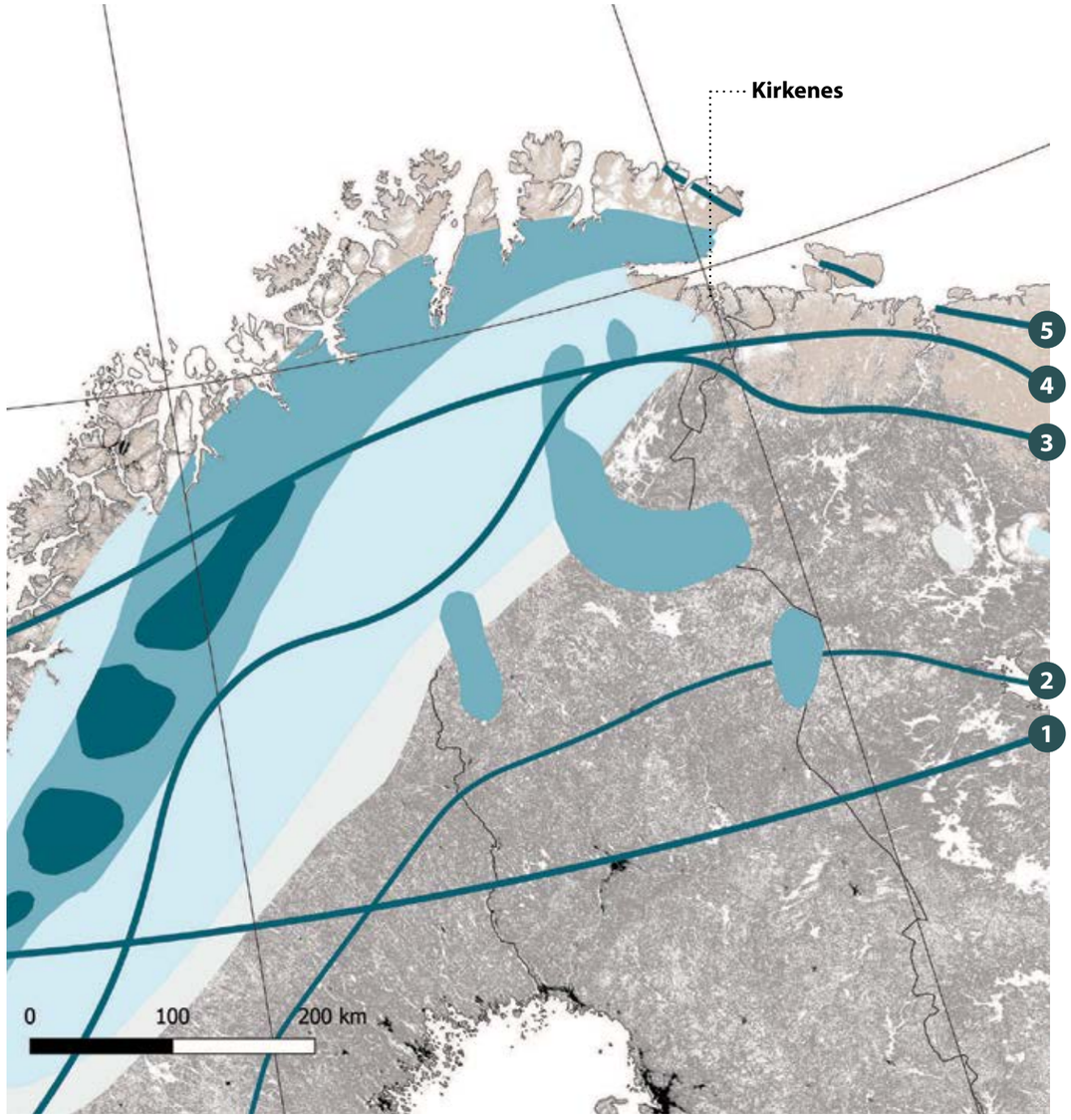
▼ *Maps / 13-15* **Setting /** *Höller*





▲ *Map / 16* **Kirkenes, Northern Norway**

NORTH-NORWAY
GEOGRAPHIC CHARACTERISTICS



▲ *Map / 17* **Kirkenes, Northern Norway /** *Höller*

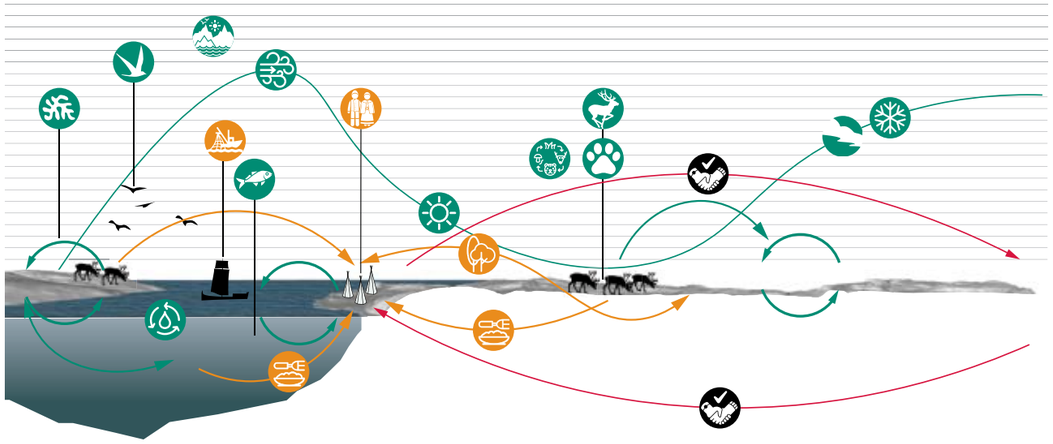
▲ *Map / 18* **Kirkenes, Northern Norway /** *Höller*

- Continuous permafrost (90-100%)
- Discontinuous permafrost (50-90%)
- Sporadic permafrost (10-50%)
- Isolated permafrost (0-10%)

1. Arctic Circle 66°30´ N
2. Southern border of the Sápmi or Same-Ätnam territory of the indigenous Sámi in Fennoscandia
3. Northern border of boreal ecozone changing into Tundra
4. July 10° Celsius isotope (year avg. temp. lower than 10° Celsius)
5. Arctic tree line is the northernmost latitude in the northern Hemisphere where trees can grow

- Water
- Boreal forest
- Grassland
- Tundra
- Bareland
- Permanent ice cover

KIRKENES
SÁMI LAND



▲ *Figure / 21* **Transformation before 1900 /** *Höller*

Before 1900

Archaeological discoveries showed that the area around Kirkenes, especially close to today´s Grense Jakobselv, was inhabited already 10000 years ago. (GoNorway, n.d.).

Before the big iron exploitation started in Kirkenes and Sør-Varanger in 1906, the land was mostly used by the Sámi for reindeer herding, fishing and living, which therefore have been depending on nature and the well being of their semi-domesticated reindeer herds. Their indigenous livestyle has structured their worldview around elements and phenomena of the natural environment making them, compared to western ideologies, a very different and important part of Fennoscandia`s characteristics.

Nonetheless Sámi are far from being a single homogenous group. The topography and harsh environment not only made the land barely accessible for westerners but also affected the composition of languages, dialects and other cultural traditions (Barclay, n.d.).

State

- Socio-ecological system and synergy between Sámi and their surrounding natural system
- Temporality of settlements and highly connected with natural seasons and dynamics
- Experiential: knowledge, especially language is gained by doing tasks and experiencing the world.
- Apprenticeship: knowledge is passed from an older person to a younger person through doing activities together and storytelling.
- Oral tradition: informal storytelling serves as a means of transmitting knowledge.
  Narrational: multiple stories of how people operate in the world (world-views) and cultural knowledge are acceptable.
- Non-binary: objects in the world are classified mentally and linguistically according to utility or relevance.

◄ *Map / 19* **First settlements, Kirkenes /** *Höller*

◄ *Photo / 11* **First settlements, Kirkenes 1898**

◄ *Photo / 12* **Harvesting Carex vesicaria, Kirkenes, Sør-Varanger, Norway**

Before the start of „Norwegianization“, reaching is height around after 1900 as well as before new borders between Finland, Norway and Russia emerged, Sámi where able to cross different states. The Skolt Sámi traditionally migrated within the territory between the location of today´s Murmansk in Russia and Lake Inari in Northern Finland.

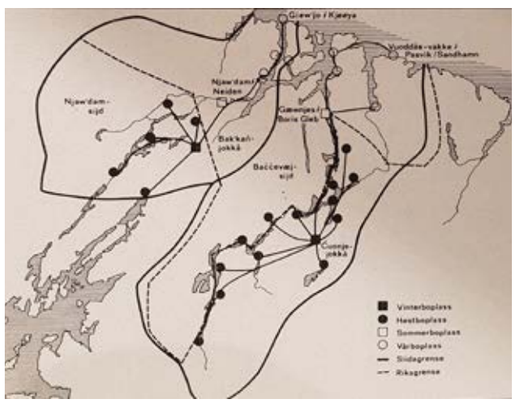
First limits of reindeer heerding have been set in the 1790s to avoid conflicts between farmers and reindeer herds. The biggest constraint to the ability to migrate from the different grazing pastures was set in 1852 by a treaty between Russia and Sweden-Norway which resulted in the closure of the borders. In 1889 the closure of the Russian-Finish border set the complete end to the free movement of the Sámi within the Sapmi (Sámi homeland including parts of Sweden, Finland, Norway and Russia). Many Sámi had to decide in which country they wanted to stay. Especially in Finmark, Norway, Sámi lost large parts of their winter pastures in Finland and the other was around, where Finish Sámi lost the summer pastures along the North Norwegian coast (Wielgolaski et al., 2006).

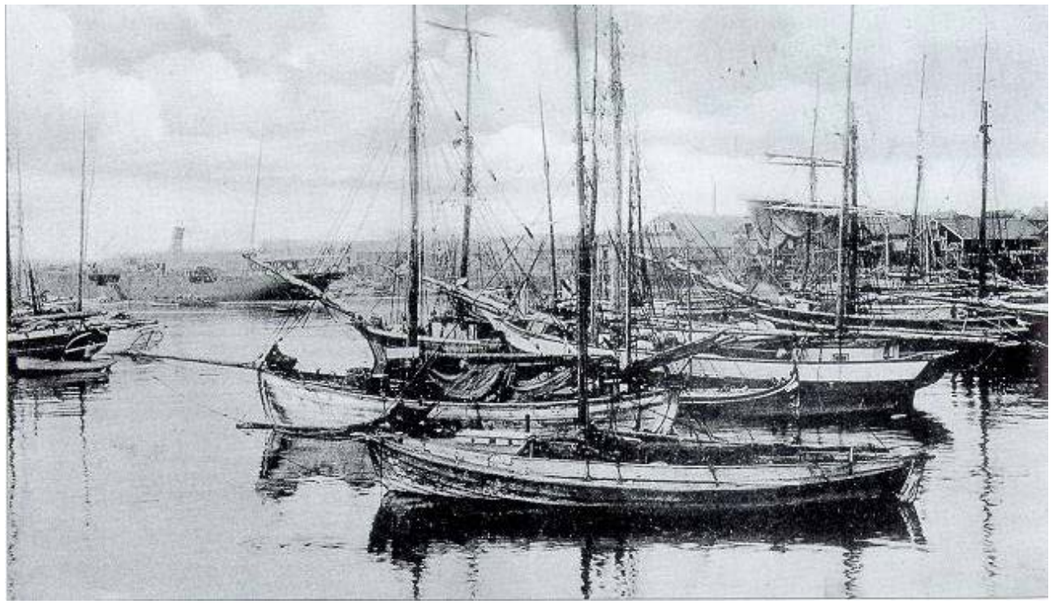
Pomor Trade:

Long-lasting trade already existed many hundreds of years between Northern Norway, Finish Lappland and the north-eastern parts of Russia.
The so called „Pomor Trade“ beginning in the 18th century and lasting until 1917, spread along large parts of the Northern Norwegian coast up until areas along the Pomor coastal communities of the White Sea of Northwest Russia (Wråkberg, 2019, p.7). As defined, Pomor can be translated as “by the sea“ and indicates the trade based on salted dry fish coming from Norway and Russian grain products, such as barter, timber and tar (University Library of Tromsø, 1999).

This important trade-relation resulted in an economic boom and well-being, especially for cities along the Norwegian coast, such as Vardø, which became the Norwegian Pomor capital at that time. The increased shipping and fishing activities shaped long-lasting traditions of the many smaller and bigger coastal com-munities along the Barents Sea (Wråkberg, 2019, p.7).

▼ *Photo / 13* **Sámi migration Sør-Varanger before 1800**

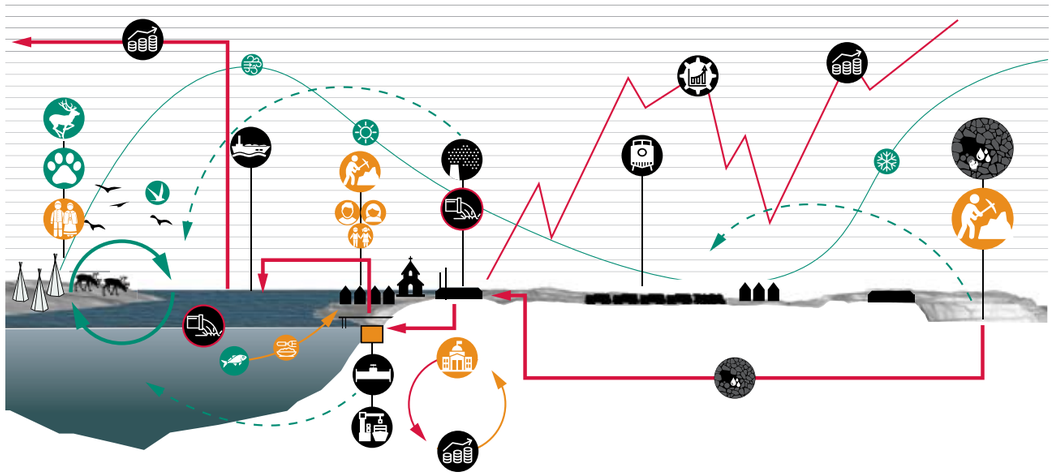




► *Photo / 14* **Vardø was the Pomor capital of Norway. The harbour of Vardø about 1900, with Russian and Norwegian ships.**

► *Photo / 15* **The market place on the island Kildin, showing Sámi, Western Europeans and Russians exchanging goods, in the end of the 16th century, more than a century before the real „pomor“ trade had begun /** *from van Linschoten, 1601*

KIRKENES
MINING TOWN



▲ *Figure / 22* **Transformation from 1906 /** *Höller*

From 1906

In its pre-mining state at around 1862, a few cabines and houses surrounding a church (the original towns name was Piselvnes for Pis=River and Nes=Headland to Kirkenes deriving from the word Kirke=Church and Nes=Headland) on a low lying area on the shore of Bøkfjord, connecting the location to the Varangerfjord and the Barents Sea.
While iron ore in this region was already discovered in 1866 by mine inspector Tellef Dahll, it took another 40 years until 1906 when mining specialist and entrepreneur Christian A. Anker was allowed to open the local mining company Sydvaranger which started to operate one year later due to German, Swedish and Norwegian private capital investment (Sydvaranger, n.d.).

The ore is located in Bjørnevatn, a few kilometers land inwards of Kirkenes, which could be reached by railway. Kirkenes was therefore choosen as the harbour city to transport the iron ore goods by ship around the world. At this time, Kirkenes expanded into a company town (Wråkberg, 2019).

During the World War I, the economic base for iron mining was destroyed. Nonetheless iron became an important good for rebuilding the aftermath of WWI. Between 1914 and 1918 Sydvaranger employed around 1800 people and was the most important industrial establishment in Northern Norway.

Due to the following turbulences in the 1920, refinancing in 1927 allowed the mine to operate until WWII. During this period, the mine was used as bunkers to seek shelter from the multiple air raids by the Germans as well as Allies. Just before the WWII started, the mine employed it highest number of people (around 1700). After the big impact WWII had on the area, the mine had to be kept alive through Swedish and German foreign investments. Nonetheless, due to rising iron ore prices, the mine recovered and had its, until now, last golden age between 1970 and 1980. From 1910 to 1997 the mine unearthed over 200 million tonnes of ore (Sydvaranger, n.d.).

State

- Global finance
- Ecological extraction
- Cultural hegemony

- Work and labour
- Community and mutual
- Free trade
- Heritage / dark history

- Waterfront infrastructure
- Industrial focus
- Suburban sprawl

- Single sector vulnerability
- Branch plant dependency

- Workers
- Owners
- Business
- Family structure

- Municipal/company socialism
- City-region partnership

- Local pollution
- Local/global resources

- Local and global environments
- Social exclusion
- Economic externatilities

◄ *Map / 20* **Mining town around 1910, Kirkenes /** *Höller*

◄ *Photo / 16* **Historic map Sør-Varanger, 1938**

◄ *Photo / 17* **Construction along waterfront**

KIRKENES
MINING TOWN

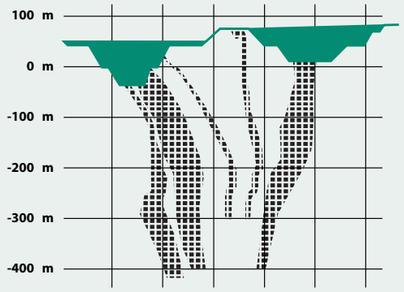
▼ *Figure / 23* **Mining history /** *Höller*

▼ *Photo / 18* **Kirkenes bulk quay**

1930 Kirkenes as mining town most social buildings, ammanities and infrastructure (e.g. worker houses, sewage and street lights provided by mining company

1925-1927
Depression and 1st bankrupcy of Sydvaranger mine;
Financial support by the Norwegian State and interest from Sweden and Germany

► *Figure / 24*
Mining depth / *Höller*
Data: Sydvaranger AS, Wråkberg (2019), SSB Norway



1980
Decreasing market conditions
Norwegian State as new main owner of Sydvaranger mine

1914-1918
Rising iron ore demand during WWI and right after to rebuild Europe

1940-1945
Sydvaranger Mine under German controll
Mine as air-raid shelter during WWII

1985
Public amanities + infrastructure, e.g. sewage, streets, etc. provided by Sør-Varanger municipality instead of Sydvaraner Mining AS

2019
Planned new operation of Sydvaranger Mine
TSCHUDI AGGREGATES AS and Orion Mine Finance

1906-1910
Sydvaranger AS Mining Company
German, Swedish and Norwegian private capital;
First railway from load of iron ore from the Bjørnevatn mine to Kirkenes

1950
Modernisation of the Sydvaranger mine
62% state owned

1996
Bankrupcy, mining in Kirkenes gets abolished

1866 + 1906
First dicovery of iron ore in Bjørnevatn

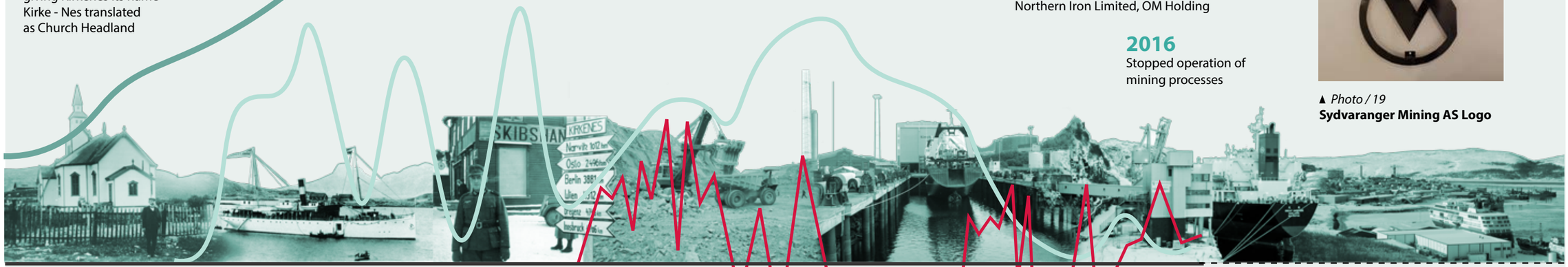
1970-1979
Golden age of iron ore extraction
Sydvaranger Company market leader in Northern Norway

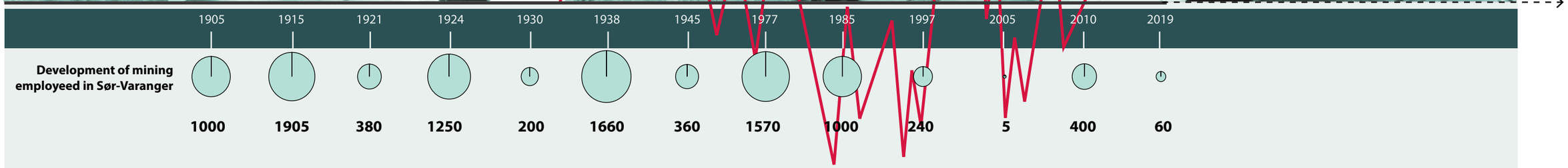
2007-2015
New operation of Sydvaranger:
Main stakeholder TSCHUDI KIRKENES AS,
TSCHUDI AGGREGATES AS
Northern Iron Limited, OM Holding

1862
Building of the church giving Kirkenes its name
Kirke - Nes translated as Church Headland

2016
Stopped operation of mining processes

▲ *Photo / 19*
Sydvaranger Mining AS Logo





KIRKENES
MINING TOWN

As stated before, mining activities allowed Kirkenes to grow into one of the most important Arctic agglomerations in Fennoscandia at this time. Between 1900 and 1920 the business led to an increase of population from 1912 to almost 4800 inhabitants.

Until 1980 the city was more or less company-owned and the mining enterprise took care of many of the urban economic, social and cultural needs and functions within the area. One example is the electrification of company-owned houses and areas. While other parts remained without electricity until 1934, the mining town of Kirkenes and Bjørnevatn already had been connected to the electrical grid of the company in the early1900s (Pasvik Elva, n.d.).

From 1940 till 1944 the population almost 10-folded compared to the pre- and post-war period. Around 70.000 inhabitants, most of them German soldiers, resided in Kirkenes. Many of the buildings and industrial structures got repurposed or reused by the German occupants, which planned the invasion of Nort-West Russia (Wråkberg, 2019, p.5).

The harbour of Kirkenes changed its role from being an important infrastructure for exporting mining materials and connecting people via shipping to the remote and hard-to-reach area into a strategically important access to the sea for the Germans. The importance of a logistic hub for bringing troops and equipment to attack the 250 km distant Murmansk was crucial for the Germans. During this period, Kirkenes was heavily bombed. Almost 320 air raids by both fractions destroyed everything besides several houses.

Kirkenes was the first Norwegian town being liberated by the Soviets on 25 October 1944.

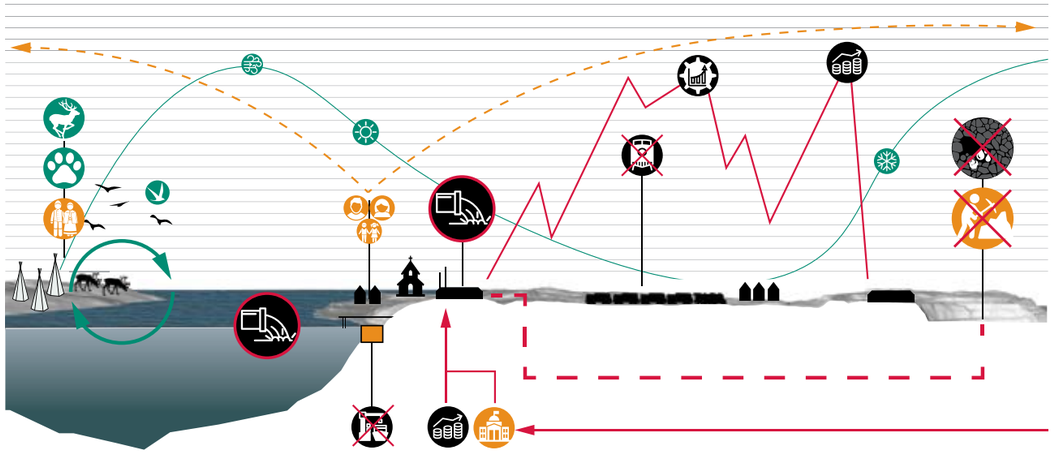
◄ *Photo / 20* **Sydvarangers malmlastekai i Kirkenes**

▼ *Photo / 21* **Kirkenes waterfront 1916**

▼ *Photo / 22* **Bird´s-eye view Kirkenes pre-WWII**

▼ *Photo / 23* **Bird´s-eye view Kirkenes after air-raid**

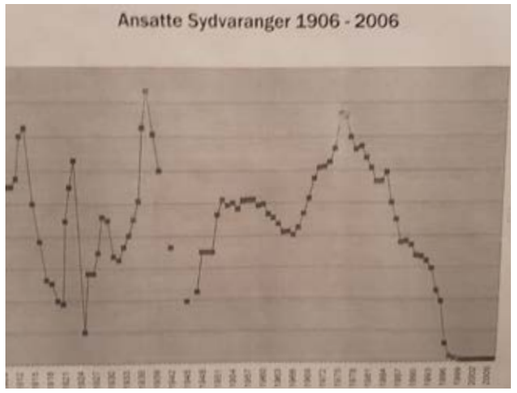
KIRKENES
BOOM AND BUST



▲ *Figure / 25* **Transformation after 1980** / *Höller*

After 1980

After being a mining town for the last 80 years, the impact of the ending of the Sydvaranger mine on Kirkenes was big. Due to the drop of global iron ore prices the company had to close its doors. Eventhough the mine had two short term re-openings (1980-1996 and 2009-2015) both attempts failed due to the unprofitable global economic conditions. Also the support by its investors as well as by the state did not change anything on this situation due to growing skepticism. Between 1980 and 1990 inhabitants started to fight for their jobs and the closure was never accepted, nonetheless more and more people became unemployed (Viken et al., 2008).



▲ *Photo / 24* **Abandoned mining facility**

▲ *Photo / 25* **Mining workers loosing jobs**

▲ *Photo / 26* **Employment statistics Sydvaranger**

Linear Change

- Linear systems (mechanical)

- Hollowing
- Unemployment
- Alienation

- Global finance
- Ecological extraction
- Cultural hedgemony

- Dole culture
- Fragmented community
- Neo-liberal heist
- Cultural alienation

- Obsolet infrastructure
- Industrial dereliction
- Hollowing and shrinking

- Disinvestment
- Asset liquidation
- Structural unemployment

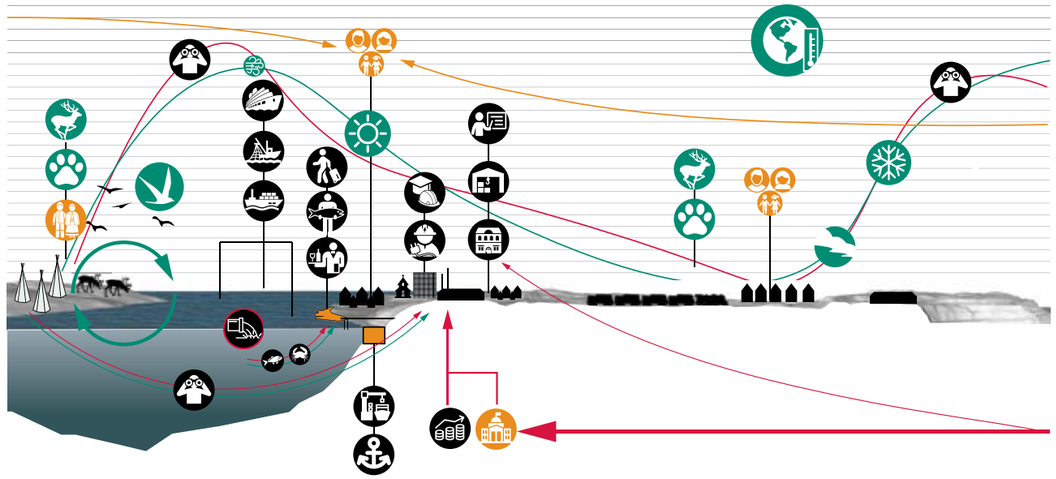
- Alienation and migration
- Ethnic tension
- Generation gap
- Gender role conflict

- Union labour decline
- Local/national conflict
- Public deficits

- Dereliction ans disinvestment

- Increasing externalities

KIRKENES
REINVETION OF AN ARCTIC CITY



▲ *Figure / 26* **Transformation today** / *Höller*

Today

From 1980 until now the municipality but also the Sydvaranger company have received large amounts of state support. Since the abolishment of mining in 1996 and 2015 Kirkenes and the whole Sør-Varanger Municipality is struggling with at-tempts to reinvent the city.

Today, Kirkenes is a town and the administrative center of the Sør-Varanger Municipality in Finnmark. Together with its „suburban" neighbouring towns Hesseng and Bjørnevatn, Kirkenes includes around 7200 inhabitants and Sør-Varanger a total of 10000 (Barel, n.d.).

▲ *Photo / 27* **Welcome to Kirkenes**

▲ *Photo / 28* **Russian translations all around Kirkenes**

▲ *Photo / 29* **Barents Spektakel 2020**

Adaptive Change and Development

- Complex adaptive, dynamic systems

- Restructuring ?
- Cosmopolitization ?
- Exclusion or inclusion ?
- Ecology displacement or nature inclusion ?

- Global finance or regional wellbeing ?
- Ecological extraction or sustainability ?
- Cultural hedgemony or multicultual ?

- Cosmopolitization ?
- Consumerism ?
- Individualism or collective?
- Commodification or commons ?

- Restructuring ?
- Suburbanization or compactness ?
- New nodes and gateways or local/regional links ?

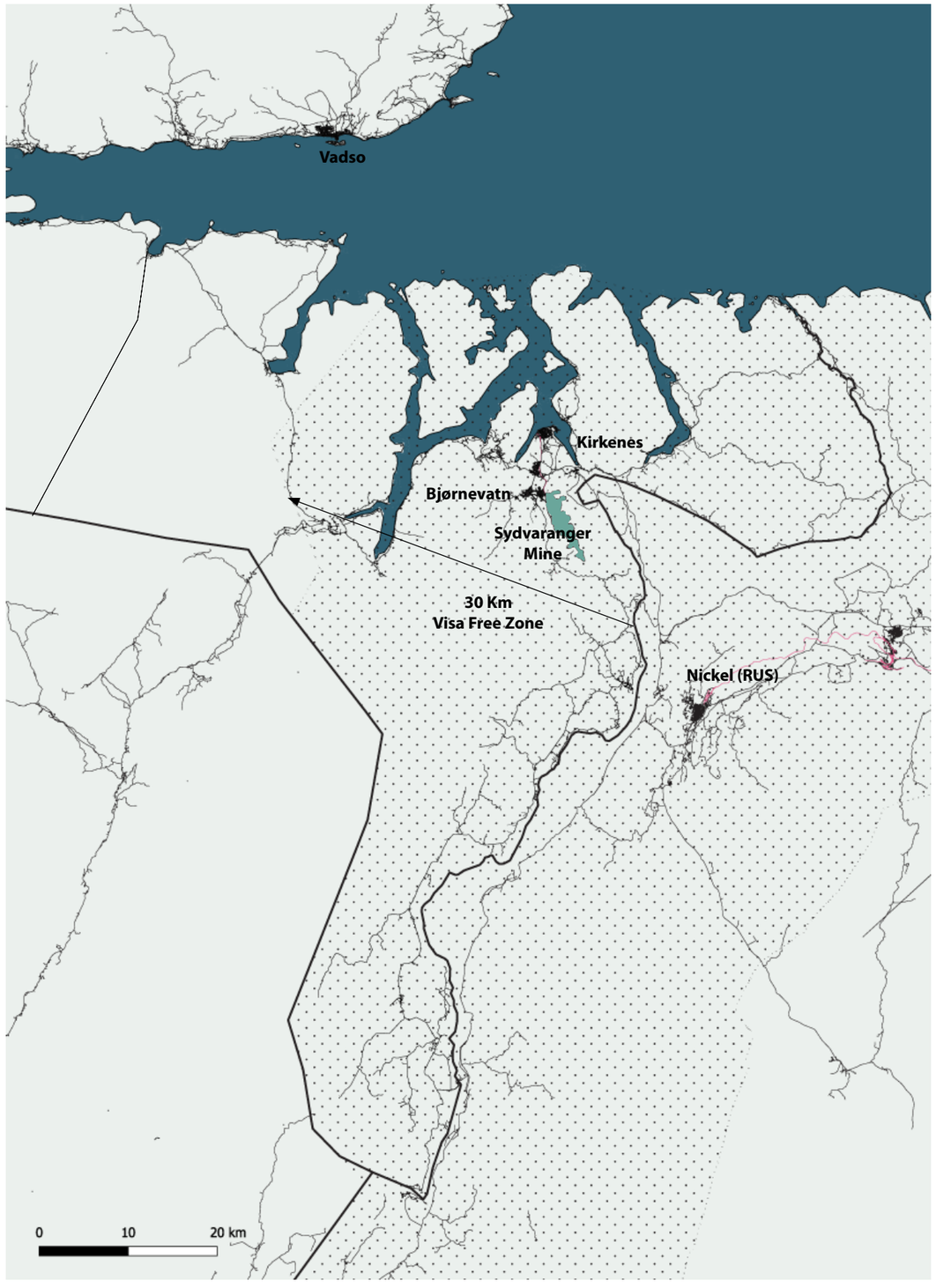
- Service shift or tradition ?
- Tourism and leisure focus or equillibrium ?
- Prosperity boom and bust or resilience ?

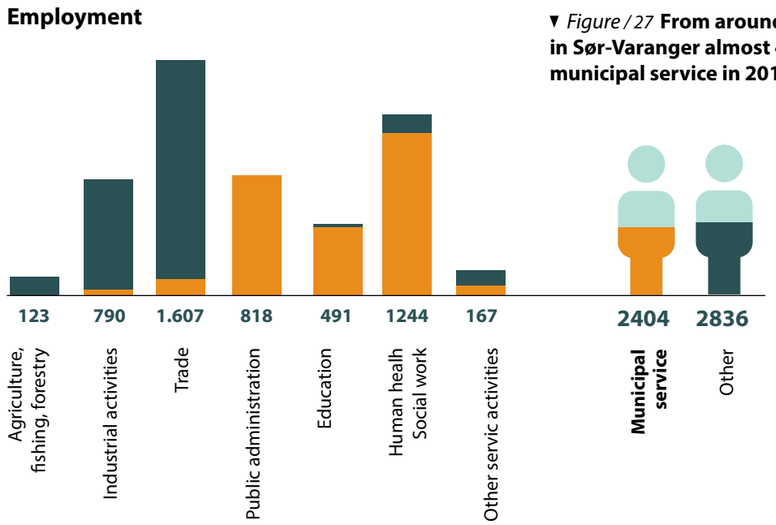
- Cosmopolitization ?
- Social restructuring or tradition ?
- Mobility shift ?
- Skills shift or tradition ?

- New governance model ?
- Public-private hybrids or top down planning ?

- Local selective cleaning or inclusion ?
- Displacement to global resources or sustainability ?

▼ *Map / 21* **Border-region Sør-Varanger** / *Lukas Höller*





▼ *Figure / 27* **From around 5300 employed people in Sør-Varanger almost 48% worked in public/ municipal service in 2019** / *Source: SSB Sør-Varanger*

▼ *Map / 22* **Kirkenes build-use and current port structure** / *Höller*

Quays
Tschudi Aggregate AS (Sydvaranger) Industrial Area
Residential
Centrum Area
Industrial Area
Port Area

▲ *Photo / 30* **AMFI, one of the new shoppingcenters to create new economy from cross-border trade**

Another restructuring process visible in Kirkenes is the narrative of being a border town. The implementation of a visa-free zone, including 30 km within both states Norway and Russia, tries to develop the city into a regional trade center (Viken et al., 2008, p. 29).

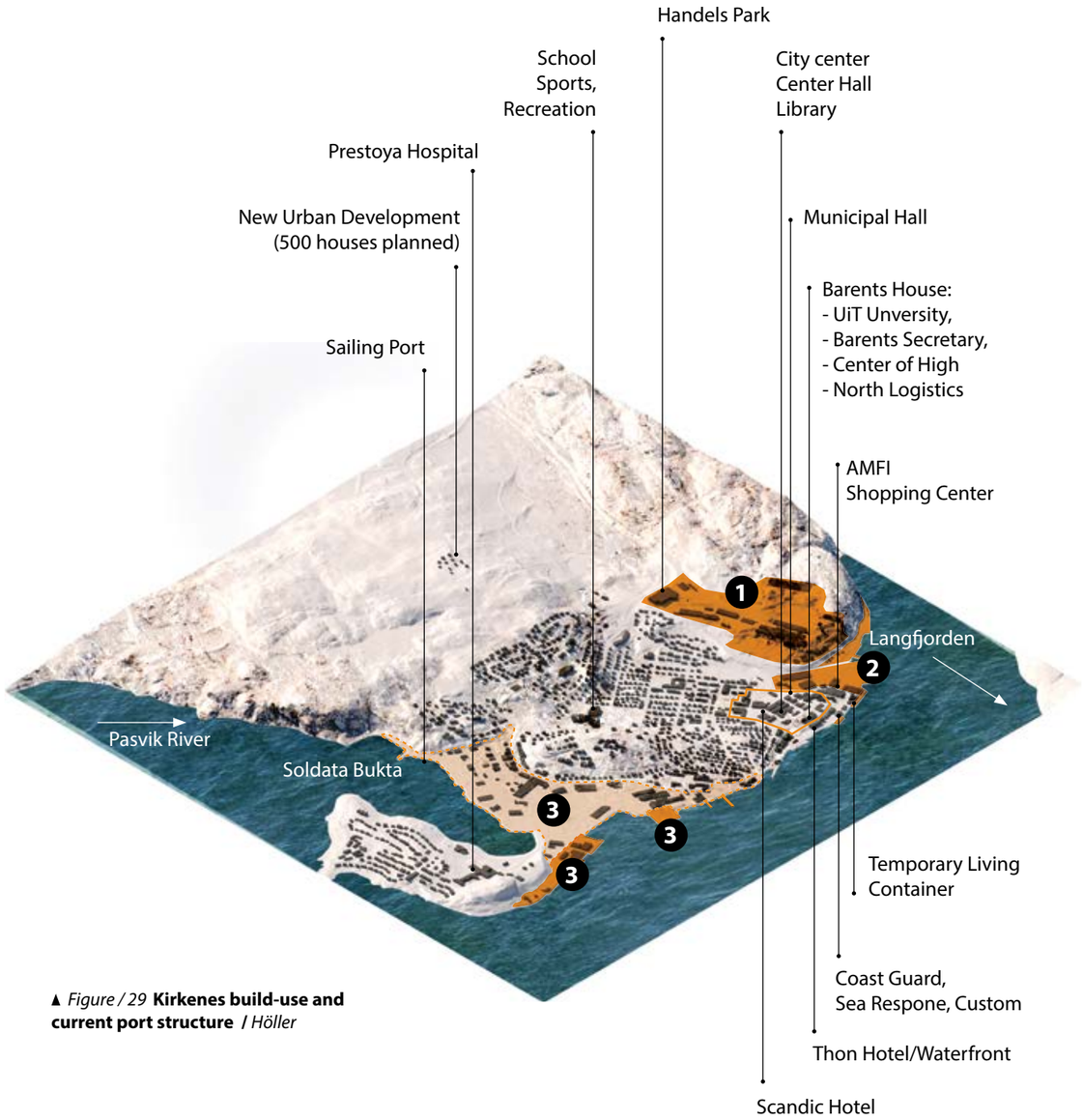
▼ *Figure / 28* **Sør-Varanger Utvikling, municipal intern restructuring company**

SØR-VARANGER utvikling

Furthermore, the municipality founded its own restructuring company called Sør-Varange Utvikling or Sør-Varanger development. On a timeframe of six years, in which the support of the Norwegian State founds the redevelopment actions of the municipality, one objective is to create new job opportunities and a resi-lient and sustainable business sector for a local and regional long-lasting positive development. This shows another attempt of the city, re-branding or reinventing itself as an inclusive and multicultural city.

KIRKENES

BUILD-USE AND CURRENT PORT STRUCTURE



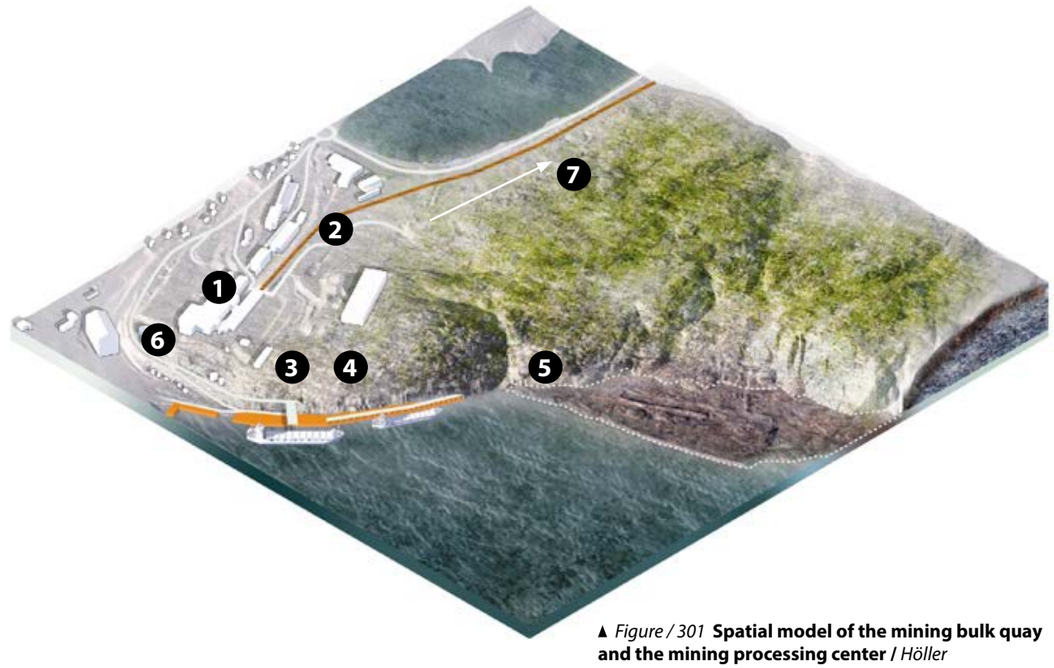
▲ *Figure / 29* **Kirkenes build-use and current port structure** / *Höller*

1. Sydvaranger Iron Ore Processing Center
   now: Tschudi Group
2. KIMEK Ship and rig repair yard
   Service port
3. Deep sea quay, Kirkenes base port,
   Cruise ship quay,
   Kirkenes Terminal, Industrial Center

Sydvaranger Iron Ore Processing, Waterfront

After the mine closed in the 1990s as well again in 2015, Kirkenes had to find new ways to make money. Nonetheless, the spatial and cultural presence of mining still exists within the citie`s structure and people`s minds. The area of the currently closed Sydvaranger Iron Ore Processing Center in Kirkenes, but also the surrounding mining infrastructure and the mine itself, still dominate the visual and spatial appearance of the town, waiting to awake for its planned next operation period, which will be investigated later in this part.

Economic and especially manufacturing and industrial activities continue around the sleeping mine. One outcome of the shifts in Kirkenes has been the permanent development of the harbour.

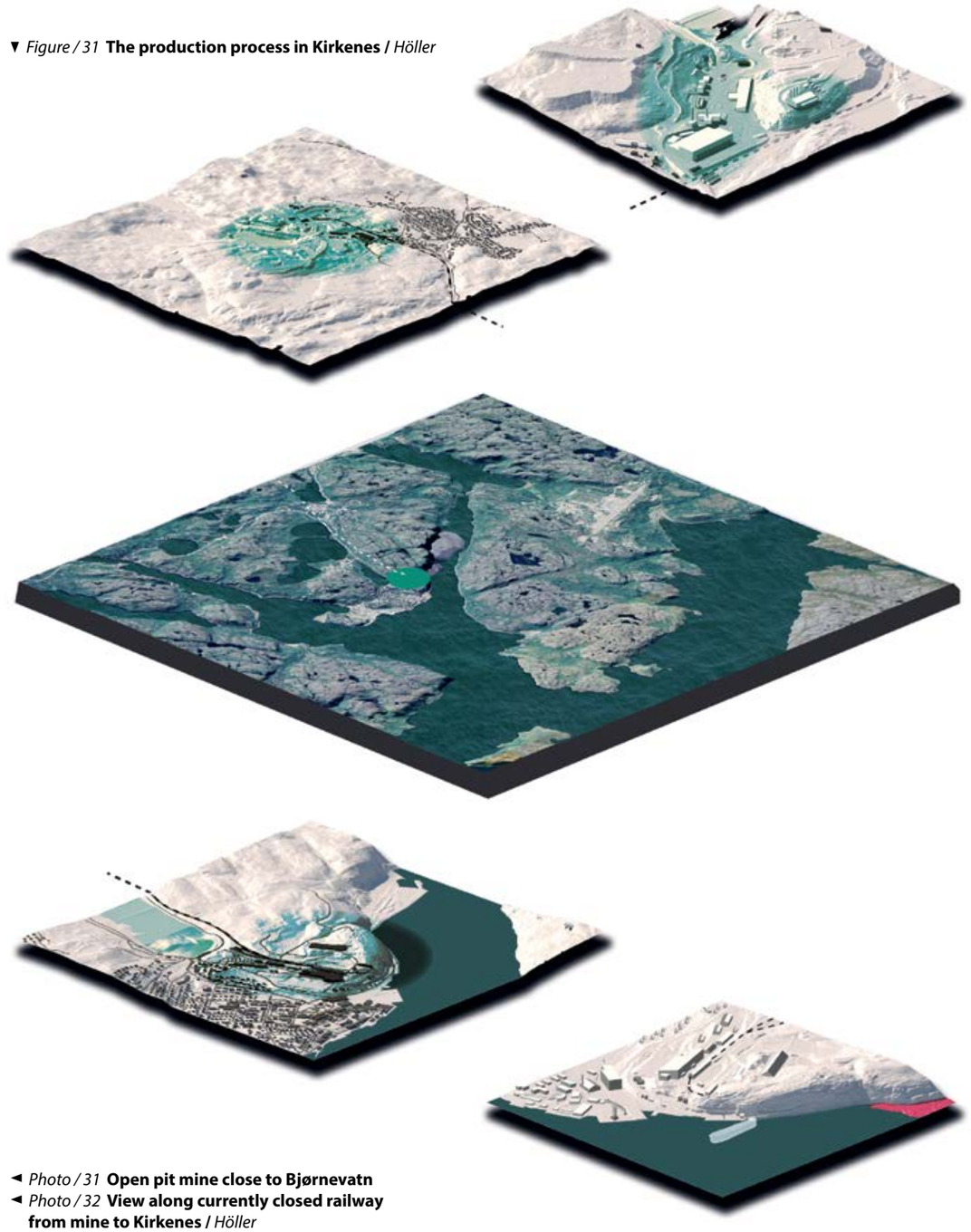


▲ *Figure / 301* **Spatial model of the mining bulk quay and the mining processing center** / *Höller*

1. Iron/copper ore processing center
2. Railway to Bjørnevatn mine
3. Importkaia/import quay
4. Eksportkaia/ export quay, dry bulk dock
5. Deep sea mining tailings
6. Oil/gas service, refueling station
7. Sydvaranger mine,
   around 8 km away in Bjørnevatn

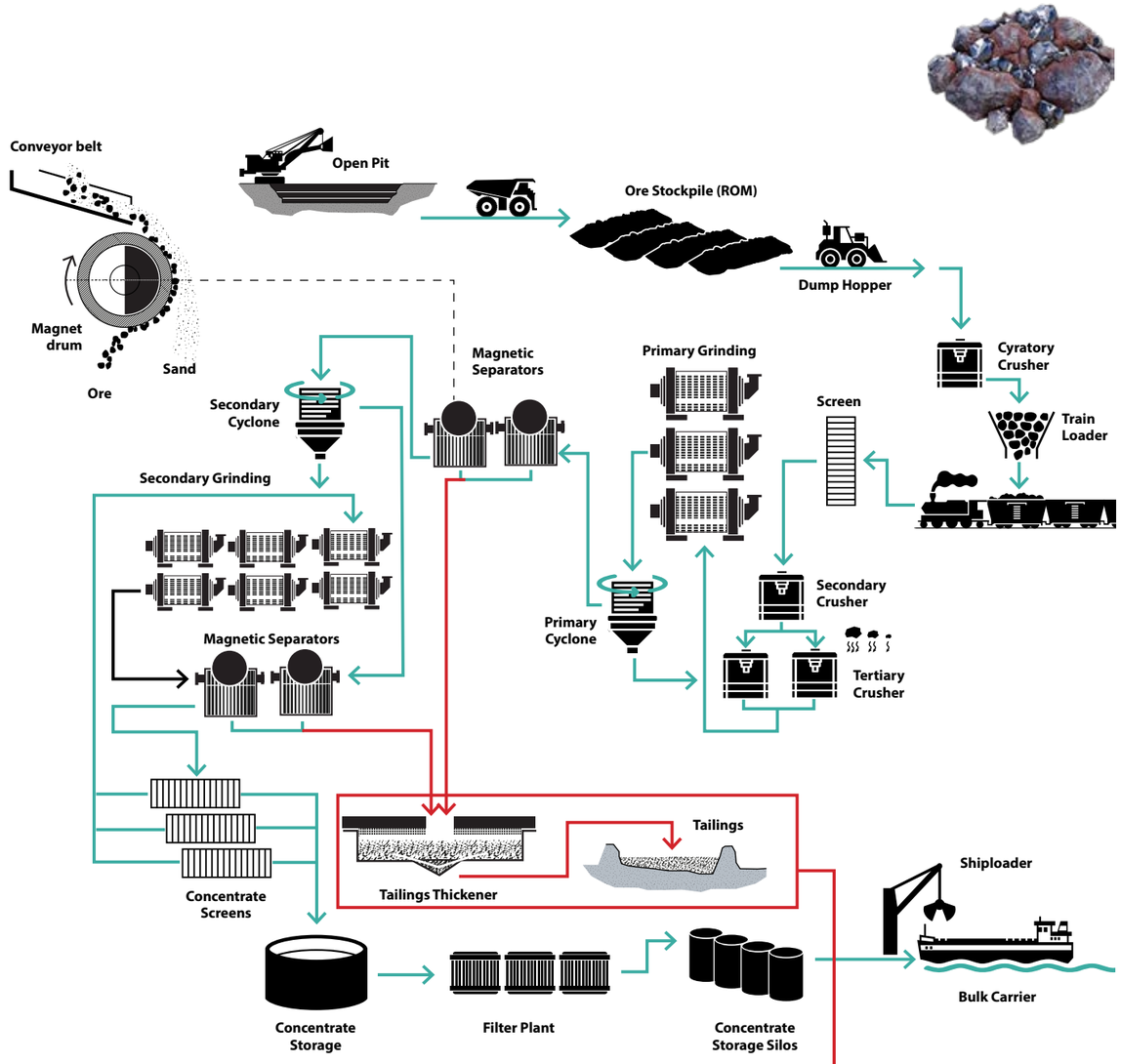
Spatial Impact from Mining

▼ *Figure / 31* **The production process in Kirkenes /** *Höller*



◄ *Photo / 31* **Open pit mine close to Bjørnevatn**
◄ *Photo / 32* **View along currently closed railway from mine to Kirkenes /** *Höller*
◄ *Photo / 33* **Ship loading mining bulk at the waterfront Kirkenes**

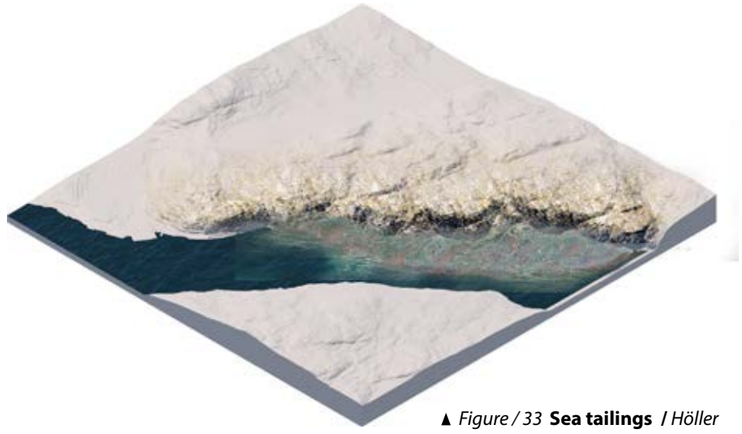
Iron Ore Processing



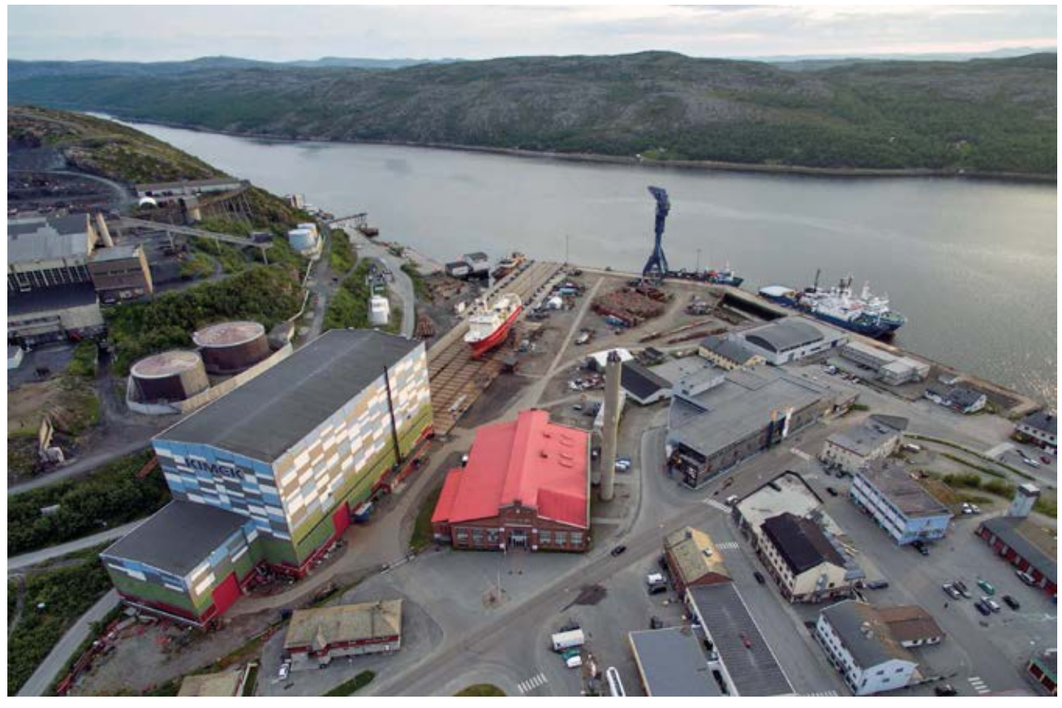
▲ *Figure / 32* **The production process, Northern Iron (2013)** */ adapted by Höller*

► *Photo / 34*
Filled up with tailings after decades of iron ore mining, the narrow fjord just outside Kirkenes

▲ *Photo / 35* **View on the mining processing center from the end of the city center in Kirkenes** */ Höller*



▲ *Figure / 33* **Sea tailings** */ Höller*



▲ *Photo / 36* **The KIMEK Drydock as new "landmark" of Kirkenes /** *Höller*

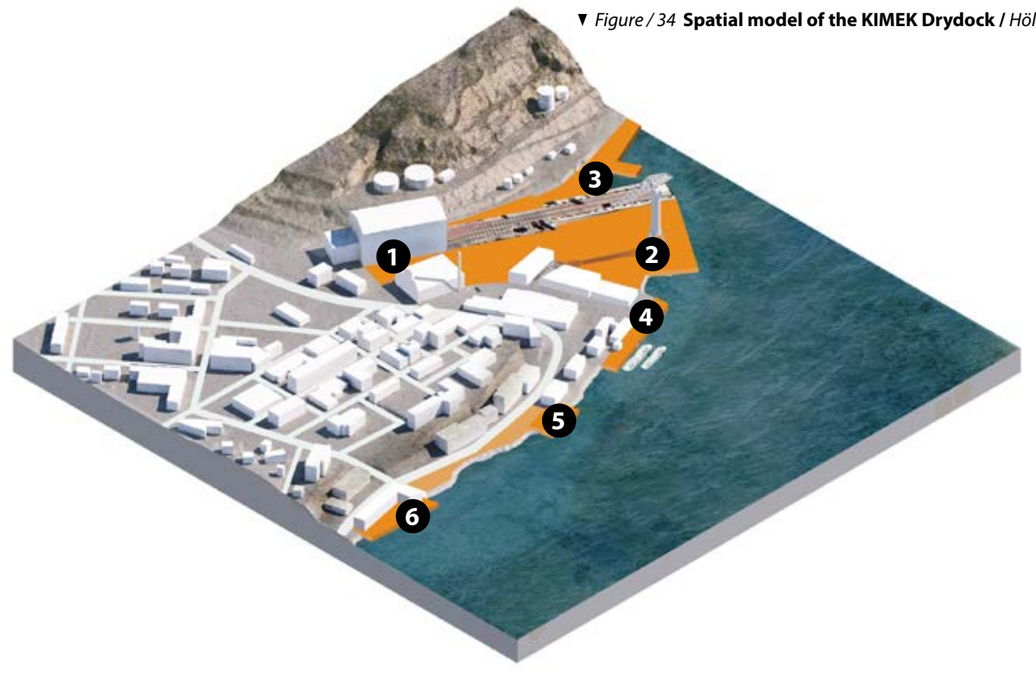
▲ *Photo / 37* **Bird´s-eye view on the KIMEK company area**

Drydock, Shipwarft and Waterfront

The shipping industry is a new and growing important structure within Kirkenes. Especially one develop-ment shows the refocus on maritime industries within the city. KIMEK, former mechanical support of the mining company Sydvaranger, shifted its skills towards services for maritime activities. Mainly collaborati-on with Russian fishermen, but also with the off-shore sector, resulted in the emergence of the biggest drydock and shipyard north of Trøndheim. Almost 90% of Russia`s Arctic fishing fleet lands on Northern Norwegian ports. Kirkenes, therefore, became a significant service harbour for the fishing industry due to its modernized infrastructure but also proximity to Murmansk, where many of the fishermen live. (Nilsen, 2020).

Today the KIMEK building (3000 m2 and almost 80 meters tall with its blue loading crane) can be seen as a new maritime monument within the city of Kirkenes. Furthermore, between 100-200 new jobs have been created due to the skill shift from mining to maritime service and symbolizing a manifest and continuing industrialization (Viken & Nyseth, 2012).

▼ *Figure / 34* **Spatial model of the KIMEK Drydock /** *Höller*



1. KIMEK Drydock, shipwarft
2. Heavy load crane
3. Drydock mechanism to put ships from water to land
4. Coast guard and maritime security
5. Additional quay
6. Thon Hotel (privatized waterfront)

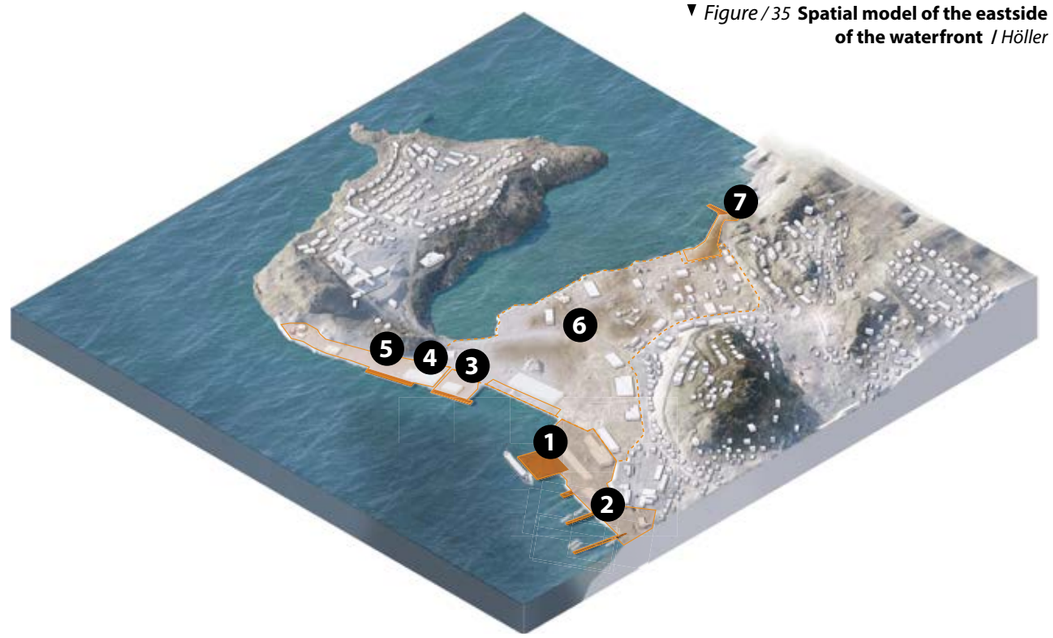
▲ *Photo / 38* **Cargoship landing at Port of Kirkenes**

▲ *Photo / 39* **Construction of the deep-sea quay in Kirkenes**

Port Base, Cruise Ship Port, Fishing Port and Industrial Area

Another step towards the increasing importance of shipping in Kirkenes was the development of the deep-sea quay by the Port of Kirkenes, which is used for large operations, loading, and unloading processes. The industrial waterfront covers the whole sea/land interface of Kirkenes.
While maritime service activities, mining bulk and import-export activities are handled at the west-side, land, and sea-logistics, fishing and storage as well as cruise ship activities, are located in the east. The area used for the development of the port structure and for retail and industries behind the waterfront didn't exist in earlier times. The compa-rison of histori-cal maps with today´s aerial pictures shows that the location was a former intertidal flat, regularly flooded by the changing tides as well as by increased water discharge by the entering Pasvik River.

▼ *Figure / 35* **Spatial model of the eastside of the waterfront** / *Höller*



1. Deep-sea quay for logistic purposes
2. Quay for fishing boats and fishing related services
3. Crusie ship quay (around 1,5 km away from city center)
4. Maritime logistics quay
5. Kirkenes Terminal, fish storage
6. Reclaimed industrial/retail area
7. Soldata Bukta, quay for private sailing boats

▲ *Photos / 40-42* **One of the many rebranding attempts of Kirkenes as the King Crab Capital in Norway /** *Höller*

The distance from the cruise ship terminal towards the city center is around 1,5 km which equals a 15 minutes walk through industrial and retail complexes. During the field trip to Kirkenes and the investigation of the location, many by-passing tourists coming from board of one of the daily Hurtigruten cruise ships, asked for direction towards the city center. This already depicts, that the arrival in Kirkenes, but also the distance between touristic activities within the city and the actual cruise ship terminal are creating confusion and problems, which are not contributing for Kirkenes´ promotion of a touristic spot.

▼ *Photo / 43* **Thon-Hotel in Kirkenes, waterfront**

▲ *Photo / 44* **Hurtigruten post ship, dropping off passengers and tourists in Kirkenes /** *Höller*

KIRKENES
BOOM REGION

Despite the efforts for reinventing Kirkenes and change its face from industrial development to futureproof, sustainable and resilient economic branches, mining, as well as manufacturing and industrial development, never stopped being a hu-gely important topic in Kirkenes as shown by the restructuring of the port infrastructure.

Currently, Kirkenes seems to drive even more towards the development of new and the reopening of old industrial struc-tures.

A large part of the funding support given by the state was used to keep the mining company alive. Almost 40 million NOK have been spent, as well as reopening plans that occurred in 2001, 2005-2006, and 2009.

Now, the reopening of the mine in 2021 is a fixed decision. The Tschudi Group, already being part of the mining operations in 2009 together with Northern Iron Ltd. as well as operating as an important stakeholder in Arctic logistics in Kirkenes, bought the Sydvaranger mine and is looking forward to starting operations in the near future.

Furthermore and as an essential part of this thesis, Kirkenes released several plans to become a leading player in Europe-Asian trade via the Northern Sea-Route. Therefore many port-plans have been released since that. Kirkenes` representati-on as future cargo, oil, mining and transport hub shows the collective memory of the city.

Nonetheless, such a development can have significant negative impacts on many levels and could be a step back from the initiatives of reinventing the city.

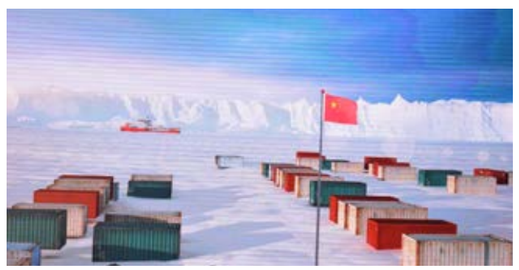
The Sydvaranger processing plant in Kirkenes. Photo: Atle Staalesen

Iron miners set for a restart in Kirkenes

The Sydvaranger mine gets a long awaited permission for renewed mining along Norway's border to Russia.

The Worlds Northernmost Chinatown

Railway between Rovaniemi and Kirkenes is the most important project to develop East Finnmark .



Adaptive Change and Development

- Complex adaptive, dynamic systems

- Restructuring
- Cosmopolitization
- Exclusion
- Ecology displacement

- Global finance
- Ecological extraction
- Cultural hedgemony

- Cosmopolitization
- Consumerism
- Individualism
- Commodification

- Restructuring
- Suburbanization
- New nodes and gateways

- Service shift
- Tourism and leisure focus
- Property boom and bust

- Cosmopolitization
- Social restructuring
- Mobility shift
- Skills shift

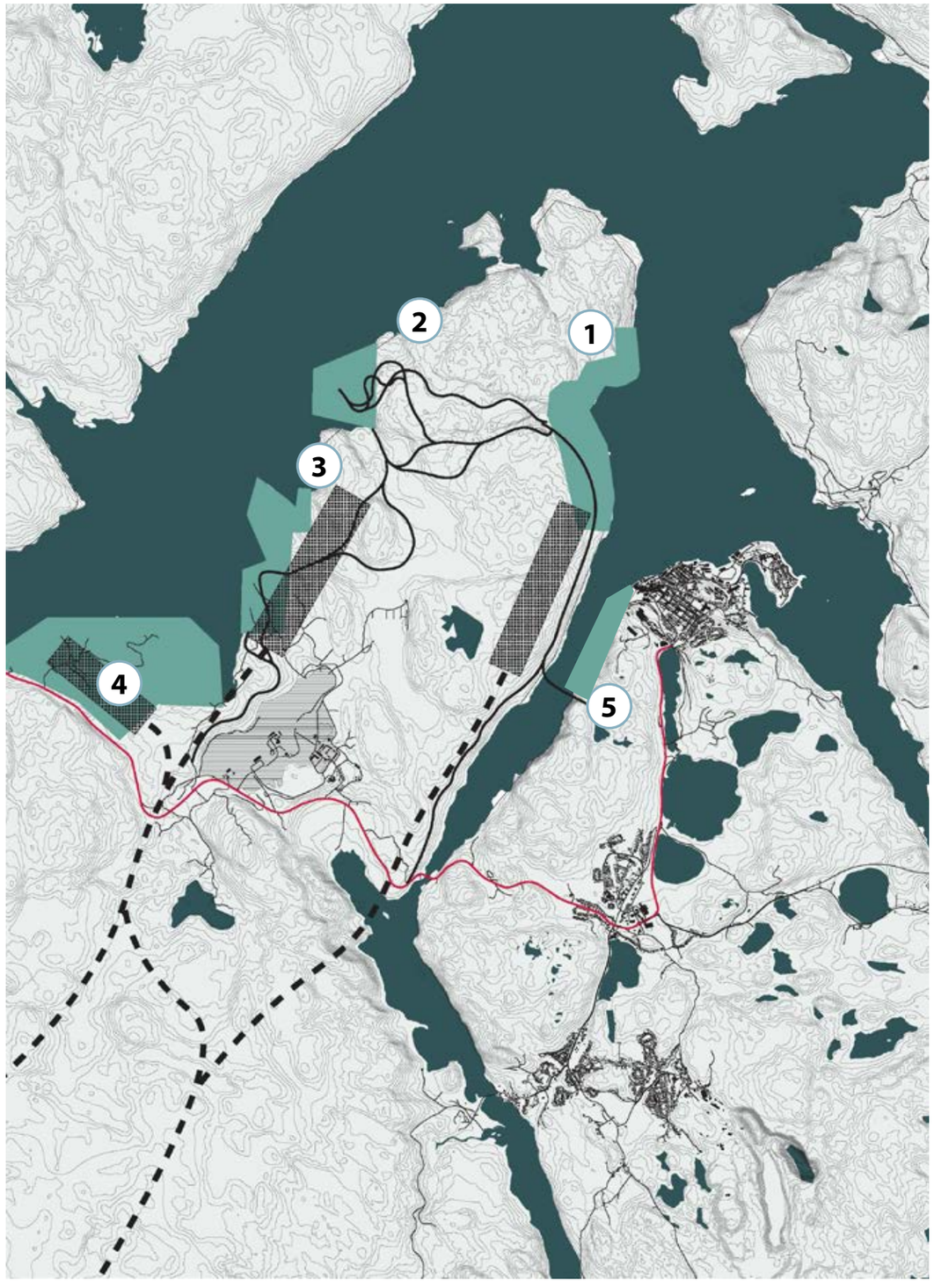
- Suburban shift
- New governance model
- Public-private hybrids

- Local selective cleaning
- Displacement to global resources

- Neo-liberal type management and re-framing of externalities

◄ *Photo / 45* **Iron miners set for a restart in Kirkenes**
◄ *Photo / 46* **The world`s northernmost Chinatown**
◄ *Photo / 47* **Railway between Rovaniemi and Kirkenes is the most important project to develop East Finnmark**
◄ *Photo / 48* **China has big Arctic ambitions**

▼ *Map /23* **Port development /** *Höller*



KIRKENES
PORT DEVELOPMENT

❶ Leirpollen

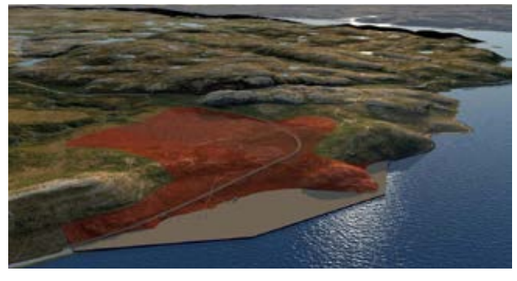
Kirkenes together with Norterminal AS, is currently investigating, if and how suitable the location Leirpollen, north east located is. This area could function as a new main-terminal for an integrated Kirkenes port solution as well as reloading terminal for oil products or transport of large volumes.

❷ Gamnes

Gamnes could function as new oil and gas trans-shipment terminal. Norterminal AS currenty has a floating and temporary solution for such transshipments close to the area.

❸ Pulkneset

Pulknes could become the new oil related base for future explorations in the Barents Sea.



❹ Høybukta west

Next to Leirpollen, also Høybukta west is in discussion as one suitable solution for a new Kirkenes Maritme Park. The filled in area on the illustration is approximately four square kilometer wide and would offer an industrial park next to the docks and quays.

❺ KILA (Kirkenes Industrial Logistic Area)

A 1 million m^2 large areal, proposed by Tschudi AS to increase the companies` maritime transport and logistic capacity. Furthermore it could include a combined solution for services for the oil- and off-shore industry.

◄ *Photos / 49-53* **Port developments planned**

KIRKENES
PORT DEVELOPMENT

Port of Oslo:
Biggest port in Norway

Container throughput (2018)
(12 months operating period):
238,000 TEU or
19.800 TEU per month

Source: https://www.marineinsight.com/shipping-news/norways-largest-container-terminal-yilport-oslo-records-highest-container-volume/

Port of Gothenburg:
Biggest port in Scandinavia

Container throughput (2018)
(12 months operating period):
753.000 TEU or
62.750 TEU per month

Source: https://www.portofgothenburg.com/about-the-port/ports-of-the-world-in-figures/?type=10602&area=11286

Port of Kirkenes:
Proposed size

Proposed container throughput
(7,4 months operating period) :
550.000 TEU or
74.000 TEU per month

Source: Arctic Ministry of Transport and Communications, 2019)

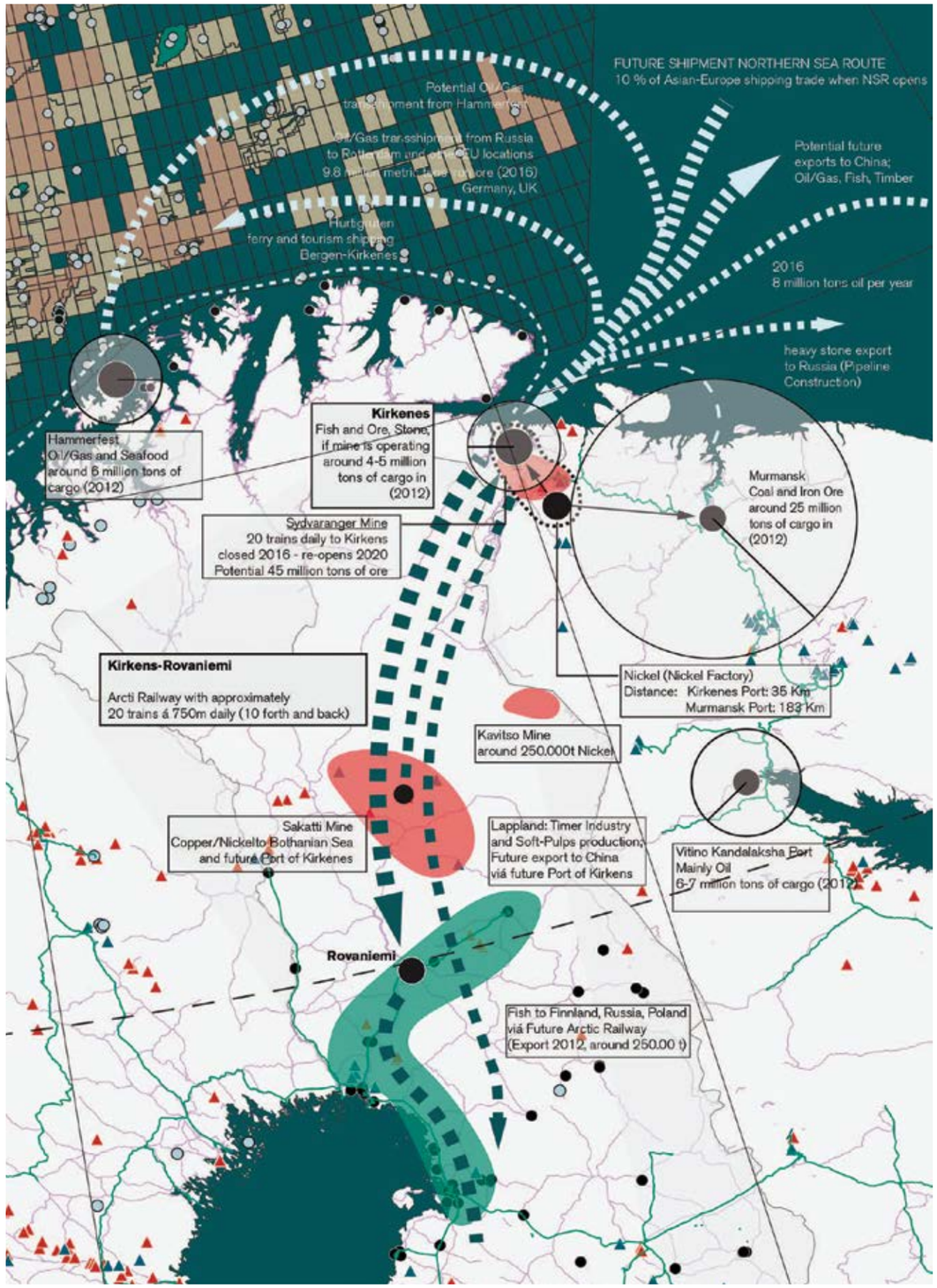
Port of Rotterdam: Biggest port in Europe

Container troughput Rotterdam (2018)
(12 months operation period): 14.512.661 TEU or
1.200.000 TEU per month

Source: https://www.portofrotterdam.com/en/our-port/facts-and-figures/facts-figures-about-the-port/throughput

▲ *Figure / 36* **Kirkenes the Rotterdam of the North**

▼ *Map / 24* **Future shipment and logistic flows** / *Höller*

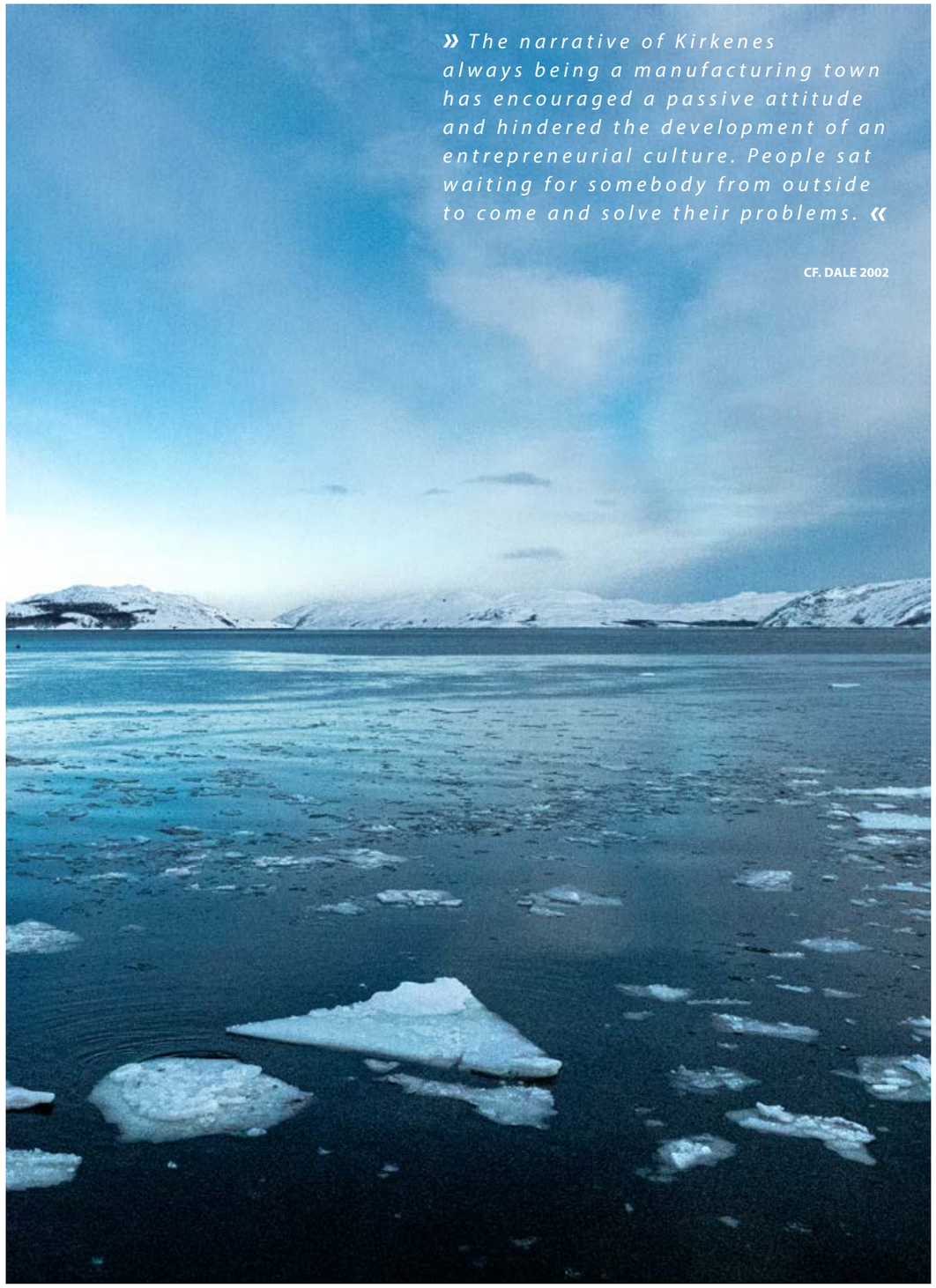


KIRKENES
PORT DEVELOPMENT

10 % of Asian-Europe shipping import goods are transported on this railway line with a rail link to Finland continuing to Scandinavia, the Baltic countries and Western Europe (Arctic Ministry of Transport and Communications, 2019)

- 10 southbound cargo trains per day from Kirkenes to Finland and on to other destinations (20 trains daily forth and back)
- 550,000 containers transloaded per year – or 37,000 containers per month – from Asia via the Port of Kirkenes (74.000 containers TEU per month forth an back) during a 7.4-month navigation season
- Expected: 400-600 people direct employment in Kirkenes
- Terminal port in Kirkenes must have equivalent or greater capacity than the Port of Gothenburg.
- Projeted container traffic between Asia and Europe may threefold in 2040: even a share of 3-4 % of the combined container imports from China, Taiwan, South Korea and Japan to Northern Europe would generate comprehensive activity
- Connecting mining, timber and tourism industry in Finland as potential off-season sectors

▼ *Photo / 54* **Impression Kirkenes /** *Höller*



KIRKENES
SUMMARY

As Viken and Nyseth (2012) elaborated, Kirkenes` path dependency due to its mining history but also current narratives of "Kirkenes as Border City" or "Kirkenes as political place" restrain the city of defining legitimate scenarios.

As one can observe, while looking at the port development plans, which already exist since more than ten years, the decisi-on-making conflicts within the city but also with Southern Norway (Oslo) as well as the fall-back into earlier priorities and decisions will have a huge impact on the future of Kirkenes.

The refocusing on industrial patterns like the reopening of the mine or the new development of port structures that will rely on unstable global economic conditions can be fatal.

Furthermore, the social exclusion, especially of the Sámi, but also of the civil society when it comes to large scale devel-opments show the danger of an uncoordinated row of path-dependent decision-making by only a few of the citie`s stake-holders.

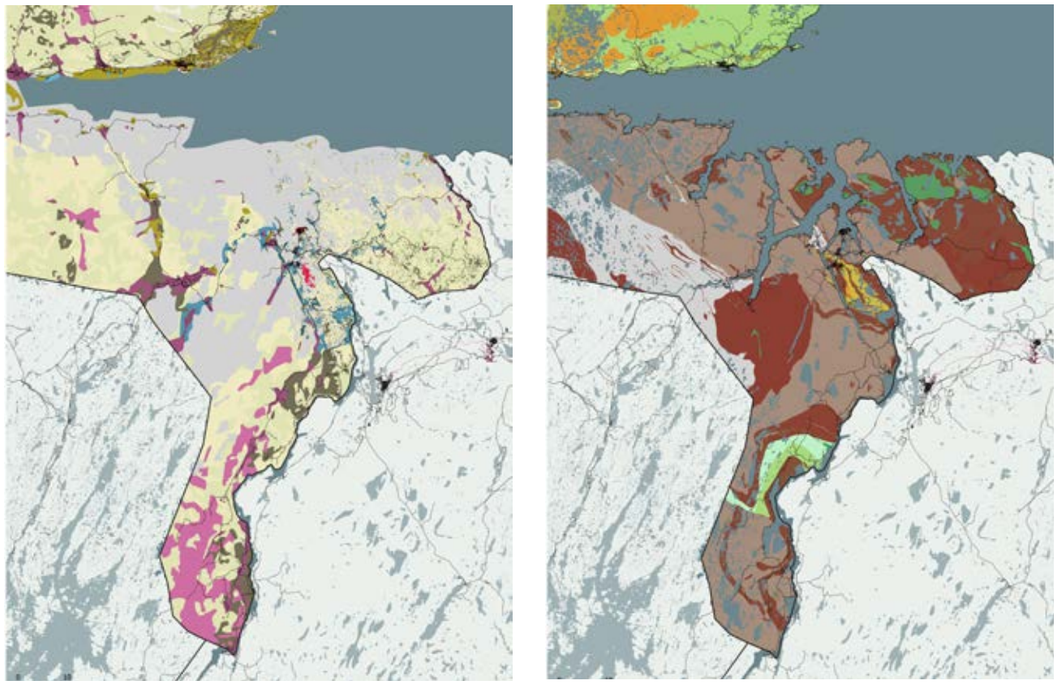
05 ECOSYSTEM ANALYSIS
NATURAL DYNAMICS

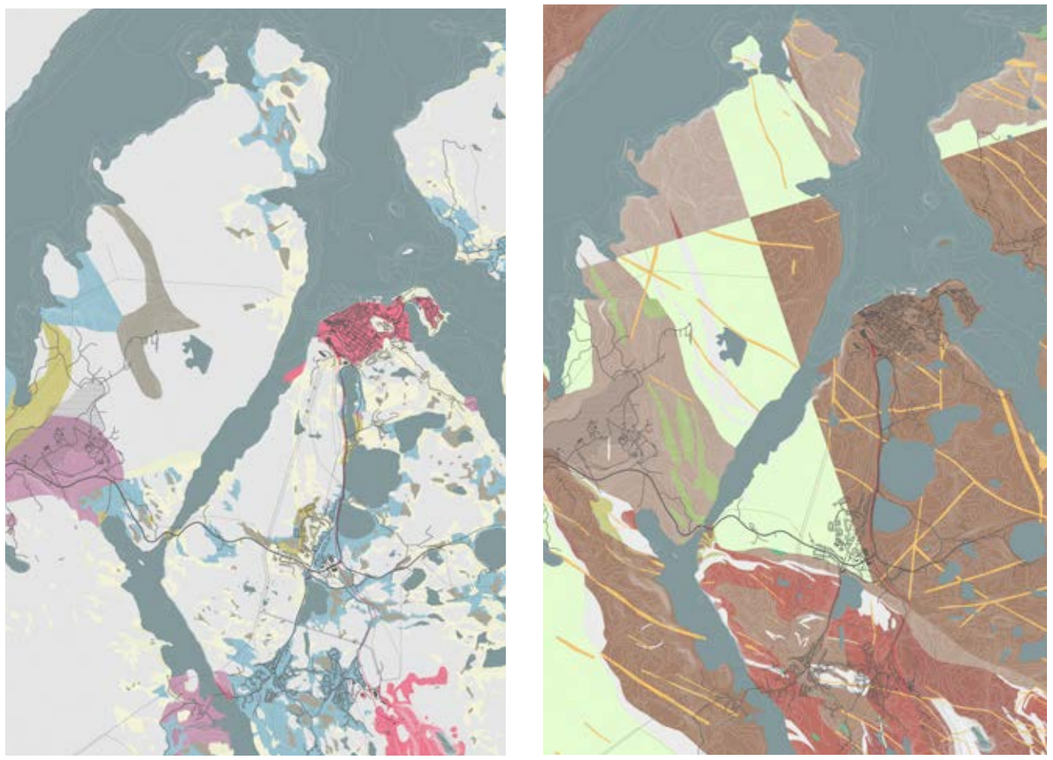
▼ *Photo / 55* **Reindeer heerding**

» *Only a design project taking into account this bigger landscape picture is able to deliver a realistic fundament for a city development under the conditions of precariousness.* «

L. DIEDRICH, 2013, P. 3

▼ *Map / 25-28* **Landformation** */ Höller*





SØR-VARANGER
LANDFORMATION

The region of Sør-Varanager is characterized by super-crustal rocks that were formed around 3000 million years ago during the Late Archaean, which hosts the rich amount of iron and copper ores along today`s border between Norway and Russia (Ramberg., Bryhni, Nøttvedt, Rangnes; 2008).

Even though the region is rich in earths mineral, the rock-formation processes in a combination of harsh climatic conditions make the land not very productive for agriculture, which is one of the reasons for the dispersed and remote character of built environments. While Norway already has a meager amount of ag-riculturally used area (3% compared to around 40% average of OECD countries), the amount of agricultural land to Finmarks total area-size is only 0,5% (NIBIO, 2017). Large areas of bare rock cover the surface, or unsuitable soil/substrate formations are identified within the subsurface, making traditional agriculture impossible.

Nonetheless, this does not mean that the Northern Sub-Arctic part of Norway is not full of nature and ecology. The most important characteristic is, that the area of Sør-Varanger is located within the interface of the Arctic Tundra (Varanger Peninsula) biome in the north and the boreal forest, also called Taiga, in its southern part (Pasvik)

Soil/Sediment types,
Sør-Varanger/Kirkenes
(left top and bottom):

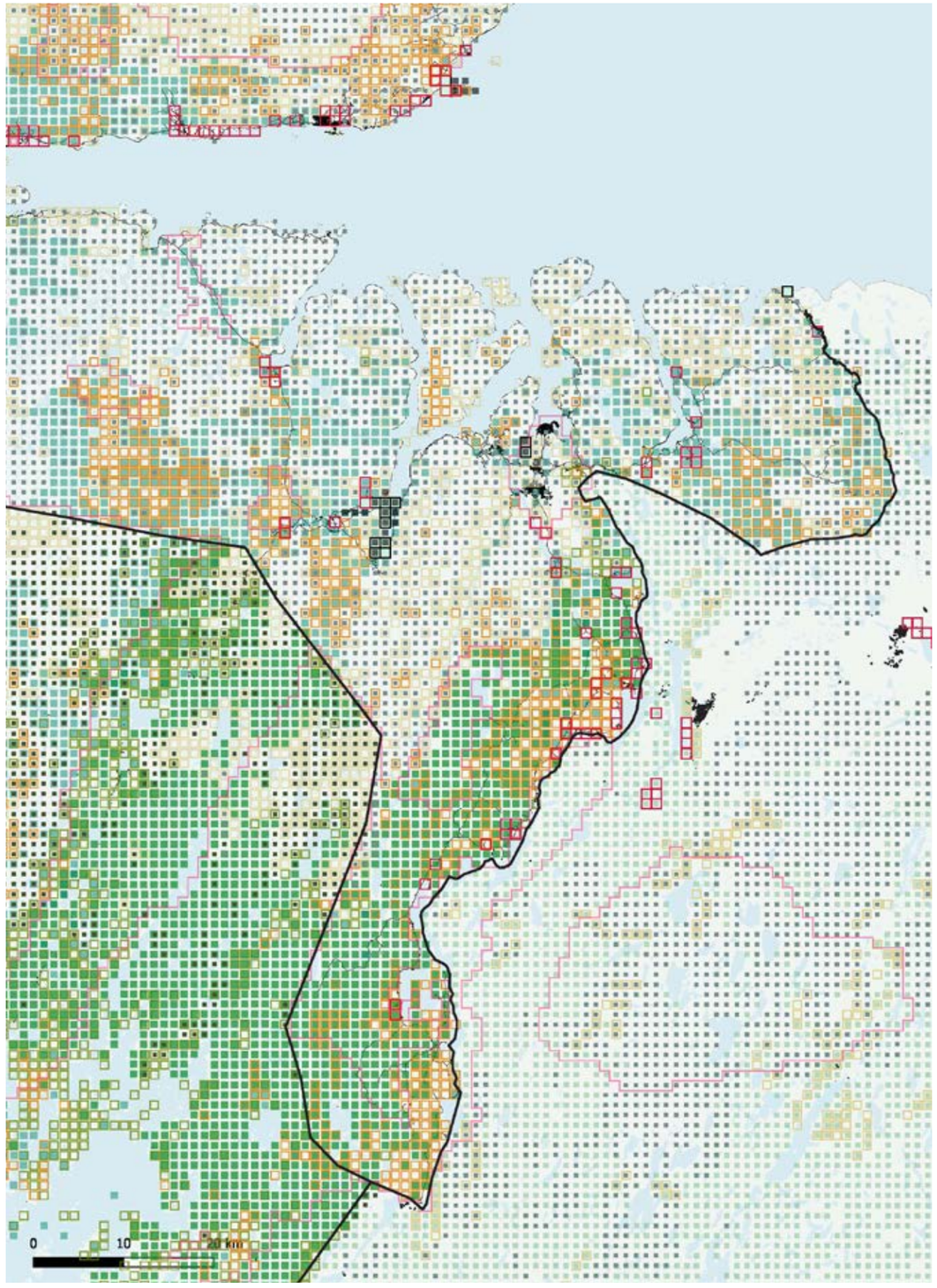
- Endmorainal material
- Bare rock
- Glaciofluvial deposit
- Fluvial deposit
- Anthrophogenic infill
- Sea- and Fjordsediments
- Bare rock under water
- Marine sediments
- Morainal sediments
- Peat

Bedrock types,
Sør-Varanger/Kirkenes
(right top and bottom):

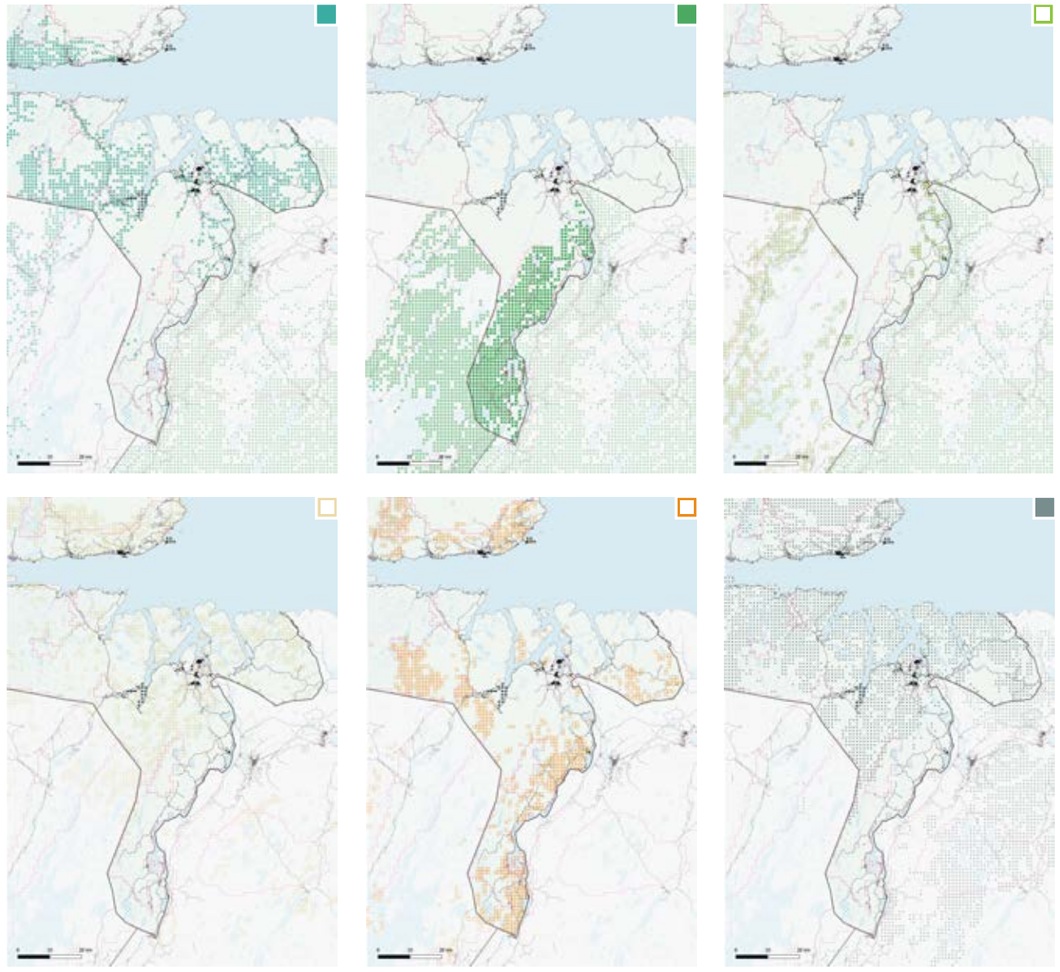
- Amfibolit
- Diorite
- Gabbro
- Gneiss
- Granite
- Sediment Conglom
- Quartzite
- Monzonite
- Sandstone
- Vulcanic stone

▲ *Map/ 29* **Tundra / Taiga**

▼ *Map / 30* **Land-use** / *Lukas Höller*



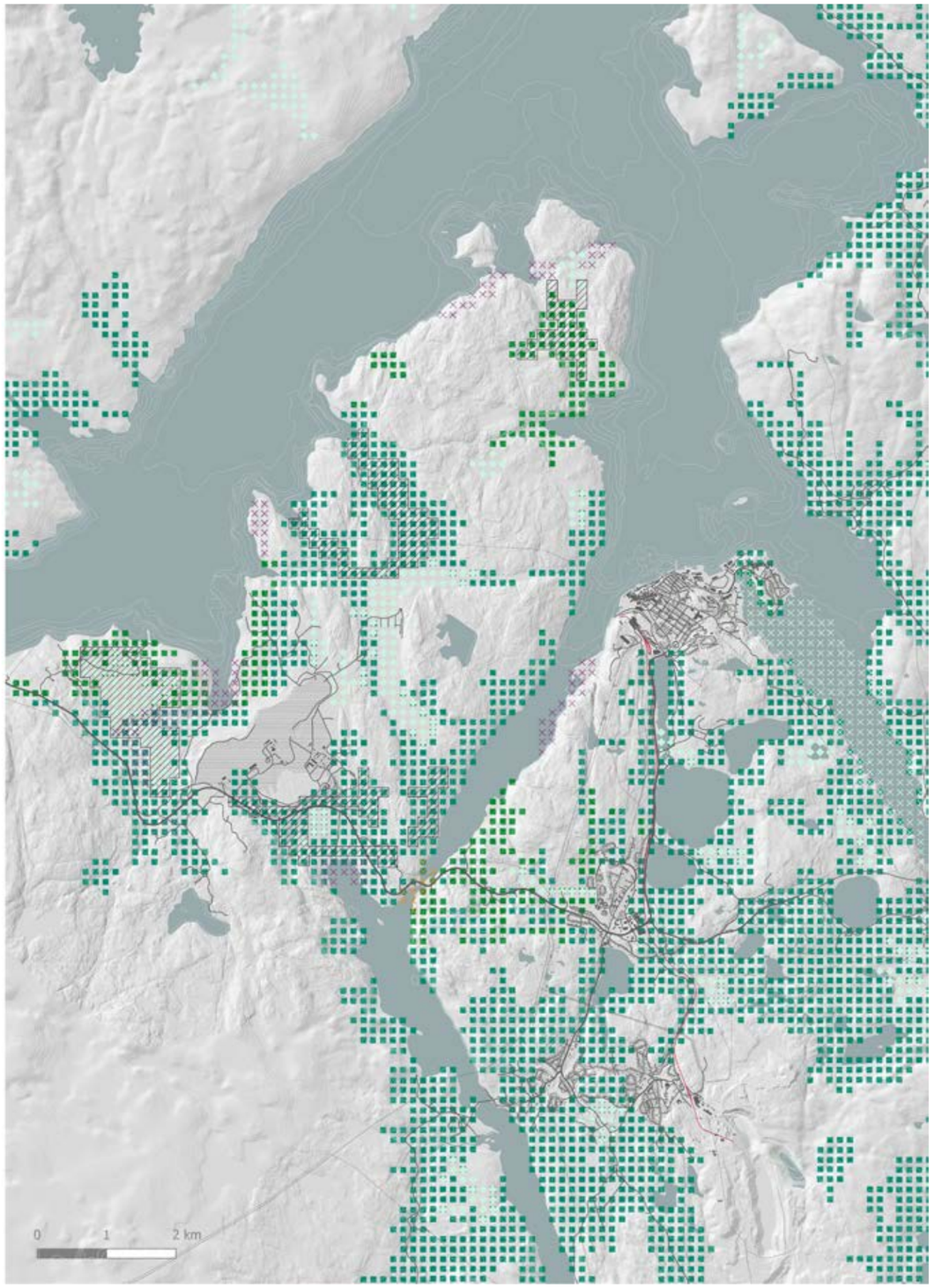
SØR-VARANGER
LAND-USE



▲ *Maps / 31-37* **Single land-uses from left to right: Broad-leaved trees, conifer forest, mixed forest, moor and heathland, peatbogs, sparesly vegitated area, inland tidal flats** / *Höller*

- Broad-leaved trees
- Conifer forest
- Mixed forest
- Moor and heathland
- Peatbogs
- Sparesly vegitated area
- Inland tidal flats
- Agricultural land
- Preservation area

▼ *Map / 38* **Land-use** */ Höller / Data::geonorge.no Data: geonorge.no*



KIRKENES
LAND-USE

Nature in Sør-Varanger

Due to its remote character, the North of Norway is rich in seemingly untouched nature. One example of Finnmark`s unique natural ecosystem is the so-called Øvre Pasvik, located around 100 km south of Kirke-nes. It is one of the last and largest remaining areas of primeval and untouched boreal pine forests world-wide. The flat and low lying area of forest is intertwined with important lakes and bogs, providing habitats for several rare species in Norway and Western Europe (Pasvik Inari, n.d.).

Not only the protected areas contribute to Northern Norway´s rich nature, but also the ecosystems surrounding the often small urbanized locations are essential to nature´s and human´s wellbeing.

The primary analysis of the chapter "Natural Dynamics" starts with the classification of the area according to the Corine Landcover (Copernicus Land Monitoring Service) to show an overview of the natural conditi-ons in the project area.
Most of the location is dominated by sparsely vegetated Tundra-like zones as well as bare-rock areas. The classification of the area of Sør-Varanger can be found on the following page, with the description of the single classification categories.

Nature around Kirkenes

The location in and around Kirkenes is also dominated by a large amount of bare rock and sparsely vegetated zones. Critical areas here are the wetlands/ bogs on the Tømmerneset Peninsula on the west side of Kirkenes as well as some areas in the east of the town.

Furthermore, intertidal flats along the shoreline of the peninsula and along the two river exits of the Langfjorden (left) and Pasvik (right) are vital zones, especially for the aquatic ecosystem.
Furthermore, the area is covered by coniferous or mixed forests.

Within the following chapter, the ecosystem will be analyzed further. The main focus is set, especially on the reindeer communities roaming within the area. Furthermore, birds and fish are two significant natural participants as well, not only for the stability of the natural ecosystem but also for the inhabitants living in those regions and tourists visiting.

- Mixed forest
- Conifer forest
- Wetland
- Lichen-rich areas
- Tidal extreme areas
- Water with naturally low oxygen
- Intertidal coastal zones
- Streets

ECOSYSTEMS
LAND-USE COVER

▼ *Figure / 37* **Land-use cover /** *Höller*

Coniferous Forest

- Pure or mixed stands of fir (Abies), pine (Pinus), among others;
- Optionally sporadically occurring patches of broad-leaved trees with < 25 % share of the tree covered area;
- Sporadically occurring < 25 ha patches of shrubs and dwarf shrubs; herbaceous vegetation (grasses and herbs); mosses and lichens;

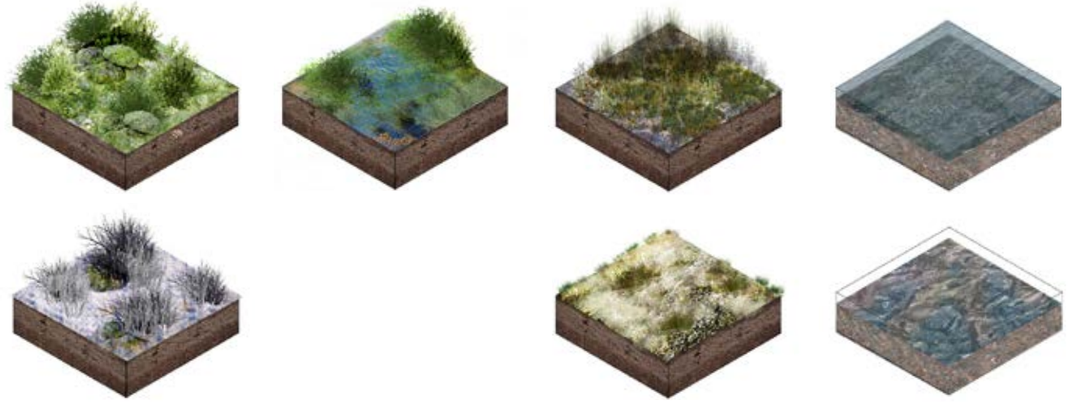
Broad Leafed Forest

- Pure or mixed stands of poplar *(Populus)*, birch *(Betula)* species among others;
- Riparian and gallery woodlands, with dominant Alnus, Betula, Populus or Salix;
- Optionally sporadically occurring patches of coniferous trees not exceeding 25 % share of the tree covered area;
- Sporadically occurring <25 ha patches of shrubs and dwarf shrubs;
- Herbaceous vegetation (grasses and herbs); mosses and lichens;

Mixed Forest

- Mature forests with at least 30 % crown cover density, where both broad-leaved and coniferous trees occupy at least 25 %, but maximum 75 % of tree-covered area, of natural or anthropogenic origin;
- Deciduous or evergreen broad-leaved trees with 25-75 % share;
- Evergreen or deciduous coniferous (needle-leved) trees with 25-75 % share;
- Sporadically occurring < 25 ha patches of shrubs and dwarf shrubs;
- Herbaceous vegetation (grasses and herbs); mosses and lichens; denuded spots.

Source: *Description of the Land-use Covers according to: EEA. (2019). Corine Land Cover (CLC) 2018, Version 20.*



Moor and Heathland

- Dwarf pine *(Pinus mugo)* coverage above the upper tree limit in the Alpine zone or in the bottom of large depressions with temperature inversion;
- Maritime, prostrate, windswept and cushiony heaths with maritime ecotypes;
- Arctic moors areas with moss, lichen, gramineous coverage and small dwarf or prostrate shrub formations *(Betula nana, Salix lapponum, Salix glauca, Juniperus alpina, Dryas spp., Vaccinium myrtillus, Empetrum nigrum)*;
- Shrubs and dwarf shrubs, dominating the vegetation;
- Trees of dwarf growth form, not higher than 3 m; herbaceous vegetation (grasses and herbs); mosses and lichens; outcrops of natural bare surfaces not reaching 50 % cover of the area;

Peat Bogs

- Boreal peat bogs with reticulated structure (aapa) with Sphagnum spp., Empetrum spp., Vaccinium spp., Betula nana, Salix nana, Carex spp., Eriophorium spp., Utriculara spp., Drosera spp.;
- Fossil Arctic peat bogs (palsa) with Vaccinium spp., Betula nana, Salix lapponum and Salix glauca, lichens and Carex spp.;
- Mosses (mostly Sphagnum spp.);
- Acidophillous herbaceous plants (grasses and herbs), such as Carex, Molinia, Drosera species;
- Woody plants: dwarf shrubs, such as Vaccinium, Erica species, shrubs and dwarf-growth trees, such as Betula nana, Salix nana;
- Scattered trees;
- Non-vegetated peat surfaces under exploitation; water surfaces: bog eyes (open water surface occurring near the centre of raised bogs), canals and pools of peat extraction.

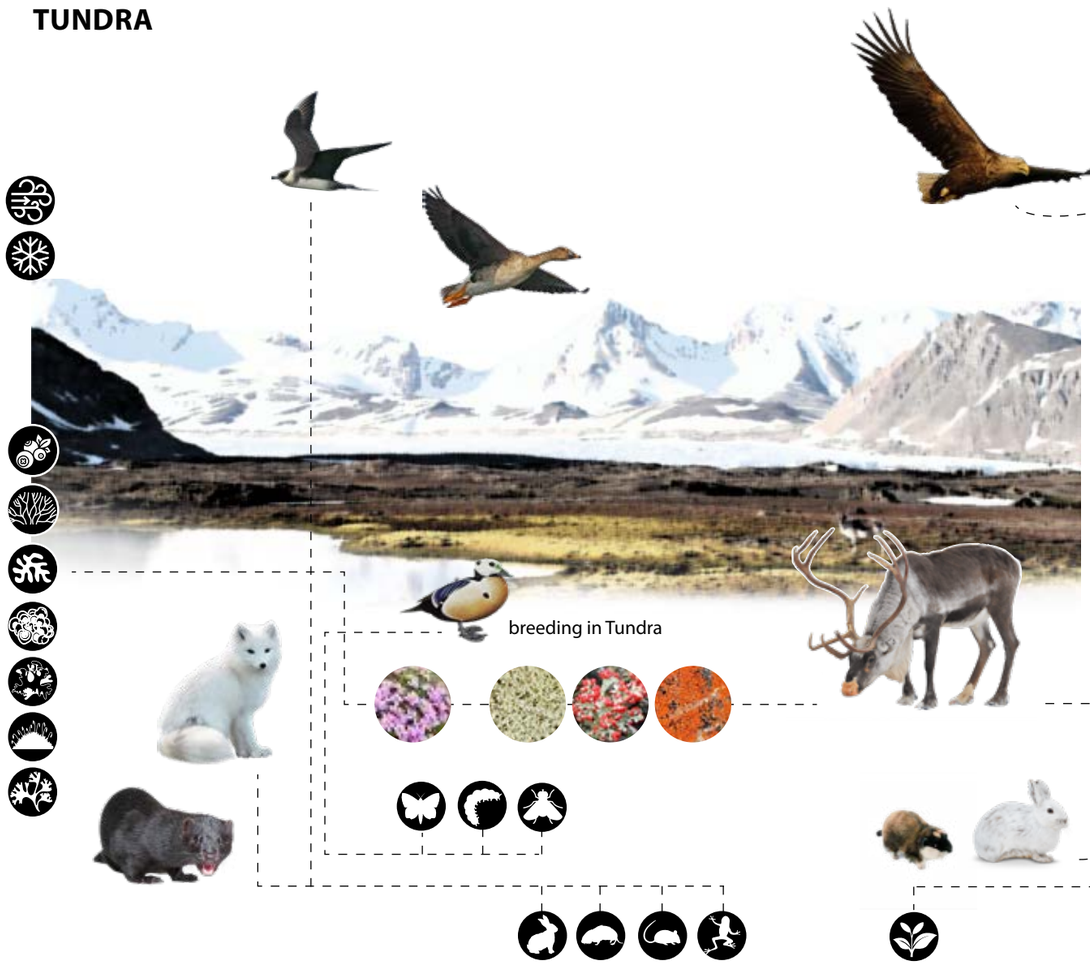
Sparsley Vegetated Area

- Areas with sparse vegetation, covering 10-50% of surface: Tundra, lichen heath, badlands;

Intertidal Flats

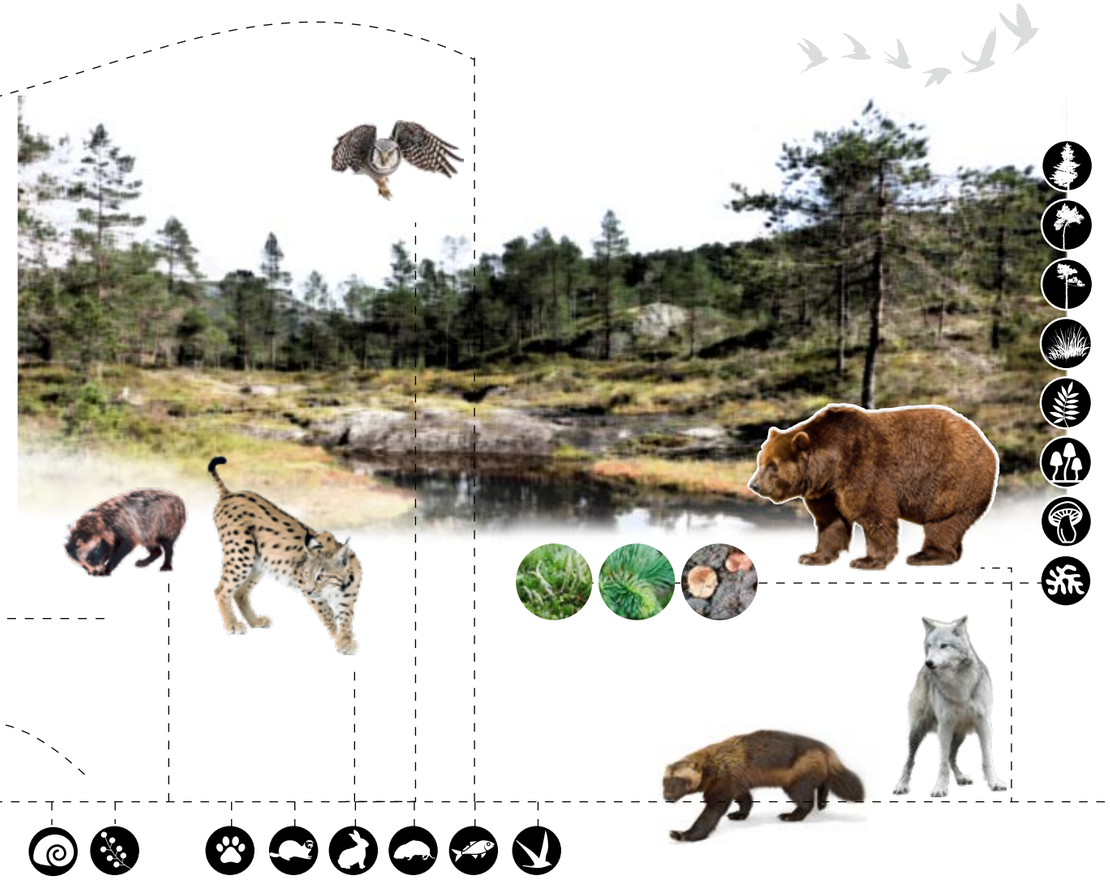
- Coastal zone under tidal influence between open sea and land, which is flooded by sea water regularly twice a day in a ca. 12 hours cycle. Area between the average lowest and highest sea water level at low tide and high tide. Generally non-vegetated expanses of mud, sand or rock lying between high and low water marks;
- Mud and sand plains, intertidal shattered rocks or boulders, eventually seaweed-covered;
- Scattered halophytic plants on the transition zone between intertidal flats and salt marshes;

HABITAT
TUNDRA



The Tundra ecosystems are treeless, sparsely vegetated biomes covered with large amounts of bare rocks. Climatic condi-tions are cold, windy with less precipitation. Most of the time, those regions are covered by large amounts of snow, but in summer, life comes back to the region. Even though the average temperature is between -6 and -34 degrees celsius, the Tundra offers habitats for many vital species, like reindeer, snow fox, snow-rabbit, wildflowers, and a large community of migratory birds (Sciencing, 2018).

HABITAT
TAIGA



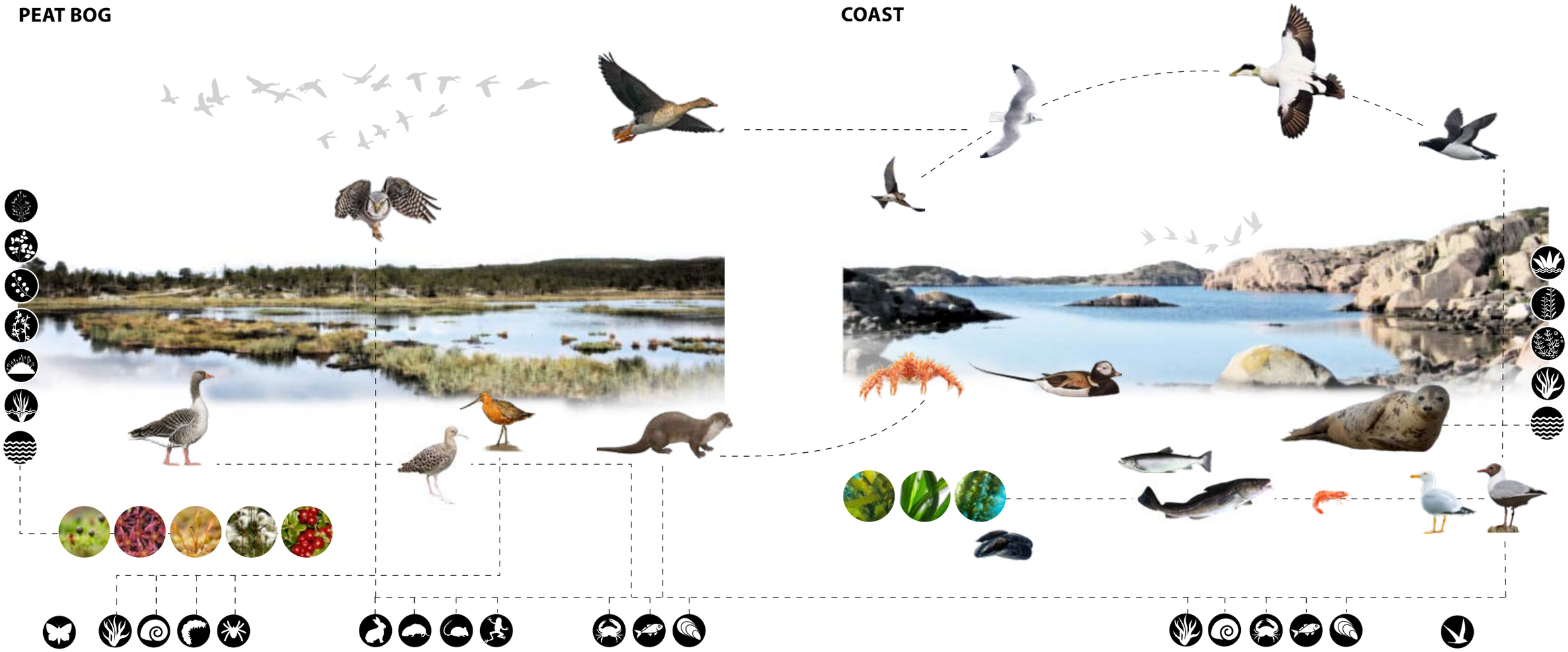
The Taiga ecosystem, also called the boreal forest, is the main-zone within Sør-Varanger. The composition of trees is mainly needle-leaved or scale-leaved evergreen trees, e.g., pine (Pinus), spruce (Picea), larch (Larix), fir (Abies). But also leaved trees like birch (Betula) and poplar (Populus) are common in this area. The winters are long and have a moderate to high precipitation rate in form of snowfall (Sciencing, 2018).

The floor is usually covered with organisms like mushrooms and lichens, which grow directly on the ground or have shallow roots, so they can survive the cold climate and limited light conditions.
Furthermore, the Taiga is home for many different animals adapted to the cold and harsh climate as well. Next to bears, lynx, wolves and reindeers, a large number of birds inhabit the area. Most of them are mig-rating to southern locations during the long and dark winter (National Geographic, n.d.)

▲ *Figure / 38* **Habitats Tundra and Taiga /** *Höller*

HABITAT
PEAT BOG

HABITAT
COAST



Peat bogs and wetlands almost cover 10 % of the total land in Norway and Russia. The swampy and grassy areas are signi-ficant for the world's climate. Peat bogs are large storage for CO2, which gets trapped underneath the peat moss as well as within the frozen grounds.
Peat mosses (Sphagnum spp.) are the most popular bog-species worldwide. Even though they often take over large amounts of land and therefore impact other species, they provide vital habitats for all kinds of aquatic and terrestrial eco-system participants (Lehigh University, 2018).

The Barents Sea covers the shallow continental shelf along the Eurasian landmass. As one of Europe´s last large, clean, and to a significant degree, undisturbed marine ecosystem and because of its high productive-capacity, the Barents Sea is habitat for diverse flora and fauna. Along its coastline but also directly within the water, numerous species of seabirds, such as puffins and guillemots, can be found. Furthermore, the high productivity of phytoplankton and kelp emerges a richness of fish. From Arctic Cod to haddock and herring, the Barents Sea is an essential habitat for spawning fish (WWF Arctic, n.d.)

▲ *Figure / 39* **Habitats Peat bog and coast** / *Höller*

LICHEN
AN IMPORTANT SYMBIOTIC PLAYER

▲ *Figure / 40* **Sparsley vegetated area, lichen heath /** *Höller*

Lichen are essential but often underrated parts of ecosystems worldwide, but especially in Arctic or other harsh environ-ments. For a long time, science thought of lichen as one species. However, research found out, that lichen are two orga-nisms working together within a process called symbiosis. One part of the two organisms is a fungi (heterotrophs), which means that they have to ingest their food sources. The second part, the cyanobacteria or algae, is producing energy through photosynthesis. Algae are generally found within moist or aquatic territories and usually can not survive on terrest-rial areas.

Nonetheless, the lichen, so the algae and the fungi within their symbiotic state, have created a mecha-nism to produce their own food. The fungi provide the algae with moisture, filtered from the air, while the algae supply sugar for the fungi through photo-synthesis. The lichen is an exceptional example of symbiosis or synergies within the natural environ-ment. Due to this mechanism, the lichen can sur-vive on the most sparse grounds (U.S. FOREST SER-VICE, n.d).

▲ *Photo / 56* **Reindeer**

▲ *Photo / 57* **Lichen**


PLOS ONE

RESEARCH ARTICLE

Lichen Symbiosis: Nature's High Yielding Machines for Induced Hydrogen Production

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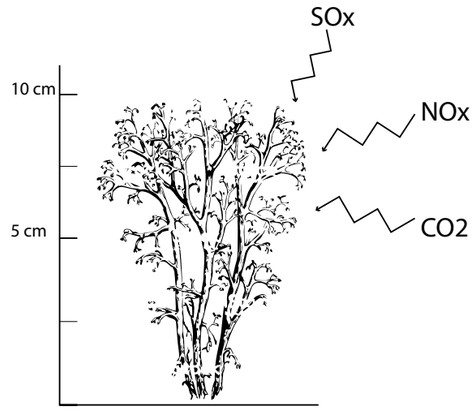
The functions Lichen have for the natural but also human ecosystem are manifold. From an abiotic per-spective, they regulate the rock composition, soil regeneration and -formation, the subsoil tem-perature, they fix nitrogen, prevent erosion of bare-rock areas, filter and regulate the water flow. They can be an important indicator for air quality due to their sensitivity to SOx.

Furthermore, Lichen provides an important food source for animals, especially within Arctic climate regi-ons. Reindeer use the Lichen (mostly Cladonia rangiferina) as their primary winter food source and are de-pending on the distribution of the Lichen (Zedda, Nöske, Rambold; 2014).

New research found out that Lichen, being a robust and adaptive symbiotic organism, could be the key to future energy production. It is long recognized that cyanobacteria, green algae, are capable of pro-ducing hydrogen through the biological process of photosynthesis. The biggest obstacle during this process is the O2 sensitivity of the hydrogenase en-zyme. The combination of mycobiont and photobi-ont in Lichen is seen as a promising perspective for future hydrogen production.

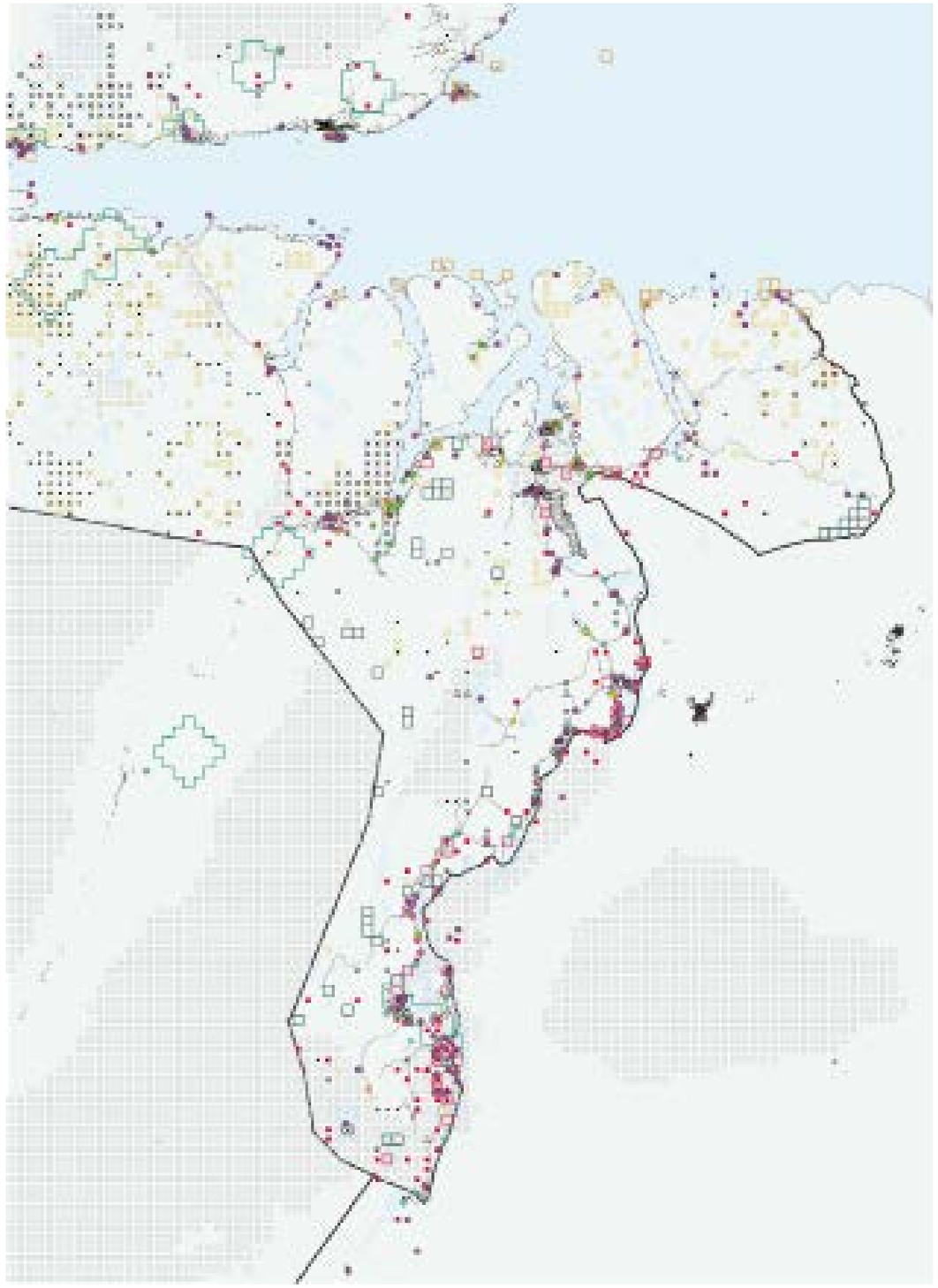
The O2 consumption of both can create the needed anoxic state for the hydrogenase within a closed sys-tem (Papazi, Kastanaki, Pirintsos & Kotzabasis; 2015).

As a small conclusion of the investigation on Lichen, it can be said that they are crucial players in today`s Arctic natural and human environment but can also be a potential driver for a new Arctic development, which will be displayed in the designs of the port-city region in the last part of this thesis.



▲ *Figure/ 41* **Lichen**

▼ *Map / 39* **Mammals Sør-Varanger /** *Höller*



SØR-VARANGER
MAMMALS RED LIST

Especially the undisturbed areas of Sør-Varanger, are populated by some of the most endangered red-list species of Norway. As already stated, the remote character and the high amount of untouched and protec-ted nature provides shelter and habitats for those species. However, as already seen in the analysis of Sør-Varanger and Kirkenes, but also in the upcoming part of the impact analysis of current and future planned developments, pressures including pollution, infrastructure and climatic changes create immense stress on parts of the vulnerable mammal-community. The following page includes an overview of the most im-portant species mapped in and around Kirkenes and Sør-Varanger.

- Ringed seal
- Polar fox
- Brown bear
- Eurasian lynx
- Eurasian river otter
- Wolverin
- Elk
- Raccoon dog
- Mountain hare
- Grey wolve

RED LIST
MAMMALS IN SØR-VARANGER

Ringed Seal / Pusa hispida
- **Habitat:** Arctic Sea, resting on ice floe –> moving farther north for denser ice
- **Food:** Mysids, shrimp, Arctic cod, herring
- **Predators:** Arctic fox and glaucous gulls take ringed seal pups
- **Risks:** The seal is still extremely endangered and will need protection for years to come. In addition to climate change, the ringed seal is threatened by fishing nets and disturbance.

(NOAA Fisheries, n.d.)

Brown Bear / Ursus arctos
- **Habitat:** Mountain woodlands, Tundra, meadows
- **Food:** Omnivorous, grass, shoots, berries, fruits, nuts, plums, roots, insects, mammals
- **Risks:** Bears were ruthlessly hunted in the early 20th century, and almost exterminated. In 2017, only seven litters were born.

(WWF, n.d.)

Wolverine / Gulo gulo
- **Habitat:** Northern boreal forests and Sub-Arctic Tundra;
- **Food:** Primarily scavengers, small mammals or pups, eggs, birds (especially geese), roots, seeds, insect larvae, berries;
- **Predators:** Grey wolve, brown bear;
- **Risks:** The wolverine used to be widely distributed in Norway, but became locally extinct in parts of its range in the first half of the 20th century. This fact has led to concern that global warming will shrink the populations. This requirement for large territories brings wolverines into conflict with human development, and hunting and trapping further reduce their numbers, causing them to disappear from large parts of their former range; In the last three years, population in Norway has declined.

(NatureWorks, n.d.)

Lynx / Lynx lynx
- **Habitat:** Boreal and deciduous forests;
- **Food:** Hoofed animals (reindeer), birds, eggs, small mammals (snow hare);
- **Risks:** The lynx is widely distributed in northern Europe, but a substantial proportion of the population lives in Norway, Sweden and northwestern Finland. All three countries are therefore independently responsible for lynx management within their borders, and also have a joint responsibility for management in the region as a whole, since lynxes range widely across national borders.

(WWF, n.d.)

Raccoon Dog / Nyctereutes procyonoides
- **Habitat:** Forests, farmlands, and urban areas, near water, moist meadows, shores of rivers and lakes;
- **Food:** Omnivores; insects, rodents, amphibians, birds, fish, reptiles, mollusks, carrion, fruits, nuts, berries;
- **Predators:** Wolves, eagles, wolverines;
- **Risks:** Road kills, persecution, government attitudes, epidemics (scabies, distemper and rabies) and pollution (organtins, lead, PCDDs, PCDFs and PCBs) remain the major threats to the species across its range. (Animalia, n.d.)

Grey Wolve / Canis lupus
- **Habitat:** Forests, inland wetlands, shrublands, grasslands (including Arctic Tundra);
- **Food:** Moose, deer, wild boar
- **Risks:** The original Scandinavian wolve population died out during the 1960s. The wolves found in Norway and Sweden today are descended from a small number of animals from the Finnish-Russian population that dispersed as far as southern Scandinavia in the 80s and 90s. It is red-listed as critically endangered in Norway today. (Defender Org, n.d.)

Arctic Fox / Vulpes lagopus
- **Habitat:** Arctic Tundra, well adapted to living in cold environments;
- **Food:** Lemmings, hares, ringed seal pups, fish, waterfowl, and seabirds, but also carrion, berries, seaweed, and insects or other small invertebrates.
- **Predators:** Eagles, bears, wolverines, red foxes, wolves;
- **Risks:** diseases, global warming; Despite strict protection in Norway since 1930, the small and severely fragmented population has never recovered to a viable level and is classified as critically endangered in the revised Norwegian Red List for species (2015). So it is one of the most seriously endangered mammals in Norway.

(MammalAge, 2020)

American Mink / Neovison vison
- **Habitat:** Wet areas such as swamps and marshlands or along rivers, lakes and streams;
- **Food:** Carnivore; rodents, fish, crustaceans, frogs, and birds;
- **Predators:** Eagles, bears, wolverines;
- **Risks:** Diseases and parasites;

(Animalia, n.d.)

Eurasian River Otter / Lutra lutra
- **Habitat:** Unpolluted body of fresh waterways, lakes, streams, rivers, fjords, coasts, strongly territorial;
- **Food:** Mostly fish, amphibians, crustaceans, insects, birds;
- **Risks:** Threatened by a number of factors including being hunted and killed for its fur, pollution and loss of habitat. Other threats include bearing few cubs per litter, having a short life span (four years) and a long maternal care period.

(Raspberry, n.d.)

Mountain Hare / Lepus timidus
- **Habitat:** Boreal forests, mountain grassland, dry rocky hills, moorland and Tundra;
- **Food:** Leaves and twigs, alpine plants, grasses and lichen;
- **Predators:** Eagles, wolverines, foxes, wild cats;
- **Risks:** Human impacts, habitat loss and fragmentation. Resulting in expansion of winter tourism, growing visitor numbers, and a huge increase in all forms of activities, the mountain hare has been transferred from the category Least Concern in 2010, and is red-listed in the category Near Threatened in 2015. This is because their populations have declined considerably over a number of years, and a similar trend has been observed across large parts of Fennoscandia.

(Kauhala, Hiltunen & Salonen, 2009)

▲ *Figure / 42* **Mammals Red List characteristics** / *Höller*

▲ *Photo / 58* **Transportation of goods, and distinguished persons, occurred with reindeer and sleds in winter.**

▲ *Photo / 59* **A Sámi man and child in Finnmark, Norway, circa 1900**

▲ *Photo / 60* **Sámi reindeer heerding with Snowmobil**

▲ *Photo / 61* **In the past, herders monitored and migrated reindeer on skis**

▲ *Photo / 62* **A Sámi family in Norway around 1900**

▲ *Photo / 63* **Sámi reindeer heerding with helicopter**

REINDEER HEERDING
INDIGENEOUS SÁMI

The only officially as indigenous people recognized ethnicity in Europe - the Sámi - inhabit the transborder-territory of Norway, Finland, Sweden and Russia already for thousands of years. Their lifestyle and worldview is based on natural phenomena, which was the reason for their survival as gatherer and hunter.

While there is still disagreement within the research about the genetic origin and the development of the rich and manifold Sámi population, today´s distinctions are mainly based on the geographical characteris-tics and the interconnected livelihood, e.g., being coastal, mountain, river, reindeer or forest Sámi (Sli-erings, 2020, p. 42).

During modern times, their traditional and close-to-nature culture and lifestyle was extremely oppressed because of educational and religious assimilation processes driven by intruding western cultures. Since the origin of the Norwegian, Finish and Swedish nation-states, Sámi were resettled or removed from their tra-ditional habitats. Furthermore, Christian missionaries tried to erase the traditional Sámi culture and prac-tices in order to Christianize the High North (Partida, n.d.).

Even though the constitution of Norway from 1814 accepted the Sámi language on the same level as Nor-wegian, but the ongoing Norwegianization (fornorsking av samer starting around 1850), systematically stopped teaching and forbid the use of the language by, e.g. special schools making the Sámi as Norwe-gian as possible (Minde, 2005).

This lead to a strong decrease of their culture and traditional values. Only since 1997 the Sámis´right to develop their own culture, language and society was introduced and formalized in the Norwegian Constitu-tion. This Norwegianization process has an impact until today. Due to the loss of culture, identity and col-lective memory the assimilation process had, many inhabitants of the northern regions may do not know until today that they are origin from Sámi culture.

Furthermore, Sámi still have to fight against stigmatization, racism and exclusion within many decision-making processes, even though the Sámi Parliament gains increasing influence within the process of secur-ing the given rights of their people.

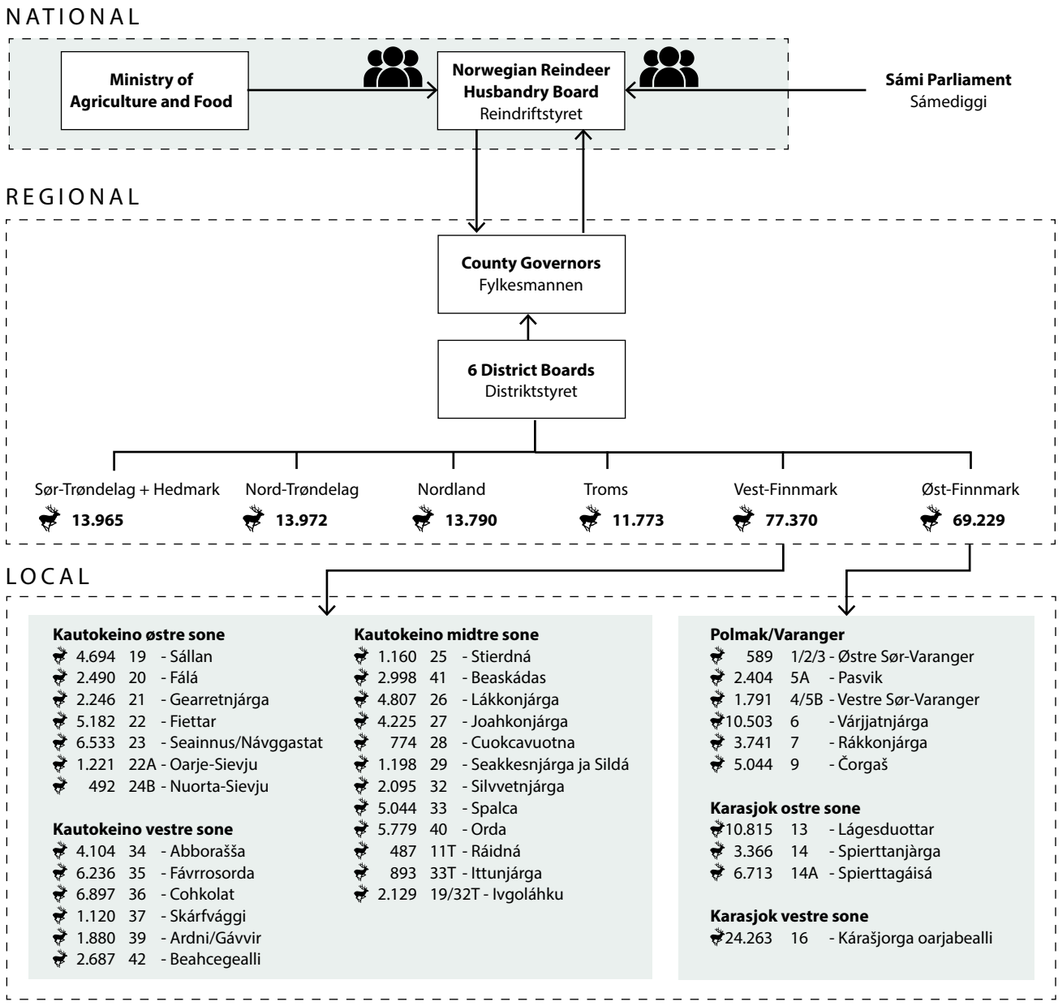
Today, economic and climatic changes impact the livelihood of the Sámi. Living with and directly from na-ture, making them part of the landscape, makes their culture very vulnerable towards those impacts. This is visible in one of the texts of Paulus Utsi.

„As long as we have water, where fish live
As long as we have land where reindeer graze and walk
as long as we have land where the wild hides
We have consolation on this earth
Once our homes don't exist any longer
and our lands are destroyed
Where shall we then live
Our own land, our livelihood has shrunk
Lakes have risen
Rivers have dried out
Creeks sing with sorrowful voices
Lands blacken, the green withers
Birds become silent and flee
All the good we have been given
Does not reach our hearts
That which would have made our lives easier
Lost its value
Hard stone roads make our movements painful
The calm of the wild person
Weeps in its heart
The hurrying time is thinning our blood
our unison snaps the water stops roaring"

(PAULUS UTSI)

Historical and contemporary impacts show the cultural value of resilience within their culture. Over centu-ries they needed to adapt to different human or nature-made changes, thus they wish for a diverse, sus-tainable, resilient and cooperative Sápmi, rooted in both healthy nature and thriving Sápmi culture, where people and nature have a long term capacity to constantly renew themselves and sustainably evolve espe-cially in times of significant changes (Sami Parliament, n.d.)

REINDEER HEERDING
GOVERNANCE



▲ *Figure / 43* **Reindeer governance scheme with regions and districts** **/** *adapted by Höller*

Reindeer herding is a long tradition within the culture of the Sámi. The migration together with the animals is a long-lasting lifestyle. In the Sápmi or Sámi-Homeland, wild reindeers always have been a vital source of food. Already in the middle-ages, Norway, Sweden and Russia claimed territories in northern Fennoscandia and demanded taxes from the Sámi population. Next to fishing, the herding of semi-domesticated reindeer became an important part. Today the herding husbandry areas in Finland, Sweden and Norway cover around 40 % within each country and are divided in so-called Siidas or reindeer herding districts (Käyhkö & Horstkotte, 2017).

As shown on the map, the area of Sør-Varanger is devided into three different Siidas, the Østre Sør-Varanger, the Vestre Sør-Varanger and the Pasvik Siida.

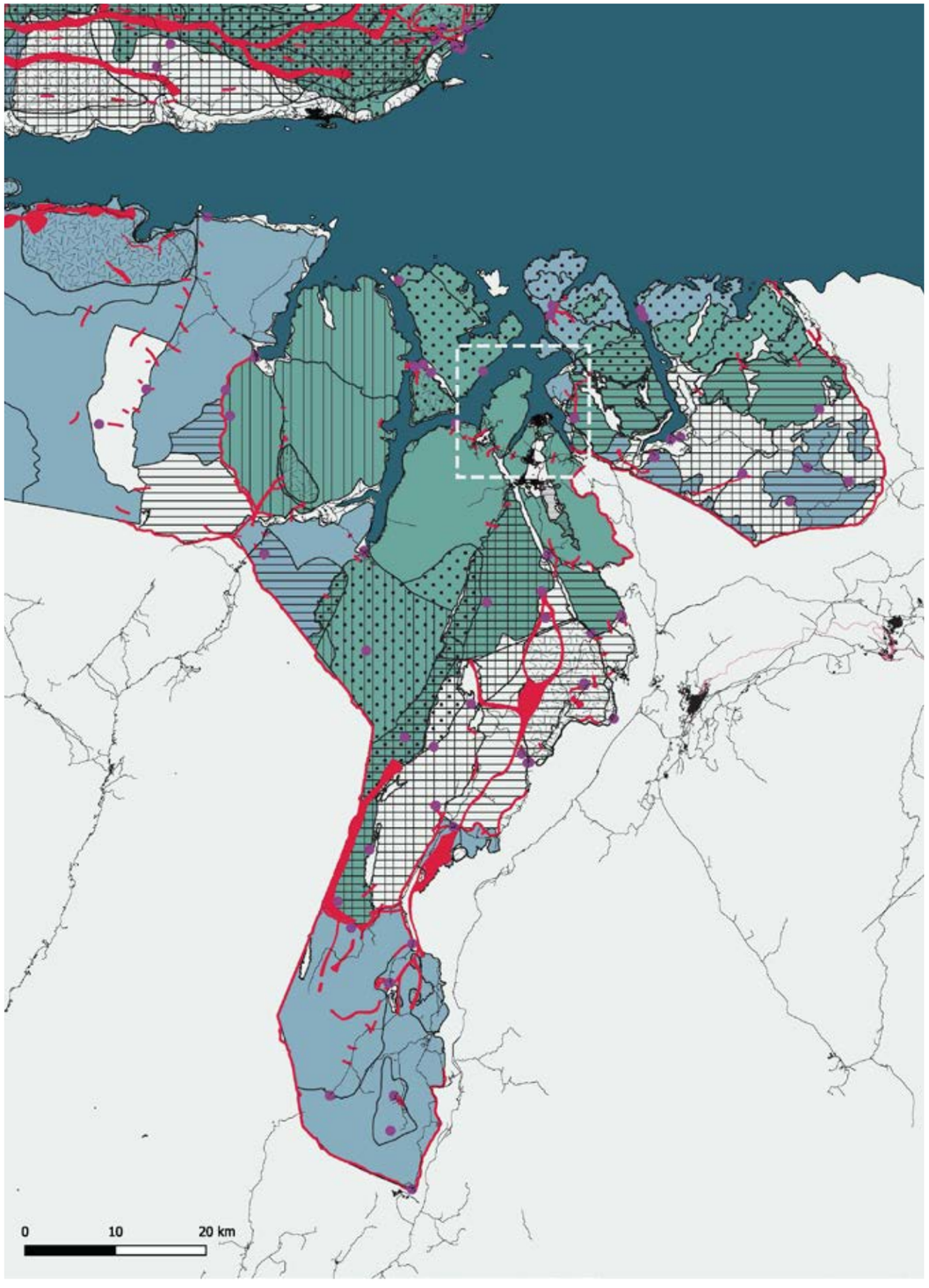
The legal perspective of Sámi Reindeer herding is similar within the three countries due to historical development. Nonetheless, each of the states has their specific parliamentary laws on herding reindeer.
Only member of the Sámi community are allowed to hold reindeers. Only a view concession areas exist in the south of Norway where also Non-Sámi groups can herd reindeer.
In Norway the Sámi population has the right of immemorial usage to practice Reindeer Husbandry.
Most of the total 71 districts are within the county of Finnmark (Käyhkö & Horstkotte, 2017)

In historic times, the herders followed the migrating reindeers according to the time of the year and the natural dynamics. Today, only 10 % of the Sámi population is involved in Reindeer Husbandry. Also the process of herding adapted to the newest technology. Snowmobiles and helicopters help the herders to move the semi-domesticated animals from grazing area to grazing area.

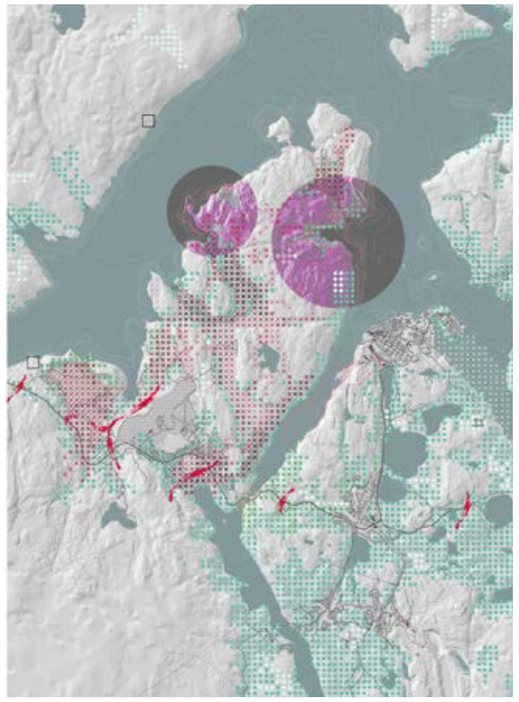
Nonetheless, herding still follows the same natural rules and dynamics as hundreds of years ago.

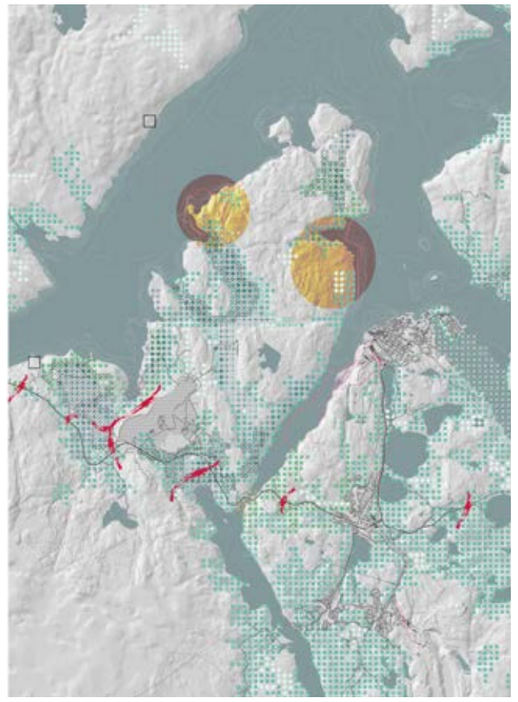
▲ *Map / 40* **Heerding districts Sør-Varanger** **/** *Höller*

▼ *Map / 41* **Reindeer migration Sør-Varanger /** *Höller / Data: geonorge.no*



REINDEER HEERDING
MIGRATION





▲ *Maps / 42-43* **Reindeer migration Kirkenes and Tømmerneset Peninusla summer - winter /** *Höller*

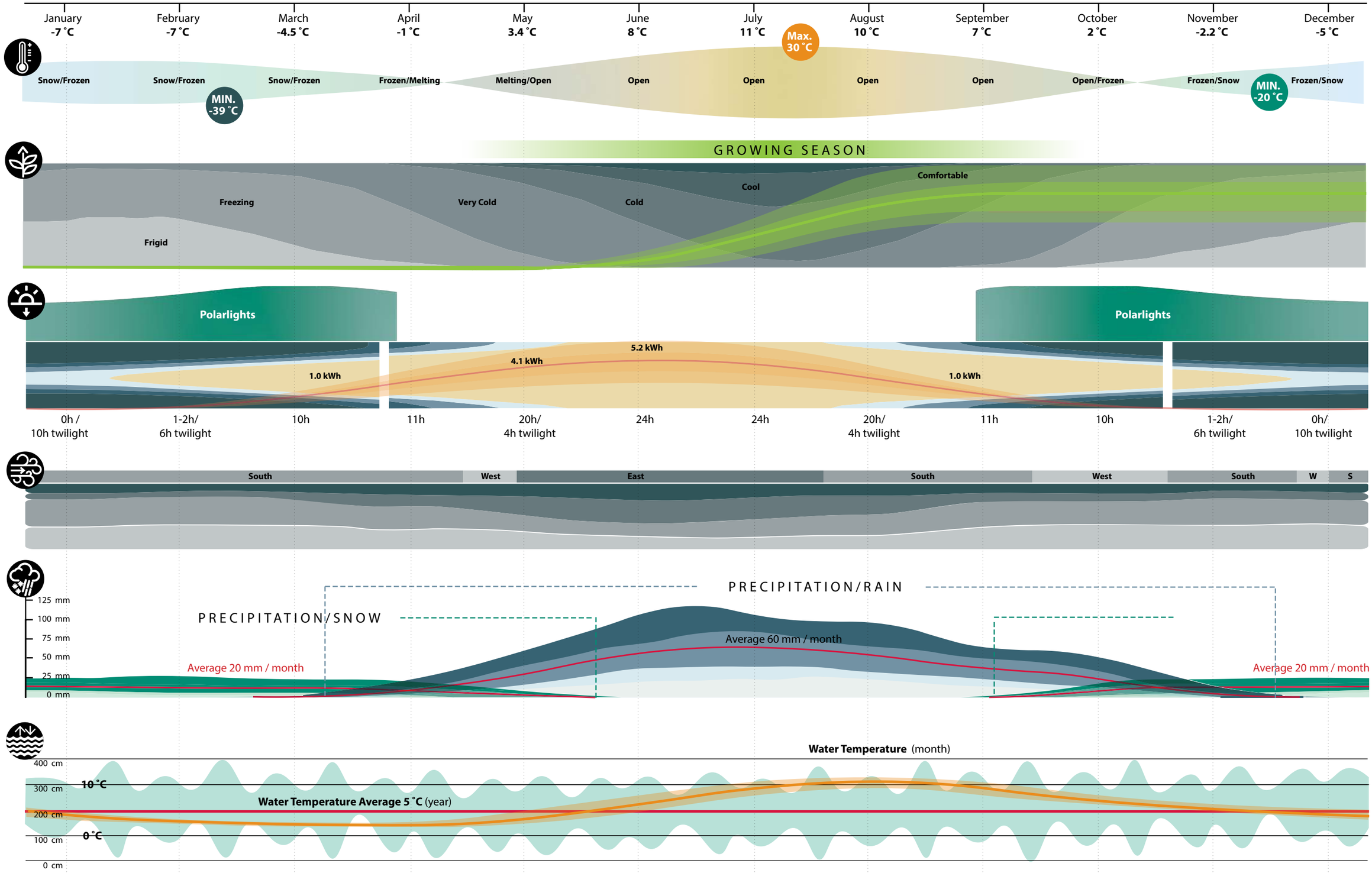
The reindeer (Rangifer tarandus) is one of the most important mammals within the area of Fennoscandia, epecially for the indigenous Sámi. They might not be on the red list, but developments driven by the increasing economic changes within the Arctic, the reindeer as well as their closely bound human counterpart, the Sámi community have to deal with increasing impacts.

- Port activity summer
- Port activity winter
- Mixed forest
- Conifer forest
- Wetland
- Port development outline
- Reindeer migration route
- Reindeer location summer
- Reindeer location winter
- Streets

- Finnish border of the Sámi homeland
- Pasture / winter grazing
- Pasture / summer grazing
- Reindeer migration routes
- Pasture / spring grazing
- Pasture / autumn grazing
- Pasture / autumn-winter grazing
- Reindeer routes Tømmerneset

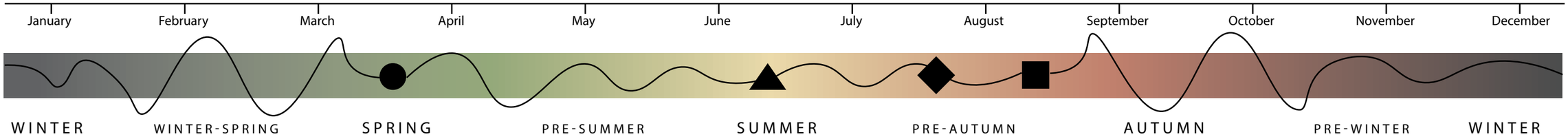
REINDEER HEERDING
BIOPHYSICAL DYNAMICS

▼ *Figure / 44* **Biophysical factors** / *Höller*

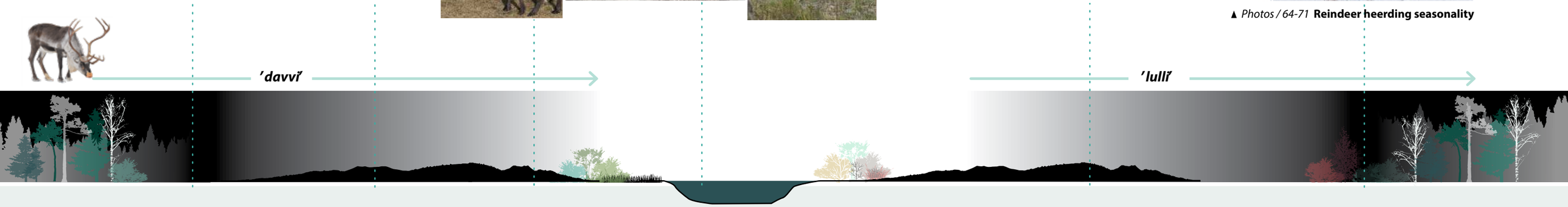


REINDEER HEERDING
SEASONALITY

▼ *Figure / 45* **Reindeer Husbandry** */ Höller*



▲ *Photos / 64-71* **Reindeer heerding seasonality**



At the end of the Winter, in-between Winter and Spring, the reindeer herds start their migration from the forests towards the calving grounds in the mountains. Initiated by the pregnant females, the herde returns to the roughly same place every year. Sámi and their reindeers therefore move prior to the birth of the calves, marking the start of a new cycle.

During Spring-time, temperature increases and snow starts to melt. It is important that reindeer and human reach the calving grounds before the snow turns to lush and the ice turns into dangerous fast-flowing rivers. The calving ususally is done at the foothills of the mauntains.

The Pre-Summer season gives the reindeer and their herders time to rest and prepare for the marking of the new-borns. The availability of food is crucial and scarcity could affect the calves and the rest of the herde dramatically.

The Summer season is shaped by twenty-four hours of daylight. The animals are set to graze along the rich and green coastal areas. The marking of the new reindeers must be done to denote the ownership between the different herding-families and Sámi communities

Pre-Autumn is the time, where the Sámi prepare for the long, cold and dark winter. They choose bulls for slaughter to sell it and stock-up their own food supply. If the summer was plentiful, the large group of reindeer has good chances to overcome the winter months. According to the weight and grazing quality of the summer months, the herders have to decide how many animals they will keep over the winter.

Autumn is the time of „rut" or the reproduction of the mammals. Before returning to the winter-grounds the reindeer start mating. During this time the Sámi also focus on coastal or river fishing as an additional food-source for the winter. When temperature drops, the herd starts their way back towards the forest-zones.

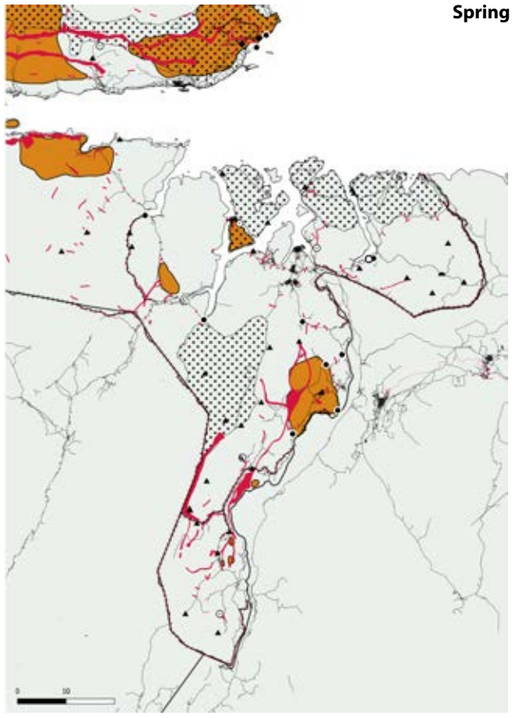
The herders lead their reindeers towards lowland bogs, where vegitation and food is still available. The last amount of sunlight marks the period where also the last vagitated lowlands are hospitable for the animals and humans.

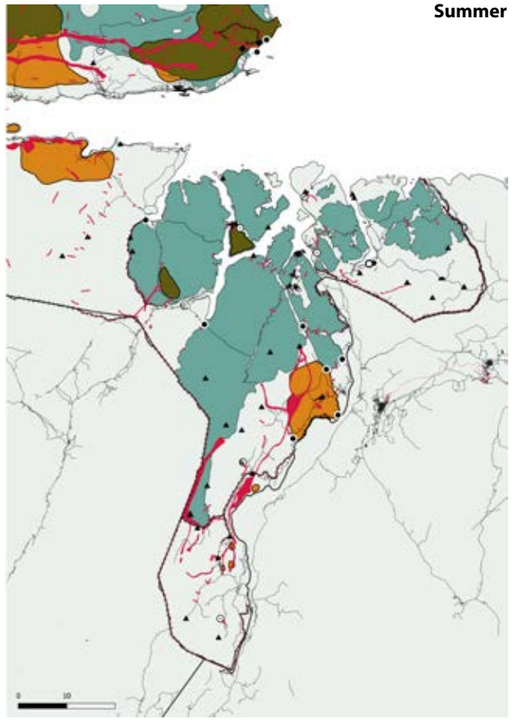
In Winter, covered under twenty-four hours of darkness, the Sámi and the Reindeer finally arrive to the forest areas, where they will find lichen and other food-sources. Here they wait until the first sun-rays mark the start of a new cycle again.

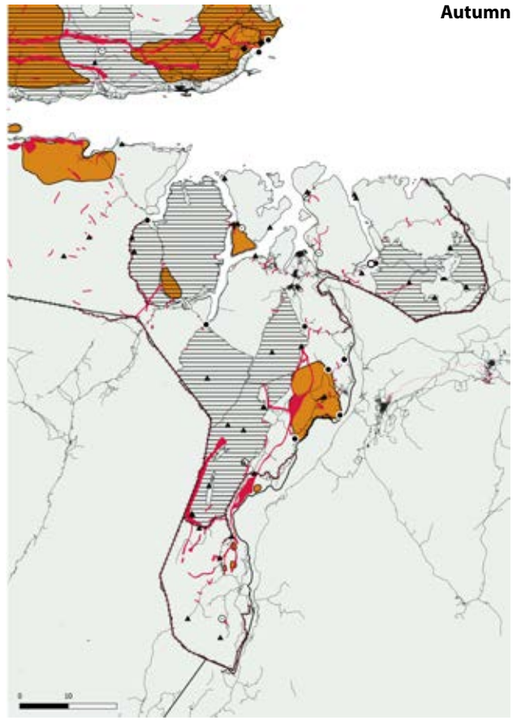
*Sámi do not base their direction upon their position according to geographic characterisitcs, but rather rely on their knowledge of their own landscape. This can be depicted by the terms **´davvi´** and **´lulli´**, which are often translated as towards the north and away from the north. For the Sámi the two words mean **´towards the coast´** and **´away from the coast´**. In combination with the word **'oarji'**, meaning **´to one´s left'**, the of the words can infact mean many different directions (north, south, east, west), based on how the herd is located to the coast.*

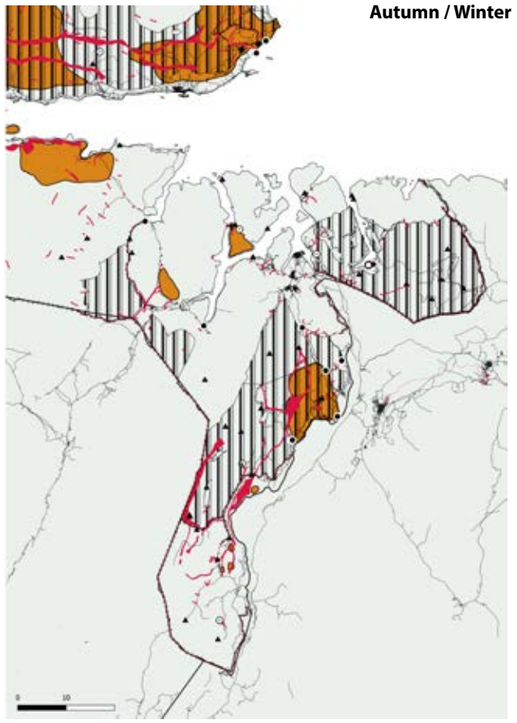
(Source: Redding, n.d.)

REINDEER HEERDING
SEASONALITY



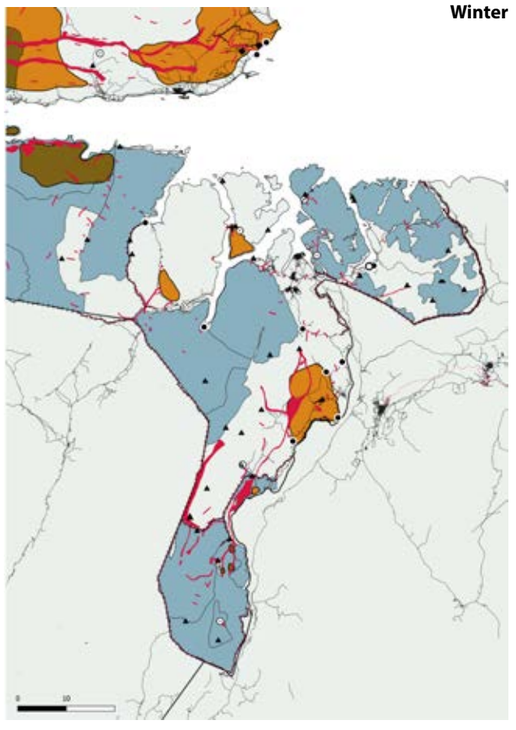




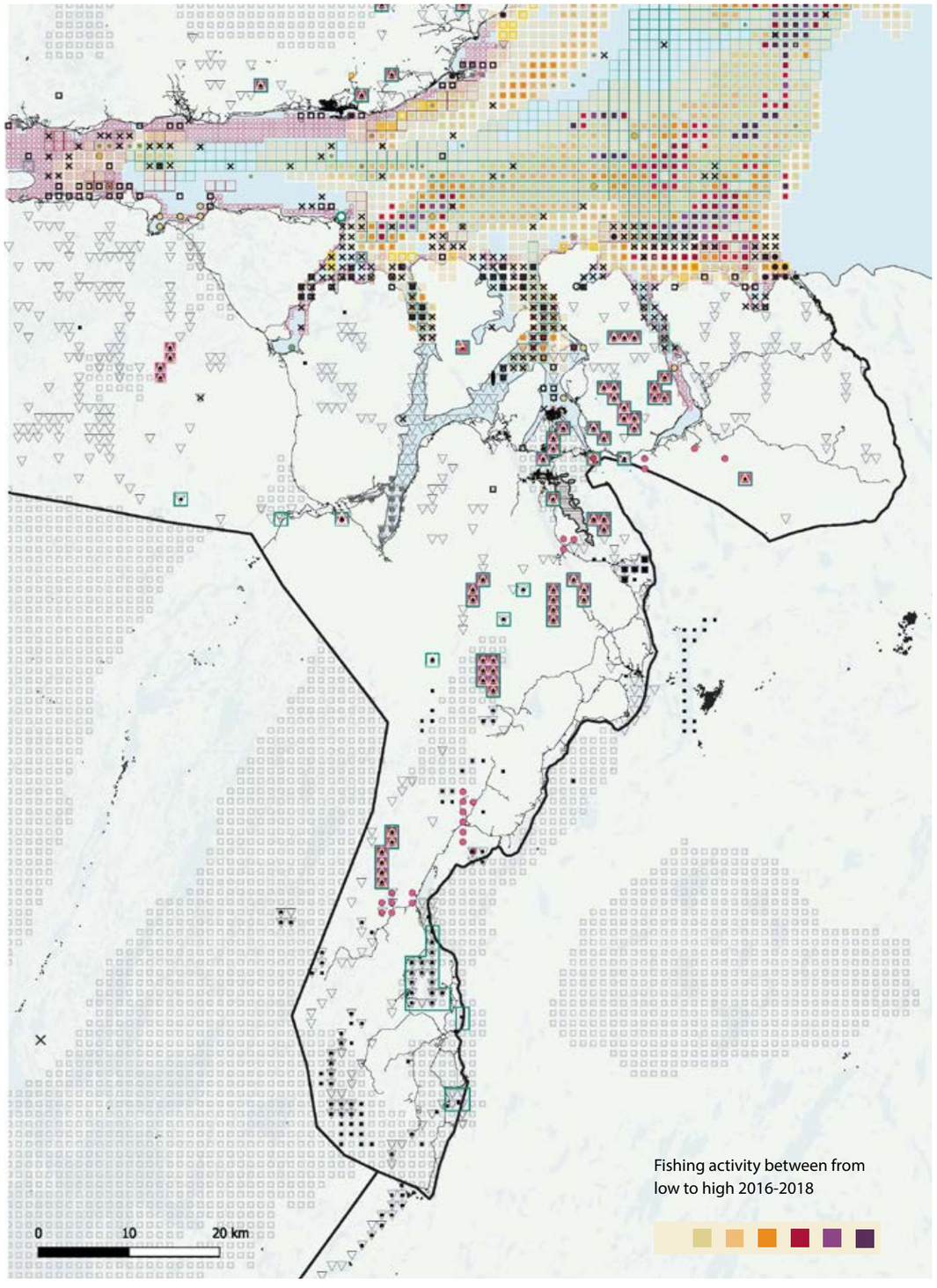


▲ *Maps / 44-48* **Seasonal reindeer migration /** *Höller*

- Migration and tracking routes reindeer
- Reindeer collection area
- Summer pastures
- Winter pastures
- Spring pastures
- Autumn pastures
- Autumn-wInter pastures
- Herder accommodation
- Mobile accommodation
- Gamme
- Fence



▼ *Map / 49* **Fish stocks** */ Höller / Data: Norwegian Directorate of Fisheries*



SØR-VARANGER
FISHING

The aquatic ecosystem of the Barents Sea and Lofoten area is rich and varies. The warm Atlantic water provides all year round ice-free conditions along the Nothern Norwegian coast, especially within the Ba-rents Sea. The warm aquatic zone of the Atlantic and the colder Arctic water mix along the so-called polar front, which enables the production of a high amount of planktonic algae, which are grazed by zooplank-ton, which furthermore provides food for fish, seabirds and other marine mammals (Norwegian Environ-ment Agency, 2018).

Therefore the relatively shallow Barents Sea is an important base for Norwegian, but also Russian or other foreign fishing industries.

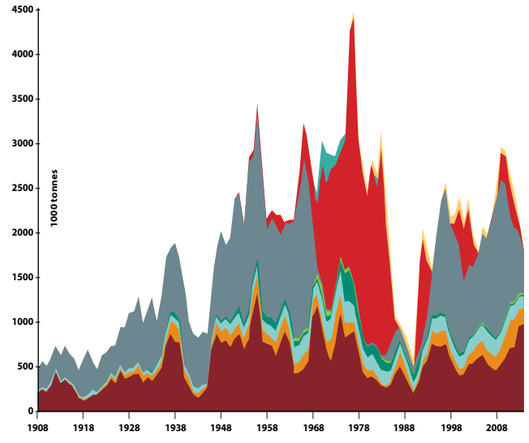
The fishing industry was and still is an essential driver for the development of the region. Many of the smal-ler villages along the coast of Northern Norway developed due to the richness of fish stocks within the area. Furthermore, the development of fishing was essential for the centralization process over the past centuries. Many people resettled, migrated or have been relocated in order to strengthen the efficiency of the fishing industry. Factories have been located at specific strategic areas and the increase in shipping technology, as well as the appearance of machinery, caused the population decline of fishermen in some of the municipalities like Alta, Hammerfest and Kirkenes (Slierings, 2020).

Nonetheless Kirkenes is still an important player for the fishing service industry, especially as a service port for Russian companies, often exchanging their crews or store their catches before returning to Murmansk.

The fishing industry highly relies on the stability of environmental patterns. Different fish move towards or away from the reachable fishing grounds during different times of the year (see dynamics of fish).

The main species is the Arctic Cod, mostly caught in the winter months. Currently, the conditions of the stock of codfish is as good as never before. In 2009 the 214.000 tonnes of caught codfish equaled a mone-tary benefit of around 3.5 billion NOK.

Haddock and herring are other essential species mostly captured in the summer months (Norwegian Sea-food Export Council, 2019).



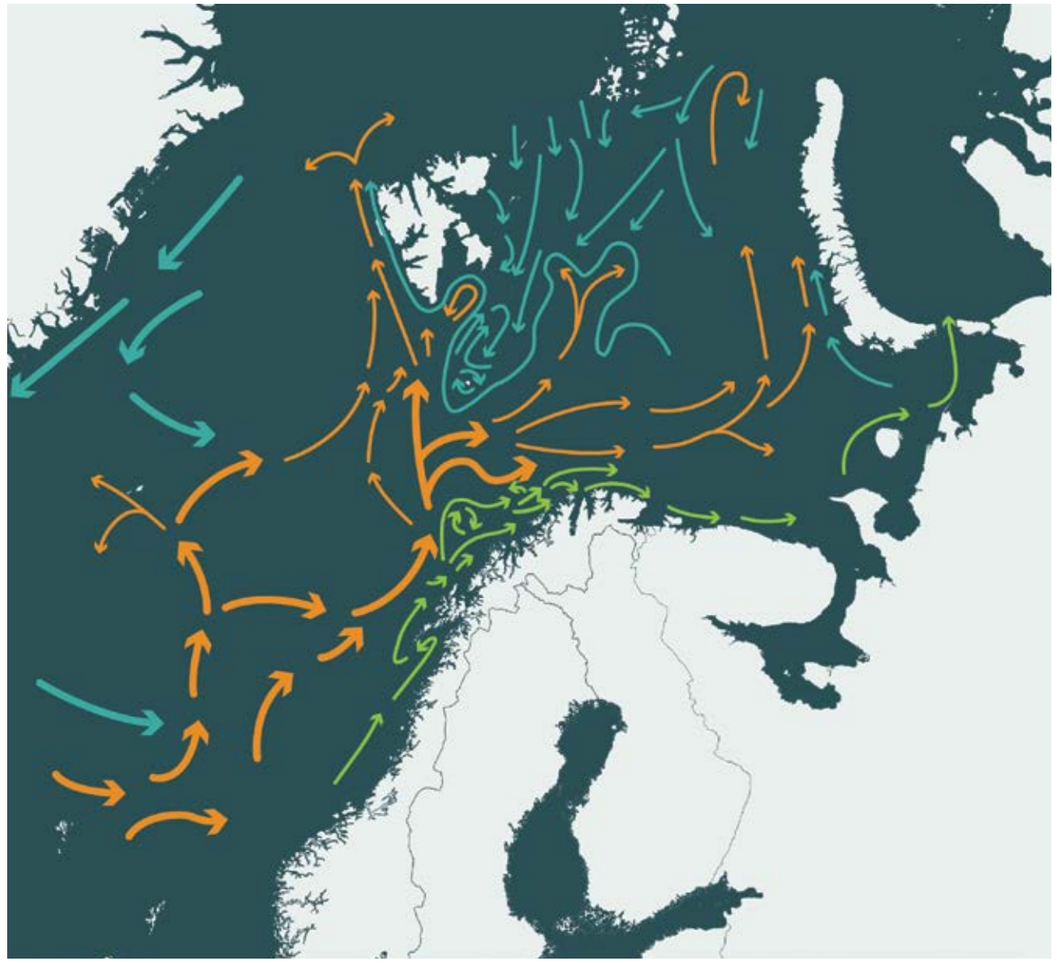
▲ *Figure/ 46* **Catches of main stocks in the Barents and Norwegian Seas 1908-2014** */ Historically, the catch reached a level between 2 and 3 million tonnes in the 1950s and has since mostly been within this range. A peak in the 1970s was due to large capelin catches, and a dip in the late 1980s was caused by low catches of all stocks.*

- Coastal fishing grounds
- Mussel grounds
- Shrimps and crabs
- Pleice
- Cod/skrei
- Piked dogfish
- White whale
- Redfish
- Eel
- Bullhead
- Largemouthed bass
- Minnows and carps
- Salmonids
- Pikes
- King Crab

Aquaculture:

- Salmon
- Cod
- Kelp/algae
- Mussel
- King Crab

- Cod
- Haddock
- Saithe
- Redfish
- G. halibut
- Herring
- Capelin
- Polar cod
- Shrimp



▲ *Map / 50* **Circulation of the Atlantic, Arctic Sea and Barents Sea /** *Eriksen, Rune, Gjøsæter & Primicerio, 2017 adqapted by Höller*

BARENTS SEA

OCEAN CIRCULATION AND FISH MOVEMENT

▲ *Maps / 51-52* **Overlap of biological valuable areas for cod, herring, haddock, and saithe (orange) spawning areas, and (green) larval areas /** *E. Olsen et al., 2009, p.99 / adapted by Höller*

▼ *Maps/ 53-55* **Fish movements in the Barents Sea /** *Hunt et al., 2013, p.57 / adapted by Höller*

DYNAMICS
FISHING

▼ *Figure / 47* **Dynamics fishing** / *Höller*

January February March April May June July August September October November December

SEA / BOAT AND COASTAL

(POLAR)-COD
HADDOCK
CAPELIN
POLLACK/SEI
RED-FISH
CHAR
HALIBUT
SHRIMP
KING-CRAB
MUSSELS

Boat & Coastal Fishing
Ice-Fishing Regular fishing Ice-Fishing

RIVERS & CATCHMENT

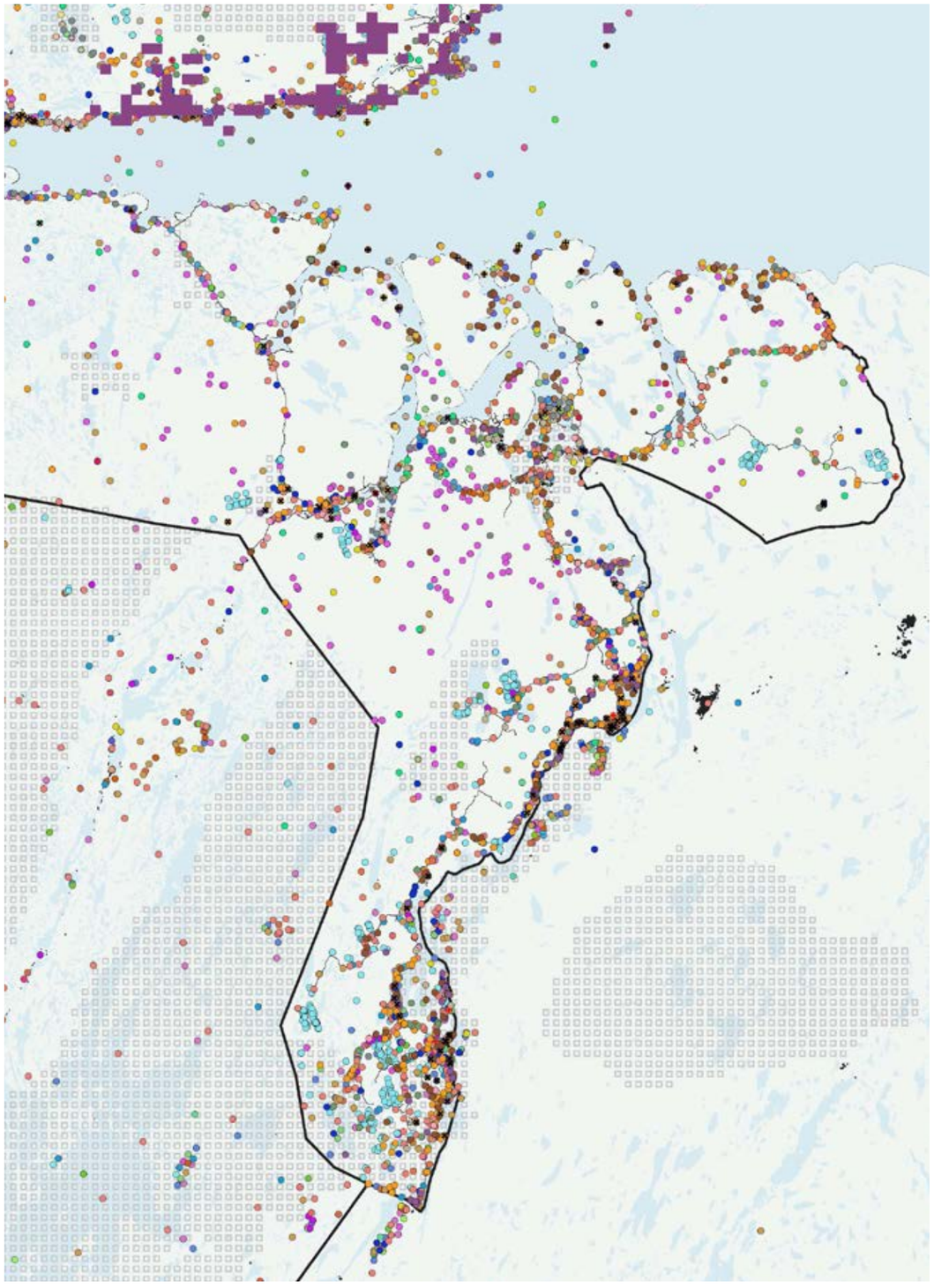
WHITE FISH
PIKE
PERCH
MUSSELS
SALMON

Once established: year round harvest Year 1: Hatchery Year 2: Growing - Transfere

AQUACULTURE

SALMON
KELP
ALGAE
MUSSELS

▼ *Map / 56* **Birds Sør-Varanger /** *Höller*



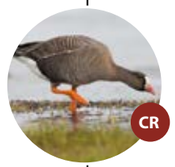
SØR-VARANGER

BIRDS RED LIST

RE	**Corn Bunting**	Emberiza calandra
CR	**Guillemot**	Uria aalge
	Rustic Bunting	Emberiza rustica
	Lesser white fronted Goose	Anser erythropus
	Corn Crake / Landrail	Crex crex
	Ortolan Bunting	Emberiza hortulana
EN	**Black-legged Kittiwake**	Rissa tridactyla
	Ruff	Calidris pugnax
	Arctic Warbler	Phylloscopus borealis
	Red Knot	Calidris canutus
	Razorbill	Alca torda
	Northern Lapwing	Vanellus vanellus
	Common Tern	Sterna hirundo
	Garganey	Anas querquedula
	Northern Fulmar	Fulmarus glacialis
	Hen Harrier	Circus cyaneus
	Thick-billed Murre	Uria lomvia
	Black-tailed Godwit	Limosa limosa
	Eurasian Eagle-Owl	Bubo bubo
	Snowy Owl	Bubo scandiacus
VU	**Steller's Eider**	Polysticta stelleri
	Smew	Mergellus albellus
	Little Gull	åHydrocoloeus minutus
	Pintail	Anas acuta
	Bean Goose	Anser fabalis
	Black-headed Gull	Chroicocephalus ridibundus
	Little Bunting	Emberiza pusilla
	Northern Shoveler	Anas clypeata
	Velvet Scoter	Melanitta fusca
	Lapland Longspur	Calcarius lapponicus
	Eurasian Curlew	Numenius arquata
	Sanderling	Calidris alba
	Greater Scaup	Aythya marila
	Eurasian Skylark	Alauda arvensis
	Atlantic Puffin	Fratercula Arctica
	Western Marsh-Harrier	Circus aeruginosus
	Great Grey Owl	Strix nebulosa
	Horned Grebe	Podiceps auritus
	Common Coot	Fulica atra
	Fork-tailed gull	Xema sabini
	Ivory Gull	Pagophila eburnea
	Black Redstart	Phoenicurus ochruros
	Common Rosefinch	Carpodacus erythrinus
	Ural Owl	Strix uralensis
NT	**Common Eider**	Somateria mollissima
	Mew Gull	Larus canus
	Willow Ptarmigan	Lagopus lagopus
	Long-tailed Duck	Clangula hyemalis
	Reed Bunting	Emberiza schoeniclus
	Parasitic Jaeger	Stercorarius parasiticus
	Bluethroat	Luscinia svecica
	Common Scoter	Melanitta nigra
	Common Cuckoo	Cuculus canorus
	Sand Martin	Riparia riparia
	Osprey	Pandion haliaetus
	Northern House-Martin	Delichon urbicum
	Yellow-billed Loon	Gavia adamsii
	Yellowhammer	Emberiza citrinella
	Common Starling	Sturnus vulgaris
	Gadwall	Anas strepera
	Twite	Carduelis flavirostris
	Northern Goshawk	Accipiter gentilis
	Gyrfalcon	Falco rusticolus
	Dark-bellied Brant	Branta bernicla
	Rook	Corvus frugilegus
	Eurasian Hobby	Falco subbuteo
	Eurasian Collared-Dove	Streptopelia decaocto
	Leach's Storm-Petrel	Oceanodroma leucorhoa
	Great Crested Grebe	Podiceps cristatus
	Great Snipe	Gallinago media
	Little Ringed Plover	Charadrius dubius

▼ *Photos / 72-76*
Common Murre / Common Guillemot

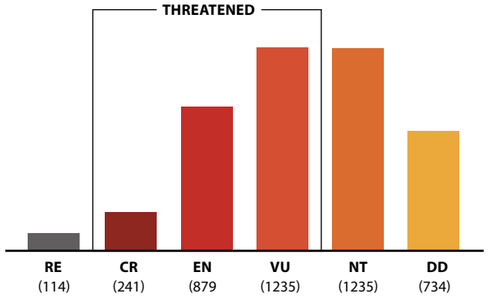
Rustic Bunting



Lesser White-fronted Goose

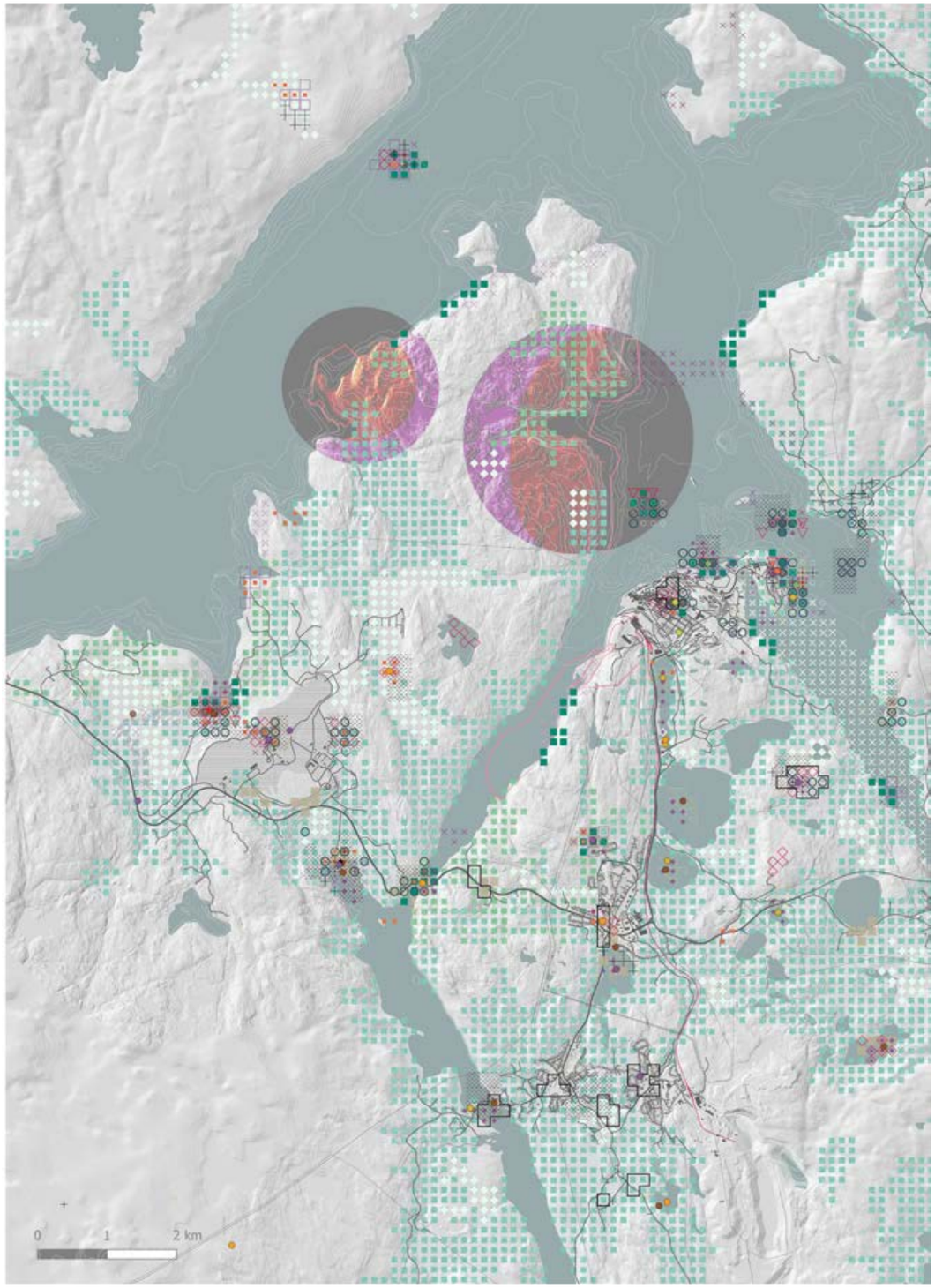
Corn Crake / Landrail

Ortolan Bunting



▲ *Figure / 48* **Species on the Norwegian Red List split between categories /** *Of the 4438 red-listed species, 11.3 % (2355 species) are threatened: in other words assesed as Critically Endangered (CR), Endangered (EN) or Vulnerable (VU).*

▼ *Map / 57* **Birds Kirkenes** */ Lukas Höller*



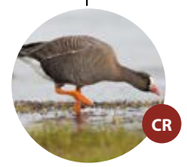
KIRKENES
BIRDS RED LIST

CR	**Lesser white fronted Goose**	Anser erythropus
EN	**Black-legged Kittiwake**	Rissa tridactyla
	Ruff	Calidris pugnax
	Razorbill	Alca torda
VU	**Steller's Eider**	Polysticta stelleri
	Bean Goose	Anser fabalis
	Black-headed Gull	Chroicocephalus ridibundus
NT	**Common Eider**	Somateria mollissima
	Mew Gull	Larus canus
	Sand Martin	Riparia riparia
	Parasitic Jaeger	Stercorarius parasiticus
	Long-tailed Duck	Clangula hyemalis
	Bar-tailed Godwit	Limosa lapponica
	Hawk Owl	Surnia ulula
	Sea Eagle	Haliaeetus albicilla
	Alkenvögel	Alcidae

The area around Varanger is an essential habitat for birds from around the world. Every year thousands of sea- and coastal birds gather along the coast due to the richness of food and shelter given by the sea, birch forest, marshes, river deltas, wetlands. Within and around Kirkenes, there are two crucial birding grounds.

One of them is located outside within the Pasvik area, which is shaped by the Taiga. Bluethroat, Sedge Warbler, Willow Warbler and Tree Pipit, Taiga Bean Goose, Smew, Northern Hawkowl, Siberian Jay, Siberian Tit, Bohemian Waxwing and Pine Grosbeak, as well as other species like Common Crane, Short-eared Owl, Capercaillie, Black Grouse, Willow Grouse, Tree-toed Woodpecker, Black Woodpecker and Hazel Hen, are only some of the species that either habitat all year round or migrate there during summer (Birdwatching Norway, n.d.)

The other location is called Prestøya, a peninsula connected to the city of Kirkenes. The steep and rocky coastline consists of rich birch forests and herbal floor vegetation of lichen and cloudberry. Furthermore, the intertidal flat and the currents within the area are essential foraging grounds, where the birds find fish, mussels, urchins, crabs and more.
A total of 120 different species, most of them migrating but also some nesting during the winter, have be-en found along the area of Prestøya, Kirkenes (Visit Varanger, n.d.).



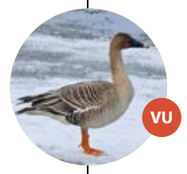
▼ *Photos / 77-83*
Lesser White-fronted Goose

Black-legged Kittiwake

Ruff

Razorbill

Steller's Eider



Bean Goose

Black-headed Gull

BIRDS NEAR KIRKENES
CHARACTERISTICS

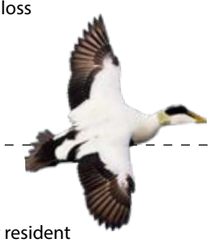
Sea Eagle / Bird of prey
- **Migration:** Winter –> short routes, southern regions
- **Habitat:** Lakes, rivers, coastline
- **Breeding Season:** Beginning spring - 06
- **Nesting:** very large, positioned in trees, sometimes on cliffs
- **Food:** Fish, aquatic birds and small mammals
- **Risks:** Insecticides, pollution
- **Protected species:** around 40 % of all breeding couples in Norway

Long-tailed Duck / Smallest diving sea duck
- **Migration:** in severe winters to ice-free zones
- **Habitat:** living environment: aquatic, breeding on land
- **Breeding Season:** 05 - 07
- **Nesting:** In Tundra pools and marshes, along sea coasts
- **Food:** Crabs, musseles, snails, fish, waterplants
- **Predators:** mew gulls, glaucous gulls and jaegers, arctic and red fox
- **Risks:** many predators, climate change

Hawk Owl
- **Partial migrant:** only if condition become to extreme; day and night active;
- **Habitat:** Taiga, in boreal forests half open landscapes
- **Breeding Season:** 03 - 06
- **Nesting:** hollow/dead trees
- **Food:** mouses, small mammals, birds
- **Preditors:** Eagle owl, wolverin
- **Risks:** Climate change, human disturbance by breeding;

Steller's Eider / Duck
- **Migratory bird:** short distances, usually staying
- **Habitat:** open sea/coast
- **Breeding Season:** if free from ice / 05 - 07
- **Nesting:** tundric lakes
- **Wintering:** Norwegian Varangerfjord
- **Food:** Crabs, Mussels and Shrimp and insects
- **Predators:** Fox, jaeger, snowy owl, gull, raven, eagle
- **Risks:** Pollution, Fishery, Habitat loss

Razorbill / Alkbird
colonial seabird that only comes to land in order to breed
- **Migratory bird:** weiter südlich
- **Habitat:** Sea, Küstengebiete
- **Breeding Season:** 04 - 05, in colonies
- **Nesting:** coastal cliffs in enclosed or slightly exposed crevices
- **Food:** Fish, crabs, marine worms
- **Risks:** marine oil pollution, fishing nets, high pollution level



Common Eider / Duck
- **Migration:** Short distances oder resident
- **Habitat:** Sea, coastal areas
- **Breeding Season:** 05 - 07 (often in colonies)
- **Nesting:** In hollows on the ground, on the coast in kelps
- **Food:** Mussels, crabs
- **Predators:** Fox, birds of prey, climate, downs!!

Parasitic Jaeger / Seabird
- **Migratory bird:** wintering at sea in the tropics and southern oceans
- **Habitat:** Sea and Coast
- **Breeding Season:** Mid 05 - mid 06
- **Nesting:** dry Tundra, higher fells and islands
- **Food:** Rodents, insects, eggs, chicks and small birds and kleptoparasitism
- **Risks:** numbers declined drastically in the early 2000s.

Sand Martin / Swallow
- **Migratory bird,** winters in eastern and southern Africa, South America
- **Breeding Season:** 05 - 06
- **Nesting:** in winding holes in sheer sandy hills
- **Food:** small insects, mostly gnats and other flies whose early stages are aquatic
- **Risks:** habitat loss and fragmentation, high level of nest predation

Black-legged Kittiwake / Seabird
- **Migration:** wintering range extends further south, winter at sea and rarely touch ground during this period
- **Habitat:** Northern Oceans
- **Breeding Season:** Ende 05 - 08
- **Nesting:** In teeming colonies on cliffs by the sea side
- **Food:** Fish, copepods, polychete
- **Predators:** Nest raiders
- **Risks:** Fish availability, global warming

Black-headed Gull / Seabird
- **Migratory bird:** Mid August towards sub-Saharan Africa and India
- **Habitat:** Pale Arctic
- **Breeding Season:** 05 - 06
- **Nesting:** Cliffs and Bare Rocks along coastal line,
- **Food:** variety of different foods, including insects, plant material, earthworms and human leftovers
- **Predators:** Nest raiders
- **Risks:** Fish availability, global warming

Mew Gull / Seabird
Circumpolar
- **Migratory bird:** Moves to icefree aqautic areas
- **Breeding Season:** 04 in small/big colonies on land; 05 - 07
- **Habitat:** Peat bogs/lakes, aquatic coast
- **Nesting:** above Arctic treeline
- **Food:** Crabs, small fish, mussels, waterplants
- **Risks:** many predators, climate change

Lesser White-fronted Goose / Goosebirds
- **Migratory bird:** Winter –> southern regions
- **Habitat:** variety of Arctic open habitats, particularly scrub-covered and lightly wooded tundra near taiga zone;
- **Breeding Season:** 05 - 06
- **Nesting:** Swamp Marsh Land, free from snow, covered by grass and plants
- **Food:** Gras, herbs, moss and seeds
- **Risks:** Hunting
- **Endangered:** only few breedings in Skandinavia

Bean Goose / Goosebirds
- **Migratory bird:** Winter –> southern regions
- **Habitat:**
- **Breeding Season:** 05 - 06
- **Nesting:** Swamp Marsh Land, free from snow, covered by grass and plants
- **Food:** Gras, herbs
- **Risk:** Hunting
- **Endangered:** only few breedings in Skandinavia

Ruff / Snipe bird
- **Migratory bird:** Winters to S-Africa, S-Asia and Australia
- **Habitat:** scrubland, wetlands;
- **Breeding Season:** End 05 - 08
- **Nesting:** Peat bogs, in marshes and wet meadows
- **Food:** omnivores, seeds or berries, flies, frogs, small fish, beetles, snails, spiders, worms,
- **Risks:** Climate change, habitat loss, strongly protected;

Bar-tailed Godwit
- **Migratory bird:** Long distances **–>** W-Europe, Atlantik, Afrika
- **Breeding Season:** 06 - 07
- **Nesting:** dampy Arctic Tundra, peat bogs
- **Food:** Insects, marine worms, spiders, molluscs
- **Globaly endangered:** Climate change, habitat loss, might be disappear in the European range

▲ *Figure / 49* **Birds Red List Characteristics /** *Höller*

▼ *Photo / 84* **Cree leaders join anti-railway demonstrations in Finland**

ECOSYSTEM
SUMMARY

The different ecosystems within Norway, Finnmark and the municipality of Sør-Varanger play an essential role for the natu-ral participants as well as for many members of the different societies inhabiting the remote area.

Reindeer herding is by far the most crucial nature-human relation which could be analyzed in this region. The Sámi´s well-being is inseparably connected to the well-being of their natural environment, especially the reindeers.

Not only the terrestrial but also the condition of the aquatic environment is essential for the livelihood of many animals and humans.

Nonetheless, increasing developments, such as industrialization processes, due to the mineral and maritime industry, as well as climatic changes, increase the pressure on the overall well-being of humans and nature.

There is a long-lasting but growing conflict emerging within the area. On the one side, people see the growing economic opportunities, especially strengthened by global warming. On the other side, indigenous societies such as the Sámi, but also a growing part of the urban societies, see the conflict between the urge of sustainability and money-making.

◄ *Photo / 85* **For the first time ever, a bulk carrier with non-Russian flag is using the Northern Sea-Route as a transit trade lane, when transporting iron ore from the Northern Norway to China via Arctic and Russian waters.**

06 PROBLEMS AND IMPACTS
PORT X CITY SCAPES

▼ *photo / 86* **Decade mining facility**

» *The only way you can estimate environmental influences is by measuring them.* «

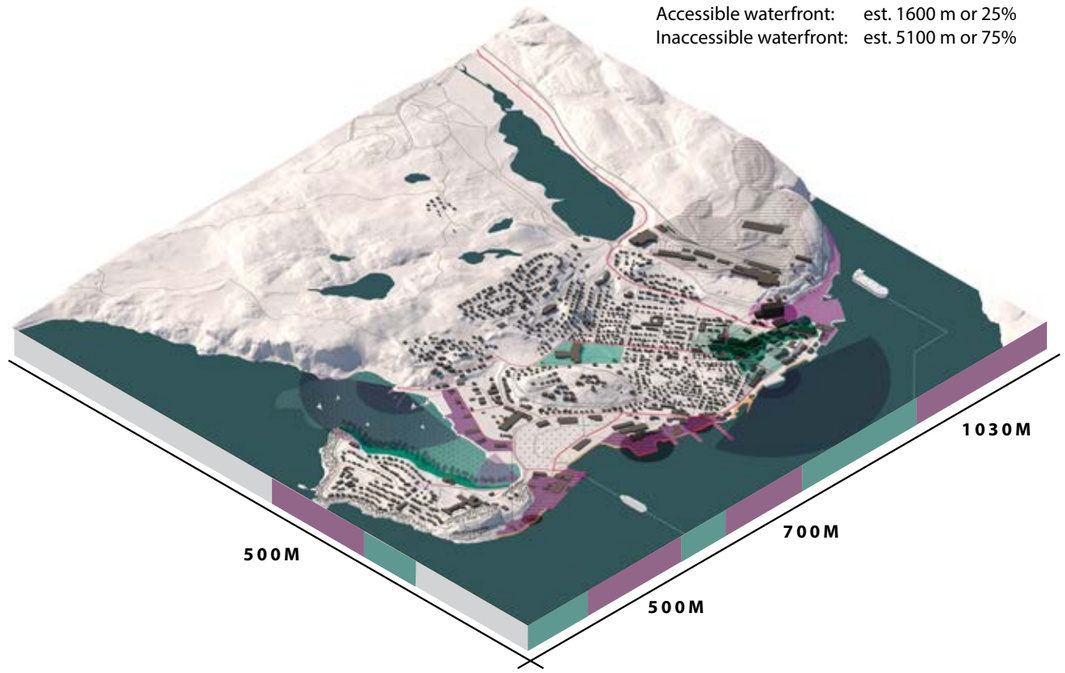
RICHARD BENTALL

EXISTING PROBLEM

LOST CONNECTION TO SEA AND NATURE

▼ *Figure / 50* **Kirkenes port structure** */ Höller*

Total waterfront: est. 6700 m
Accessible waterfront: est. 1600 m or 25%
Inaccessible waterfront: est. 5100 m or 75%



▲ *Photo / 90* **View on port/fishing operations in Kirkenes /** *Höller*
▲ *Photo / 91* **Sydvaranger Mining Processing Center on top of Kirkenes /** *Höller*

◄ *Photo / 87* **Blocked view and restricted access towards the waterfront /** *Höller*
◄ *Photo / 88* **Stored fishery equipment /** *Höller*
◄ *Photo / 89* **Closed gates in front of the Sydvaranger Mine /** *Höller*

EXISTING PROBLEM
LOST CONNECTION TO SEA AND NATURE

The current maritime built environment, being an industrialized waterfront, shows the economic importance of the port for the city. Within the role of being a tourist during my field trip to Kirkenes, no otherwise spatial, architectural, cultural and societal connection to the water could be observed.

One example for the missing link between society and the water as a surrounding connecting element of coastal cities is the comparison of the two pictures of Kirkenes` hotspot for a view on the fjord.
The upper picture (Lukas Höller) was taken during winter, as close as possible on the waterfront. Post-production creates an image of a beautiful Arctic maritime scape.
In comparison, the picture on the right (Google Streetview) shows the exact same spot. One of the few existing accessible areas towards the sea is used as a parking spot for tourists using the neighbouring Thon Hotel, which has blocked and transformed the waterfront into a privatized good for the people staying over-night.

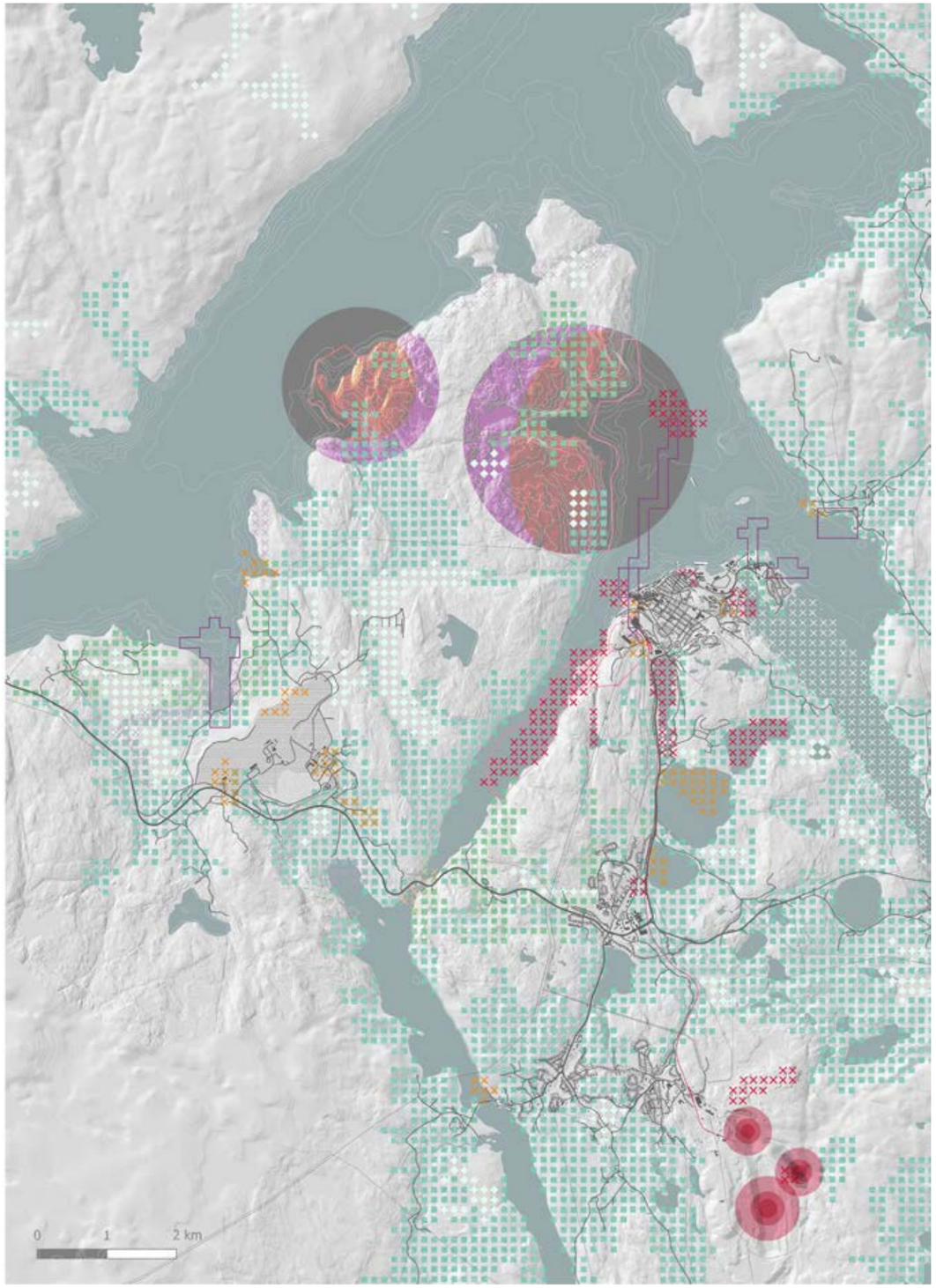
Another example is the fact that Kirkenes is the location of the Barents House, in which The Arctic University of Norway (UiT), the International Barents Secretariat (IBS) and the Center of High North Logistics are sharing their seat. All three insti-tutions are dealing with the Barents Region and the borderland from societal, political and environmental point of view. Main focus hereby is the water and the Barents Sea as overall connecting elements of the regions in Norway and Russia.
The architecture, location and the built character of the company headquarters of those vital institutions show the missing importance of cultural aspects connected to the sea (Goolge Streetview).
A proposed but never realized vision of a new Barents House being located at the waterfront and creating cultural im-portance of those institutions dealing with scientific and political aspects all interrelated to the Barents Sea

◄ *Photo / 92* **Prominent hotspot in Kirkenes for taking pictures of the fjord /** *Höller*
◄ *Photo / 93* **Same hotspot a few meters away from the waterfront**

◄ *Photo / 94* **Proposed, but never realized design of a new Barents House**
◄ *Photo / 95* **Barents House in Kirkenes /** *Höller*

◄ *Photo / 96* **View on the beautiful northern lights from a rare dark spot along the waterfront /** *Höller*
◄ *Photo / 97* **Attempt to capture the northern lights through the light pollution along the waterfront in Kirkenes /** *Höller*

▼ *Map / 59* **Pollution in Kirkenes due to port-and other industrial activities** / *Höller*



EXISTING PROBLEM
ENVIRONMENT X PORT

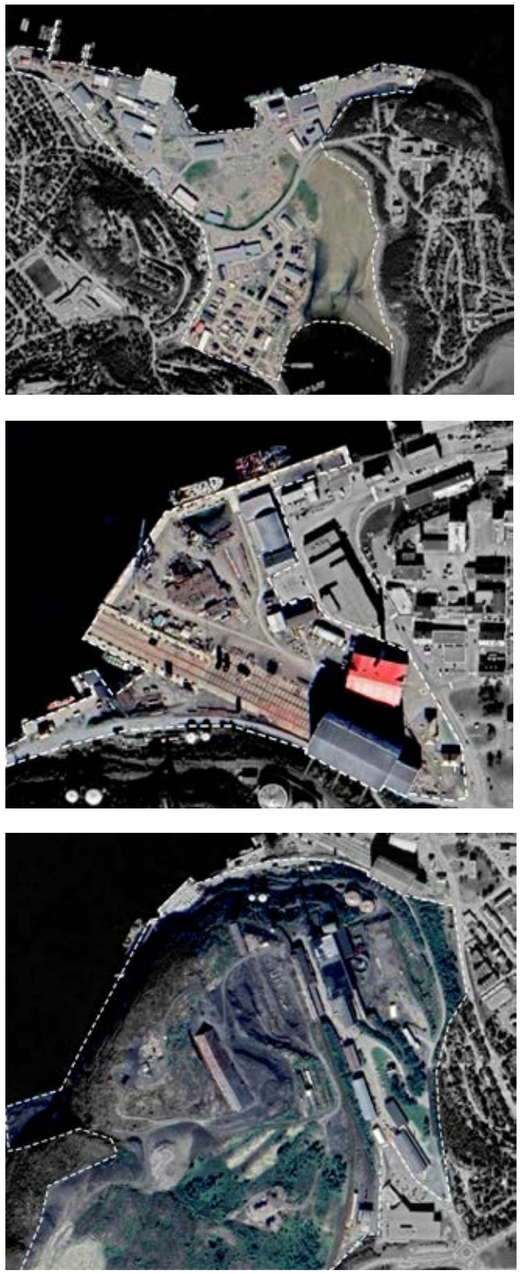
Already now, pollution is manifold along Kirkene´s port-city waterfront, but also land-inwards, heavy indus-try and manufacturing are causing soil and groundwater pollution.

The first area is the current industry/retail district in the east of Kirkenes, close to the cruise ship termi-nal and fishery port. This area was a former intertid-al flatland as the rest of the remaining waterscape shows. For urban growth, the spot was reclaimed with stones from the iron ore mine. Due to all kinds of industrial activities, the area is currently polluted by arsen, kadmium, chrom, copper, lead, zinc and nickel.

Another very much polluted area is the KIMEK Dry-dock area, where ships get repaired and checked. On- as well as offshore activities result in high ground and aquatic pollution. Copper, PAH, which is found in crude oil and zinc have been detected.

A third area is the mining processing center of the Sydvaranger AS. Sadly no data for ground pollution have been found or are available. Nonetheless, the large amount on mining bulk being transported to and stored at the area has a huge impact on the ter-restrial and due to groundwater intrusion of run-off an im-pact on the aquatic system as well.
Besides the work with pre-processed goods, the next page will show the impact of the dumping of post-process-waste into the neighbouring Lang-fjorden.

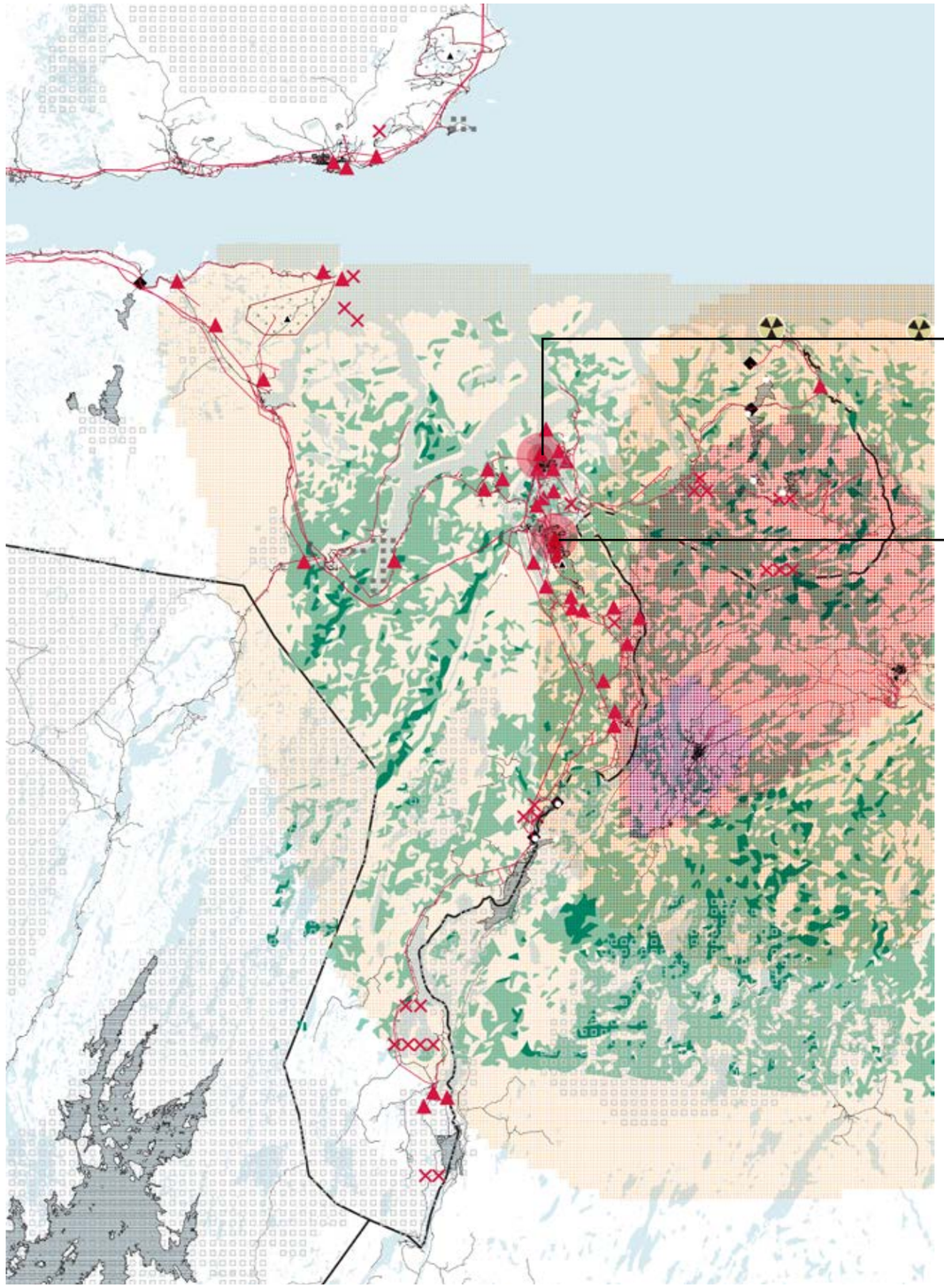
- New port location
- High pollution from industries
- Medium pollution from industries
- Mixed forest
- Conifer forest
- Wetland
- Lichen-rich areas
- Sewerge treatment and discharge
- Pollution hotspot
- Water with naturally low oxygen
- Intertidal coastal zones
- Streets



▲ *Photo / 98-100* **Three of the most polluted areas along the waterfront in Kirkenes**

EXISTING PROBLEM
ENVIRONMENT X MINING

▼ *Map / 60* **Pollution Sør-Varanger, mining tail dumping /** *Höller*



◄ *Photo / 101*
Langfjorden, filled up with tailings from the iron ore processing plant

◄ *Photo / 102*
A bird's-eye view of the Sydvaranger mining operation

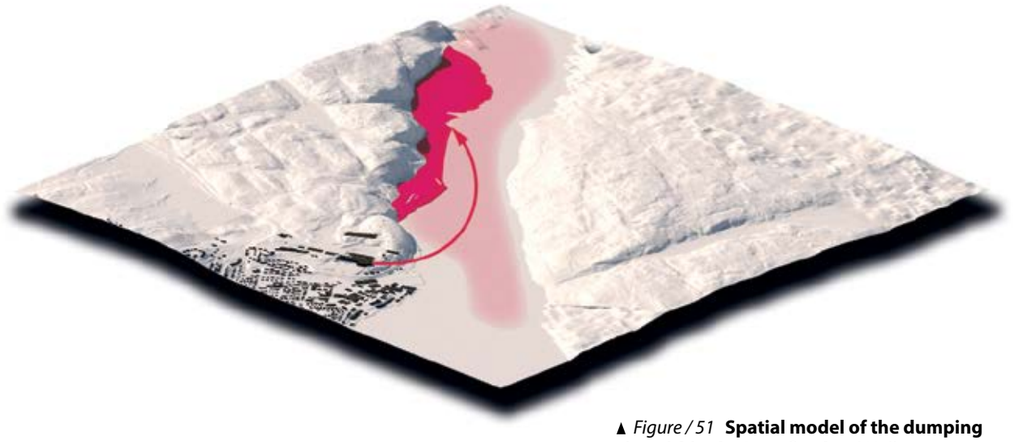
EXISTING PROBLEM
ENVIRONMENT X MINING

During the extraction of mining materials only a view percentage of useable metals or further mineral or stone products can be used for profit. Over 90% are residual materials or tailings where no use can be found. Those materials, composed of sand, silt and fine sediments however need to be stored either on land or by deep submarine tailing dumping. (Norwegian Institute for Water Research, 2011).

Norway, together with Papua New Guinea and Indonesia is one of the last countries not having banned the dumping of mining tailings into aquatic environments. Since the start of the mining operation in Kirkenes, residual waste products have been dumped as tailings (deep submarine tailings placement) into its neighbouring Langfjord and since 1970, due to the already filling up of the fjord, into the Bokfjord. Both fjords are classified as "national salmon fjords" where wild salmon spawns, has its habitats and therefore should have special protective measures (Barents Observer, 2016).

Langfjord, which was around 60 meters deep and 400 meters wide is now filled up, so its current proportions have been reduced to a depth of 1 meter and a width of only around 30-40 m at its most narrow spot. Emissions to the Langfjord exceeded on a large scale until today (Lund, 2015). Besides those enormous physical and optical degradation of the fjords, the consequences by this dumping method on the maritime and bathymetric environment are immense.

Already during the extraction-processes on land, various chemicals are used to separate the useable and valuable minerals from the unuseable tailings. Furthermore chemicals are within the process of Flocculation, in which sedimentaion of the fine particles in the tailings is enhanced as well as facilitates the water recycling in the thickener (Norwegian Institute for Water Research, 2011).

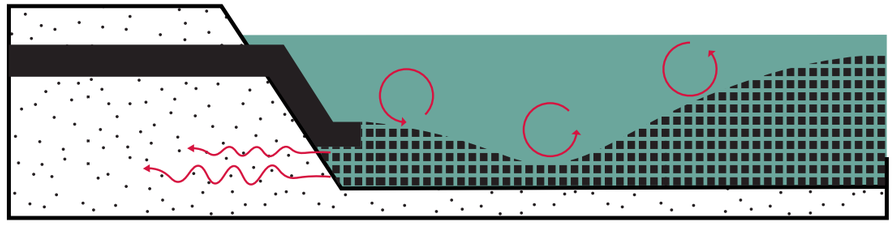


▲ *Figure / 51* **Spatial model of the dumping site within the Langfjorden /** *Höller*

Topographic and sedimentary changes of the seabed will result in the disappearance of the bottom fauna and has an cumulative effet on animal societies, depending on feeding, shelter and spawning areas. Last but not least, the tailings still contain traces of heavy metals like copper and iron which disolve in the water and have all together yet unknown longterm effects on the aquatic flora and fauna.

"It is unwise, and totally irresponsible, to dump tailings in the sea. It is an irreversible process that one can't foresee the consequences of. We take a long-term risk to save some little money now. The damage to marine life, today and in the longer run, can prove to cost way more than saved in the first place. That bill will be passed over to others than the mining companies." (Bernt Nilsen in Barents Observer, 2016)

Bernt Nilsens quote shows, how a short term economic benefit and the proivsion of employment overweights environmental damages, which is typical for the collective memory and path dependency of the High North.



▲ *Figure / 52* **Process of the accumulation of mining tailings due to deep sea dumping and the clogging of the fjord /***Höller*

EXISTING PROBLEM

POWER IMBALANCE PORT DEVELOPMENT

▼ *Figure / 53* **Power imbalance diagram about in- and exclusion during the port planning process** / *Höller*

PORT-INTERNS:

1 Port employees

Owners of port:

2 Sør-Varanger Municipality (current Port-Authority)
3 TSCHUDI GROUP (new port)
4 KIMEK AS (new port)
5 NOROIL AS (new port)

Foreign Investors:

6 China Ocean Shipping Company (COSCO) (new port)
7 Finest Bay Area Development (Arctic Railway)

Port-agency:

8 Nye Henriksen Shipping Service AS

PUBLIC SECTOR:

9 Port authority (Sør-Varanger Municipality)

National Government, ministers

10 Transport Ministry (Finnland, Norway)
11 Finance Ministry
12 Environmental Ministry
13 Legislators
14 Urban development authorities (e.g. Sør-Varanger Municipality, Sør-Varanger Utvikling)

MARKET PLAYERS/CORPORATE BODIES:

Port-related industries:

Shipping logistics

15 TSCHUDI Logistic Group
16 Solar Norge Avd. Kirkenes
17 Nor Lines AS (Samskip AS)
18 Bring Transport AS

Rail, Truck, Air-Logistics:

19 Solar Norge Avd. Kirkenes
20 Kirkenes Transportsentral AS
21 Bring Transport AS
22 TBN Transport
23 Jarus AS

Ship building/repair/supply:

24 KIMEK AS
25 Kirkenesterminalen AS
26 ST1 NORGE DEPOT KIRKENES

Fishing and fishing supply

27 Kirkenes Processing AS
28 Fishing Companies (NOR)
29 Fishing Companies (RUS)
30 Fishing Companies (Other)
31 Free agent-Fishermen (NOR)
32 Free agent-Fishermen (RUS)
33 Nye Henriksen Shipping service AS
34 KIMEK AS
35 Kirkenesterminalen AS

Cruise ship companies

36 Hurtigruten
37 Havila (2021)

Offshore Oil/Gas Industry

38 NORTERMINAL AS

OTHER BUSINESSES

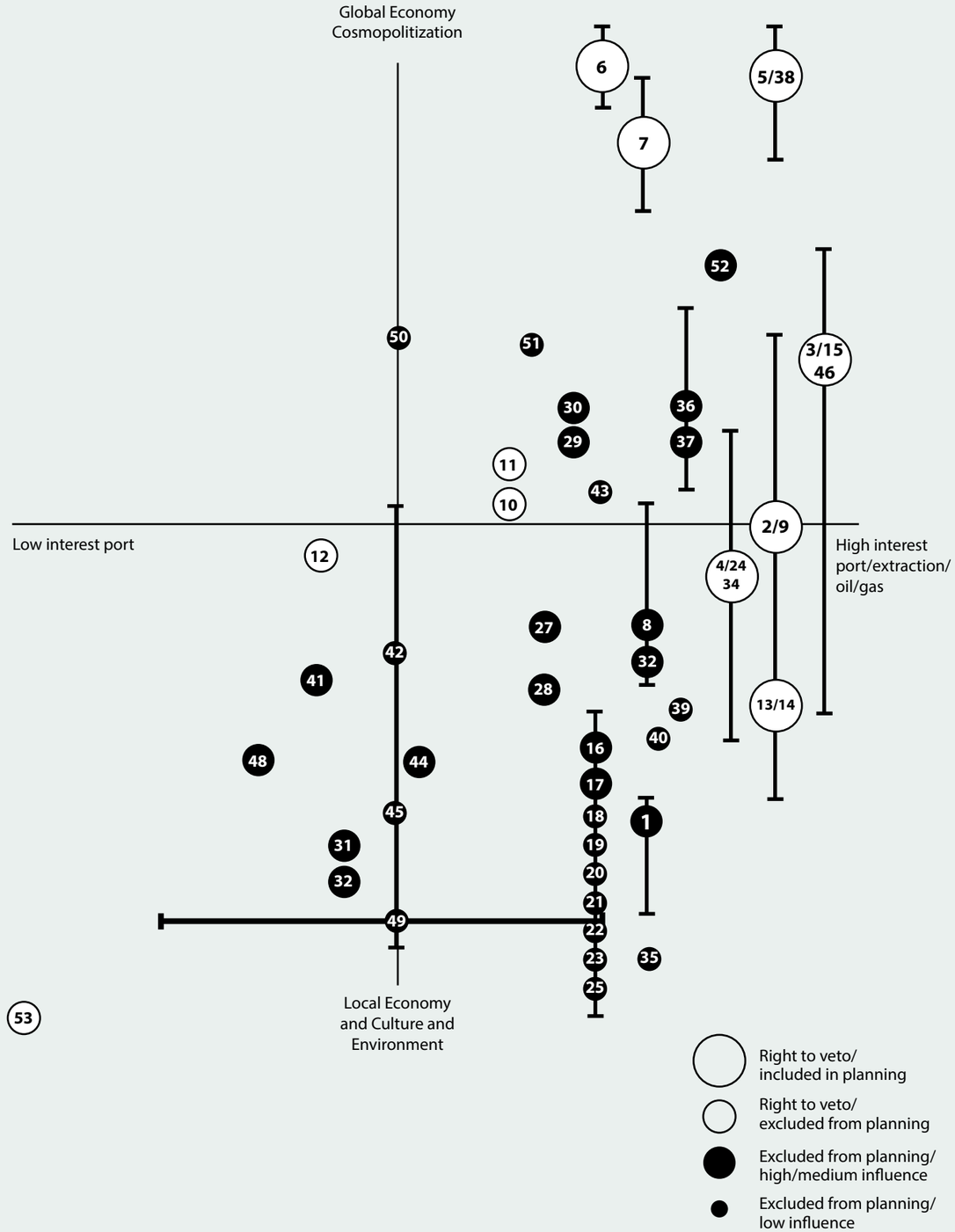
39 Tourism sector, e.g. Hotels, Tours
40 Leisure businesses, e.g. Restaurants, Bars
41 Research/Universities (e.g. UiT, Barents Secretariat)
42 Food Industry
43 Technology/IT
44 Planning/Engineering/Architecture
45 Production
46 Extraction/ Mining-Industry (TSCHUDI Group)
47 Energy Sector (Varanger Kraft)
48 Creative Sector (e.g. Terminal B)

CIVIL SOCIETY

49 Permanent residents
50 Seasonal/periodical residents (e.g. Fishermen)
51 Short-term guests (e.g. Shipping Crews)
52 Tourists

INDIGENOUS SOCIETY

53 Sámi



EXISTING PROBLEM

POWER IMBALANCE PORT DEVELOPMENT

What can be investigated after doing the power analysis concerning the new planned port development, multiple aspects occur:

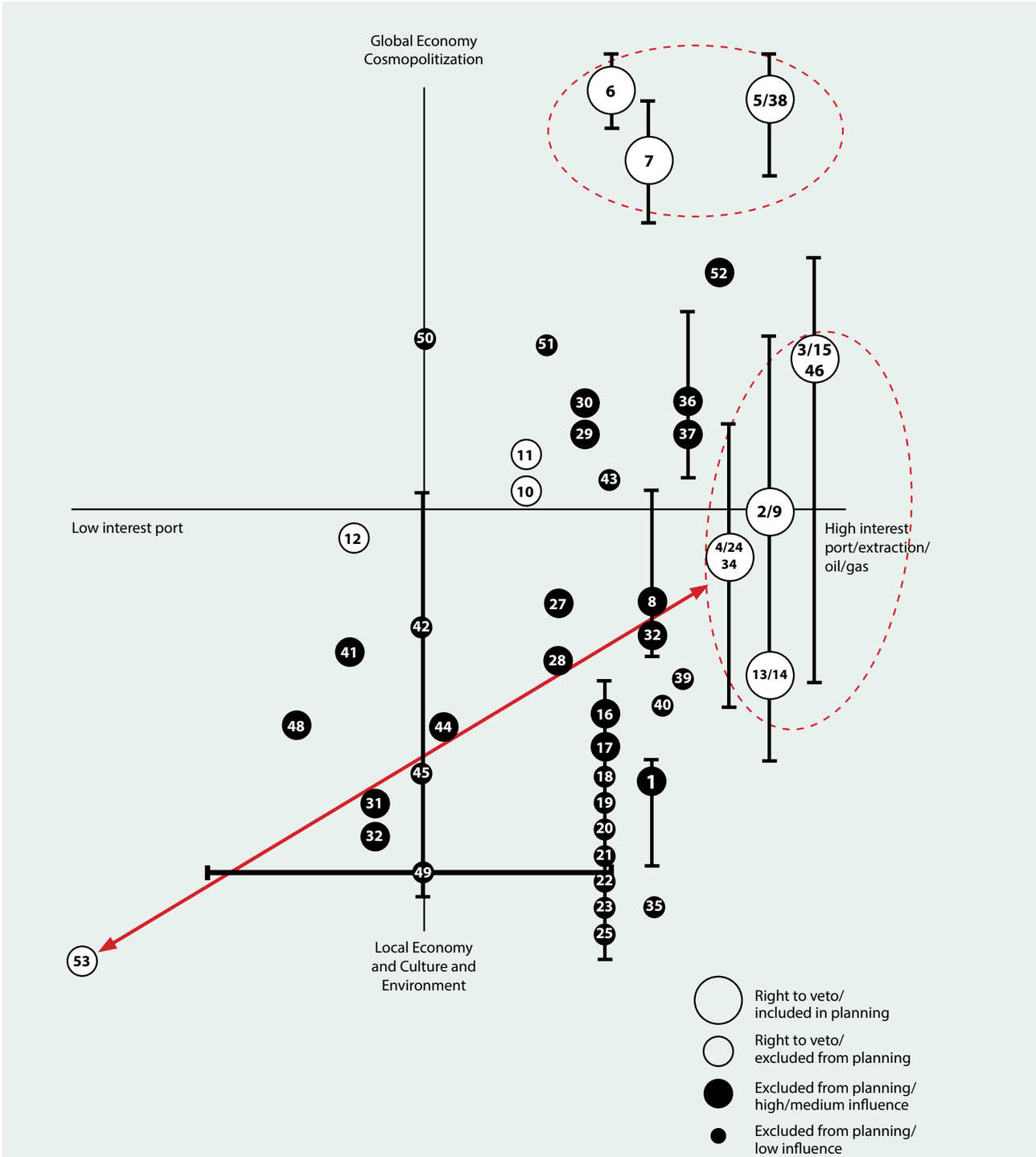
1. The biggest finding was to see that many of the global and influential stakeholders are presented more than once within the stakeholder analysis.
The TSCHUDI Group, being a pioneer in Arctic maritime logistics, is not only one of the driving forces when it comes to the port development, but also is now the owner of the Sydvaranger mine, which will restart its operation soon. Also, KIMEK, a locally very important stakeholder in the current port is presented within the category of the potential new port-owner/cooperation members.
Furthermore, as analyzed within the chapter about Kirkenes`s` path dependency, the Sør-Varanger Munici-pality, as one of the main drivers and political activists for the port development in Kirkenes sees itself trapped between its tasks as a legislator as well as the role of the opportunist to drive economic develop-ment into the area, even if this means a backfall into old, industrial patterns.

2. The number of external and foreign stakeholders can be seen as a threat to the local economy as well as society in Kirkenes, different to TSCHUDI Group and KIMEK, which have no local interest with the develo-pment of the port.
Furthermore, due to research and interviews taken in during the field trip, especially the interest of China to develop a maritime node within Kirkenes seems like a try to drive and fasten political decisions in Nor-way. China has several other options to drive their development in the Arctic.

3. The amount of unheard stakeholders is large and also important/influential local stakeholders seem to be excluded from the process of planning and decision-making.

4. Due to the law in Norway, the Sámi have the right to put vetos against development decisions, which obviously would impact their right and opportunity for reindeer herding. Kirkenes had several potential lo-cations for the port development after reducing it to two. One of the municipal and other stakeholder´s favorite and already far developed location at the Hoybukta was canceled due to the Sámis veto. The port would block several reindeer communities to enter the peninsula.
Besides their veto option, the Sámi don`t seem to be included in the planning and negotiation processes of the actual layout and function of the port.

The current state of interaction is driven by prevention instead of real negotiation and cooperation plan-ning.



EXISTING PROBLEM
TRAPPED IN PATH DEPENDENCY

Highly unstable Economic Markets

▼ *Figure / 54* **Potential future problems of the re-industrialization of Kirkenes /** *Höller*

2020
„Norway likely to keep coronavirus travel curbs until August 20“

2020
„Russian Barents Sea fisheries at risk of stopping as Norwegian ports are practically closed for crew change“

2021
TSCHUDI Group restarts mining operation in Sydvaranger Mine: In full operation mode, the mine will emerge around 400 new jobs. Additionally a job multiplicator on the city and region of 1,7 is estimated, creating a total of around 700 new jobs. (80% local employment)

2025-2030
Constructions on the new port are finished and Kirkenes` Port is fully operating. Together with the potentially build Arctic Railway, around 600 jobs could emerge within the region of Kirkenes.

2030
Based on the calculation of new employment due to industrial development (mining and port) of around 1200 new jobs and the 2,4 multiplication due to average household size in Sør-Varanger, a total of plus 2500 inhabitants within the next 10-20 years could be possible, almost doubling the size of today`s Kirkenes.

2040
Mining potential of Sydvaranger Mine might be exhausted and operation might be stopped.

POST 2040
Current worldwide developments due to the Coronavirus and the reduction of global trade, international operations and cooperations as well as touristic activities showed how impactfull those risks can be towards ports as gateways for all of the above activites.

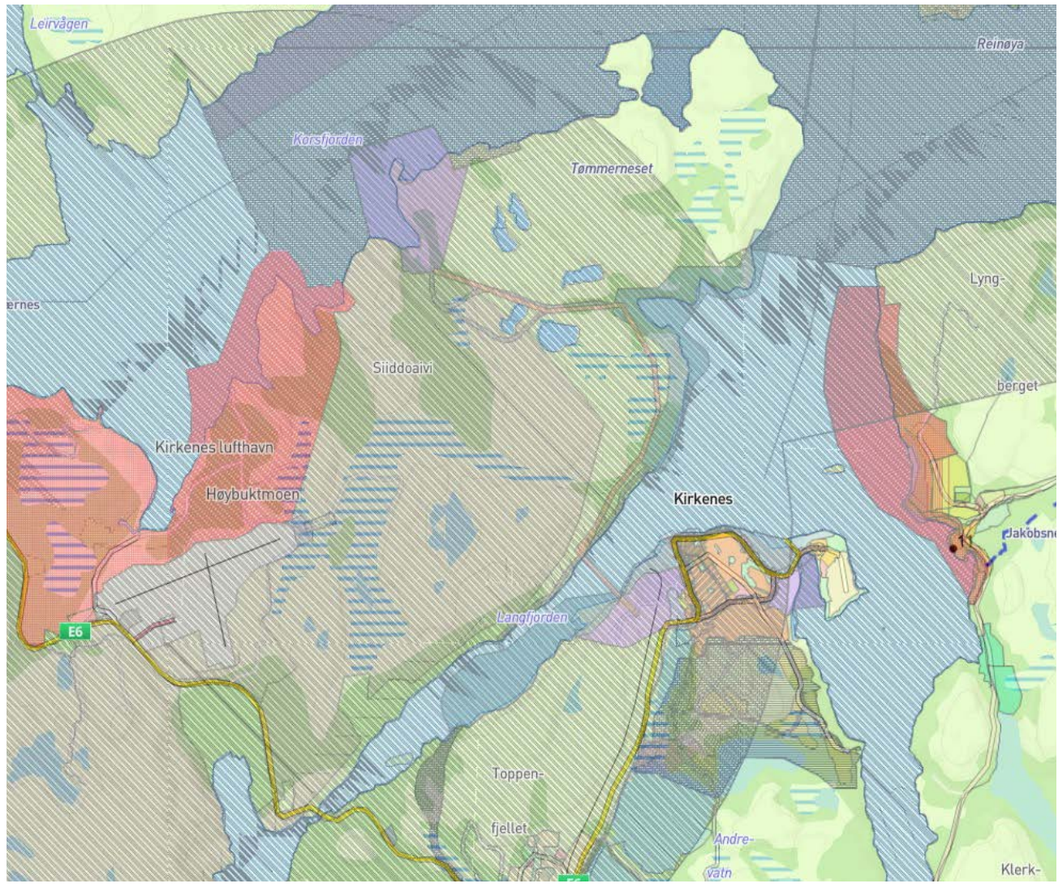
POST 2060
Cargo and container shiping is dependent on several factors:
- *Chinas interest in Arctic logistics*
- *Potential opening of even faster Arctic lgostic routes*
- *Chinas and Europes relationship with Russia*

Therefore there might be a future bust-event, making the port development in Kirkenes obsolete

?

1905

2019 2020 2040 2060 2080 2100?



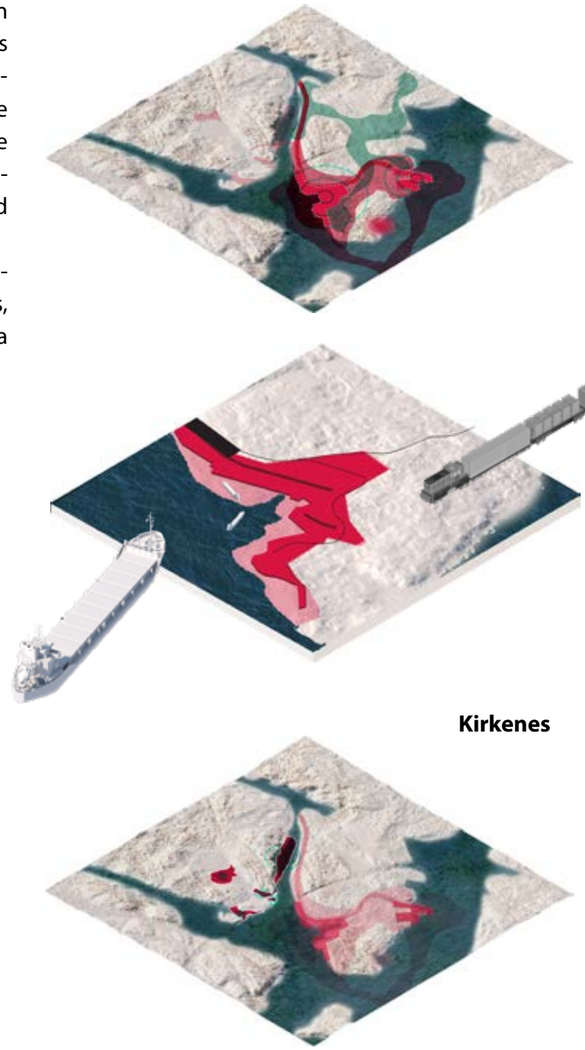
▲ *Map / 58* **Extract of kommunal-map of Kirkenes showing the two last reamaining options for the potential new port development at Leirpollen or Slambukta**

FUTURE PROBLEMS
PORT DEVELOPMENT

The new port development has the potential to create conflicts within Kirkenes, for its surrounding as well as for the transitional hinterland and the maritime foreland.

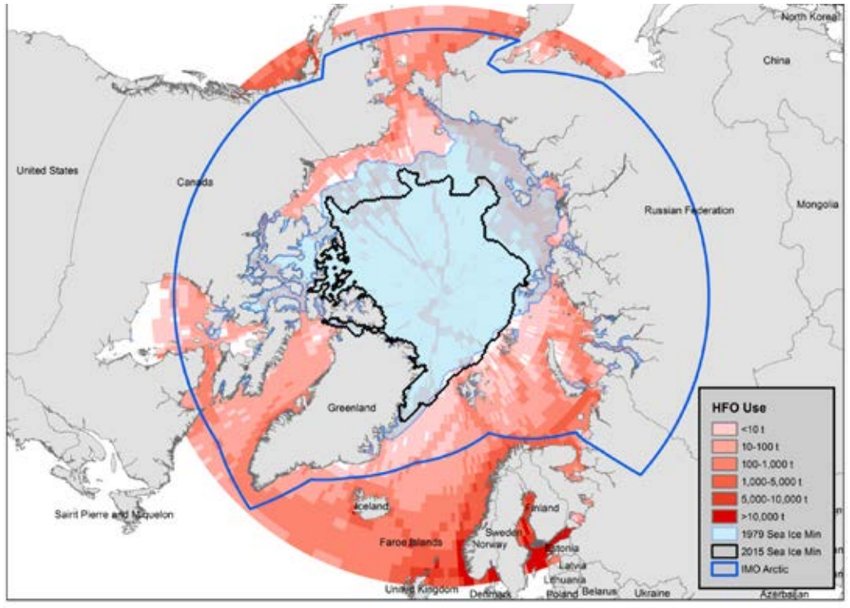
On the one hand the environmental impacts on the natural ecosystem are enormous. The construction of the port, the land-use change and the reduced habitats will generate risks for many of the natural participants on land and sea. The development of new industrial and logistic areas in combination with an increase of traffic on land creates impacts within the far hinterland of the port and causes separation of ecosystems and societies. But also the neighbouring urban environment is affected by the development of the port. Sound pollution, nuisance and visual impacts create conflicts for nature and human beyond the actual spatial component.
Old obsolete waterfronts are endangered by potential land-use changes and privatization processes, resulting in the commodification of the land-sea interface for tourism or other economic uses.

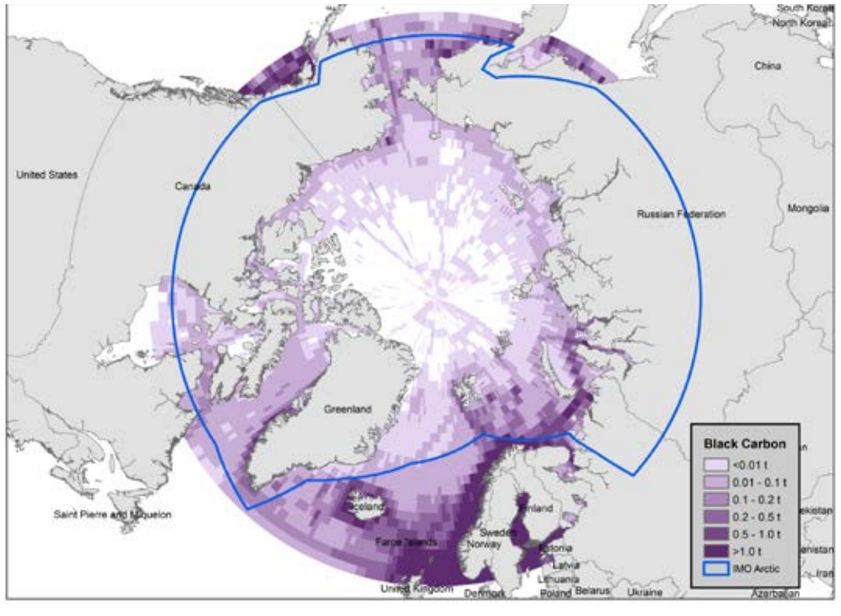
Tømmerneset Peninsula



Kirkenes

▲ *Figure / 55* **Affected areas in and around Kirkenes /** *Höller*





▲ *Map / 61-62* **Heavy fuel oil use (top) and black carbon emission in the Arctic 2015 (bottom)** / *Climate and Clean Air Coalition, 2019*

FUTURE PROBLEM
SHIPPING

The worldwide shipping logistics sector would be the sixth-largest contributor of greenhouse gas, and therefore emit more than Germany, if it was a country.
Especially black carbon is a potential climate forcer, which gets emitted when burning the often unre-fined heavy fuel oils for maritime transport. Even though it is a short-lasting gas and only stays for several hours within the atmosphere, it has several health and environmental impacts. New research shows the accumu-lation of black carbon within the ice of Arctic regions and the resulting melting process of the ice (Climate and Clean Air Coalition, 2019).

Furthermore, shipping has many other impacts on the natural but also human environment. They often result in habitat destruction, habitat loss, biodiversity loss, population decline and put many species under pressure. (Norwegian Environment Agency, 2018)

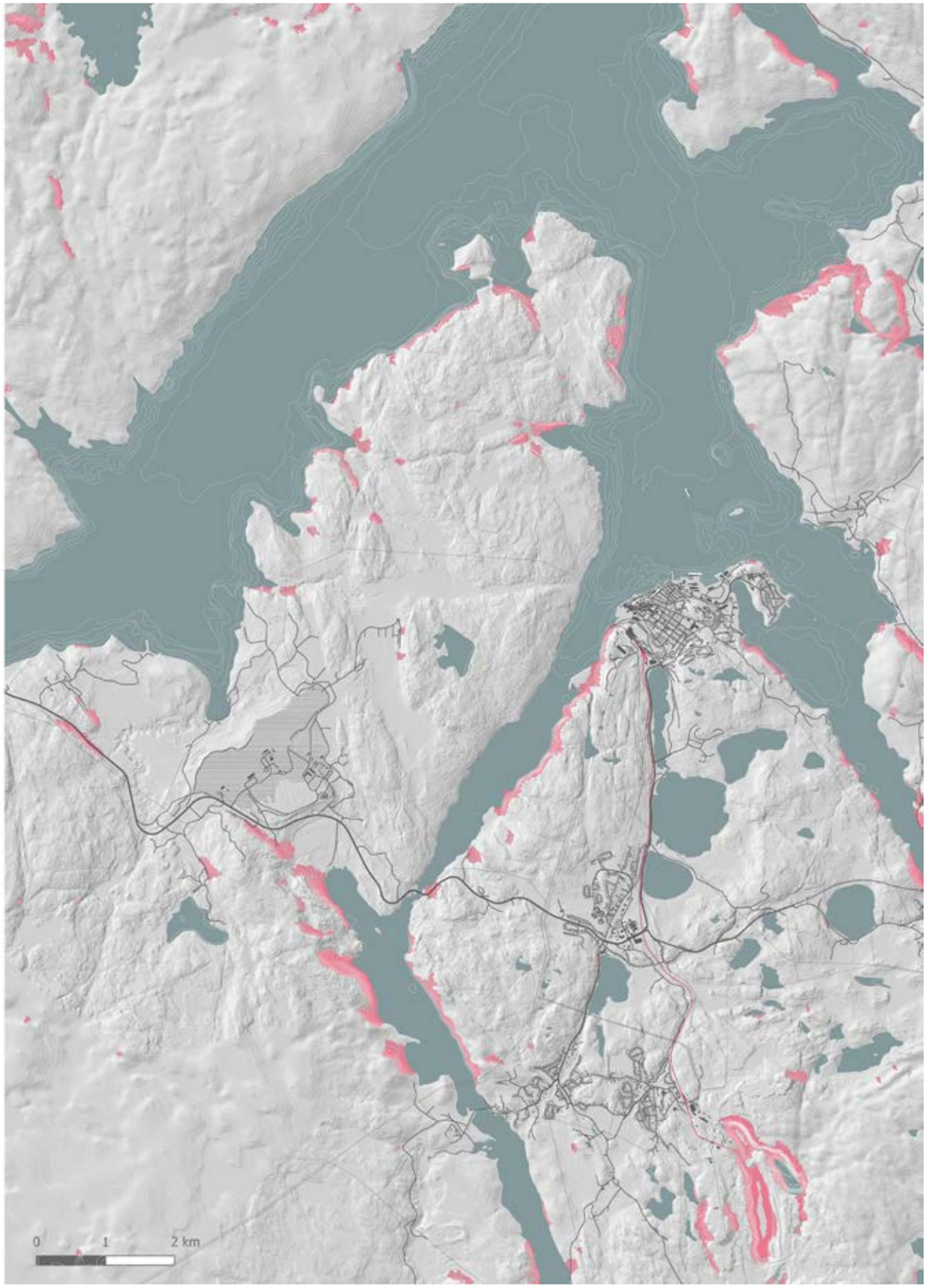
Conventional Pollution:
By burning often poorly refined Heavy Fuel Oils (HFO), ships are one of the biggest emitters of global greenhouse gases. Ships produce high amounts of toxic Sulfur Dioxide (SO2), which is not only impactful for plants and organisms like lichen, but also a cancerogenic and dangerous for humans. Nitrogen Oxide (NOx), particles and hydrocarbons are released next to the well-known climate change driver Carbon Dio-xide. Localized air pollution is created by waiting and loading/unloading vessels, docking on the port.

Ballast Water Discharges:
Cruise ships, heavy tanker, cargo ships and bulk carriers often have stored large amounts of ballast water to regulate the water depth of the ship. The water discharged into the aquatic ecosystem of the port-of-destination can contain alien and invasive species as well as bacteria collected at the point of origin or during the journey.

Waste and Waste Water:
An average cruise ship produces around 1000m3 of grey and 110m3 of blackwater every day. Similar to wastewater produced in urban environments, the spillage can cause the distribution of harmful bacteria, viruses and parasites into the aquatic system. Fish are especially impacted by those discharges of nutrients because the eutrophication of the water increases the production of algae and therefore reduces the amount of oxygen. Furthermore, the greywater from sinks and showers can contain other pollutants like chemicals from shampoos, oils and detergents. Solid waste is another product that accumulates, especially on cruise ships. Food waste, maintenance waste, paper and cardboard boxes are only a few examples. Waste and wastewater also have impact on the terrestrial environment. Produced waste can not be dum-ped or easily discharged into the water and therefore needs to be stored and treated in facilities of the port-city.

Billage Water and Oil Spills:
Oil leaking directly from bulk carriers or from older engines of regular ships is one of the most drastic im-pacts on the aquatic system. The toxic chemicals Polycyclic Aromatic Hydrocarbons (PAHs) which are com-ponents of crude oil are difficult to clean and have impacts on fish, birds and other maritime mammals.
(Transport and Environment, n.d; Cleaner Seas n.d.)

▼ *Map / 63* **Erosion and landslide susceptibility /** *Höller*



FUTURE PROBLEM
CLIMATE X PORT

Erosion

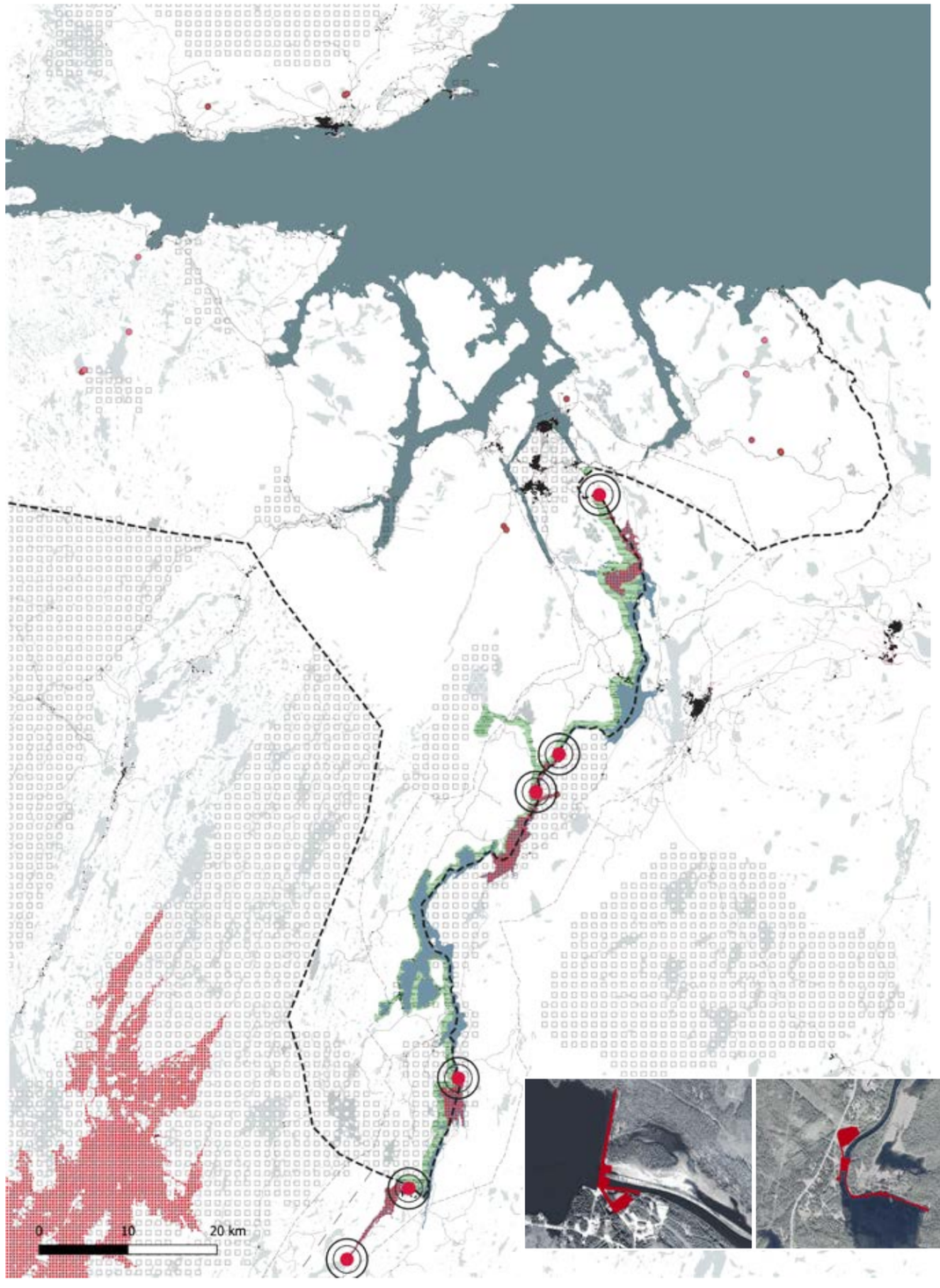
But not only the port has impact on the climate, but also the other way around. Due to the depth of the fjord, which is deep enough to accommodate bigger ships, no dredging of the seafloor is needed. Nonetheless the development in Kirkenes would result in a major terraforming process to make the terrain of mostly bare rock straight and accessible for the construction and operation of the port. Climate change results in rising temperatures, increasing the chances of landslides, due to fast melting ice within the soil and subsurface but also rock chipping due to inconsitent melting and freezing dynamics can ocurre more often (Patton, Rathburn & Capps, 2019).

Currently such an event happened in Alta, around 500 kilometers away from Kirkenes, where rapidly melting soil caused a landslide damaging several houses, but no humans.

▲ *Photo / 103* **Erosion**

◄ *Figure / 56* **Spatial model of the amount of terra-forming neccessary for the new port development at Leirpollen /** *Höller*

▼ *Map /64* **Pasvik Hydropower Dams** / *Lukas Höller*



FUTURE PROBLEM
PASVIK HYDROPOWER DAMS

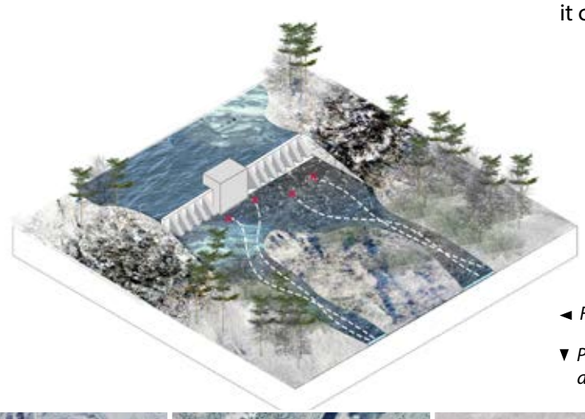
Norway is benefiting from climate change in a way that the increasing temperatures create higher capacities of waterflows and therefore more potential for hydropower production. Around 50% of Europes reservoir capacity is located in Norway (Climate-change Post, 2016).

The Pasvik River, flowing all the way from Laki Inari in Finland to its exit into Bøkfjorden in Kirkenes is one of the most important water structures in Sør-Varanger. The river is driver for many important habitats on land and water. Serveral bogs and wetlands occure along its side providing the ecosystem for hundreds of endangered birds, mammals as well as fish, like whitefish, perch and pike.

Since the melting of Nickel in the same-named town Nikel (Russia) and the mining of iron ore in Sør-Varanger consumed a lot of energy, the first hydropower plants have been installed already in 1942. Today a total of seven of such plants changed the velocity and discharge of the river. In front of each powerplant basins to store water in cases of low water level have been installed. This altered the natural appearance of the river drastically.

The prevention of inundation and flooding events of the former floodplains causes the slow overgrowth of the shallow areas as well as the disappearance of grassland and important habitats due to increased erosion and geo-forming (Pasvik Monitoring, n.d.; Pasvik Elva, n.d.).

Furthermore the blocking of spawning routes of several fishes has caused the reduction, even the disappearing of some species. Brown trout, usually living in fast flowing waters and the grayling have suffered the most, while pike, perch and whitefish profited. The ricer and the Lake Inari suffered so much, that even fish was artificially planted. Increased erosion and rapid changes of water-level due to the energy production also causes problems for bird´s nesting along the riverbanks. (Pasvik Inari, n.d.).
A new port development and the operation of the facility itself as well as a potential growth of other industrial businesses potentially increases the need for more energy.
Even though it seems that hydropower is a sustainable source of energy production, the case of the Pasvik river shows the hidden problematics, when it comes to damming rivers for energy production.

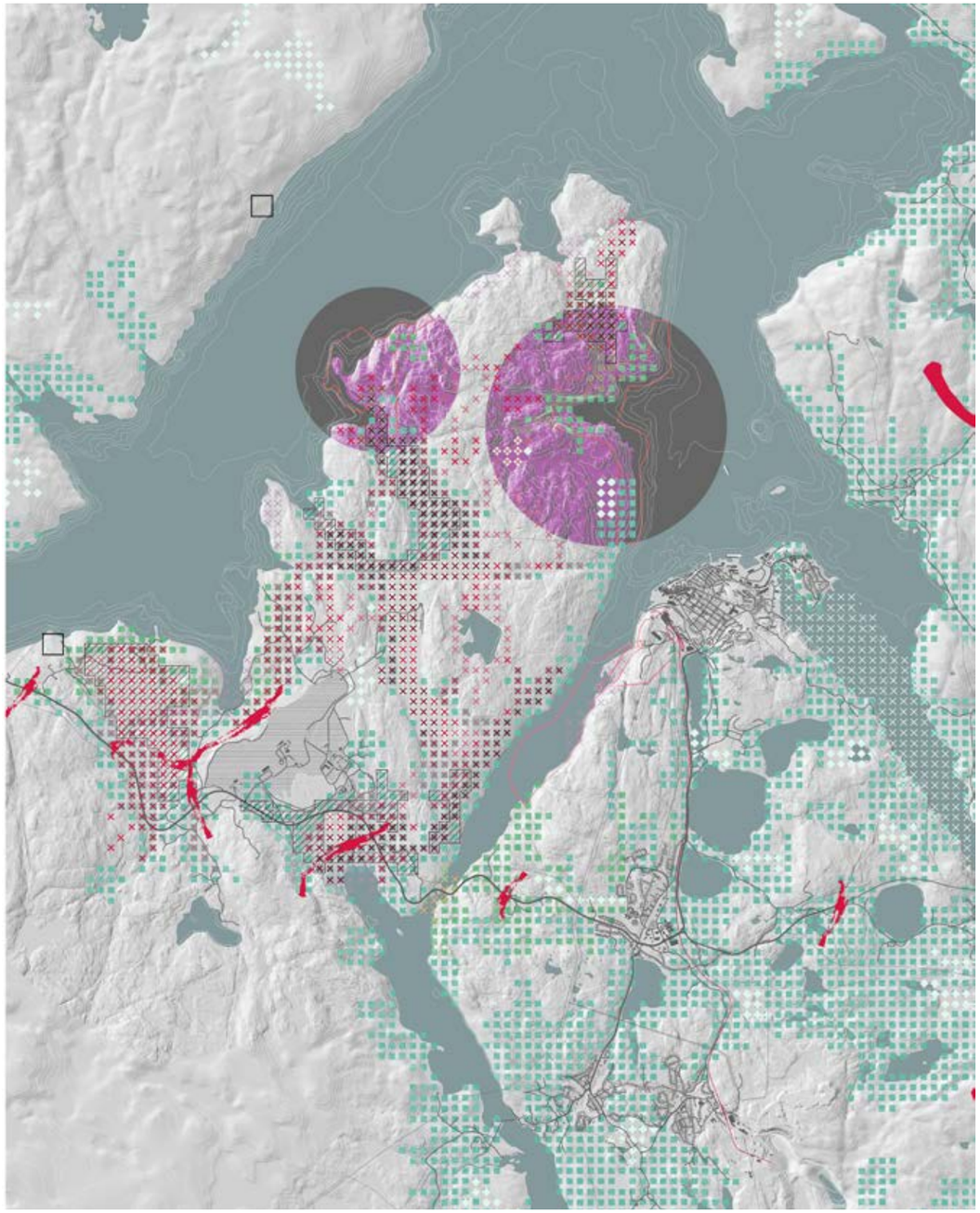


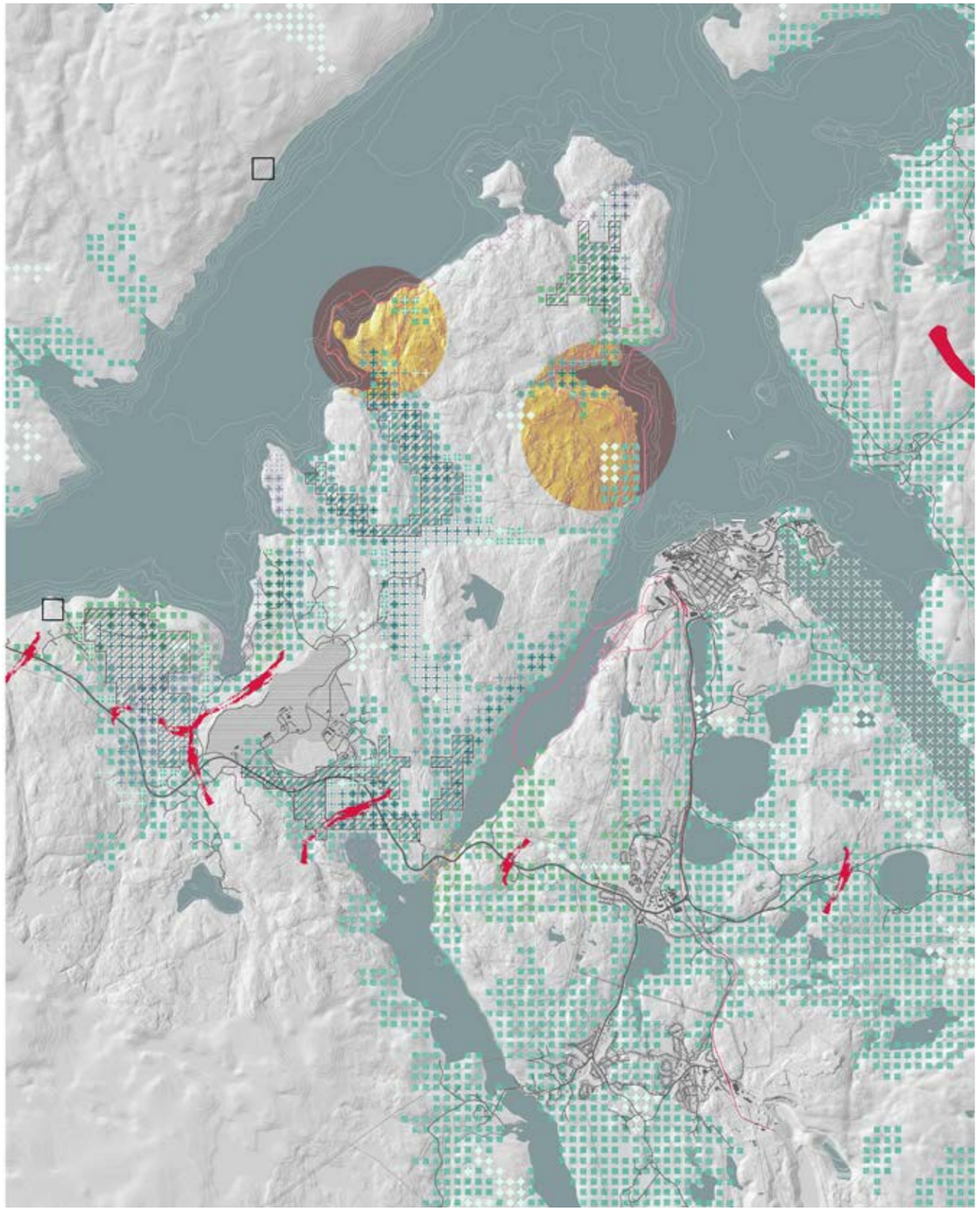
◄ *Figure / 57* **Illustration of a Hydropower Dam** / *Höller*

▼ *Photos / 104-110* **Pasvik Hydropower Dams** / *Google Earth, adapted by Höller*

IMPACTS ON REINDEER AND HERDING
PORT ACTIVITIES

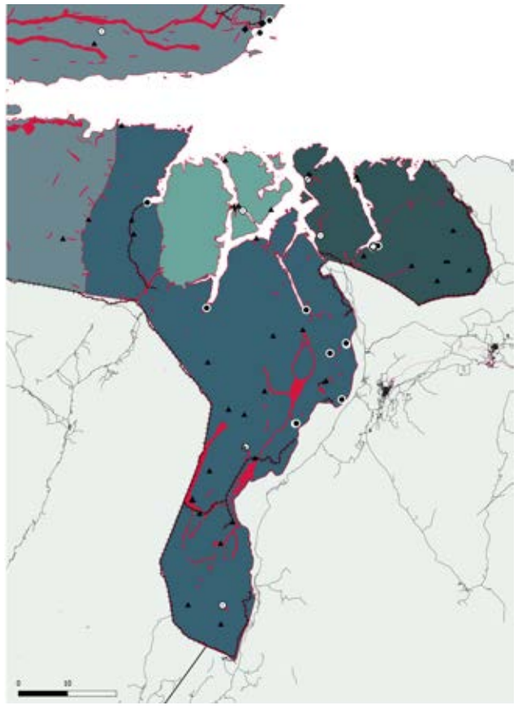
▼ *Map /65-66* **Reindeer migration Kirkenes and Tømmerneset Peninusla summer - winter /** *Höller*





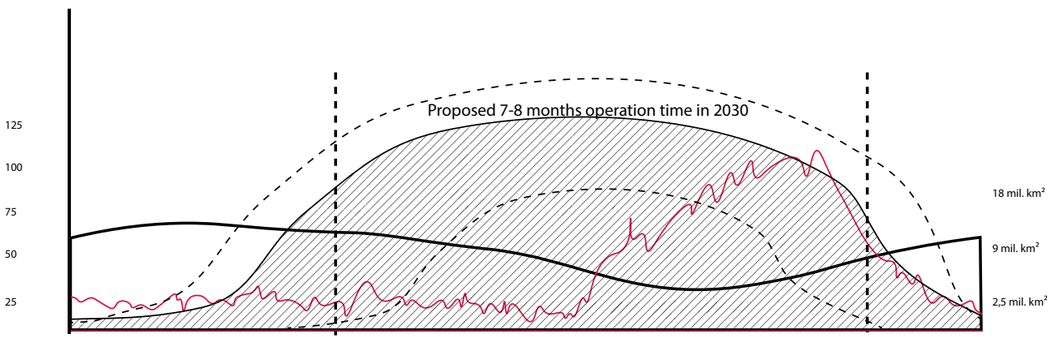
- Port activity summer
- Port activity winter
- Mixed forest
- Conifer forest
- Wetland
- Port development outline
- Reindeer migration route
- Reindeer location summer
- Reindeer location winter
- Streets

IMPACTS ON REINDEER AND HERDING
PORT X RAILWAY X INFRASTRUCTURES

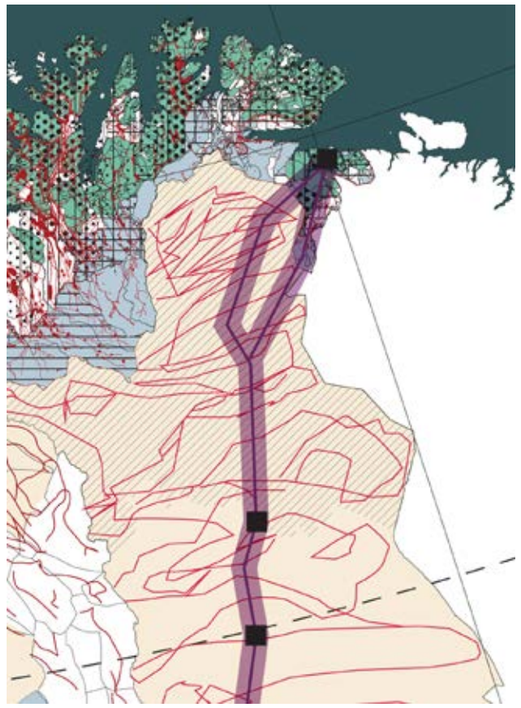


▲ *Map / 67* **Heerding districts Sør-Varanger /** *Höller*
Data: geonorge.no

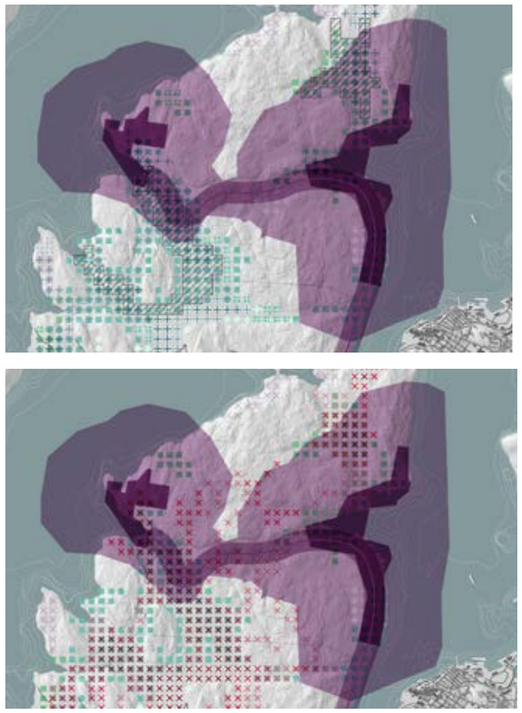
Tomeresnet, the peninsula on the western side of Kirkenes, on which the planned port is proposed, is a shared grazing area between the Pasvik Family in summer and the Vestre Sør-Varanger Family in winter. The animals cross the main road and mainly access the area from the western side of the airport. Some also enter the area from the right, downside of the airport.
During the summer months, reindeers are roaming mostly on the inner parts of the peninsula, where they can find suitable food close to the wetland and swampy areas. Also, the rough and hilly topography provi-des cool and windy spots in the summer and protects the reindeer from insects and other disturbing ele-ments. In the winter months, the reindeer gather along the shoreline or search for lichen in-between and on the snow-covered bare rocks. Due to the decrease of lichen in this area, the animals also use algae and seaweed as food sources, which they find along with the few accessible spots (Danielsen, Langeland & Tømmervik, 2015; Nemkova & Fyta, 2016).
The proposed port development would have a large impact on the animals` grazing territory. The amount of reindeer on the peninsula would need to be reduced by 400 animals, due to the loss of suitable grazing and herding space. Furthermore, the port development would create multiple boundaries such as roads and train tracks, as well as block the accessibility of the northernmost part of the peninsula, where reinde-ers especially gather in late August.



▲ *Figure / 58* **Overlap Arctic sea-ice extend over the year, amount of ships using the Northen Sea-Route over the year and the planned 7-8 months operation phase of the new port in Kirkenes /** *Höller*



▲ *Map / 68* **Potential route of the Arctic railway segregation large areas of the migratory routes of the reindeer and Sámi /** *Höller*



▲ *Map / 69 - 70* **Zoom-in Tømmerneset: Land-use and spatial impact of the port on grazing reindeers / summer-winter /** *Höller*

Also the access to the coast will be blocked by the development, which reduces the number of food-sources even further (Interview Municipality Sør-Varanger). But not only land-use blocking and separation of the territory will have an impact on the reindeers. Also, the increased sound-, air- and water pollution as well as the visual disturbance, decrease the grazing opportunities beyond the actual spatial impact.
The biggest impact on the reindeer and herding community will be caused by the proposed „Arctic Railway, “ which looks forward to connecting the new Arctic container port in Kirkenes with Rovaniemi, located around 400 km away in Finland. Due to the early phase of planning and the increasing protest of Sámi and reindeer herders, no specific picture of the potential risk can be drawn. Nonetheless, the separation of the migration routes and the whole Sapmi will have enormous impacts on the natural environment and the cultural identity of the Sámi.

▲ *Photo / 111* **Reindeer killed by railway between Helgeland region, Northern Norway**

IMPACTS ON REINDEER AND HERDING
CLIMATE CHANGE

Ice-Accumulation

Climate change has an high impact especially on winter tempreatures in Arctic and Sub-Arctic environments. A change in freezing and melting periods as well as higher precipitation numbers in form of rain instead of snow lead to the icing over of the snow covered surface. Usually reindeers can smell suitable winter food, especially lichen, in up to two meter of snow-cover.
They use their hooves to dig and free the food from snow and ice. If the layer is to hard a two-folded problem occures. Firts of all, the mostly dense layer makes it impossible for reindeers to smell and find suitable grazing spots in winter. Secondly, if they found suitable areas, the layer is to frozen to be freed from the ice-cover. In combination with the decrease of lichen due to pollution (especially by SOx) reindeers struggle to survive the long and harsh winters and more and more starve to death (Natural Resources Institute Finland, n.d.).

◄ *Photo / 112*
Ecologist Ashild Onvik Pedersen examines a reindeer cadaver Svalbard, where more than 200 have been found dead. *(Norwegian Polar Institute)*

Earlier Ice-Melting

An earlier temperature increase during spring causes lakes and rivers to melt. Formerly easy to cross as well as important connectors between territories, they become uncrossable boundaries for reindeers and herders. Furthermore, semi-frozen lakes and rivers cause reindeers to break into the water and drown as well as many reindeer herders to lose equipments like snow-mobiles, during the dangerous attempt to cross water bodies.

Harresment and Disturbance caused by Insects

Due to temperature rise, more insects, like mosquitos, survive the usually harsh and cold Arctic and Sub-Arctic winters. The increased distrubance by insects and other parasites causes the autumn weights of reindeers, especially those of young calves, to drop (Natural Resources Institute Finland, n.d.).

▼ *Photo / 113*
The timing of the spring hatching is critical for moth larvae populations in the north. Pictured here are autumnal moth larvae, which survive the winter as eggs deposited in birch trees. Extreme larval outbreaks can occur when hatching coincides with bud burst.

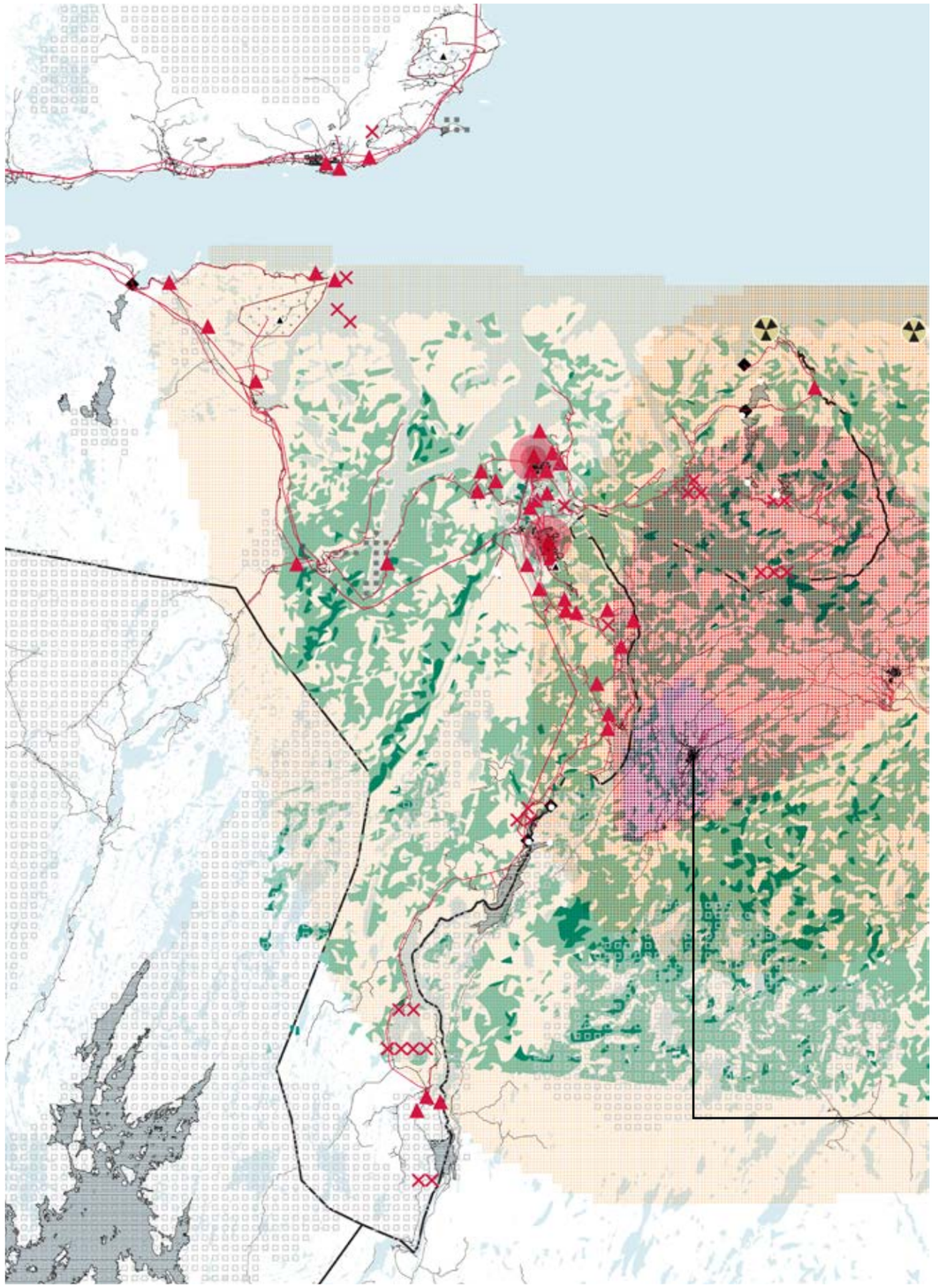
▼ *Figure / 59* **Illustration climate change impacts on reindeer /** *Höller*

Winter Birch Moth

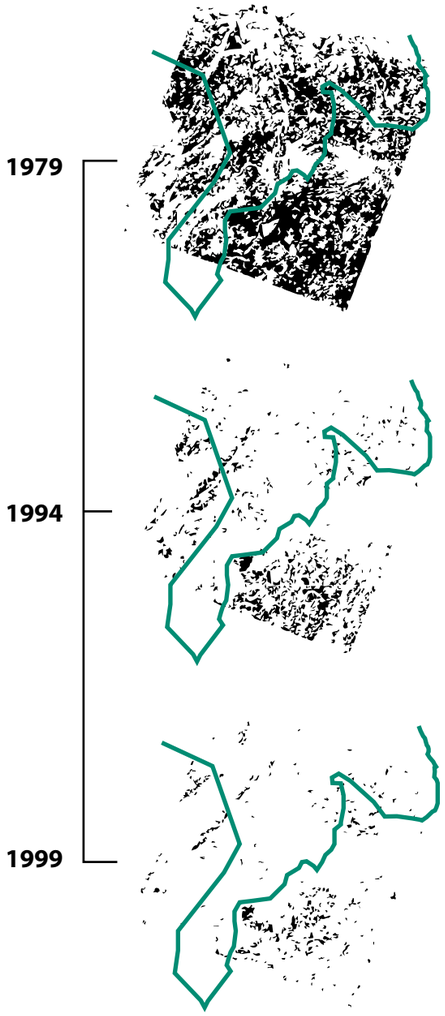
While the autumnal moth (Epirrita autumnata), a moth occuring in high densities and causing widespread defoliation and the death of some birch trees and whole forests, has been in Fennoscandia for centuries, climate change, especially higher temperatures in winter months caused the impact of an additional species, the winter moth (Operophtera brumata) (Amundsen, 2014). Its outbreak and therefore the additional stress and impact on birch trees by an additional parasite caused wide range death of ten-thousends of squaremeter of birch forest during the last two decades in North Norway, North Sweden and North Finland (Vindstad, Jepsen, Klinghardt, Ek, Ims, 2017). This is not only a problem for nature, logging industry and toursim, but especially reindeers, not finding suitable and reachable summer food anymore, causing them to look for new areas or starve.

▼ *Photo / 114* **Mountain birch trees that have been killed by a moth outbreak in Eastern Finnmark, Northern Norway.**

▼ *Map / 71* **Airpollution** / *Höller*



IMPACTS ON LICHEN
POLLUTION



Lichen Decrease in Sør-Varanger

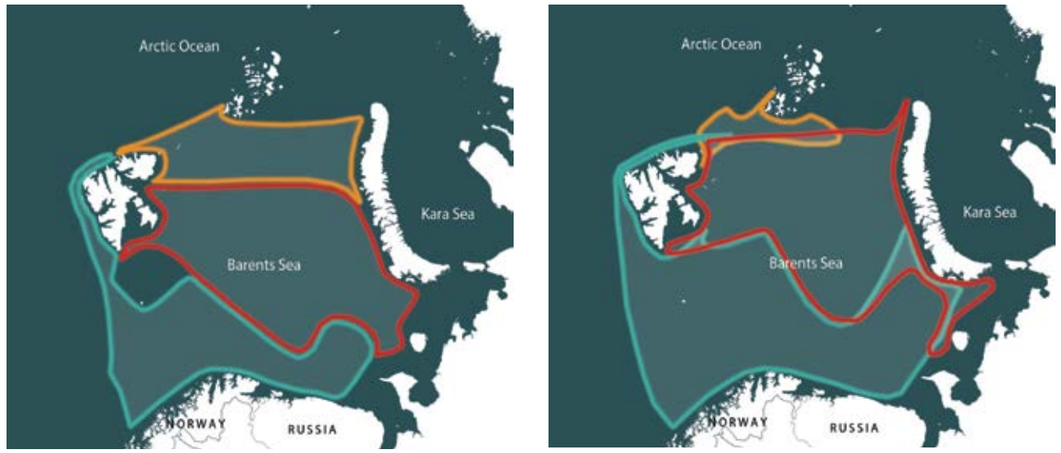
The green areas on the map, but also the three maps extracted from Tømmervik, Johansen & Pedersen (1998), on the left, show the decrease of lichen-rich land in the area of Sør-Varanger. The transboundary air pollution by the smelting industry in the town of Nikel and Zapolyarnij in Russia, only a few kilometers away from Kirkenes, signals the sensitivity of lichen to SOx and similar polluting impacts.

Air pollution stress and the interrelated damaged vegetation, defoliated forests, and lichen removal are not only impacts on those species itself but also on the animals and organisms depending on their existence. As state many times in this re-port, the impact of lichen-loss is the biggest for the reindeers.

SOx is also a common component of heavy fuel oils used by ships. The concentration and also the allowed percentage of SOx in such fuels is regulated, nonetheless, a port along Tømmerneset could have similar impacts on the lichen population and therefore on the quality of the grazing areas around Kirkenes.

◄ *Photo / 115*
Kola mining company's nickel melter in Nikel on the Kola Peninsula.

IMPACTS ON FISH AND FISHERY
CLIMATE CHANGE X POLLUTION



▲ *Maps / 72-73* **Comparison of the fish communities observed in the ecosystem /** *Survey done in 2004 (left) and the survey from 2012 (right) indicates a significant change in distribution. The Atlantic (blue) and central (red) communities (boreal fish species) have shifted north and east, taking over areas previously occupied by the Arctic (orange) community (Arctic fish species). / adapted by Lukas Höller*

Between 1961 and 2003, global oceanic temperatures have risen on average, around 0.10^{0}C. While future predictions are hard to make, an increase of even 1-2^{0}C are very likely. As the map above shows, climate change and increasing temperatures, especially along the coastal areas of the Norwegian and Barents Sea, let more and more fish species, which are common for the Atlantic, migrate into Arctic waters, occupying the habitats of Central or Arctic fish.
Furthermore, the oceans around the world absorbed around 50% of the global CO2 emissions produced since the beginning of the industrial revolution. The acidification as well as the eutrophication of the aqua-tic ecosystem, has and will have large impacts on biodiversity. Phytoplankton, usually used as a food-source by fish, can occur in bigger or in smaller numbers as well as occur within changing timeframes dis-rupting the natural feeding, migration and breeding rhythm of many species (Climate Change Post Norway, n.d.)

But not only climate change impacts the aquatic ecosystem. Also the high frequency of fishing activities within the Barents Sea endangered already vulnerable and impacted species. Even though the species pool of the Barents Sea is far from low and currently no species is endangered due to overfishing, future uncertainties might put an end to traditional fishing industries.

The catches within the Barents Sea include large numbers of Arctic Cods and Arctic Haddock. Furthermore, Redfish, halibut and shrimps, as well as the invasive species of the King Crab, are common catches as well. The stock of Capelin already varies from year to year, which can be a prediction for the future of other species as well (Directorate of Fisheries and the Norwegian Environment Agency, 2018)

Fishery does not only put pressure on harvested stocks but also has a broader environmental impact on the aquatic ecosys-tem.
Dumping of waste scrap and fishing gear and the method, especially trawling (either benthic of demersal) can influence biodiversity. Besides impacts like overfishing, bycatches, the disturbance and destabilization of the seafloor and marine flora and fauna, bottom trawling mostly impacts the livelihood of the local fishery (Worldatlas, 2018)

As explained within the analysis part of fish within the area of interest, the fishery had a large impact on the urbanization and the development of the coastal cities along the Barents Coast. The industrialization and technologization of fishing, by bigger boats as well as other methods like trawling, led to a centralization process of the industry and brought a large de-cline in local fishery with it. Larger companies using trawling technics outnumbered the local fishermen as well as Sámi with their traditional equipment and small boats.

1. Hammerfest	***-75.3***	***%***
2. Vardø	***-5.8***	***%***
3. Vardø	***-23.9***	***%***
4. Guovdageaidnu-Kautokeino	***0.0***	***%***
5. Alta	***-72.3***	***%***
6. Loppa	***-85.2***	***%***
7. Hasvik	***-59.7***	***%***
8. Kvalsund	***-90.0***	***%***
9. Måvøy	***-70.4***	***%***
10. Nordkapp	***-30.4***	***%***
11. Porángu-Porsanger	***-39.1***	***%***
12. Kárášjohka-Karasjok	***0.0***	***%***
13. Lebesby	***-52.3***	***%***
14. Gamvik	***-25.2***	***%***
15. Berlevåg	***-42.7***	***%***
16. Deatnu-Tana	***17.9***	***%***
17. Unjaargga-Nesseby	***0.0***	***%***
18. Båtsfjord	***-28.3***	***%***
19. Sør-Varanger	***-15.9***	***%***

▲ *Figure / 60* **Decline of employment within the fishing industy from 1992-2018 /** *Fiskeridirektoratet (2019) adapted by Höller*

On the one hand, the loss of local livelihood is one aspect large scale fishing industry brings with it. On the other hand, as one can see on the example of Kirkenes is the dependence on such a regional/ global industry. After the mining activities stopped, Kirkenes invested mainly in the development of the port-infrastructure. As a service port for the maritime industry, the local companies are depending on foreign or non-local fishing fleets to provided their supplying and repairing service. COVID-19 showed how dangerous such a dependency on non-local or foreign industries can be. Around 90% of Russia´s fisheries in Europe are done by 80 vessels located at the Barents Sea. Because of custom and distance-reasons to Murmansk, the Port of Kirkenes is loading, repair and crew-exchange point and built a close economic connection to the Russian fishing industry (Nilsen, 2020)
Due to the corona pandemic, those foreign companies are not allowed to use the port-facility in Kirkenes, which shows the disbenefits and instability of an economy, which is depending on regional/ global value chains.

ANALYSE
CONCLUSION

The long and extensive part of the analysis gave an insight into the social and cultural mindset as well as the interrelated economic booms and busts within the region, which are the reason for the mindset of the local/regional inhabitants. Being unable to develop new legitimate scenarios for the city/region depicts the struggle but also the cause for certain decisions that have been and will be made by the local authorities.

The second part is introduced to the characteristics of the surrounding ecosystem, which is, in the opinion of the author of the thesis, the real strength of the region. Big parts of society are depending on living with and directly from nature.

Last but not least, the current and future problems and conflicts between the economy, nature and society, especially within the context of the proposed port development, have been investigated.

All in all one can say that, Kirkenes missed to take the critical juncture to shift away from purely extractive and exploiting activities. The combination of the manifested industrial mindset of the region and the new proposed maritime develop-ments can become a dangerous mixture for the region.
Local entrepreneurs but also the local government speculate on economic profit. The interrelation to unstable, fluctuating as well as unsustainable economic branches and value chains, question that such a development can create persistent eco-nomic benefits and can drive a long-term resilient development of the city/region to overcome contemporary and future challenges. Furthermore, it is to question, if this can be a base for a healthy and mutual relationship between port and city and if the local and regional natural and human participants will accept such an impacting and risky development compared to the minimalistic benefits the port can offer the local besides a short term economic revival.

INTROCUCTION
FROM FRICTION TO FICTION

Why Design Fiction

The question which seeks to be answered within this part of the chapter is: how can Design Fiction become a usefull, thoughtfull and carefull tool for the reimagination process of port-cities?

Looking at the evolution of port-cities, one can identify a shift away from creative and imaginative interac-tions between port and city towards a pragmatism, driven by hyper-rational logic and positivistic mindsets. Nonetheless, by reflecting on general phenomena like the climatic, economic or humanitarian crisis around the world, we need to question the paths humankind is currently wandering. Living in the age of uncertain-ties, Design Fiction can be the tool to cut loose from the obvious broken, unsuitable and restricting and to allow for new creative stories without waiting for science and fact to become certain.

> *» It is unknown, thus science fiction provides opportunities for an epistemological vision of a future in which it is known. «*
>
> **KAMPEVOLD & HEMMERSAM, 2018, P.45**

The imagination of a better inhabitable world, either for someone specific or for the larger society, is as old as humankind. Utopian and innovative out-of-the-box thinking helped and still helps to create a healthier, more responsible, sustainable, and future-proof world. Different to producing, building or plan-ning, designing is a process where creativity and imagination create new and unexpected things through thoughtful and innovative thinking and reflecting (Bleecker, 2009).

Design Fiction as used within the thesis, is the fusion of science, fact, fiction and design and allows for the creation of ideas, possibilities and speculations, driven by the need for change, but not restricted by the uncertain and the pragmatism of today.

But what does that mean for port-cities?

Still following the ideal picture of the port, driven by positivistic mindsets and economic measures, port developments around the world overlay the rational logic of transport and logistics in form of territorial and infrastructural landscapes on top of the local/regional environment by-passing or even negatively affecting the specificities of societies, cultures and natur. Spatial designs inspired by fiction and supported by fact and science can therefore become a driver for the rethinking of port-cities and a mediator between both institutions and their interrelated stakeholders.

Design fiction allows for the imagination of a new form of port-city relationship, where the local uniqueness and specific character of the society, culture and nature in combination with the economic, technological and innovative force of the port as a gate to the maritime mindset, creates a third dimension of encounterscape. Within those scapes, physical and mental paradox, driven by the diversity of actors and values, as well as the wish for a more inhabitable, healthy, sustainable and secure space for all, emerges cognitive capacity which is the real power of society and allows for the imagination of a synergistic port-city ecosystem that, as a whole is much more than its single parts alone.

Designing Paradoxsynergy

After synthesizing the outcomes of the analysis, which elaborated on to the social, cultural, economic and environmental specificities and unique characteristics of the local/region, but also investigated on the dangers, impacts and conflicts the area has faced, is facing and will face, a suitable design for the port-city of Kirkenes, guided by a fictional approach, follows.

While the current proposal focuses on the layout of a functional port within the context of territorial logic of transport and logistics, this approach aims for the in-between-scapes, where port and city are intertwined and embedded within each other.

The contradicting goals and values of the two institutions and their interrelated stakeholders create the actual richness for designing the port-city from being seperated entities towards a third dimension of port-city encounters filled with heterogenity, incompareability and ambiguity. Those encounters or side by side of urban and territorial, people-planet-prosperity, local specificities and global generics will be called Paradox Synergy Scapes, due to their liminal character of being a constant interplay between paradox and synergy.

Parado[$^{x}_{s}$]ynergy

Urbanism as a profession of spatial planning and designing can either research and design those scapes within already existing layouts of port-cities, but also, like in this case, propose a new design of development which first needs to create those encounter-scapes.

07 SYNERGISTIC ADAPTIVE ECOSYSTEM
PORT-CITY PARADO[xs]YNERGY SCAPES

» Landscape is defined,
as perceived by humans,
as an area of (inter)actions
between natural and
human-made processes. «

NIJHUIS & JAUSLIN, 2015, P. 18











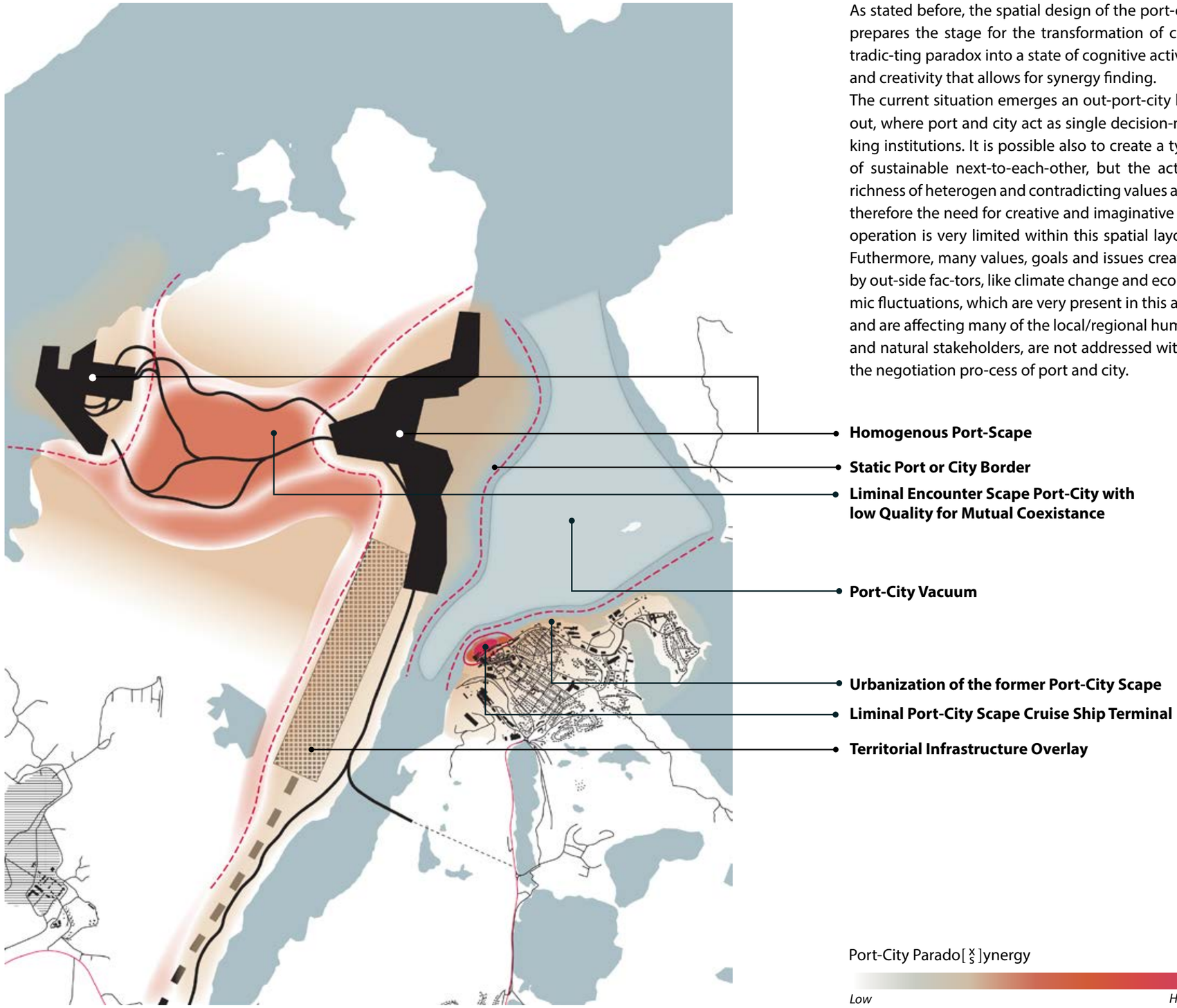




▲ *Photos / 106-123* **Impressions**

DESIGN
CURRENT STATE

▼ *Figure / 61* **Current Port-City Scapes** / *Höller*



As stated before, the spatial design of the port-city prepares the stage for the transformation of contradic-ting paradox into a state of cognitive activity and creativity that allows for synergy finding.
The current situation emerges an out-port-city layout, where port and city act as single decision-making institutions. It is possible also to create a type of sustainable next-to-each-other, but the actual richness of heterogen and contradicting values and, therefore the need for creative and imaginative cooperation is very limited within this spatial layout. Futhermore, many values, goals and issues created by out-side fac-tors, like climate change and economic fluctuations, which are very present in this area and are affecting many of the local/regional human and natural stakeholders, are not addressed within the negotiation pro-cess of port and city.

That is mainly because the proposed layout of a functional, outsourced port emerges three spatial phenomena, which already have been identified as unwanted, counter-productive and critical:

1. The Separation of Port and City due to Waterfront Redevelopment
Due to the out-sourcing of the port infrastructure towards the coastline of the neighbouring peninsula, many of the port-milieu currently embedded within the urban environment along the waterfront will move and free the space for urban redevelopment. Nevertheless the continuous dismantling of obsolete port-structures within the urban environment increases the separation of port and city, due to disconnected decision-making processes of such an urban redevelopment.

2. The Creation of a Port-City Interface
The concept of the interface focuses on the management of conflicts between port and city. Those problems and conflicts will mainly be investigated and managed along the line-like interface of port and city/region. This strengthens the separated character of both entities as oppositional players.
Such a thinking neglects the renewed imagination of port and city, territorial and local, as potential synergistic co-players within a third dimension of encounter-scapes.

3. The Emergence of a Port-City Vacuum
Last but not least, all of the above create a port-city vacuum. The spatial division is too far and therefore doesn´t allow for encounter and interaction in space and therefore neglects the ability of spatial planning as mediator for sense-making between the separated entities, their actors and their interrelated values, goals and wishes.

DESIGN
INSPIRATION

▲ *Photo / 124* **Image of a Goathe or earth house**

Sámi Architecture:

Architectural structures not only tell a lot about the understanding of societal and economic constructions within one society but also show the understanding of their relationship with its environment, nature and climate. The architectural typologies and structures the Sámi developed over several hundreds of years show their close link to natural conditions and dynamics as well as temporal changes within the environment they are living in. Compared to many western structures of Built Environments, the temporal type in Sámi architecture is usually not existing and only emerged due to the impacts, e.g. Norwegianization, resettlement, etc, by intruding western cultures.

Usually there are five spatio temporal types of build structures in Sámi culture: the ephemeral/transient, the episodical, the periodical, the seasonal and the semi permanent. While the first two to three types can be referred to nomadic to semi nomadic societies usually having pastoral reasons to migrate in-between the different seasons to follow their semi-domesticated reindeers or other animals. The last group of semi-permanent structure refers to societies or parts of the Sámi community practicing cultivation or being bound to specific environmental locations like coastal areas for fishing.
Two main structures are observed, the Goathe and the Lavvu (Bergman, 1991; Schoenauer, 1973).

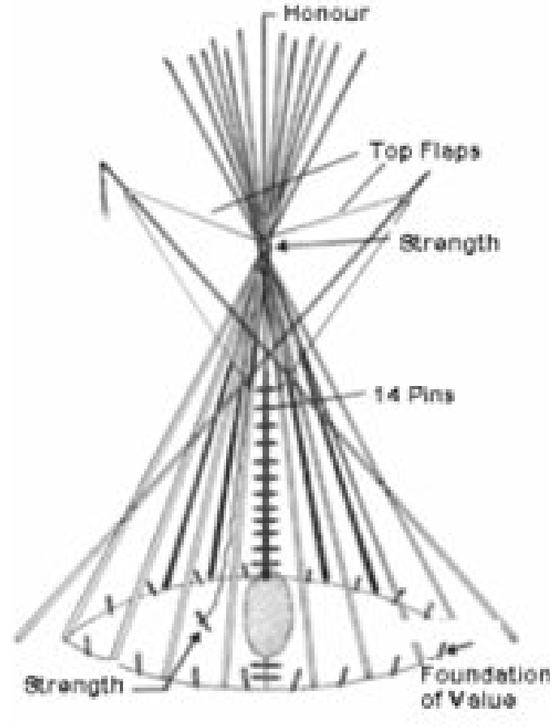
The Goathe, or earth house can be seen as a semi permanent or episodical structure, which can last up to 10 years. The used materials are taken from nature and are given back to nature after it is not used anymore. This level of flexibility but also sustainability depicts the close connection to, but also the Sámi`s knowledge about the nature they inhabit. (Anderson, 1999).

Another structure, the Lavvu also called Goathi, which can be compared with the Tipi, was ususally used by highly moveable and flexible societies. Nonetheless, it is flexible and easy to construct and deconstruct and far from endangered by environmental or other impacts. Living under the harsh conditions of the Artic Tundra, the Sámi construct the Lavvu in a way, the door always faces away from the wind, keeping warm air inside and sucuring the inside from the destructive force. Furthermore the flexible character allowes to place and when neccessarily replace the building in sheltered or more suitable spots.
All the knowledge about nature and environment allowed the Sámi to develop an unique set of implementations in their built environment which helps them to survive in the most undesireble spots in their territory (Schoenauer, 1973).

Sámi Architecture and Port-City Scapes

Reflecting these clever, efficient, adaptive and sustainable concepts can be very helpful for the proposed design of a sustainable and adaptive port-city region. One example is the identification of the different dynamics the built environment needs to react to. On the one hand those can be natural dynamics, as the report already identified while analyzing the natural participants and their functions to humans and itself.
On the other hand, also economic or societal changes, like shrinking or growth of the city, due to new or crumbling economic brenches within the city should be taken into consideration. As already investigated, the new developed settlement in the south of Kirkenes could be rethought and more flexible solutions can be found due to the uncertainty of future growth or population loss. Furthermore port-city regions are locations where many temporare, seasonal or short-term guests, like shipping crews, fishermen or tourists gather for an uncertain amount of time. Using the concept of seasons and episodes instead of permanent buildings can be a valuable knowledge while rethinking port-city regions.

As investigated, the use and re-use of natural or ready-to-take materials found within the proximit environment is one of the sustainable features of the Sámi architecture. Port-city regions are hotspots for the accummulation of materials of all sorts. Combined with the goal of circularity and sustainable port-city region development, stated in one of the AIVP Agenda 2030 goals, the investigation on suitability of certain available materials, either produced or dumped within the port or by its related industry, can help to achive a new form of sustainability and adaptability.



▲ *Figure / 62* **Sketch of a Lavvu**

DESIGN
INSPIRATION

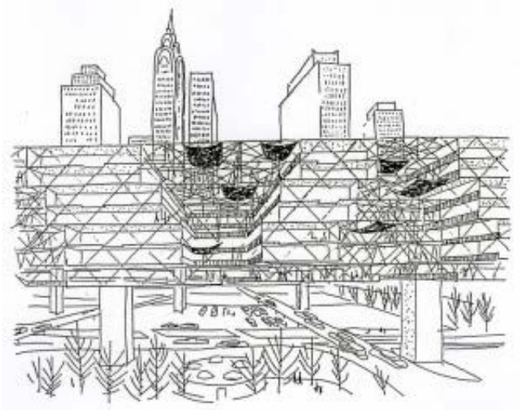
L`Architecture Mobile

In 1959 Yona Friedman released his manifesto L`Architecture Mobile in which he explains the idea of creating elevated city spaces where people can live, work and recreate. With his introduced method to build urban structures above already existing built space, he tried to restrain the land-use of growing cities and pleaded for compactness instead of ongoing expansion of urbanized areas. The concept of flexibility was achieved by a multi-layered structural skeleton grid on stilts that was put above existing structures therefore easily adaptable to changing needs and growing demands for housing. Between the hanging structures, Friedman imagined free spaces, that creates room for light and nature. His approach started the discussion about the inclination to build more and more as well as the rights for integration, self expression and self-sufficiency in a modern society. He also reflects on the role of capitalism, the use of architects and the matter of respect for natural environments.
Similar to the architecture of the Sámi, but from a western perspective, Friedman early expresses the need for flexibility but also compactness, the role of the indiviual in the overall design and planning processes as well as the importance of nature inclusion (Friedman, n.d.).

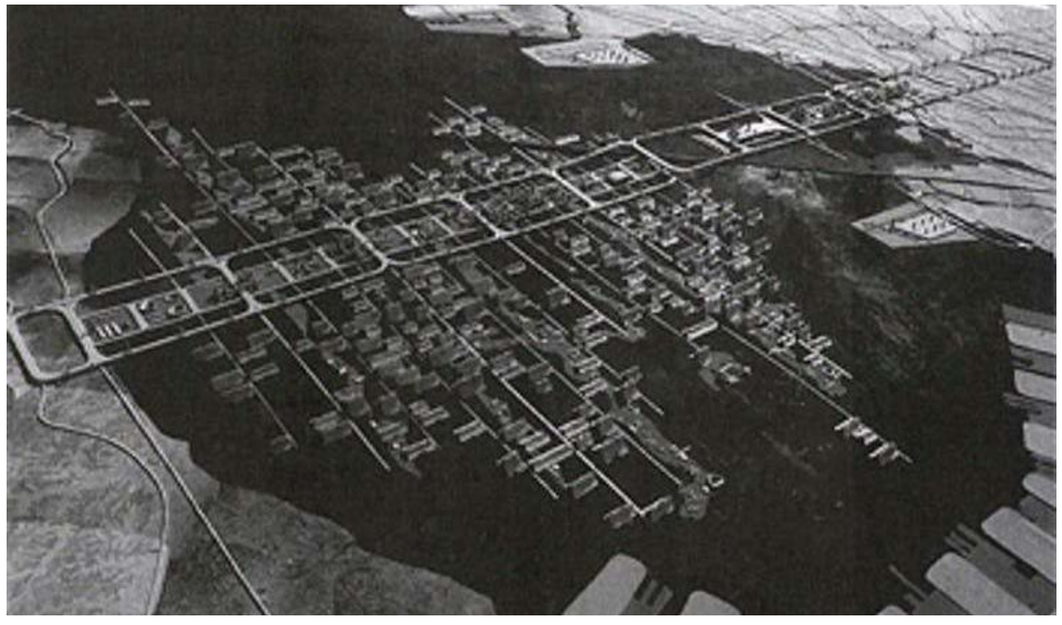
L`Architecture Mobile and Port-City Scapes

Friedmans idea to build upon existing structures to decrease land-use by urban expansions can be very interesting when talking about port-cities. On the one hand, really building ontop of industrial, almost two-dimensional operating structures, like quays and container plattforms can be a compelling concept to follow. When looking at the space, which is occupied by container terminals questions contemporary approaches of building ports, but also cities.

On the other hand, the flexible and adpative reflection on Port-City Scapes could mean, that not only built structures but also different activites, flows, dynamics and synergetic interrelations should be layerable, similar to the skeleton grid he proposed. Creating spaces that are adaptable to changing needs are neccessary to fullfill the goal of reintegrating the port and the city as well as to implement natural participants, dynamics and processes into still operating spaces.



▲ *Figure / 63* **Ville Spatiale over the city of New York / Photo: Yona Friedman, 1964**



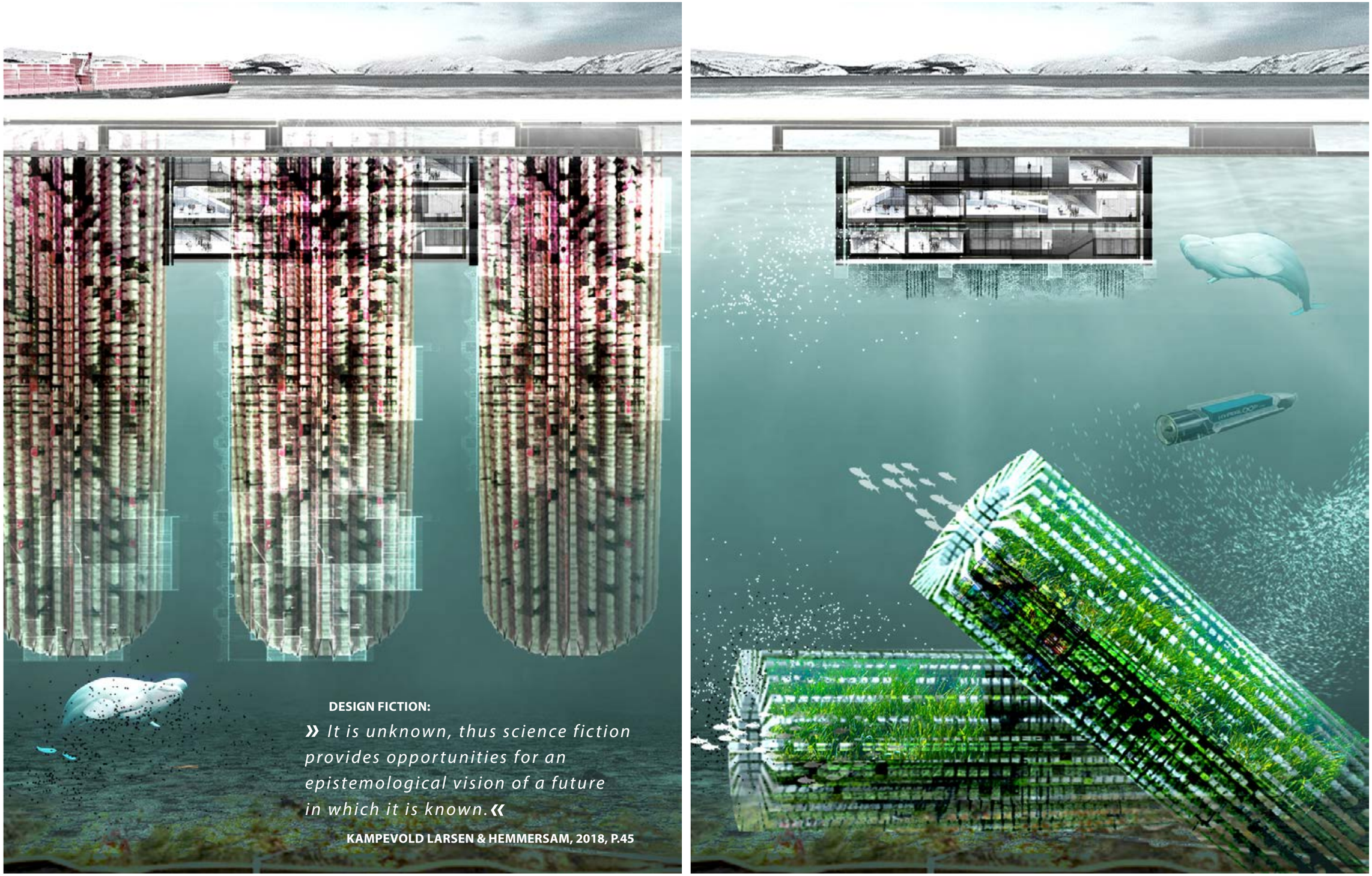
▲ *Photo / 126* **TANGE'S 1960 Tokyo Bay Plan /** *Tange attempted to impose a new physical cross-bay order on Tokyo which would accommodate the city's continued expansion and internal regeneration.*

Floating Urbanism

Most of the time, the concept of Floating or „Blue Urbanism" deals with increasing sea-level rise, flooding events and other similar risks that impact coastal cities all around the world. As the word floating already anticipates, water is given the highes priority, but mostly not because of its possibilities but because of the need to adapt to the economic and societal risks it brings to urban regions. Floating urbanism can be a suitable and valuable concept also for coastal cities which are not implicitly affected by flooding or stormwater events. The possibilities and changing perspective by building floating structures on water are manifold (Beatley, 2014).
One of the biggest opportunities is the flexibility, gained by the possibility to easily move, change and adapt built environments. Most modern floating structures can be prefabricated, similar to ships. Port-cities already have the suitable infrastructure to produce those structures in warfts and drydocks. Not only the urban environment but especially the industrial envrionment often becomes victim to tansitions and changes. As stated at the beginning of the thesis, port-cities world wide went through serveral changes of this kind. Technological innovations, like the shipping container, but also the ongoing growth of ship sizes pushed the hard-built and static structures to its limits. Some historic port-cities like Hamburg still show the once existing interconnection of port and city before they got obsolete and the port moved to the edge of the urban region.
Another advantage of floating structure is the rethinking, needed to create similar living conditions as on land. Infrastructures, like cables and pipelines need to be thought differently as on land. Furthermore, the production of energy as well as the disposal of waste and sewage work differently when living on water, if the goal of environmental sustainablitliy should be achived.

Imagining Port-City Scapes as a real mixture between aquatic and terrestrial, instead of only coastal structures, increases the possibilites for a sustainable and integrative approach.

▼ *Figure / 64* **Floating Port Design Fiction /** *Höller*



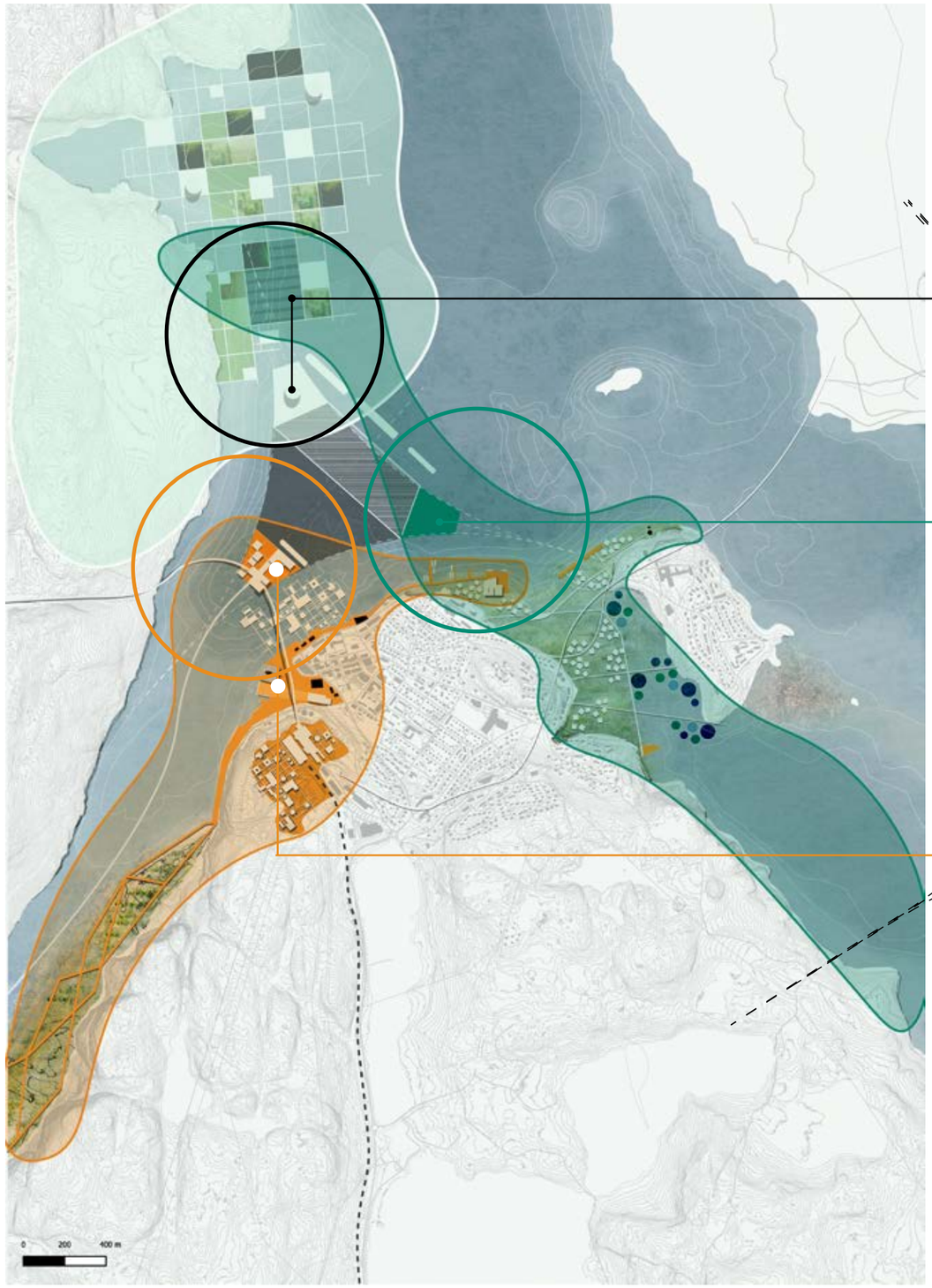
DESIGN FICTION:

» *It is unknown, thus science fiction provides opportunities for an epistemological vision of a future in which it is known.* «

KAMPEVOLD LARSEN & HEMMERSAM, 2018, P.45

FLOATING PORT
AS SYNERGISTIC CONCEPT

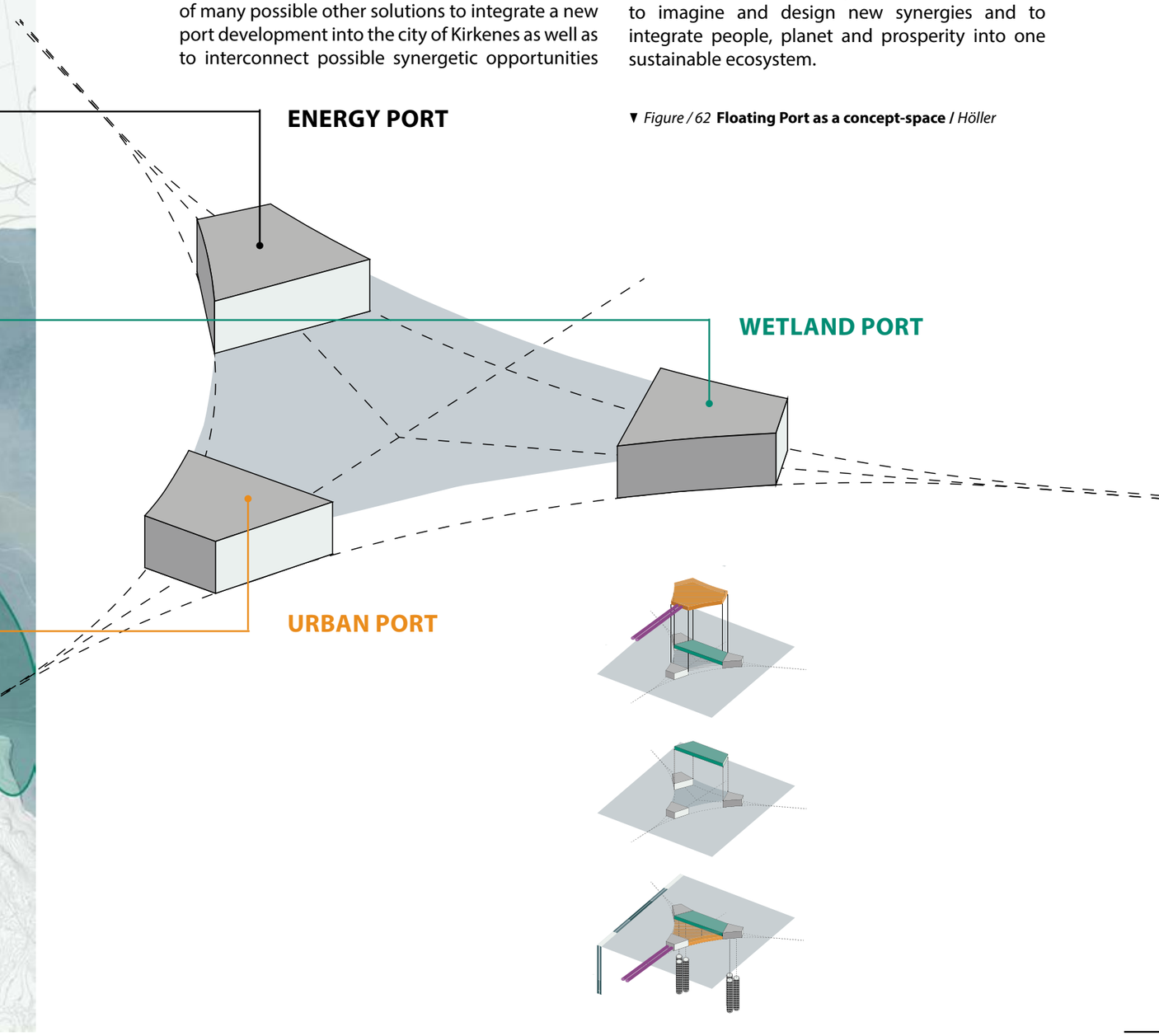
▼ *Figure / 65* **Floating Port Design Fiction /** *Höller*



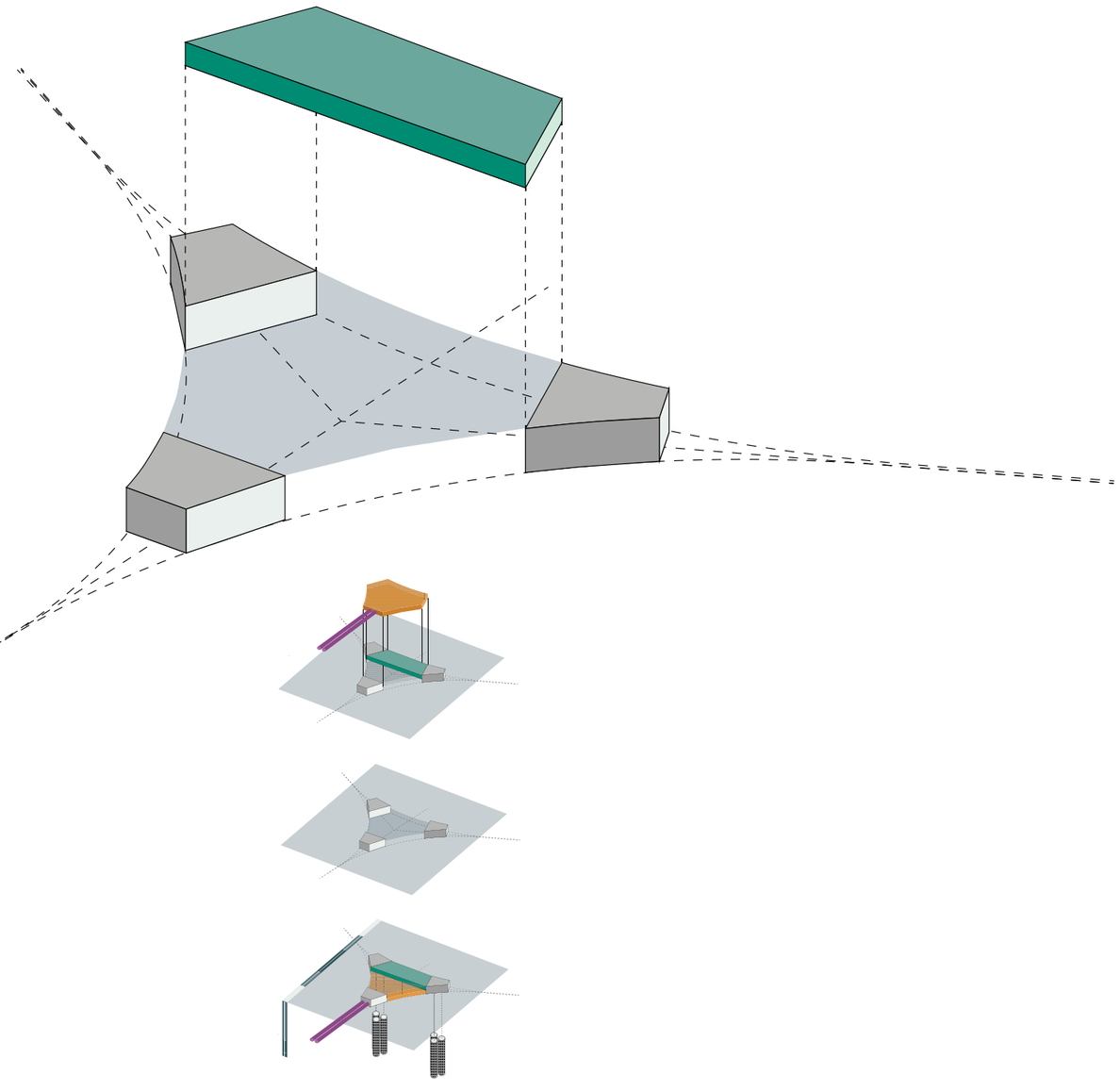
The Floating Port as a Concept-Space

The project proposes a floating port to use it as a concept to achieve a synergistic adaptive Port-City Scape. The goal is not to elaborate on the economic or technical feasibility of the floating structure. The aim of the thesis is to create a Design Fiction of one of many possible other solutions to integrate a new port development into the city of Kirkenes as well as to interconnect possible synergetic opportunities to encounter many different existing risks and future uncertainties, increased by economic development and exploitation of the region and by climatic changes.
A floating port as a conceptual construct can help to imagine and design new synergies and to integrate people, planet and prosperity into one sustainable ecosystem.

▼ *Figure / 62* **Floating Port as a concept-space /** *Höller*



▼ *Figure / 66* **Concept of the floating container terminal /** *Höller*



FLOATING PORT
AS ADAPTABILITY CONCEPT

The Floating Port as Adaptive Concept

A floating port can increase the capacity to adapt to economic changes and transitions. As already investigated, the proposed plans for the Port of Kirkenes by the municipality of Sør-Varanger thrives for becoming a player in profitable but unsustainable and instable economic brenches, like mining, container shipping and oil/gas industries.

A new port development is an expensive and risky investment. A floating port structure can reduce several of those risks:

1. If economic interrelations are changing, e.g. reduced interest of Asia-European trade by Chinca, but also political conflicts between Russia and China or the European Union or the opening of even faster sea-routes through the Arctic, a floating port structure can be sold, moved to other locations or easily repurposed. On the other hand, if economic developments are having positive trends, a floating port structure allows easy expansion without the additionaly need for new land and the risk of further ecological or societal impacts.

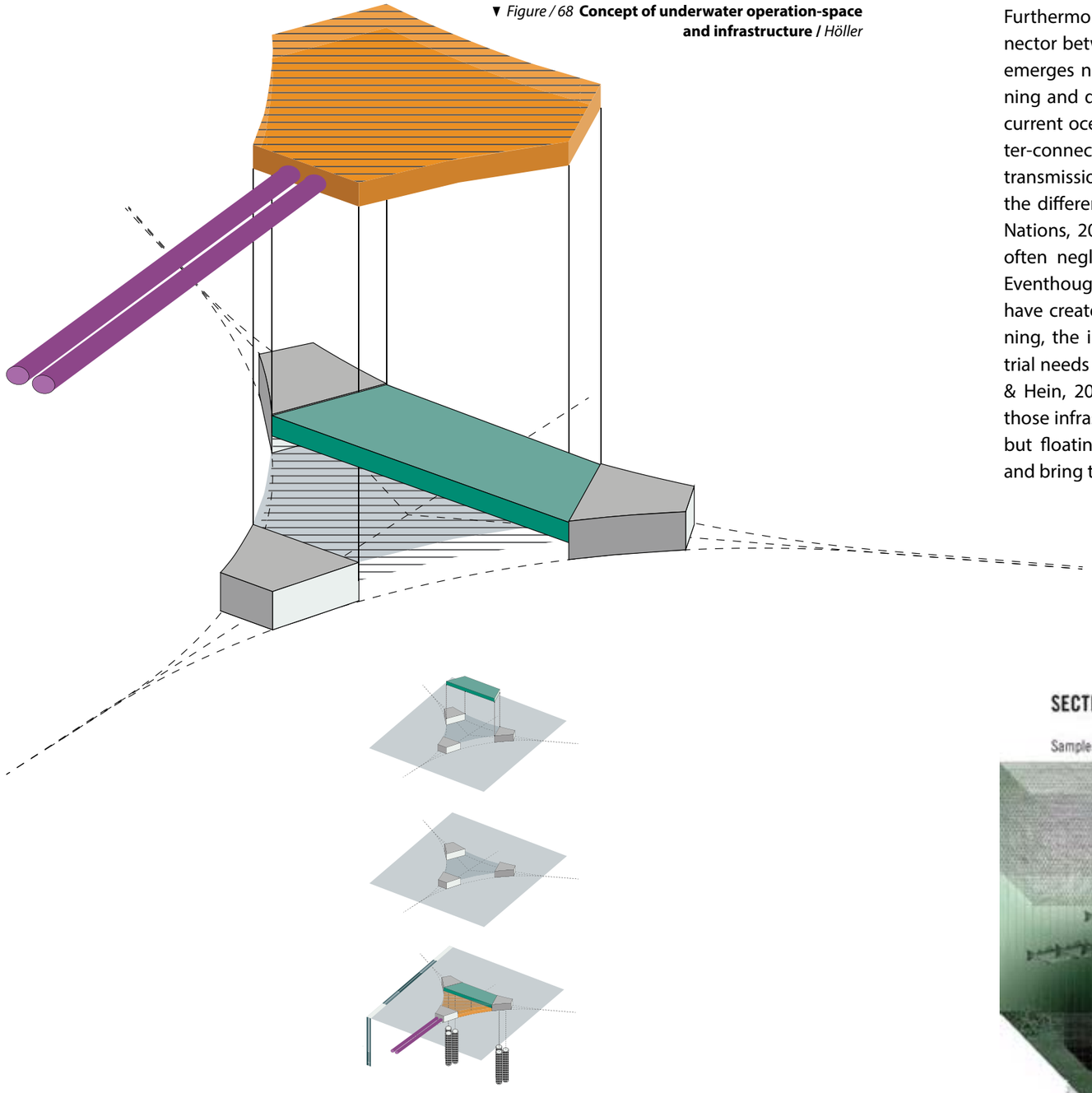
2. As shown on the next page of the thesis, the Design Fiction plays with the emergence of new technological innovations. It asks the question of gowing ship sizes but also other developments like the shrinking of structures in maritime logistics. What if the container itself becomes the ship and how can a floating port adapt to those changes? What are the integrative and synergistic opportunities for port-city regions of possible new technologies?

▼ *Figure / 67* **Submerged Baltic route. The Finnish government is also working with engineers Ramboll to establish a test track section that would run from Salo towards Turku. /** *HyperloopOne*

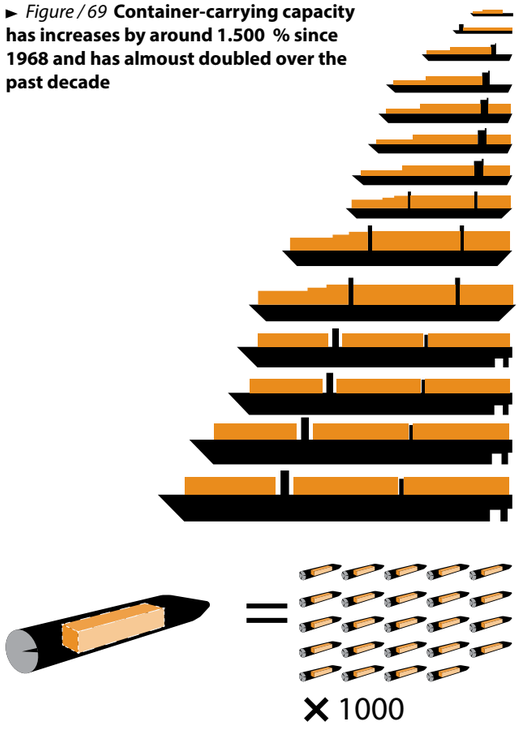
FLOATING PORT
AS ADAPTIVE CONCEPT

Furthermore a floating port as a real spatial connector between the terrestrial and aquatic system, emerges new important question about the planning and design of underwater infrastructure. The current oceanic-floor is packed with 285 cables inter-connecting all parts of the world, provide data transmission as well as enable navigation along the different sea routes around the globe (United Nations, 2017). Those infrastructural elements are often neglected in the field of spatial planning. Eventhough, engineers and infrastructural planners have created networks of the marine spatial planning, the infrastructure follows and serves terrestrial needs within an aquatic environment (Couling & Hein, 2018). Especially within port-city regions those infrastructures are hiding in the background, but floating port structures could help to reveal and bring them into the foreground.

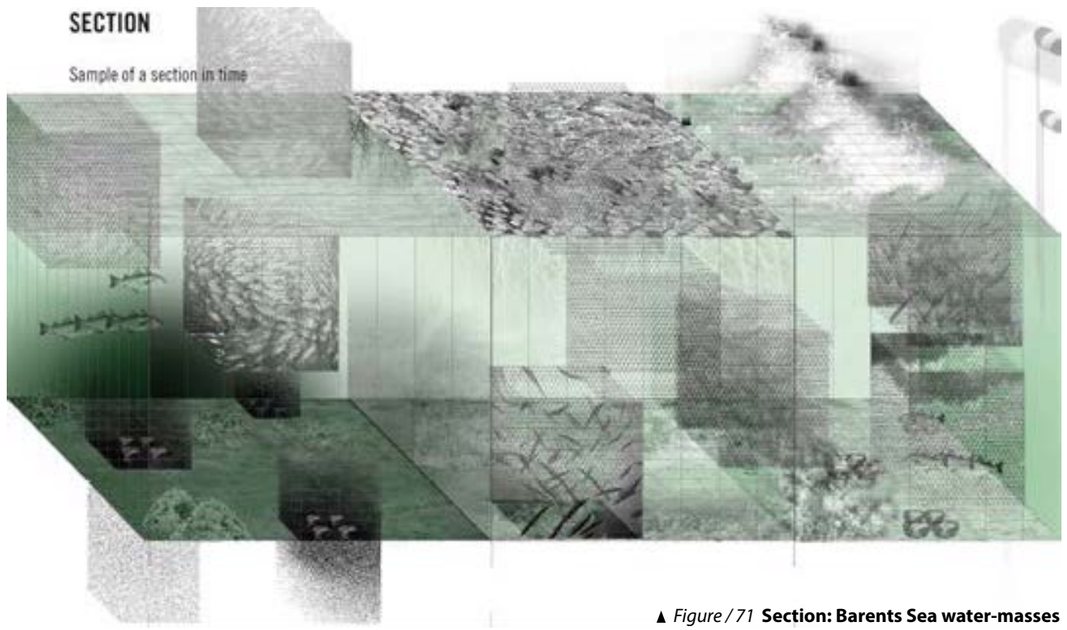
▼ *Figure / 68* **Concept of underwater operation-space and infrastructure /** *Höller*



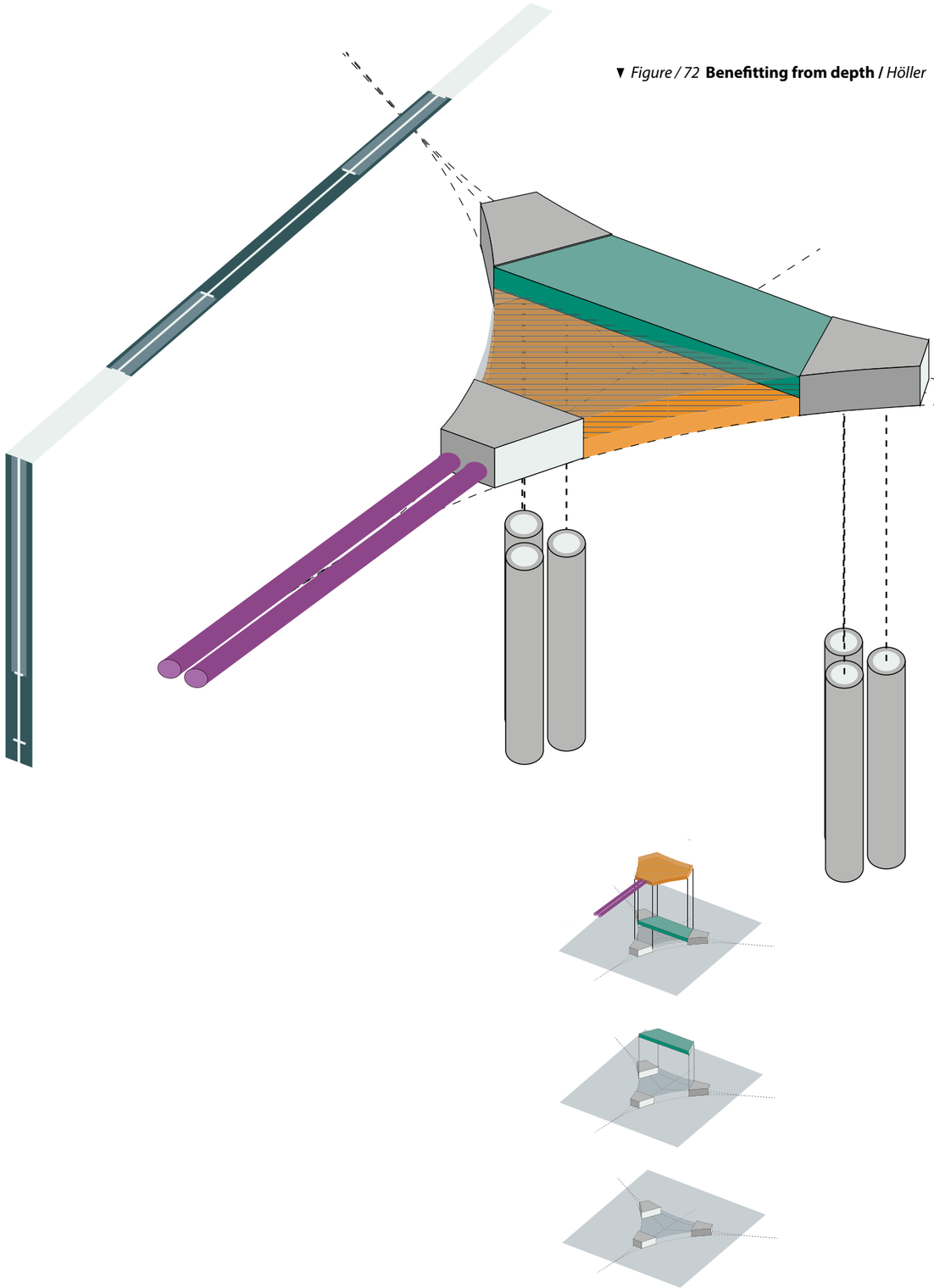
► *Figure / 69* **Container-carrying capacity has increases by around 1.500 % since 1968 and has almoust doubled over the past decade**



▲ *Figure / 70* **Amount of container-pods equivalent to a regular container ship /** *Höller*



▲ *Figure / 71* **Section: Barents Sea water-masses**



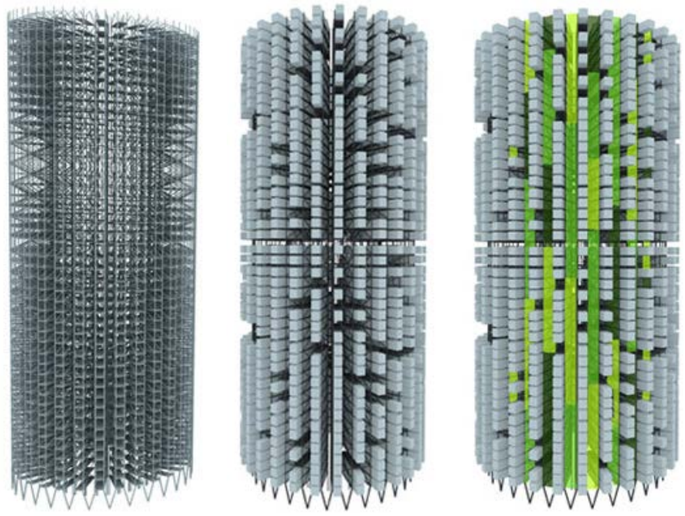
▼ *Figure / 72* **Benefitting from depth /** *Höller*

FLOATING PORT
AS SUSTAINABLE CONCEPT

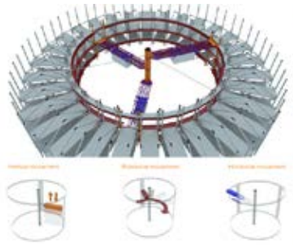
The Floating Port as Sustainable Concept

All the latter discussed elements together can make floating port structures to sustainable options for-coastal and land-based solutions.

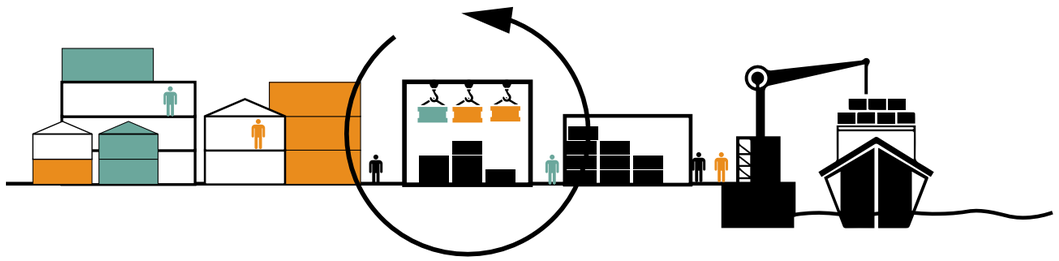
The compactness, no land-use conflict as well as new opportunities for technology and spatial planning, but also the new evolving potential risks, which need to be thought through can help to imagine a new, alternative Port-City Scape.



▼ *Figure / 73* **Compact container port /** *casanova+hernandez architects*



STRATETIC AND PLANNING TOOLS
FOR PARADO[X/S]YNERGY



Circularizing Values

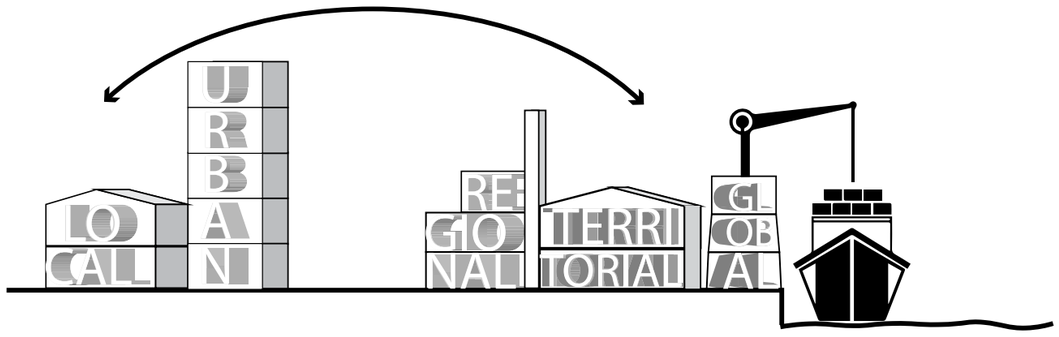
The "Circularization of values" can be defined as multiple ways of transforming global into local values.

Circularization of Materials (CE):

Ports but also local cities exchange materials in form of export, import, waste production and many more. The area where values in form of e.g. materials, but also other flows are transformed from being part of one entitiy into the other becomes the liminal space between port and city.

Circularization of People:

Port-Cities are temporal homes for workers but also tourists. The Port-City Scape, where people with global values arrive to and encounter local culture emerge to be liminal spaces between port and city.

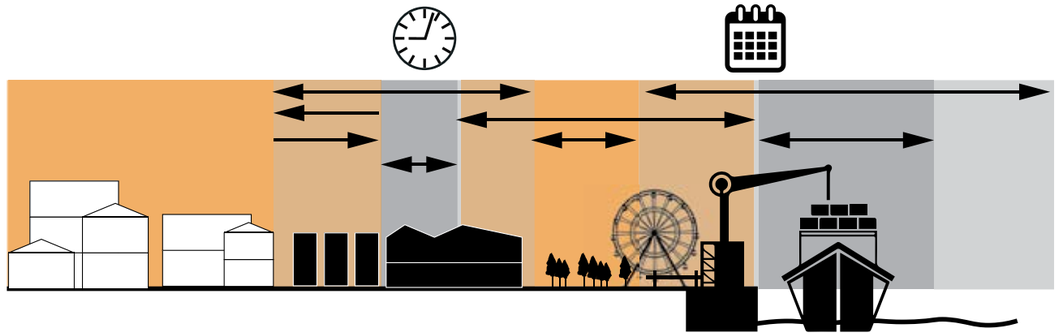


Global - Local Countering

Global-local countering ensures that the development of the Port-City Scapes does not follow a singular adaptive logic, driven by the generic impact of global dynamics, which would make the the port the determining factor for local development.

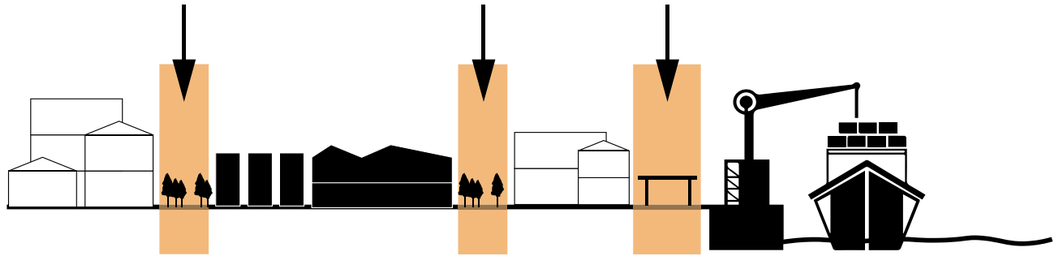
Finding local specificities as encounters to those global dynamics and developments, ensures that the local culture of the port-city region can create the value of autonomy.

This does not only create individuality but also provides the base for Paradoxsynergy between the specific, local city and the global, generic port.



Isoligrating - Filtered Sharing

Filtered sharing creates the spatial assets for a dynamic and changing port-city scape based on the temporarity of interrelating or contradicting flows and values. This allows the port and city entity to shift form, size and activites depending on different time-periods. The spatial amplitude of the shared space, in which certain port and/or city activities are filtered in and out becomes the port-city scape.



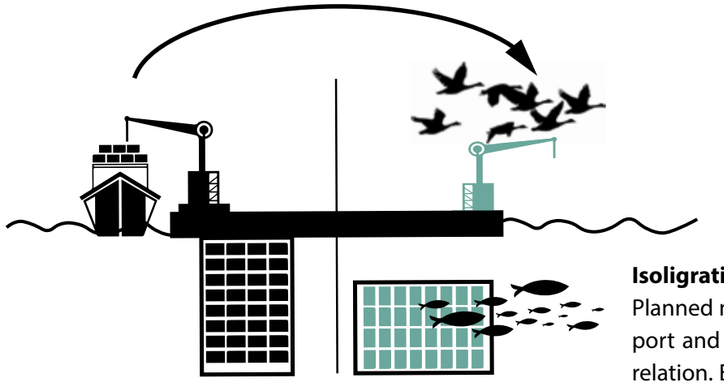
Isoligrating - Buffering

Buffering ensures the coexistence non-integratable port and city structures by isolating them, without setting them out of spatial context.

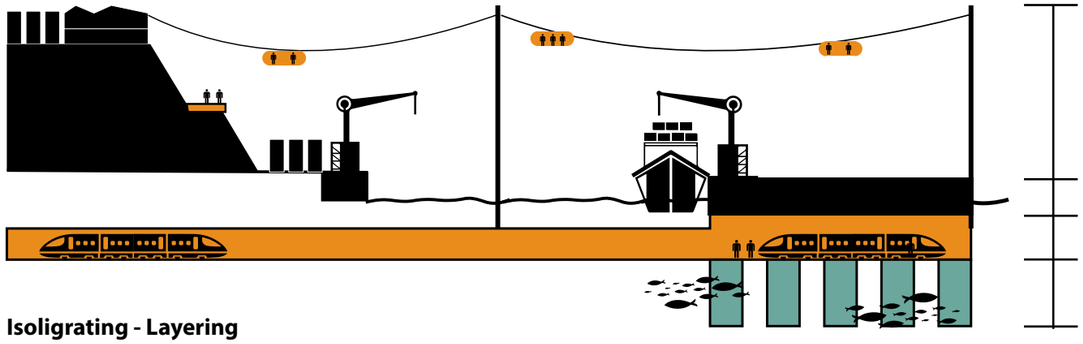
On the one hand the buffer creates a clear devision between port and city space, without decreasing the embeddedness of the port- milieu within the city.

On the other hand, the buffer zone as the liminal space between port and city can accomodate shared or combined activities, flows and values beneficial for both port and city, e.g. within water or along other forms of infrastructure.

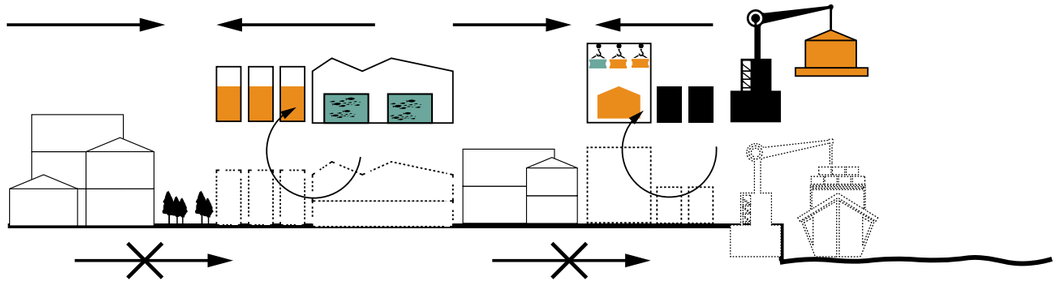
▲ *Figures/ 74* **Port-City Paradoxsynergy Scapes/** *Höller*



Isoligrating - Planned Metamorphoses
Planned metamorphoses creates inbetweenness of port and city region through a future-based interrelation. Eventhough the scape itself appears to be homogenious (either part of the port or city entity) a planned metamorphoses as a change of a space, technology or flow from one entity into the other emerges an invisible Port-City Scape within the context of time.
From a stakeholder point of view, such a long term planning of the Port-City Scape requests cooperation not only during the transition but already during the planning of such a metamorphoses-scape.

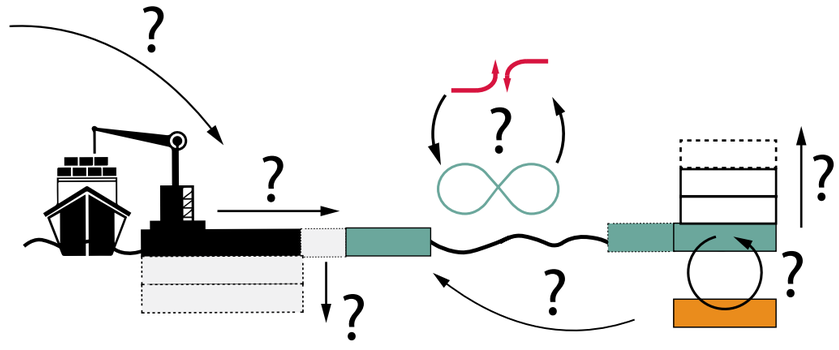


Isoligrating - Layering
Layering of port and city scapes allows for coexistence of non-integratable values of port and city due to local topograhic specificities of the land-/seascape as well as due to innovations like floating structures.
The layering of port and city scapes creates a border-scape through height and helps to achieve a compact and mutual development of the area.



Re-oppose
As stated before, the redevelopment of obsolete port-milieus embeded within the city environment (especially along the traditional waterfront) increased the spatial and institutional seperation of port and city.

The attempt of "Re-opposing" port and city entity within those areas need to find new forms of liminality between port and city instead of increasing the urban environment by outsourcing the port.
Port and city need to identify new, future-proof and acceptable forms of port operations within the cities environment, which still allows for coexistence as well as creates mutual benefits and shared/combined values between port and city.

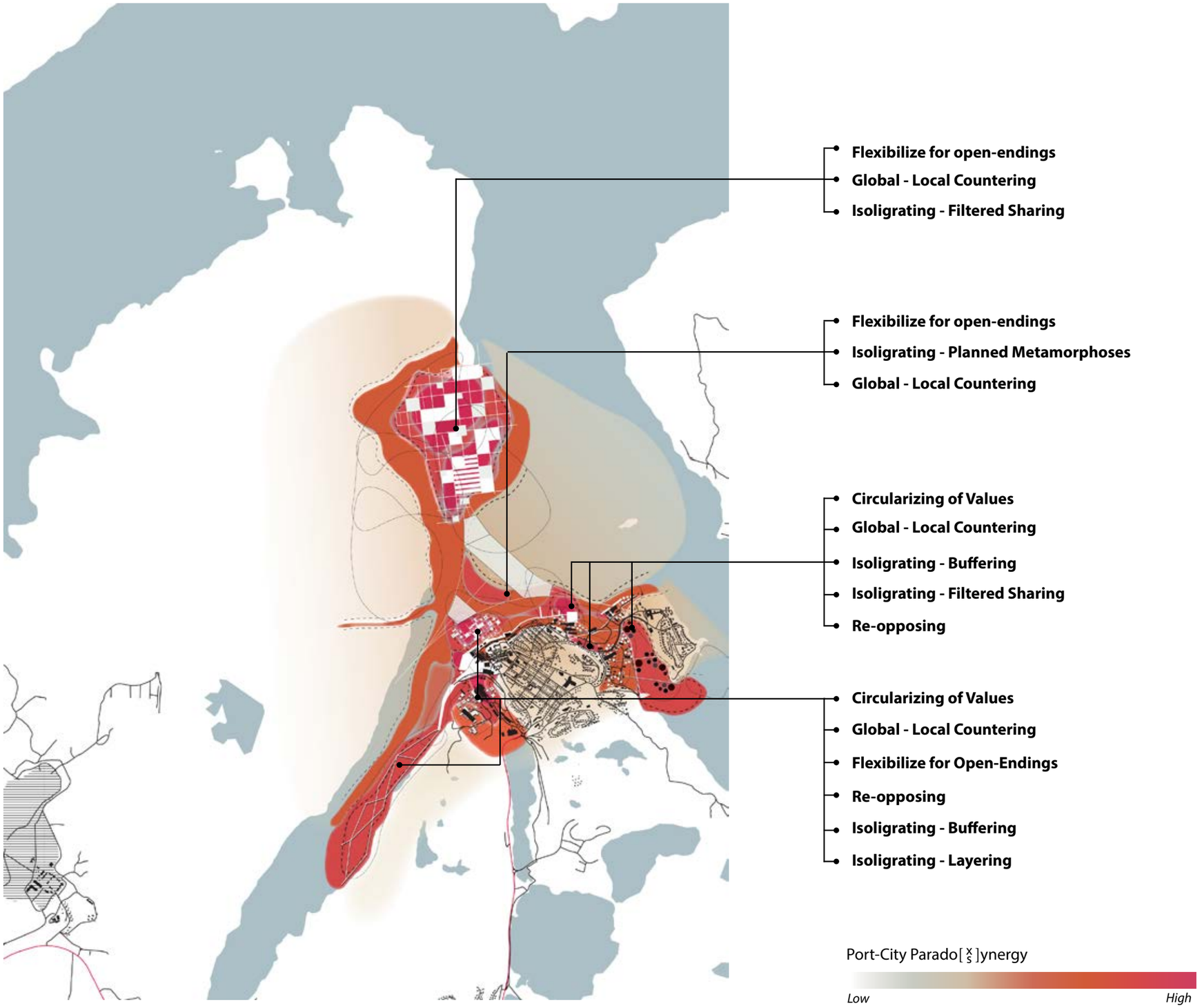


Flexibilize for Open-Endings
Flexibilizing the encounter scapes inbetween port, city and their environment helps to deal with the liminality of paradox and synergy. An open-ended planning approach but also the use of flexible spatial/technological designs creates Port-City Scapes, which are adaptive to changes in values and power and therefore allows a constant rearrangement of the scape, but also the emergence of new Paradox-synergy Scapes within the port-city region.

▲ *Figures/ 75* **Port-City Paradoxsynergy Scapes** / *Höller*

FICTION
PORT-CITY PARADOXSYNERGY

▼ *Figure / 76 Evolving* **Paradoxsynergy Scapes** */ Höller*



Therefore, the multiplication of encounters plays an important role within the design of the port-city of Kirkenes. The local specificities of the city/region become driver for the setting of the port, thus such encounter-scapes evolve.

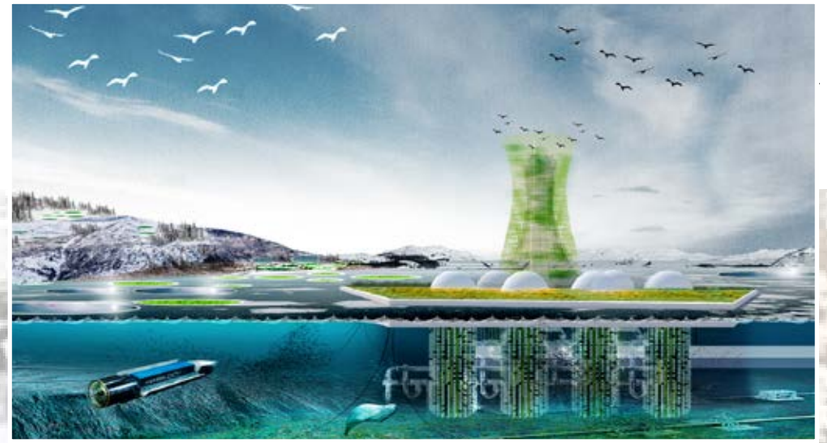
The reconnection of the port and urban environment and therefore the embeddedness of the global within the local allows, for a spatial, actors- and values-based approach, to design for coexistence of port and city within a dynamic, multi-layered third space or paradoxsynergy of port-city interrelations.

The main-proposal of the Design-Fiction is the implementation of a floating port structure. The close proximity and the result of multiply mirroring waterfronts where different functional, economic, societal, cultural and environmental values encounter. Thus, the emergence of the in-between scapes on sea and land become the accumulation-zone of imaginative and creative richness and potentials. The triangular shape of the floating port and therefore each tip and side focuses on encountering local-specificities of the city and its environment, which have been identified during the analysis of the city and its region.

The goal of the design is to find potential spatial layouts of the Paradoxsynergy-Scapes as well as to restructure and encounter the identified values of the participating actors and institutions and how those can be arranged to emerge a synergistic port-city ecosystem.

ENERGY PORT
FROM FRICTION TO FICTION

▼ *Photo / 128* **Aerial view on Tømmerneset**



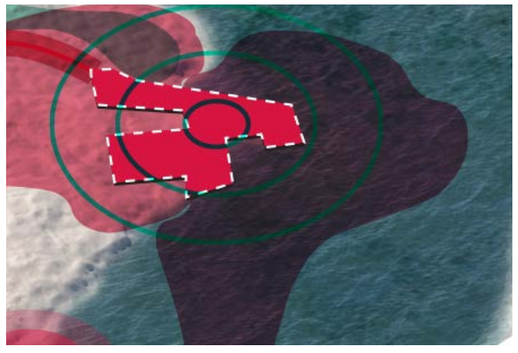
ENERGY PORT
EXISITING SITUATION

Existing Infrastructures

Tømmerneset Peninsula
The peninsula next to Kirkenes is currently occupied by three main activities: the airport, a military training ground and grazing activites by reindeers and their herders. Furthermore the location is, as investigated, rich on ecological qualities

Proposed Port development
The proposed development includes a port for several activities, e.g. container shipping and logistics, the interrelated infrastructure such as a potential railway and streets. Also, the oil/gas transshipment terminal is proposed to be located on the opposite side of the peninsula. Furthermore many other industrial waterfront activites, currently located in Kirkenes would move, as well as an industrial and commercial zone will be connected to the port.

Currently Planned Infrastructures



Existing Stakeholder

HUMAN PARTCIPANTS

Port-Interns
Port employees
Owners of port
Port-agency

Public Sector
Port authority
National Government, Ministers
Legislators
Urban development authorities

Market Players/Corporate Bodies
Port-related industries:
Shipping logistics
Ship building/repair/supply
Cruise ship companies
Offshore Oil/Gas Industry

Other Businesses
Tourism sector, e.g. Hotels, Tours
Research/Universities
Technology/IT
Planning/Engineering/Architecture
Energy Sector
Creative Sector

Civil Society
Permanent residents
Tourists

Indigenous Society
Sámi

NATURAL PARTICIPANTS

Biotic /Terrestrial:
Lichen
Reindeer
Birds

Biotic /Aquatic:
Algae and Kelp
Fish
Plants

Abiotic / Terrestrial:
Minerals, Oil, Gas
Sunlight
Soi-Substrat

Abiotic / Aquatic
Water
Sediments

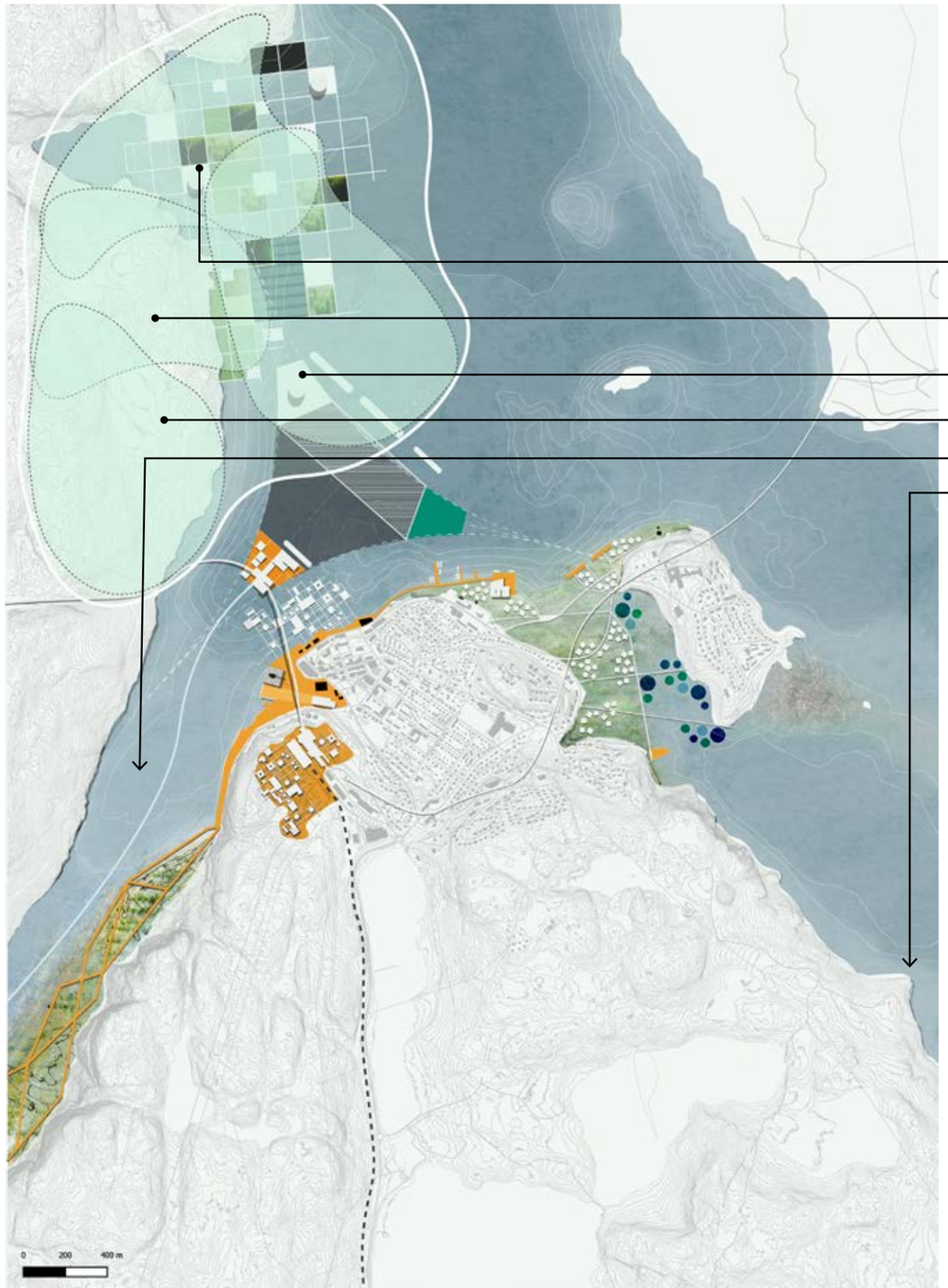
◄ *Photos / 127-128* **Aerial view on Tømmerneset**

◄ *Figures /77-78* **Spatial model of Leirpollen/Tømmerneset Peninsula /** *Höller*

◄ *Photos / 129-130* **Port developments planned**

ENERGY PORT
MAIN GOALS AND CONCEPT

▼ *Figure / 79* **Design Fiction Energy Port** */ Höller*



Main goal and concept of the Energy Port is the integration of reindeer heerding, Sámi culture, recreation and energy production as a port activity. Lichen, as important food source for the grazing reindeers and as potential biological hydrogen producer, can create the opoortunity for synergies between the future needs of the port and the maritime industry.

Synergistic Players:

Lichen as potential **energy producer** and the transition of the proposed **oil/gas transshipment terminal** into a **hydrogen powerplant** to create an unique oportunity for **Kirkenes** as a **pioneer in hydrogen production/availability** for shipping and logistics in **Artic** territories

Achieved Sustainability Goals:

Climate Change Adaptation:
4. Considering other climate change impacts, such as temperature, precipitation not only on port systems, supply chains and labor but also on *environmental participants* as well as the urban environment*;*
5. Making resilient and carbon neutrality a priority;

Energy Transition, Circular Economy and *General Circularity*:*
1. Promoting cooperation between socio-economic, *societal/ cultural and ecological/natural stakeholders** to bring their activities together and identify potential synergies;
2. Give priority to circular economy and *circularity in general** to promote and investigate exchange or recycling of materials, energies *and other potential, natural or humanmade flows**;
3. Commiting the port-city region to achieving a low carbon, low resource society (e.g through renewable energies);

Sustainable Mobilty:
3. Promote waterways, railways and other non-fossile modes of transport and mobility for shipping goods *and urban mobility*;*

Renewed Governance:
1. Guarantee better representation for all stakeholder needs, especially civil society and *natural participants** in decision-making;
4. Developing collaborative approaches, drawing on scientific, technological, *cultural and natural* knowledge* from scientific community, civil society *and indigenous or alternative societies**;
5. Adopting a land and *sea** magament policy that strikes balance between urban use, port activity and *environmental use*;*

Investing in Human Capital:
3. Provide training in preperation and *re-education possibilities*;*
4. Promote interactions and projects between schools, *universities**, training institutions and the professional world;

Port-Culture and Identity:
1. Developing all types of open spaces within Port-City Interfaces to promote developments and activites;
2. Integrate spaces and functions open to everyone into port facilities, enhancing the visibility of port-activities;
5. Organizing temporary and permanent cultural events in port-city areas;

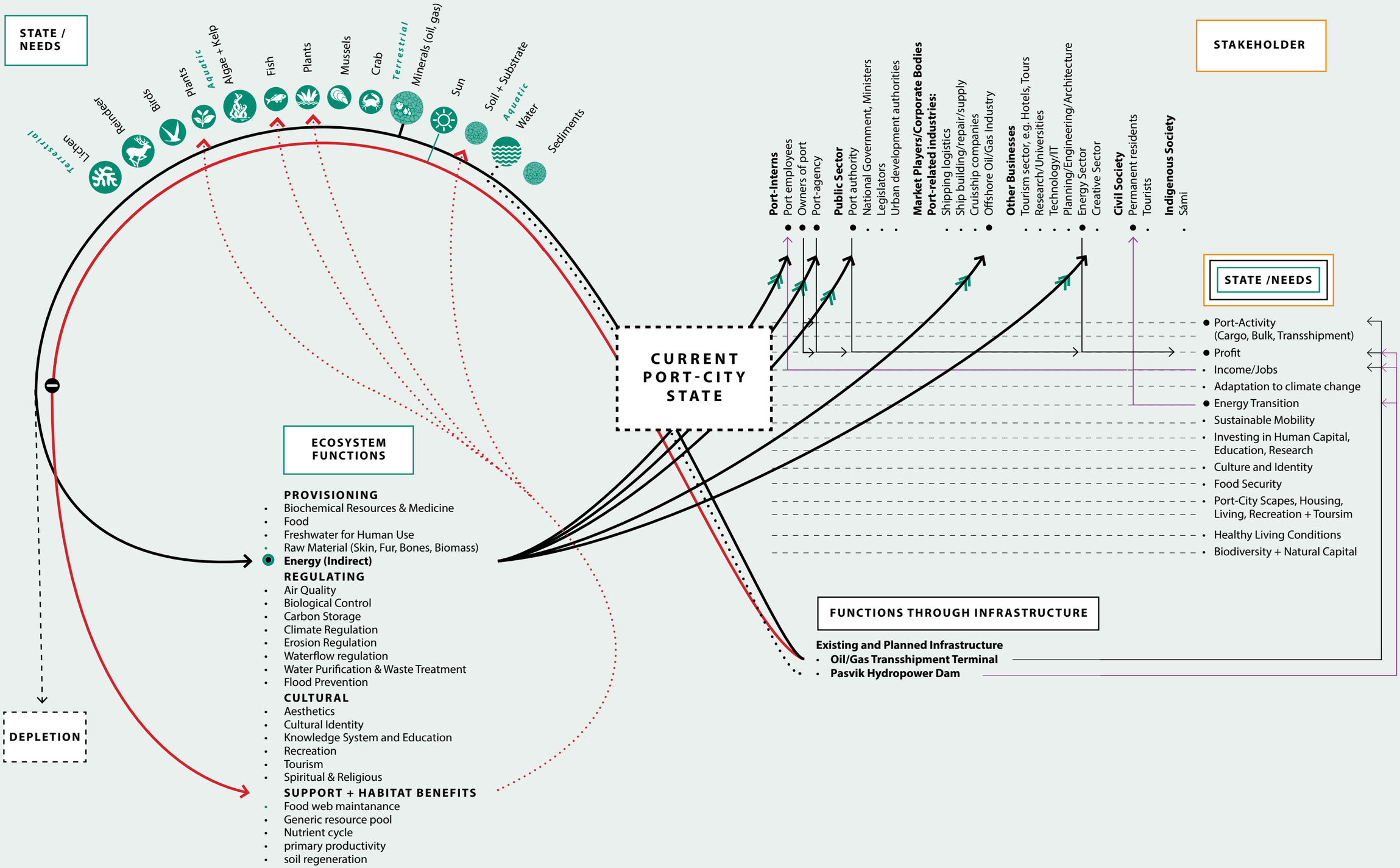
Promoting Living, Recreation and Cultural Amenities in Port-City Interface *and Region*:*
1. Incorporate measures and designes to reduce port nuisances into urban environment;
3. Develop public spaces, recreational and cultural amenities;

Healthy and Attractive Lliving Conditions for Residents, *Temporary Visitors (e.g. Fishermen, Shipping Crews) and other Members of the Society*:*
1. Independent, transparent measurements of air, water, soil quality, noise impacts, light pollution;
3. Promote green port facilities;
5. *Healty port-city environment through healthy nature*;*

Biodiversity and Natural Capacity:
1. Improving and maintaining water quality;
2. Regualar survey of biodiversity in port-city regions;
3. Prevention of destroying sensitive natural habitats when developing on- and offshore spaces;
4. Supporting civil society and indigenous/alternative societies to protect, *strengthen or even include natural participants *;*
5. Restoring and developing biodiversity *beyond protection towards integration ** in the port-city region;

ENERGY PORT
SYNERGISTIC LOOP

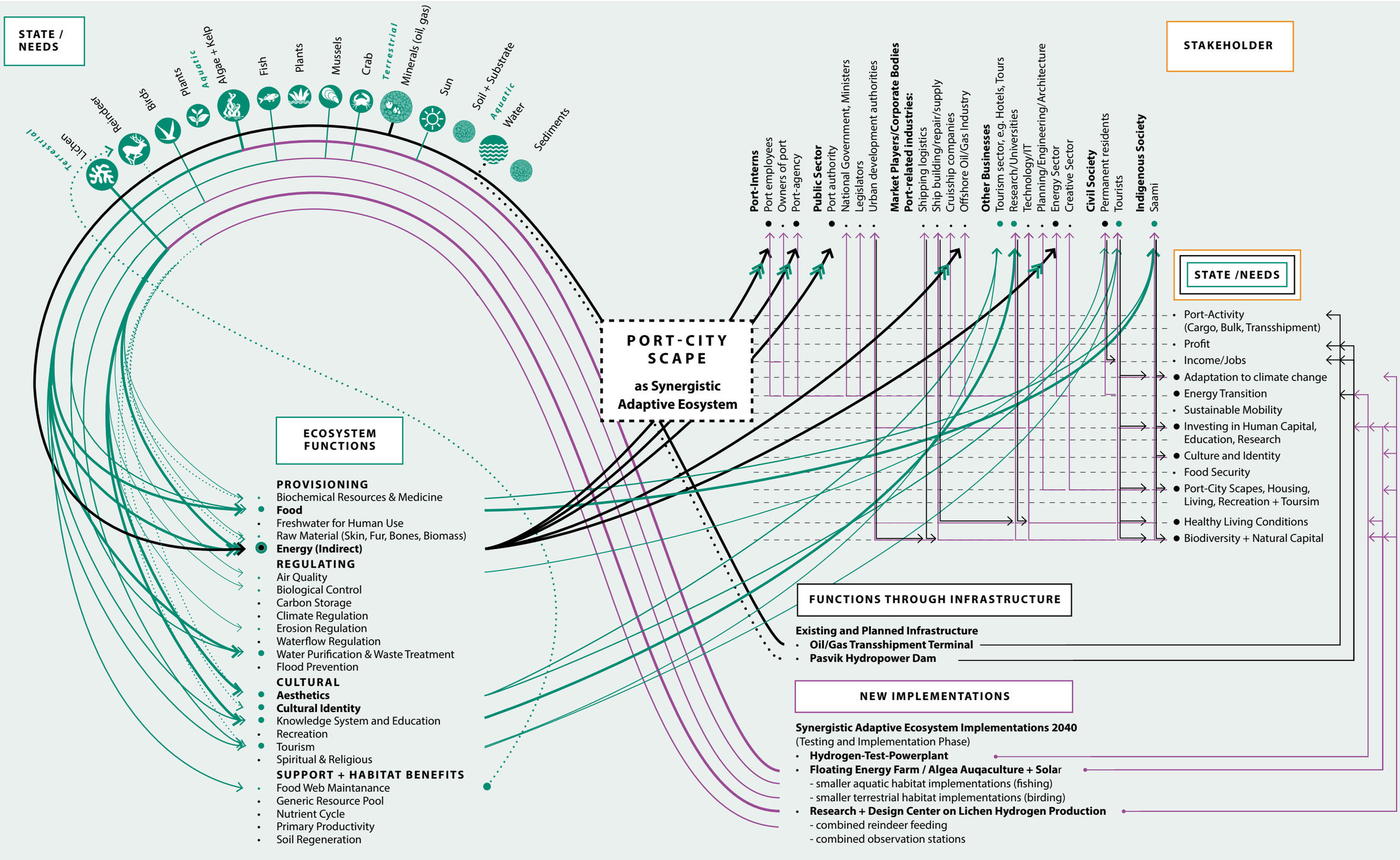
▼ *Figure / 80* **Current/Planned Port-City State** / *Höller*



ENERGY PORT 2040

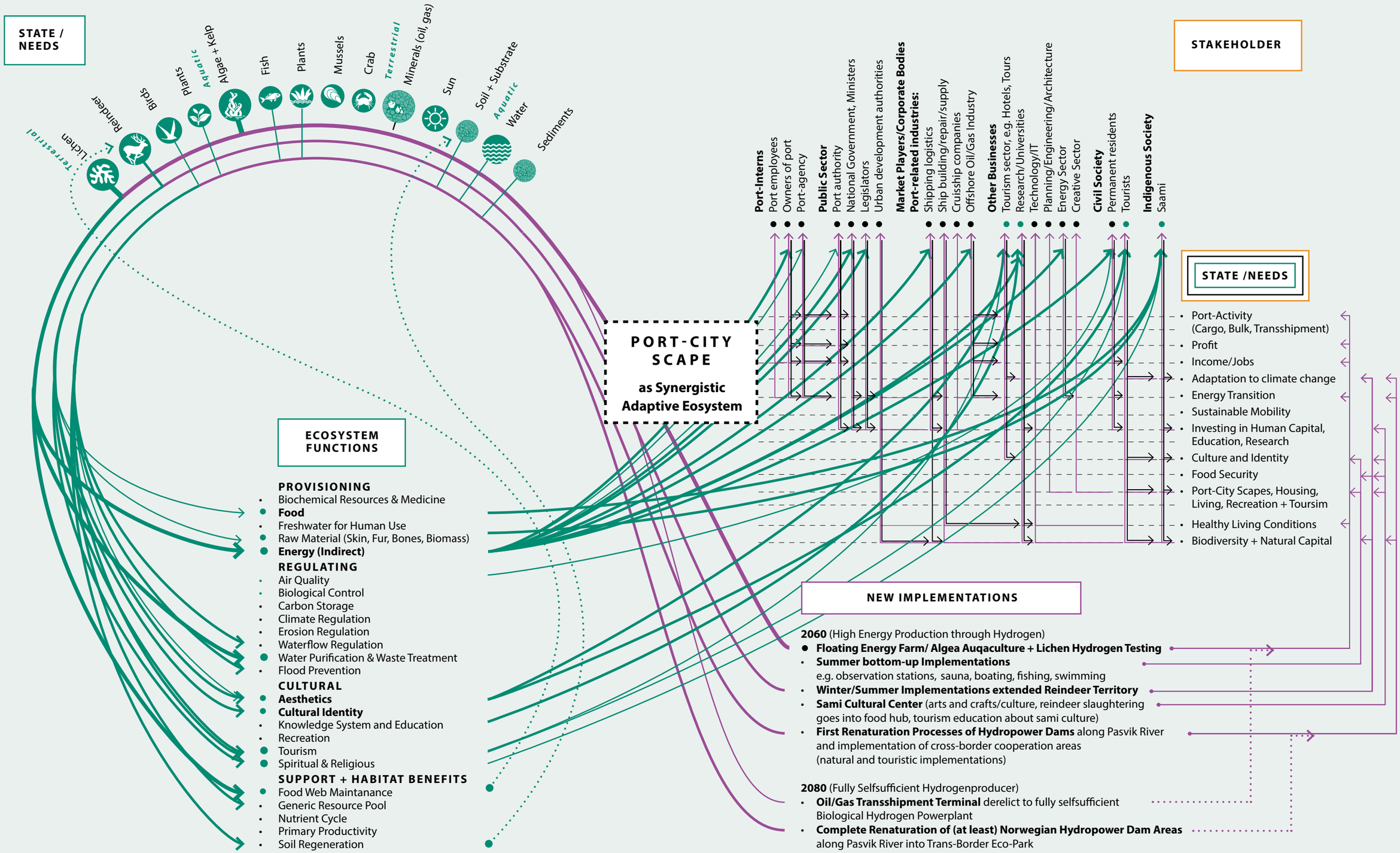
SYNERGISTIC LOOP

▼ *Figure / 81* **Synergistic-Loop 2040 Energy Port** / *Höller*



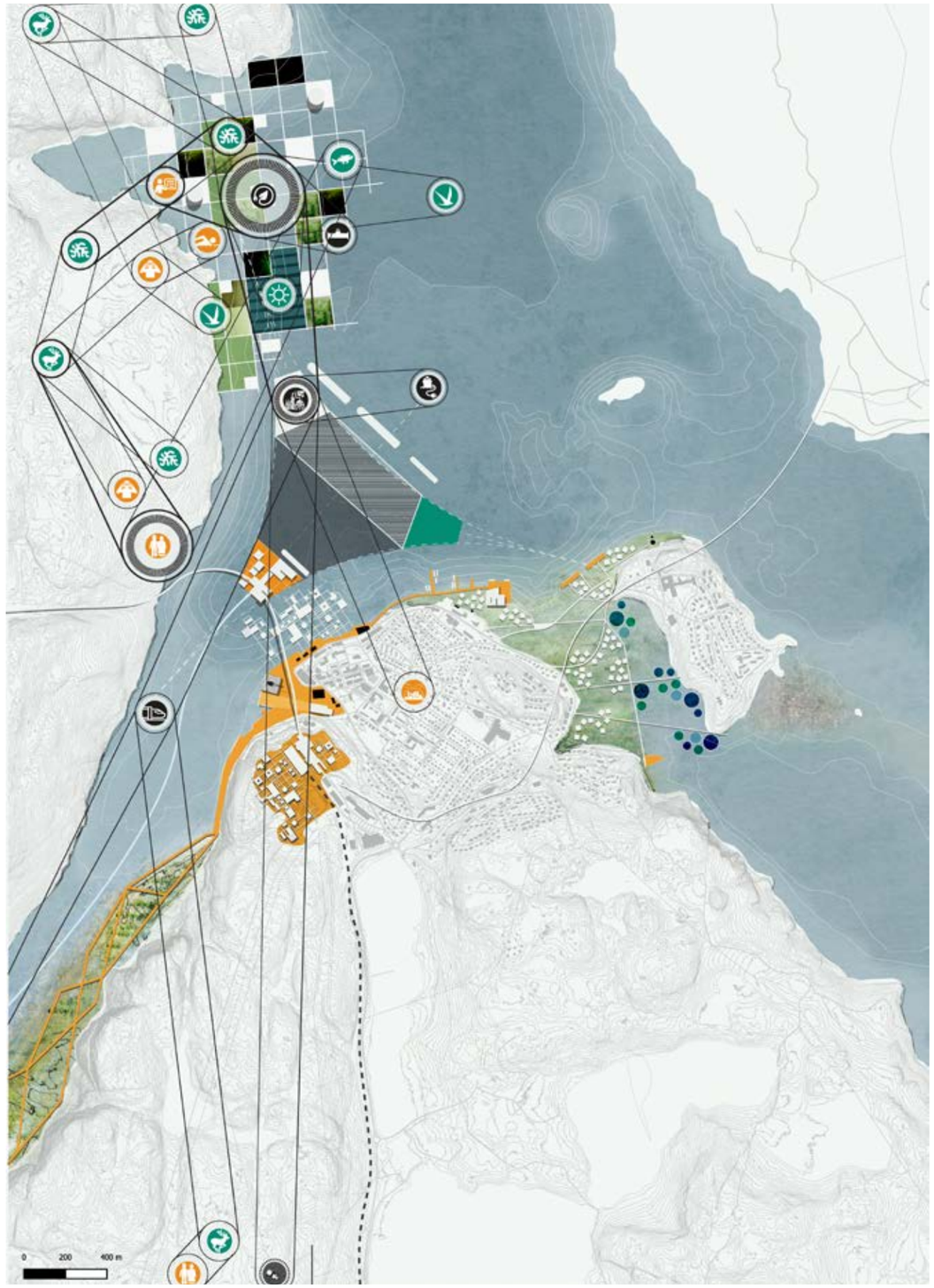
ENERGY PORT 2060/2080
SYNERGISTIC LOOP

▼ *Figure / 82* **Synergistic-Loop 2060 and 2080 Energy Port** / *Höller*



ENERGY PORT
FICTION-SYNERGIES

▼ *Figure / 83* **Synergistic Adaptive Energy Port - Design Fiction** / *Höller*



Floating Algae and Lichen Farm
Synergistic abstraction with
its three different sub-areas

1. Renatured Recreational and Touristic Area (Summer)

The newly implemented floating structure on which the algae and lichen for future energy production will be farmed, offers many recreational and touristic opportunities. The currently hard to access Tømmerneset Peninsula will be reachable through its added floating structure. On the one hand, the unique synergy between energy production through natural processes and the resulting ecosystem functions for human and natural participants like reindeers, fish, and birds offer observational and eco-touristic opportunities. On the other hand recreational/cultural implementations like floating saunas, swimming and boating areas especially in summer months create a intertwined relation of land-sea, nature, city and the port.

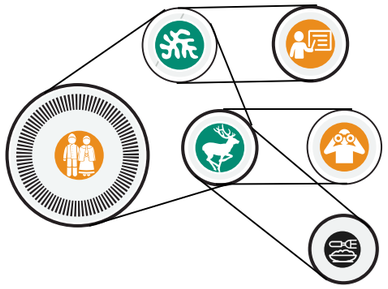
2. Additional Reindeer Heerding and Migration Area (Winter)

Tømmerneset Peninsula is an important Reindeer Heerding and grazing area for two heerding families surrounding Kirkenes. Traffic, airport and military activites already decreased the available space for nature and indigenous communities. The floating structure offer an attemped to artificially increase the natural sphere without harming or disturbing the equilibrium. During winter months, the lichen-farms provide additional food sources for reindeers as well as fishing, living and migration opoortunities for the herders. Recreational and touristic ativities are reduced. The human becomes the passive observer.

3. Hydrogen Production Area

A new Hydrogen Production Area/Powerplant can be a unique driver for Kirkenes. Firstly it will strengthen its position as important Arctic service and logistic port due to adaptability, when it comes to future fueling of ships. Hydrogen is seen as the current future way of powering maritime logistic. Furthermore, the hydrogen plant can become a driver for research and new development of job opportunities and cooperations within the green energy brench. Biological hydrogen production, which means that the produced energy comes directly from natural participants, like algae or lichen without further processing like burning, steaming or similar.

Terrestrial Sámi Cultural Center and Lichen Research Center
Synergistic abstraction with its two different sub-areas



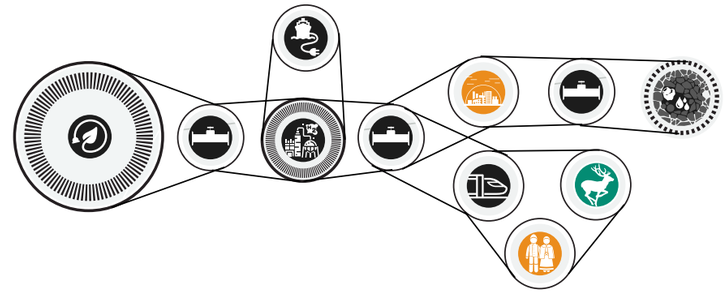
1. Sámi Cultural Center

After the end of the Norwegianization processes and the related discrimination and exclusion of Sámi communitiy, they started to gain more and more political and decision-making power, especially due to the emergence of the Sámi Parliament in 1989. Nonetheless, as seen in the stakeholder analysis for the proposed port development by the Sør-Varanger Municipality, they much more have veto options instead of real participation and co-planning opportunities. A Sámi Cultural Center integrated into the Energy-Port environment, symbolizes the need for cooperation and negotiation instead of exclusion and prevention of progress. The Cultural Center not only depict the power of the Sámi within the port-city region but also offers community, education and space for cultural/ traditional activities for the Sámi people, inhabitants and guests. During their stay on the peninsula, the center can be used as accommodation for herders. Furthermore it can offer workshops for arts and crafts to spread the important nature-related culture to an international public.
As already investigated, the Schengen-Agreement made it difficult for the Sámi to continue the production and use of reindeer products, like meet, bones, fur and further. Hygienic regulations allow slaughtering by non-licenced people or companies only for their own use. Such production facilities could open the opportunity for locally produced reindeer-products for either local offer within the new Food-Hub, which is integrated within the Wetland Port or could directly be exported by ship to customers world wide. Such an implementation could help to sustain the traditional heerding lifestyle and help to adapt to international rules and laws.

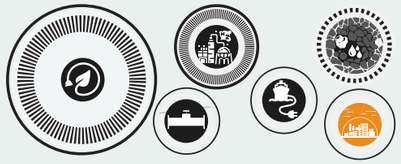
2. Lichen Research and Observation Center with integrated Raindeer Grazing Spots
(Summer)

As a first step towards a lichen-hydrogen farm, a research center for the testing and development of biological hydrogen production will be implemented on land. Different test facilities will allow the development of a unique research culture in Kirkenes for an integrated and nature-based hydrogen production in port areas. Furthermore the research implementation offers the possibility to close another synergistic cycle. As investigated before, pollution of SOx, climatic changes in temperature and precipitation rhythms as well as societal conflicts due to land-use change decrease the available sources of especially winterfood, like lichen for the roaming reindeers. Siting the research center as well as the observation stations along popular existing or, due to the artificial floating island, new reindeer-migration spots can help to ensure enough suitable as well as secured grazing opportunities for the animals.
The observation spots ensure herders to control their herds as well as offers eco-tourists the chance to come as close to the otherwise shy and easily disturbed animals.

Hydrogen Transport- and Use-Infrastructure
Synergistic abstraction with its two different sub-areas



1. Transport Infrastructure Port and City



One measurement of this project is to identify as many existing aquatic, underwater cables or pipelines as possible and find a suitable re-use option. In the case of the Energy Port, the re-purposing of the mining-tailing pipeline, which currently pumps mining-waste into the fjord, will be reused, and the mining-tailings will be re-mined, as explained later within the part of the Urban Port.
The pipeline reaches all the way from the new floating structure towards the Sydvaranger Iron Processing Center and crosses the Floating Energy Hub, where the hydrogen will be used to fuel ships. Furthermore hydrogen as a liquid ore gas can be stored in the facilities and tanks which have been used by the oil/gas transshipment terminal which will be planned to be out of use after around 2060 within this Design Fiction. Last but not least, due to natural dynamics (summer: 24/7 sunlight and winter: always dark) there could emerge an imbalance in energy availability and need. Hydrogen can easily be stored, nonetheless this requires large storage facilities. The open mine pit could offer the opportunity to use the space for energy storage as a kind of natural battery. Mining activities already created deep holes within the bare-rock subsurface of the area. It would need to be tested, but the stone could function as an impermeable layer, so that the hydrogen in its liquid form could be stored in the pits, without polluting the near by soil and surfaces.

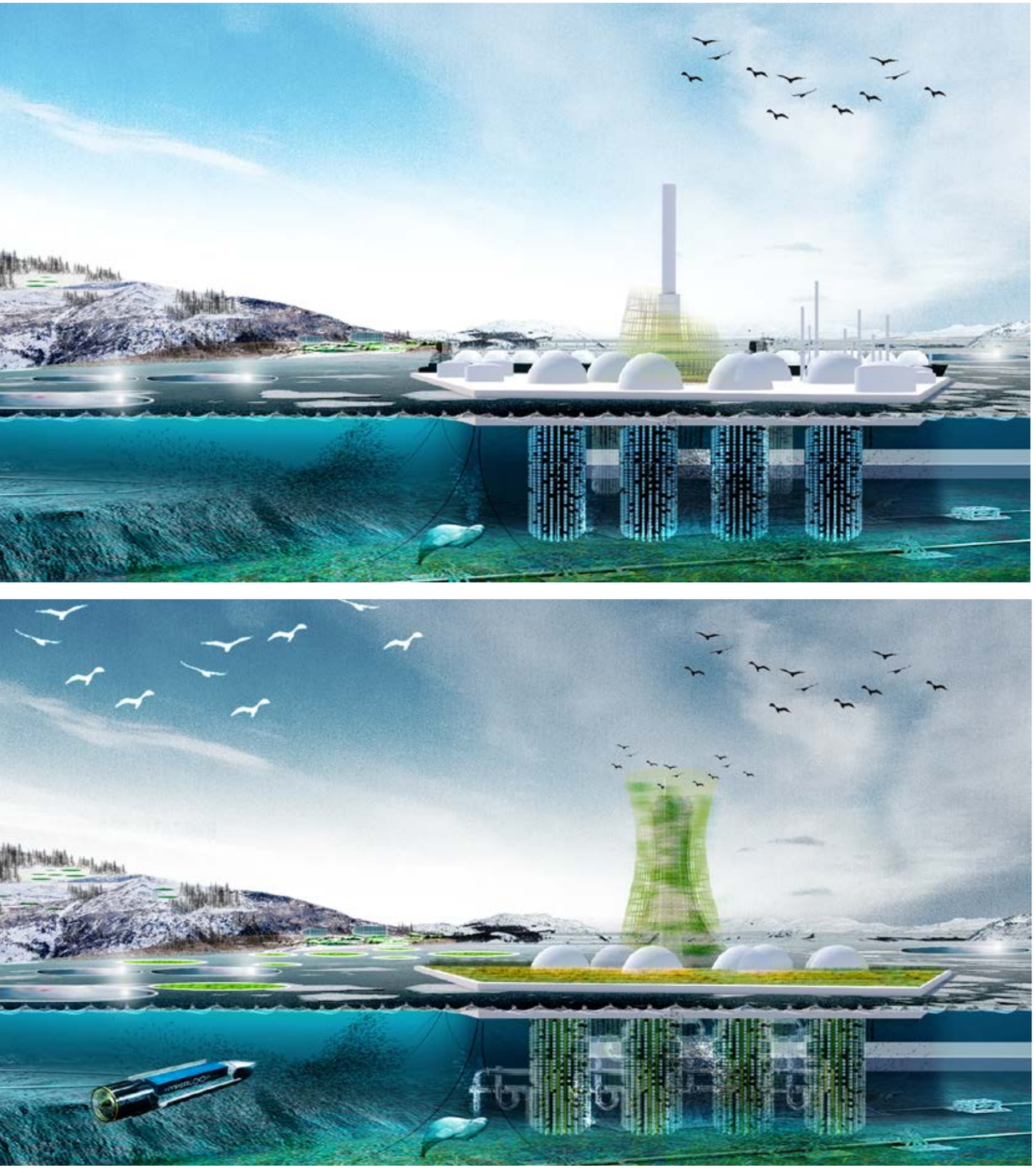
2. Hyperloop as Transport Infrastructure into Hinterland with Integrated Reindeer-Heerding Implementations

The proposed Hyperloop can be a good and less impactfull implementation compared to the Arctic railway. Due to the fact, that the Hyperloop moves inside a tube, where air is sucked out, to decrease the friction, it can easily be build on pillars, reducing the segregating effect on the reindeer migration routes. Furthermore, to power the Hyperloop and the air-pumps, using the infrastructure as an integrated pipeline to export hydrogen into the hinterland, e.g. Finland or Europe, could be a feasible and sustainable syngery.

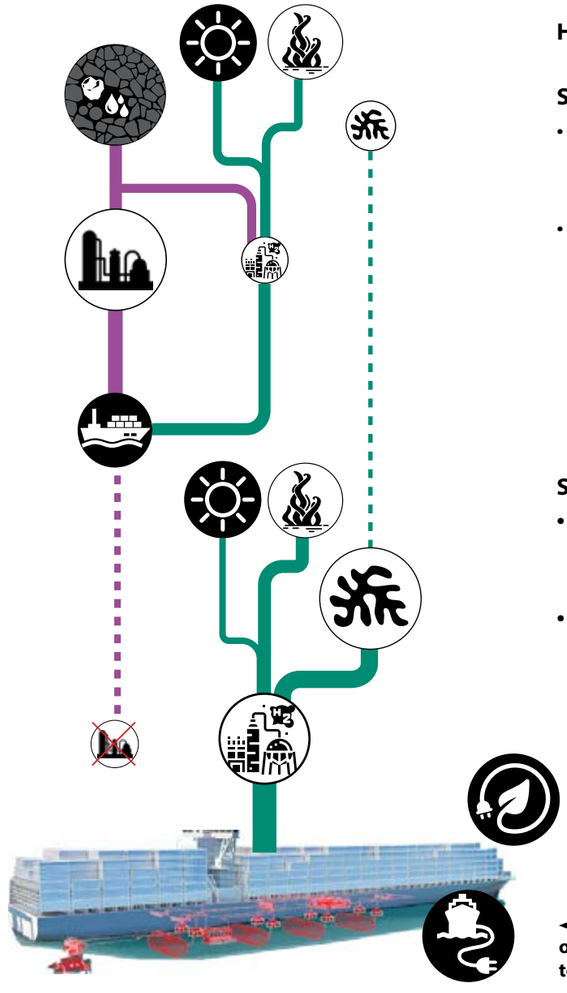
A continuous source of energy, especially within the Sub-Arctic Tundra and boreal Taiga, creates additional opportunities for implementations to support reindeer heerding and helps to adapt towards climate change impacts. The powered Hyperloop structure can follow or cross crucial points along the migration tracks to offer shelter, repair, refueling of snowmobiles and other activites. Also integrated spots for climate data measuring or the observation of the area for suitable grazing spots for example autonomous drones, charged by the hydrogen can be a futuristic but realistic implementation.

ENERGY PORT
FICTION

▼ *Figure / 84* **Illustration of the possible floating Energy Port /** *Höller*



The municipality of Sør-Varanger plans a new oil/gas transhipment terminal to be implemented into the new port structure located on the shoreline of Tømmerneset Peninsula. This aims to make Kirkenes an important player within the future oil and gas business within Arctic maritime regions. Nonetheless oil and gas industry is not only unsustainable and responsible for a high amout of CO_2 and other pollution of air and ocean, but also a non-futureproof and unstable economy. Furthermore, Murmansk, as a port within close distance to Kirkenes emerges the risk of a strong competitor.



◄ *Figure / 85* **Scheme of the transformation of the oil/gas transshipment terminal towards a Hydrogen Powerplant /** *Höller*

Kirkenes could nonetheless develop into a unique spot within the Fennoscandian Arctic. As already mentioned, hydrogen has the potential to become the future way of powering the maritime logistic and shipping industry. Norway already implemented a new law, that by 2025 many of the fjords can only be accessed by electic-powered ships. This urge to adapt, but also the chance to be a pioneer in the production and also the supply of hydrogen in the Arctic should be taken into consideration.
The Design Fiction therefore proposes a hydrogen powerplant additionally to the oil/gas transshipment terminal. The development will take place within two steps:

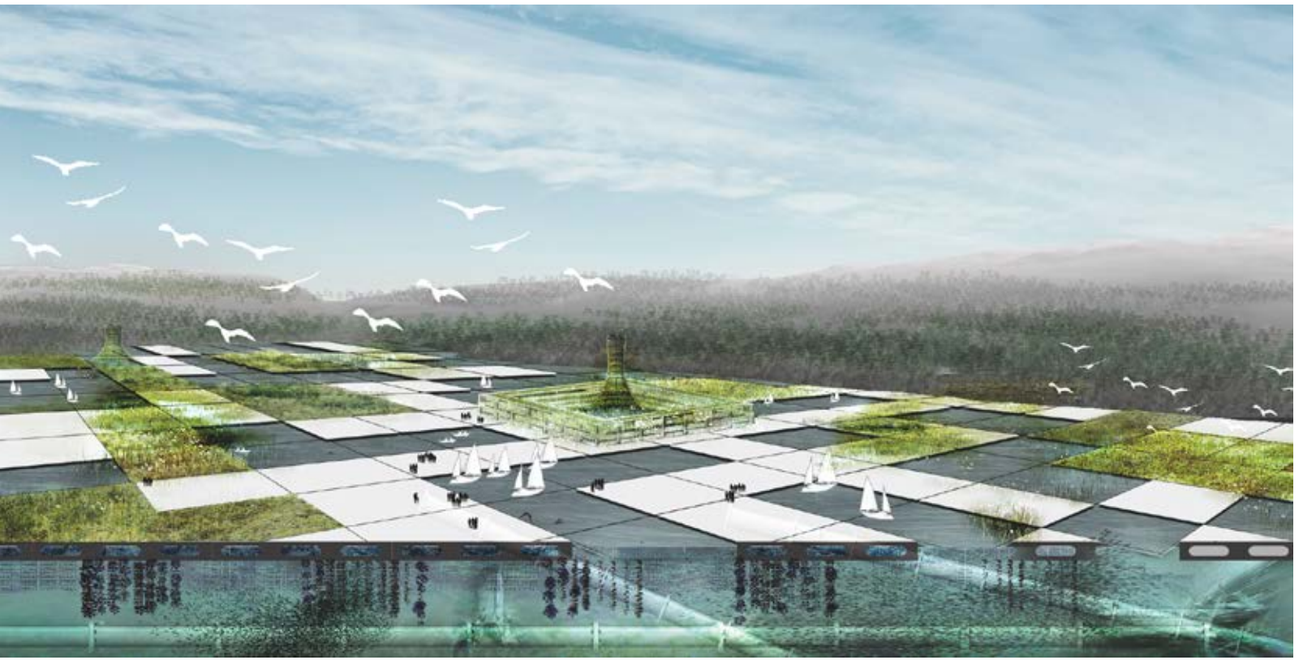
Hydrogen Energy Potentials:

Step 1 (start-2040)
- Through **oil/gas** which is already available and planned within the new proposed port infrastructure
- Through the conversion of **solar energy** to hydrogen by means of water splitting process (if this process is assisted by photocatalysts suspended directly in water instead of using photovoltaic and an electrolytic system the reaction is in just one step, it can be made more efficient)

Step 2 (post 2040)
- **Algae** as biomass for biohydrogen gasification, steam reforming, biocatalysed electrolysis or **biological hydrogen production**
- **Lichen** were identified as a potential future biotechnological hydrogen producer through **biological hydrogen production**

ENERGY PORT
FICTION

▼ *Figure / 86* **Illustration Floating Lichen/Algae Plattform** */ Höller*



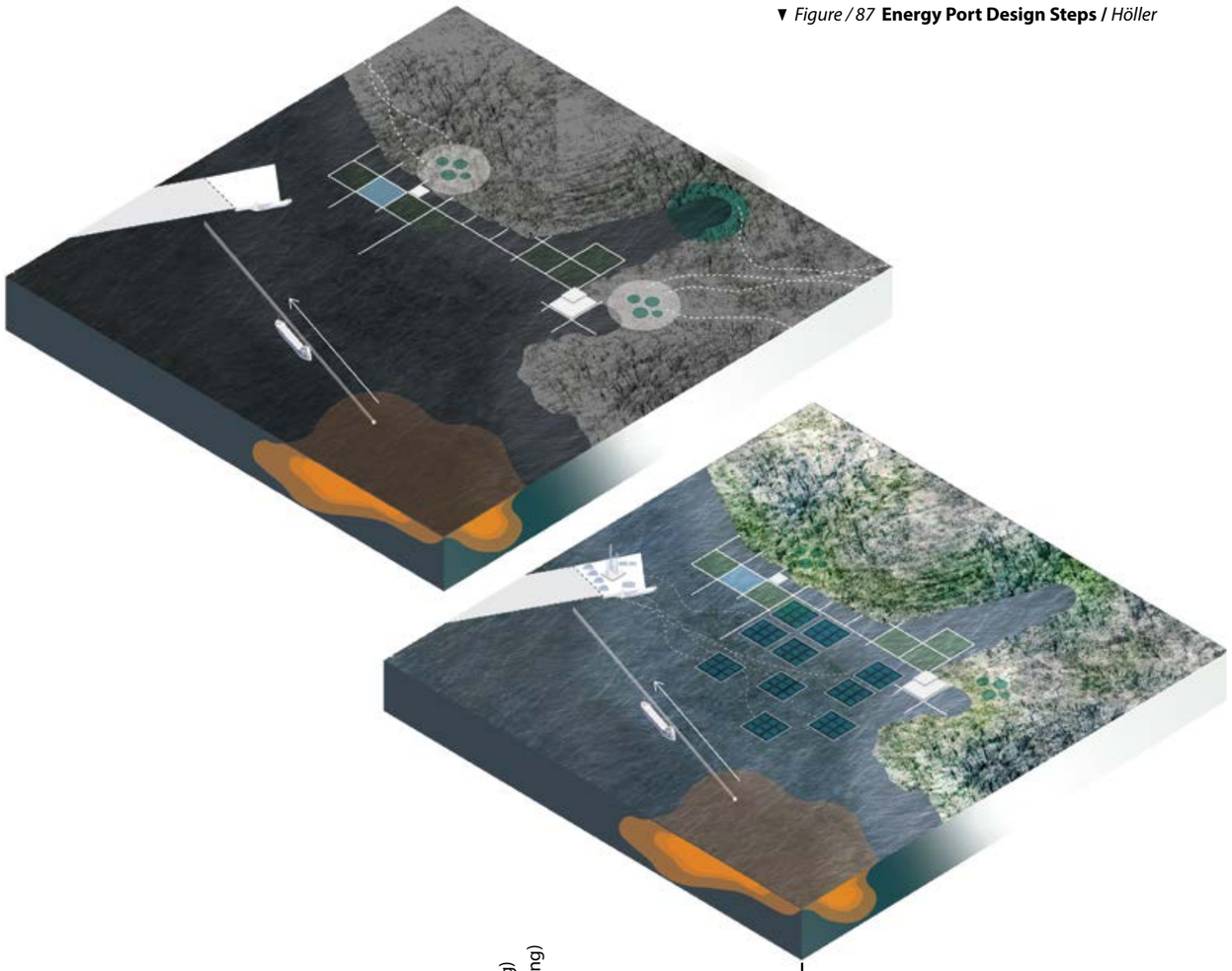
Floating Lichen / Algae Plattform

The concept of the Floating Lichen/Algae Plattform is to connect the space of the reindeers with the economic need of sustainable energy production of the port. The structure of the plattform can be prefabricated within the re-used drydock of the KIMEK Company, where scrap materials from ship repairments or mining infrastructures can be repurposed to reach the goal of a resource saving and circular society.
During the summer, when reindeers are roaming more inland of the peninsula, the plattform accommodates different opportunities for recreational activities like, sailing through the algea and lichen farms, as well as watersport activities. Those implementations can be planned together with the creative sector in Kirkenes. Also the inhabitants are involved in the decision-making and distribution of the implementations. The floating structure allows to change implementations if needs are changing.

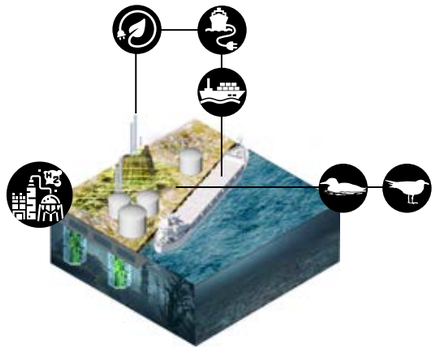
During the winter-months, the plattform will be used as an extension of the heerding and grazing territory. Selected lichen-farms will be open as food sources for the animals. The open-water segments, which will freeze during the low temperature season, in-between the plattforms can be used for ice-fishing, so the Sámi can follow their selfsufficient and nature-based culture. During this time the activities on the plattform for recreation are reduced. Only the observation stations on land and on sea are open for visitors to catch a close look on the shy reindeer.

ENERGY PORT
DESIGN STEPS

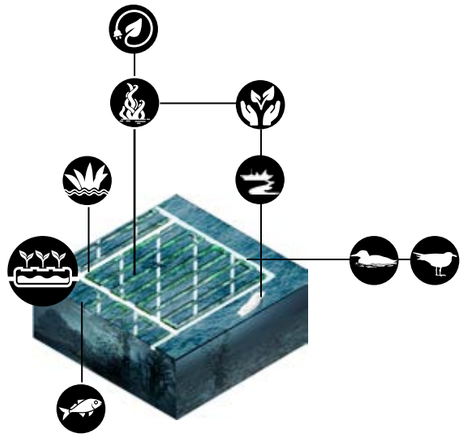
▼ *Figure / 87* **Energy Port Design Steps /** *Höller*



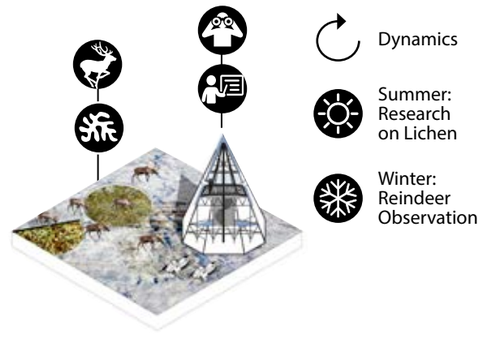
1 Hydrogen-Test-Powerplant in Oil/Gas Transshipment Terminal



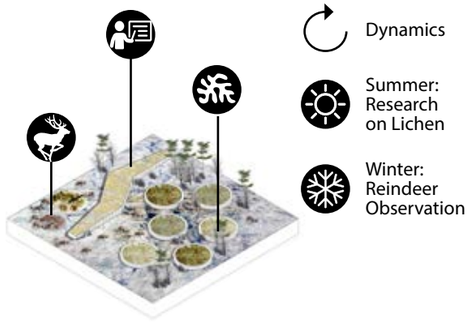
2 Floating Energy Farm / Algea Auqaculture

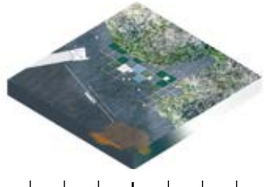


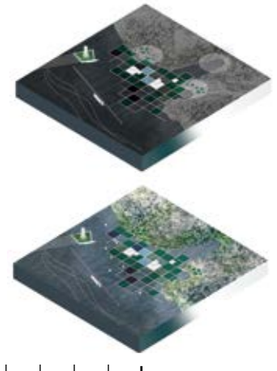
4 Research + Design Center on Lichen Hydrogen Production
Combined Observation Stations



5 Research + Design Center on Lichen Hydrogen Production
Combined Reindeer Feeding







Synergistic Adaptive Ecosystem Implementation 2040
(Testing and Implementation Phase)

1 Hydrogen-Test-Powerplant

2 Floating Energy Farm / Algea Auqaculture

3 + Solar
Smaller Aquatic Habitat Implementations (Fishing)
Smaller Terrestrial Habitat Implementations (Birding)

4 Research + Design Center on Lichen Hydrogen Production
Combined Reindeer Feeding
Combined Observation Stations

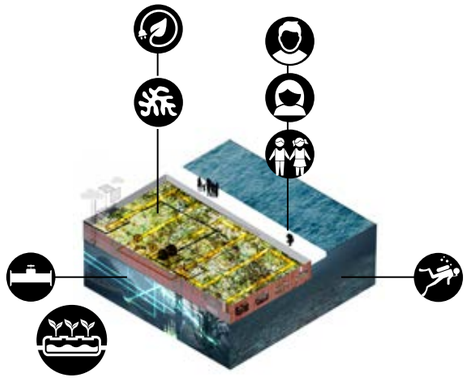
5 Re-mining Iron Ore Tailings
Reusing Existing Pipeline

6

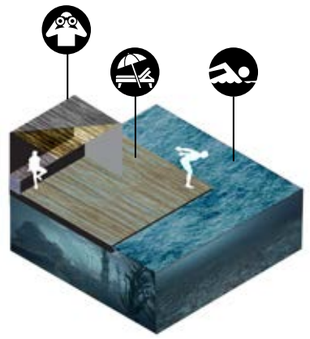
2020 **2040** **2060** **2080**

ENERGY PORT
DESIGN STEPS

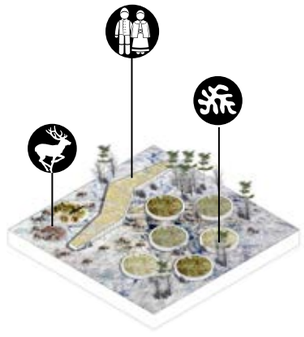
1 Floating Lichen Hydrogen Test- Modul

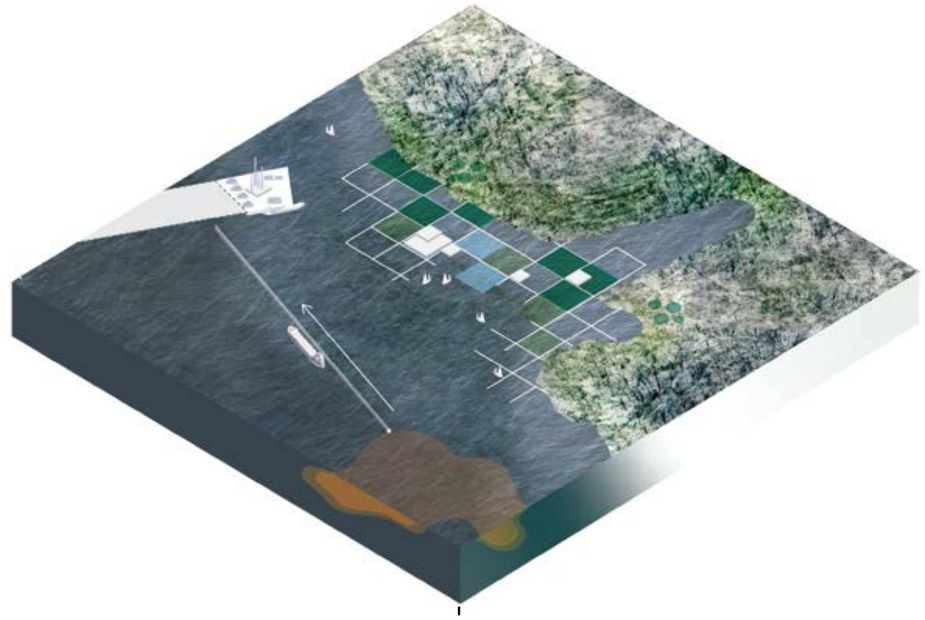


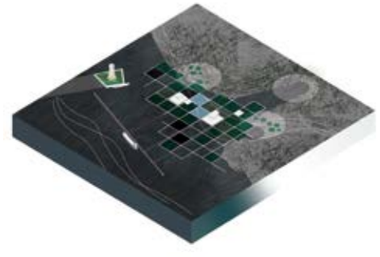
2 Recreational/Cultural Implementations
(Bottom up, Residents Engagement)

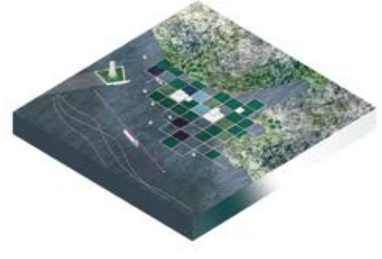


3 Sámi Cultural Center









2020

Synergistic Adaptive Ecosystem
Implementation 2040
(Testing and Implementation Phase)

Hydrogen-Test-Powerplant

Floating Energy Farm / Algea Auqaculture

+ Solar
Smaller Aquatic Habitat Implementations (Fishing)
Smaller Terrestrial Habitat Implementations (Birding)

Research + Design Center on
Lichen Hydrogen Production
Combined Reindeer Feeding
Combined Observation Stations

Re-mining Iron Ore Tailings
Reusing Existing Pipeline

2040

1 Floating Energy Farm/
Algea Auqaculture +
Lichen Hydrogen Testing

2 Summer bottom-up Implementations,
e.g. observation stations,
sauna, boating, fishing, swimming
Winter/Summer Implementations
extended Reindeer Territory

3 Sámi Cultural Center
(arts and crafts/culture, reindeer slaughtering
goes into food hub,
tourism education about Sámi culture)

2060

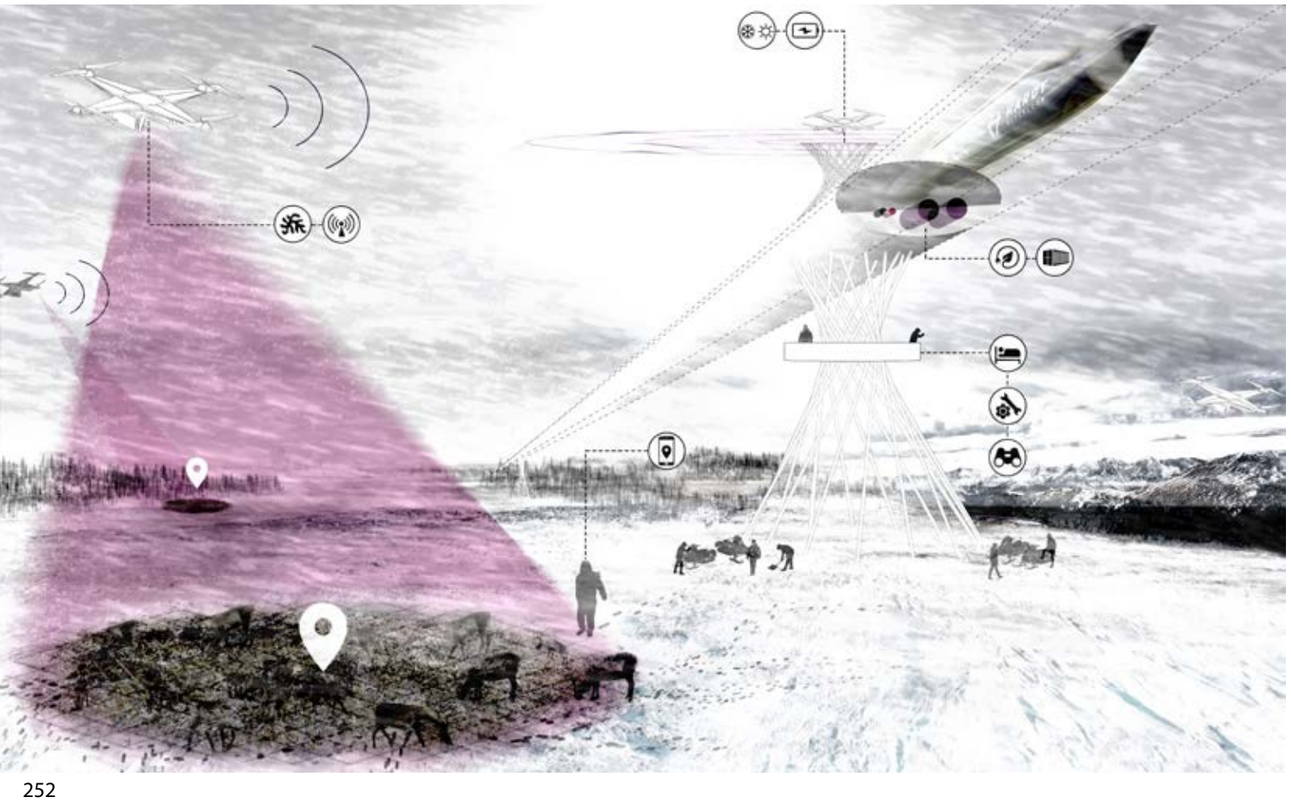
2080 (Fully Selfsufficient Hydrogenproducer)
Oil/Gas Transshipment Terminal
derelict to fully selfsufficient
Biological Hydrogen Powerplant

2080

▼ *Figure / 88* **Energy Port Design Steps /** *Höller*

ENERGY PORT
FICTION

▼ *Figure / 89* **Hyperloop following the tracks of the reindeer /** *Höller*



Hyperloop
An adaptive Measure for Reindeer Heerding

The planned Arctic Railway from Kirkenes to Rovaniemie, Finland, depicts the ideal example of the hinterland impact, port developments can have outside their usual port-city entity. The Design Fiction proposes an alternative mode of transport to move goods and people to their wished destination. Instead of segregating the migratory routes along the 400 km of railway track, the structure can be build on pillars to allow movement inbetween the grazing areas.
Furthermore the implementaion can accomodate the infrastructure for transporting the produced hydrogen into the hinterland and provides the large and harsh territory with an constant energy flow.

Through history the process of reindeer heerding adapted to technological changes. Today, herders use helicopters and snowmobiles following the migrating animals. Therefore longer distances can be travelled and the herders don´t need to stay aside the reindeer community. The Hyperloop has integrated accommodations, where the herder can take rest, restock their supply and recharge their hydrogen-powered snowmobiles.
Drones, connected to climate-measurement stations ontop of the structure collect data and can be used to track either the reindeer or suitable, not-frozen grazing spots.

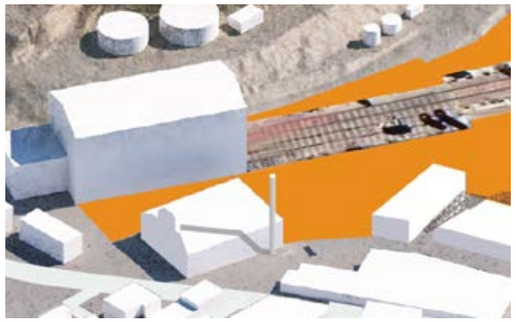
URBAN PORT
FROM FRICTION TO FICTION

▼ *Figure / 102* **Illustration of the Re-Mining Process along Langfjorden /** *Höller*

▼ *Photo / 101* **Langfjorden, filled up with tailings from the iron-ore processing plant.**

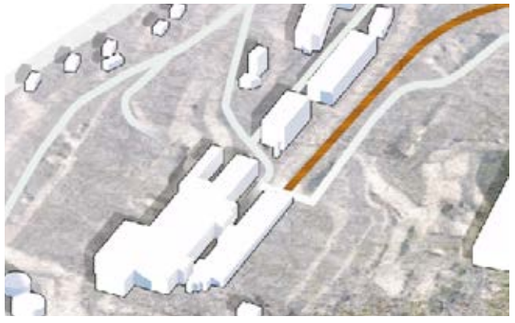
URBAN PORT
EXISTING SITUATION

Existing infrastructures



KIMEK Shipwarft
- Drydock and Drydock mechanism
- Storage Yard
- Container-/Heavy-load crane

Sydvaranger Mining Processing Area
- Iron Ore Processing Center
- Break-/Drybulk Quay
- Company Yard
- Mining Tailing Dumpsite and
- Pipeline Infrastrucutre
- Mining-Railway



Hurtigruten/Tourism Quay

▲ *Figures / 90-95* **Existing Infrastructures Urban Port** / *Höller*

Existing Stakeholder

HUMAN PARTICIPANTS

Owners of port:
Sør-Varanger Municipality (current)
TSCHUDI GROUP (new port)
KIMEK AS (new port)

Public Sector
Transport Ministry (Finnland, Norway)
Urban development authorities
Legislators

Market Players/Corporate Bodies:
Port-related industries:
Shipping logistics
  TSCHUDI Logistic Group
  Ship building/repair/supply
  KIMEK AS
Cruise ship companies
  Hurtigruten
  Havila (2021)

Other Businesses
Tourism sector, e.g. Hotels, Tours
Leisure businesses
Research/Universities
Extraction Industry TSCHUDI Aggregats
Creative Sector
Planning/Engineering/Architecture

Civil Society
Permanent residents
Tourists

NATURAL PARTCIPANTS

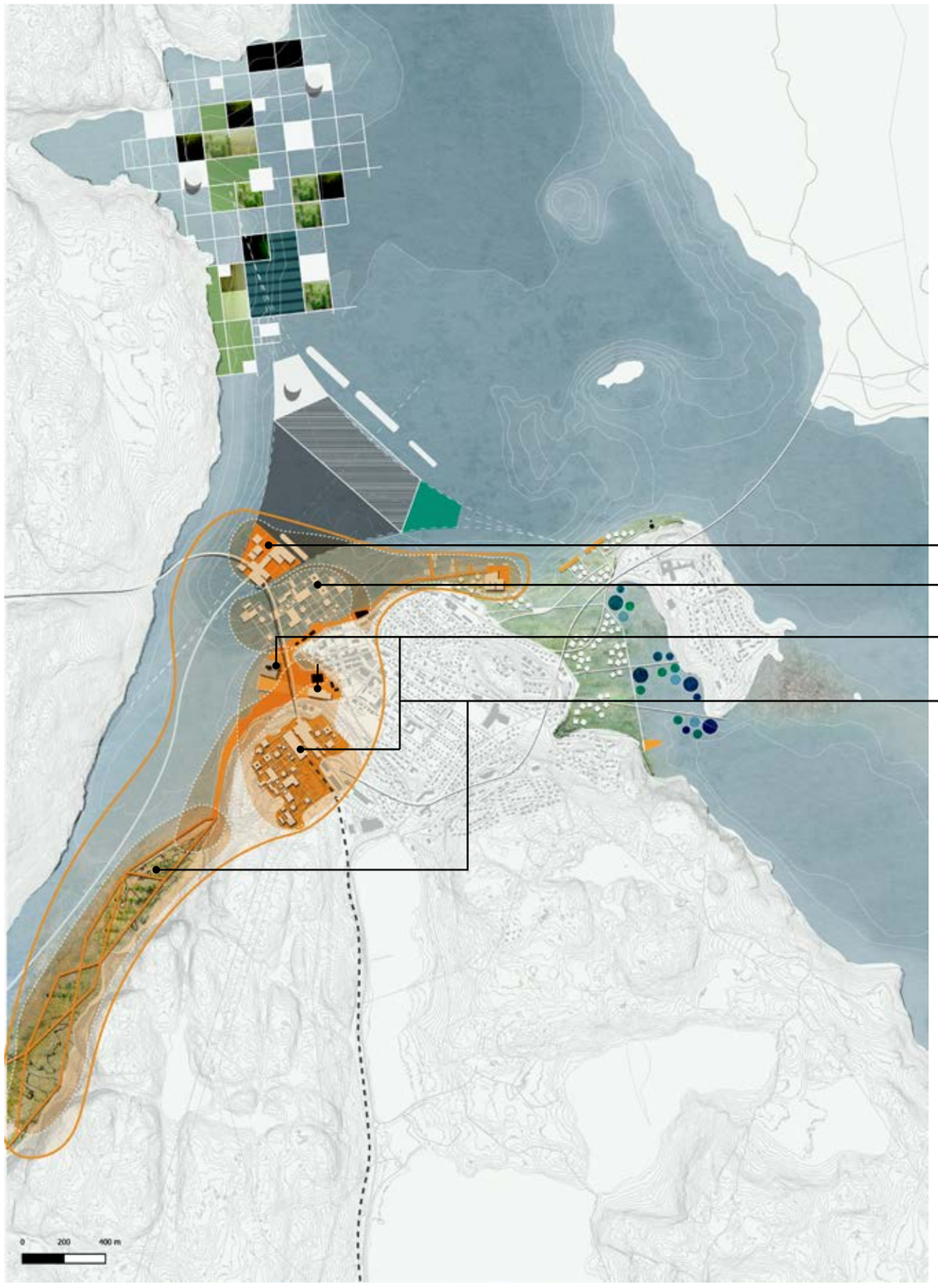
Biotic / Terrestrial:
Birds
Plants

Biotic / Aquatic:
Fish
Plants

Abiotic / Aquatic
Water
Sediments

URBAN PORT
MAIN GOALS AND CONCEPT

▼ *Figure / 96* **Design Fiction Urban Port** / *Höller*



Floating Urban Port

Floating Urban Expansion

Makers District/
Repurposed Industrial Waterfront

Mining Tailing Farming and
Renatured Urban Beach

Former Hurtigruten/cruise ship terminal will be re-located towards the Floating Port. It sets the backbone for a renewed waterfront development, which can react to the investigated, real but also potential frictions and impacts.

1. Floating cruise ship- and Mobility Port as urban connector between global and local residents of Kirkenes
2. Re-naturing/cleaning of Langfjorden
3. Flexible and adpative floating urban extension to encounter uncertainty of future growth or shrinkage
4. Redevelopment of the waterfront to Makers District for alternative and circular businesses
5. Reuse and repurposing of existing infrastructures

Synergistic Players:

Mining tailings in Langfjorden can be **re-mined** and used for the production of **buiding material** for the new **urban development** and create **jobs** beyond the actual mining activity and to create **renatured** Langfjorden
Re-use of ship-scrap or mining scrap to pre-build **modular floating structures** in reused **KIMEK drydock**

Achived Sustainability Goals:

Climate Change Adaptation:
2. Promoting the renaturalisation of riverbanks and coastlines to erosion and climate change impacts
5. Making resilient and carbon neutrality a priority

Energy transition, circularity*
1. Promoting cooperation between socio-economic, societal/cultural and ecological/naturalstakeholder* to bring their activities together and identify potential synergies
2. Give priority to circular economy and circularity in general* to promote and investigate exchange or recycling of materials, energies and other potential, natural or humanmade flows*
3. Commiting the port-city region to achieving a low carbon, low resource society (e.g trough renewable energies)

Sustainable Mobilty
1. Development of soft, multimodal and collaborative mobility esp. for commuting
3. Promote waterways, railways and other non-fossile modes of transport and mobility for shipping goods and urban mobility*

Renewed Governance
1. Guarantee better representation for all stakeholder needs, especially civil society and natural participants* in decision making
4. Developing collaborative approaches, drawing on scientific, technological, cultural and natural* knowledge from scientific community, civil society and indigenous or alternative societies*

Investing in Human Capital
3. Provide training in preperation and re-education possibilities*
4. Promote interactions and projects between schools, universities*, training institutions and the professional world
5. Create (Makers District)* collaborative space for experimentation, co-working spaces, learning and education facilities, port centers, cultural centers for interaction and new projets

Port-Culture and Identity
1. Developing all types of open spaces within Port-City Interfaces to promote developments and activites
2. Integrate spaces and functions open to everyone into port facilities, enhancing the visibility of port-activities
3. Port-Center
5. Organizing temporary and permanent cultural events in port-city area

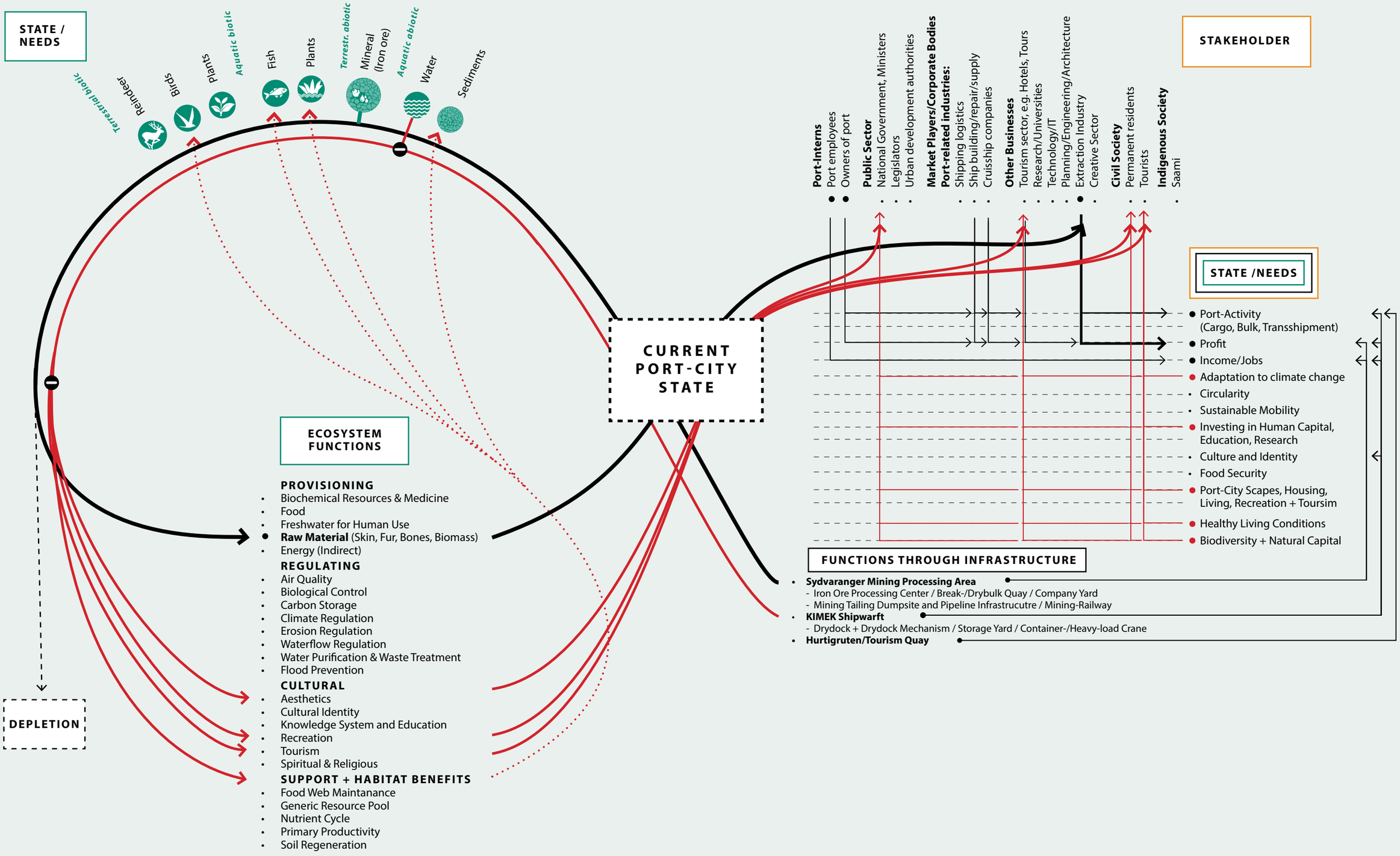
Living, Recreation and Culture in Port-City Interface
2. Revising the status of port-city region heritage and refelect the sites historical development
3. Develop public spaces, recreational and cultural ameneties, promote accessibility (local use, before commodification for touristic use*) of cultural built heritage, both new, recycled and obsolete as well as natural port-city heritage both old and new*

Healthy and attractive living conditions
3. Promote green port-facilities
4. Regulate Cruiseship stepover based on port-city region capacity but also environmental capacity (esp. eco-tourism)* without compromising equilibrium and appeal of local, natural* area
5. Healthy port-city environment through healthy nature*

Biodiversity and Natural Capacity
1. Improving and maintaining water quality
2. Regual survey of biodiversity in port-city regions
3. Prevention of destroying sensitive natural habitats when developing on and offshore spaces

URBAN PORT
SYNERGISTIC LOOP

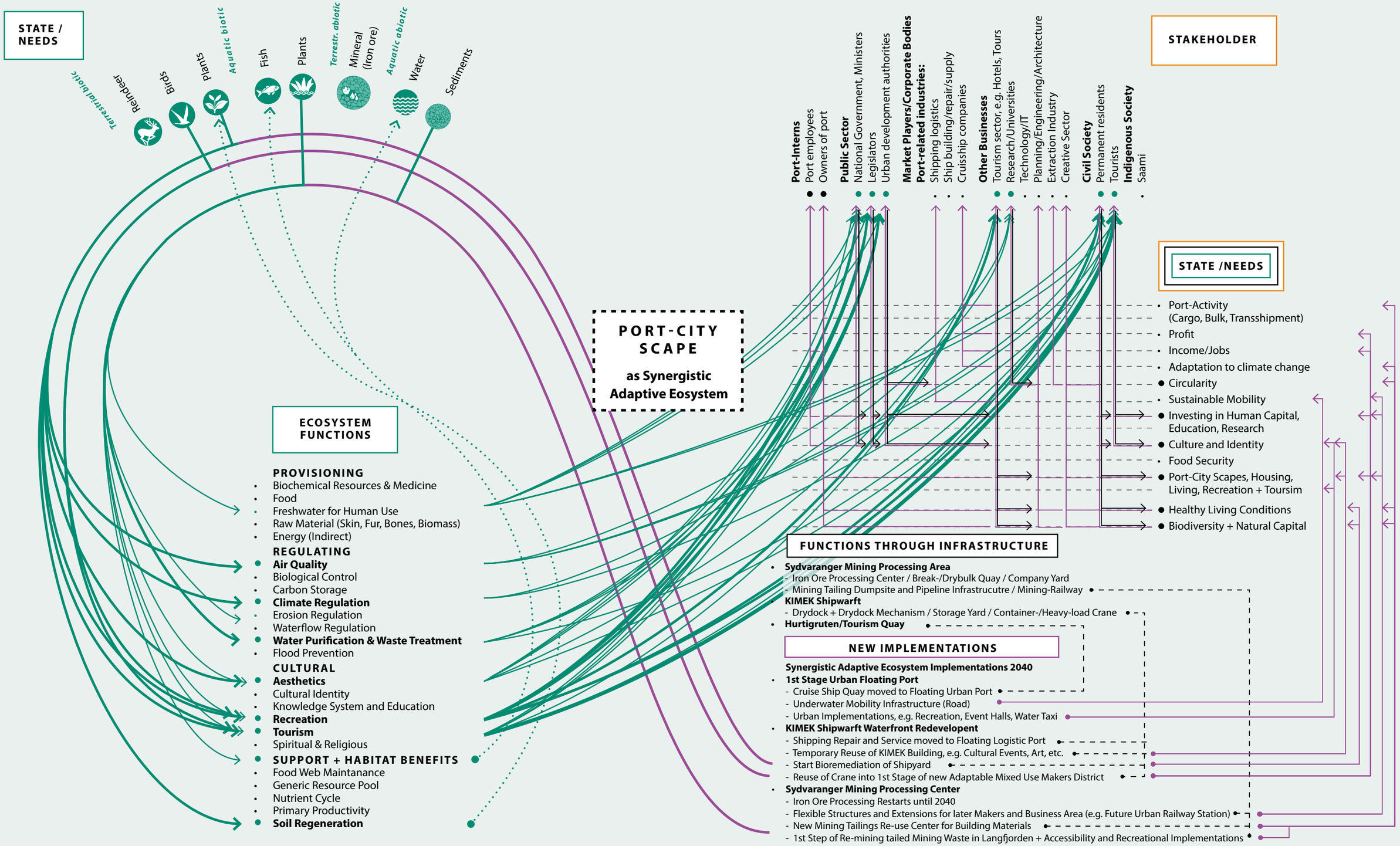
▼ *Figure / 97* **Current/Planned Port-City State** / *Höller*



URBAN PORT 2040

SYNERGISTIC LOOP

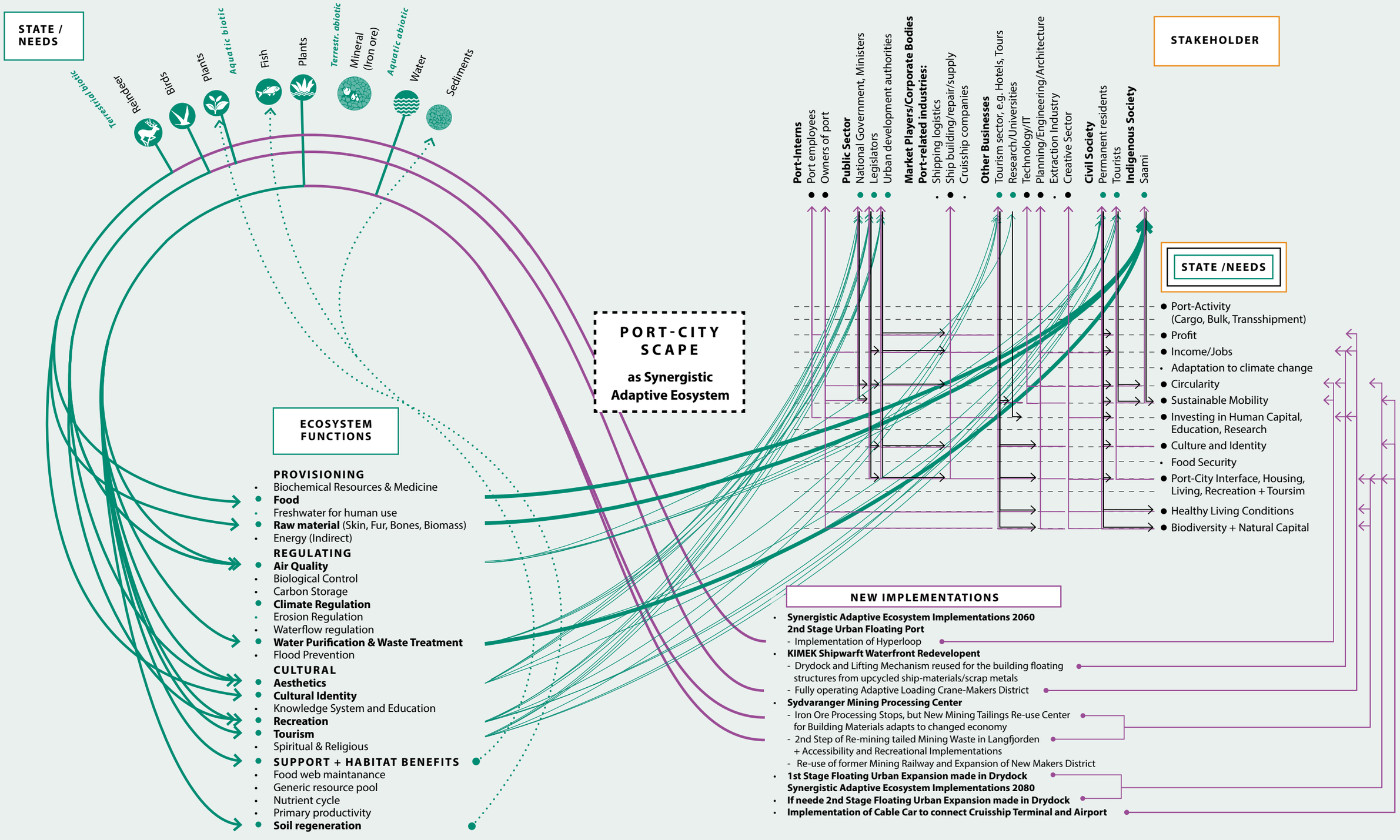
▼ *Figure / 98* **Synergistic-Loop 2040 Urban Port** / *Höller*



URBAN PORT 2060/2080

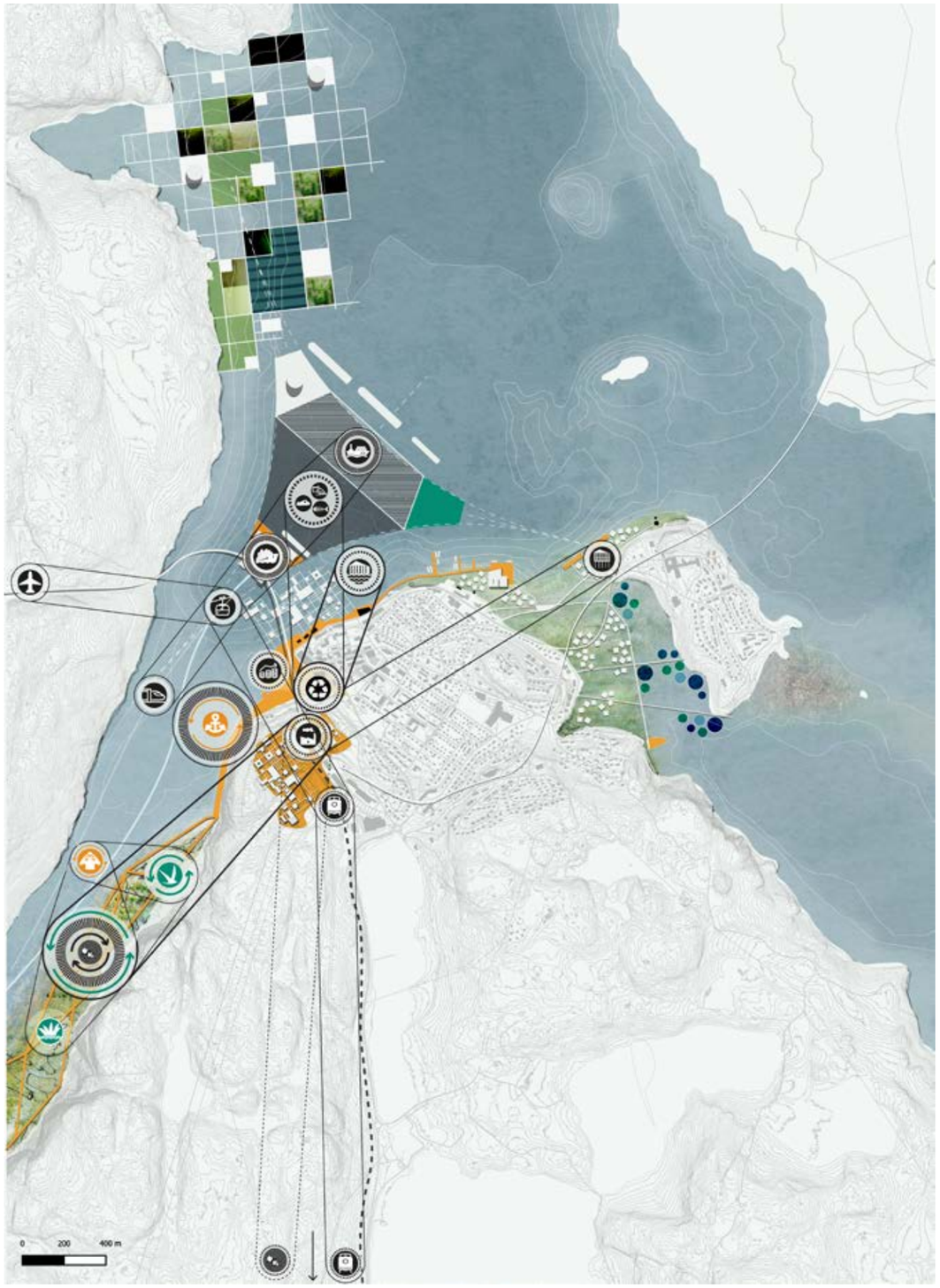
SYNERGISTIC LOOP

▼ *Figure / 99* **Synergistic-Loop 2060 and 2080 Urban Port** / *Höller*



URBAN PORT
FICTION-SYNERGIES

▼ *Figure / 100* **Synergistic Adaptive Urban Port - Design Fiction** / *Höller*



Recycling Dry Dock and Self-adapting Makers-Crane
Synergistic abstraction with its two different sub-areas

1. Re-used Drydock for upcycled, modular and prefabricated floating structures

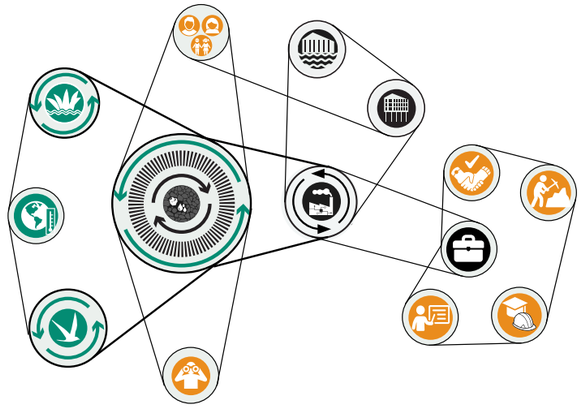
The drydock of the KIMEK AS company became a significant provider for jobs after the mining industry declined. Furthermore the building itselfe is a trademark for Kirkenes´ panorama. The new port-development envisions the drydock to move towards the new logisitc and shipping area. To encounter the "paradigm" of waterfront renewel, which would allow the city to reconquer the future obsolete port-area, a new port-city function is proposed. Therefore it is envisioned that the big production hall, as well as the mechanism for lifting and putting ships from and into the sea, will be used for the production of floating structures, which will be used as residential housing, recreational activities on water or for the construction of the floating lichen/algae port. By reusing the scrap-materials from the new drydock and supply facility within the port, materials and therefore the value of the products circularize from the port into the urban realm. The new, innovative production of floating structures creates new opportunities on the economic market as well as provides the area with new, sustainable and futureproof jobs.

2. Adaptive, self-constructing Makers-District Crane

The cargo crane of the KIMEK AS company area is another important landmark of Kirkenes Port-City Scape. A new purpose for the otherwise obsolete infrastructure can be the reuse as a self-construction and adapting built environment of the makers district. Outsources shipping container can be refurbished within the drydock and will function as modular building-blocks which will be positioned by and around the crane.

The modular units can be used by small businesses or start-ups within the innovative maritime market. Furthermore those complexes can be used as cheap and flexible work-shops or meeting-spaces for the local inhabitants. Also residential units and blocks serving the environmental sustainability of the areas, such as birding complexes or green facades for air purification can be integrated.
Depending on the needs of such spaces, the adaptive, self-constructing Makers-District Crane not only finds a new port-city function for the obsolete port- milieu, but also re-uses aesthetic and cultural important port-features.

Iron Ore-Tailings Re-mining and Urban Waterfront Re-naturation
Synergistic abstraction with its two different sub-areas



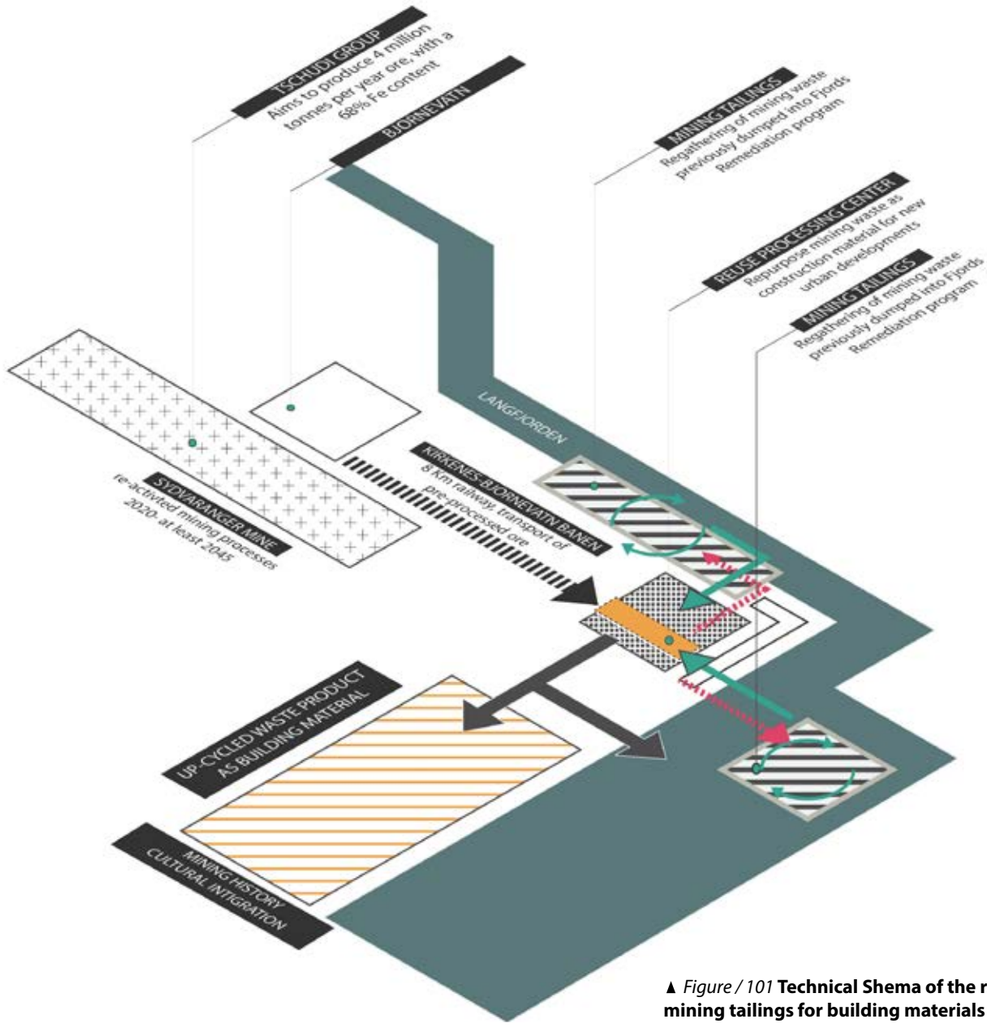
1. Re-natured and Re-cycled Tailing-Dumping, Urban Beach

As explained before, Langfjorden, in the west of Kirkenes, is currently filled up with mining waste disposals and taillings. Those waste products not only harm the maritime environment along the protected fjord, but also decrease the aesthetic of the natural environment/landscape around the city.

Methods have shown, that such tailings can potentially be re-mined and used for the production of building material, which will be explained later.
The remining of the area can help to renature the coastal aquatic system and provide new living-grounds for maritime as well as coastal/terrestrial species, especially birds. The renaturation process can reconnect the waterfront of Kirkenes and add a new semi-natural recreation area for its inhabitants and tourists.
So it creates a new connection between port, city and nature.

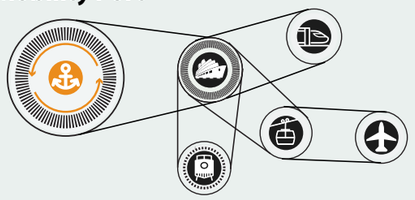
2. New Re-mining Center for Job Creation and further Circular Concepts

Due to the fact, that the mine, being the reason for the development of Kirkenes as its harbour city, the industry still plays an important role within the urban culture and societal mindset of the area. Nonetheless, it is also driver for historic and contemporary impacts on the economic stability as well as on the environmental health of Sør-Varanger. Mining will restart to operate soon and will last until 2040. Therefore it is essential to already rethink the area for a future-proof vision. As statet before, the mining waste can be re-mined and transformed into building materials for local or regional projects. To implement such a facility into the current mining processing center could help to graduately shift the activity away from unsustainable exploitation of mineral resources towards new innovative port-city businesses. The large production halls can facilitate new enterprises, the train, which is currently used solely for mining transport towards the port can function as a mobility-connector towards the regional hinterland.



▲ *Figure / 101* **Technical Shema of the reuse of mining tailings for building materials** */ Höller*

Mobility Port



Port-Cities as economic power houses of the region not only consist of maritime transport and logistic, but also transport through air, on rails and on the street. To allow for a port-city relationship, it is important to find collaborative mobility concepts suitable for both, port and city.

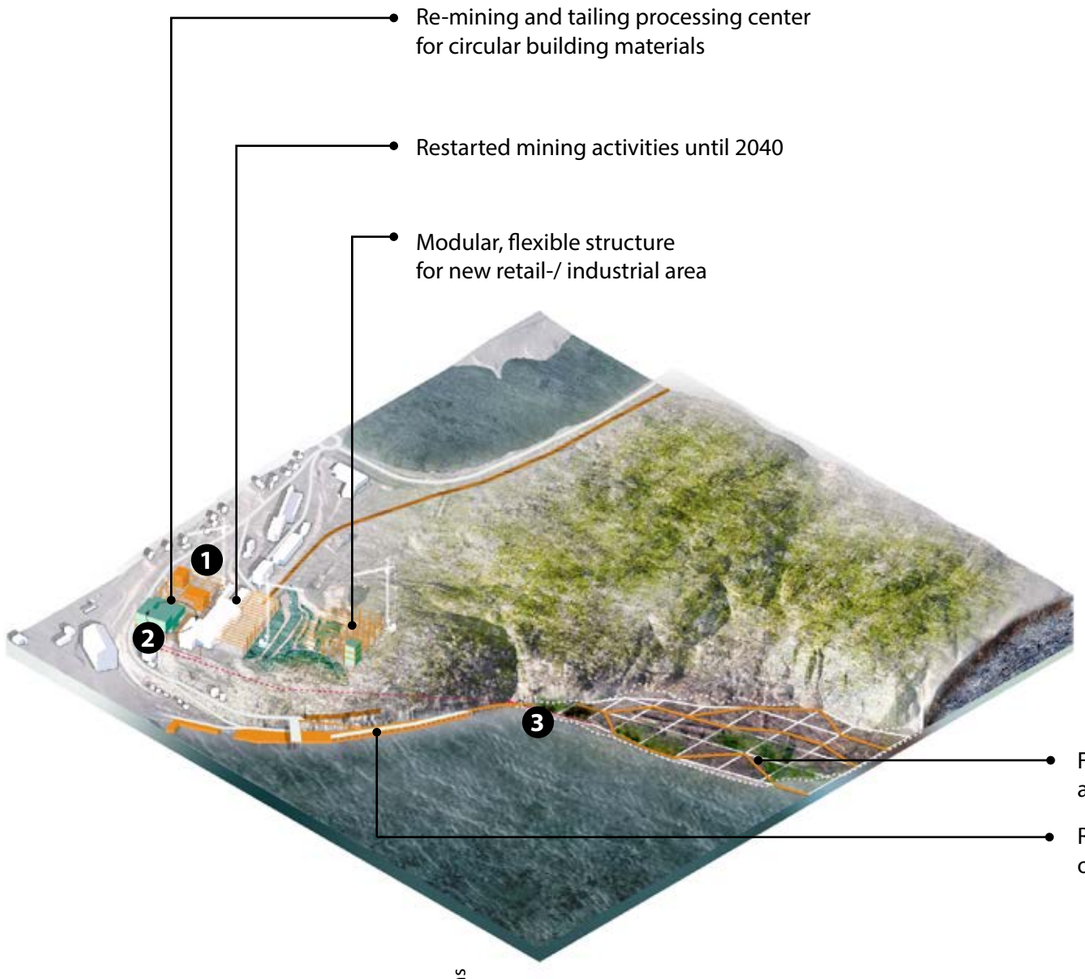
The area of the new Urban Port will become the new mobility center where all modes of transport interwind. The Floating Port will become the center for local, regional and global maritime traffic and the station of the newly proposed hyperloop which serves port as well as city.
A faster and sustainable connection via cable-car towards the airport creates a new attraction for the region and the reuse of the mining-railway will be turned into the local/regional connector of port-city and its hinterland.

URBAN PORT
FICTION

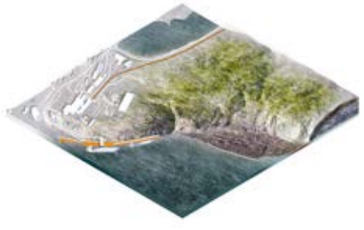
▼ *Figure / 102* **Illustration of the Re-Mining Process along Langfjorden /** *Höller*

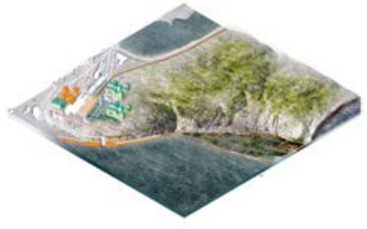
URBAN PORT 2040

DESIGN STEPS- MINING PROCESSING CENTER



▼ *Figure / 103* **Design Steps Sydvaranger Mining Processing Center /** *Höller*





Sydvaranger Mining Processing Center
Iron Ore Processing Restarts until 2040
Flexible Structures and Extensions for
later Makers and Business Area
(e.g. Future Urban Railway Station)

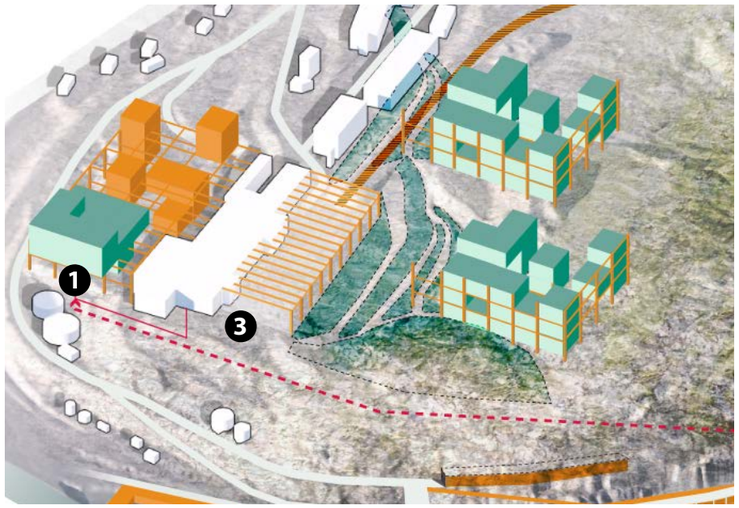
New Mining Tailings Re-use Center
for Building Materials

1st Step of Re-mining tailed Mining Waste
in Langfjorden
+ Accessibility and Recreational Implementations

2020 **2040** **2060** **2080**

URBAN PORT 2060

DESIGN STEPS - MINING PROCESSING CENTER



▼ *Figure / 104* **Design Steps Sydvaranger Mining Processing Center /** *Höller*

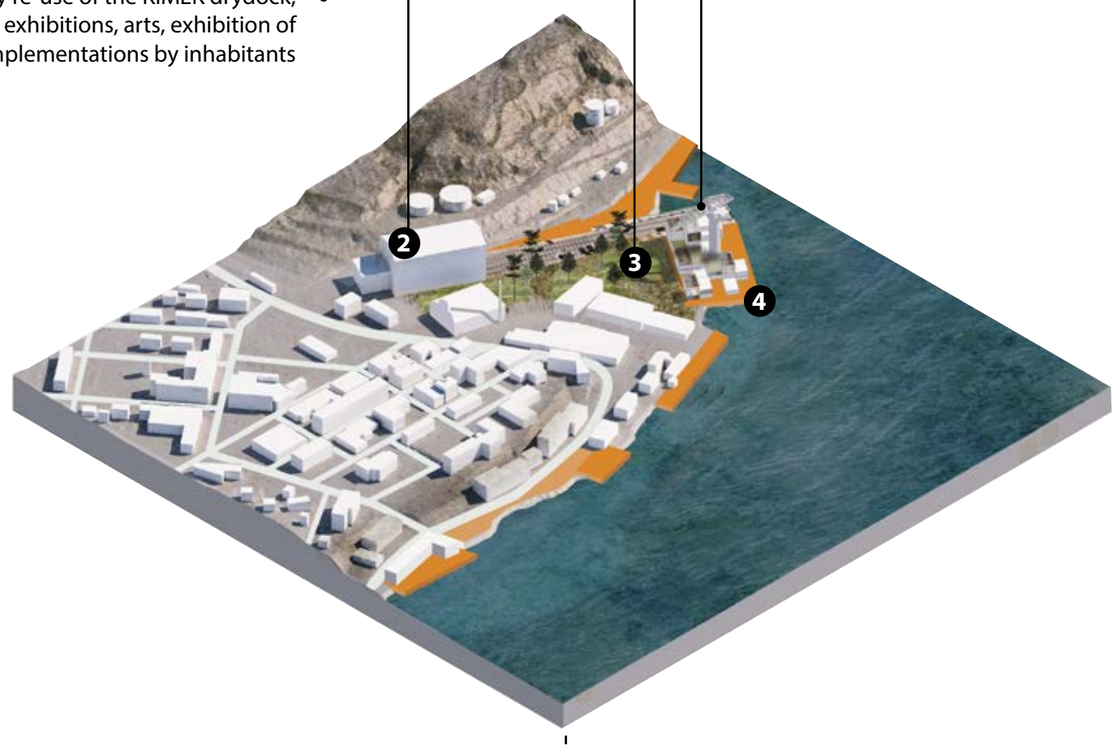
URBAN PORT 2040
DESIGN STEPS

▼ *Figure / 105* **Design Steps Urban Waterfront 2040** / *Höller*

Reuse of the loading crane to first stage of adaptive, self-constructing makers-district

Start bioremediation of area Experimental Arctic Arboretum

Temporary re-use of the KIMEK drydock, e.g. cultural exhibitions, arts, exhibition of proposed implementations by inhabitants



Synergistic Adaptive Ecosystem Implementations 2040
(Floating Urban Port)

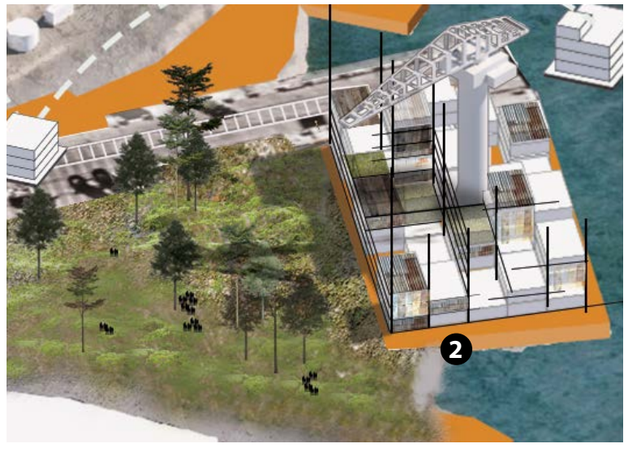
1st Stage Urban Floating Port
Hurtigruten Cruisship Quay
moved to Floating Urban Port
Underwater Mobility Infrastructure
Urban Implementations,
e.g. Recreation, Event Halls, Water Taxi

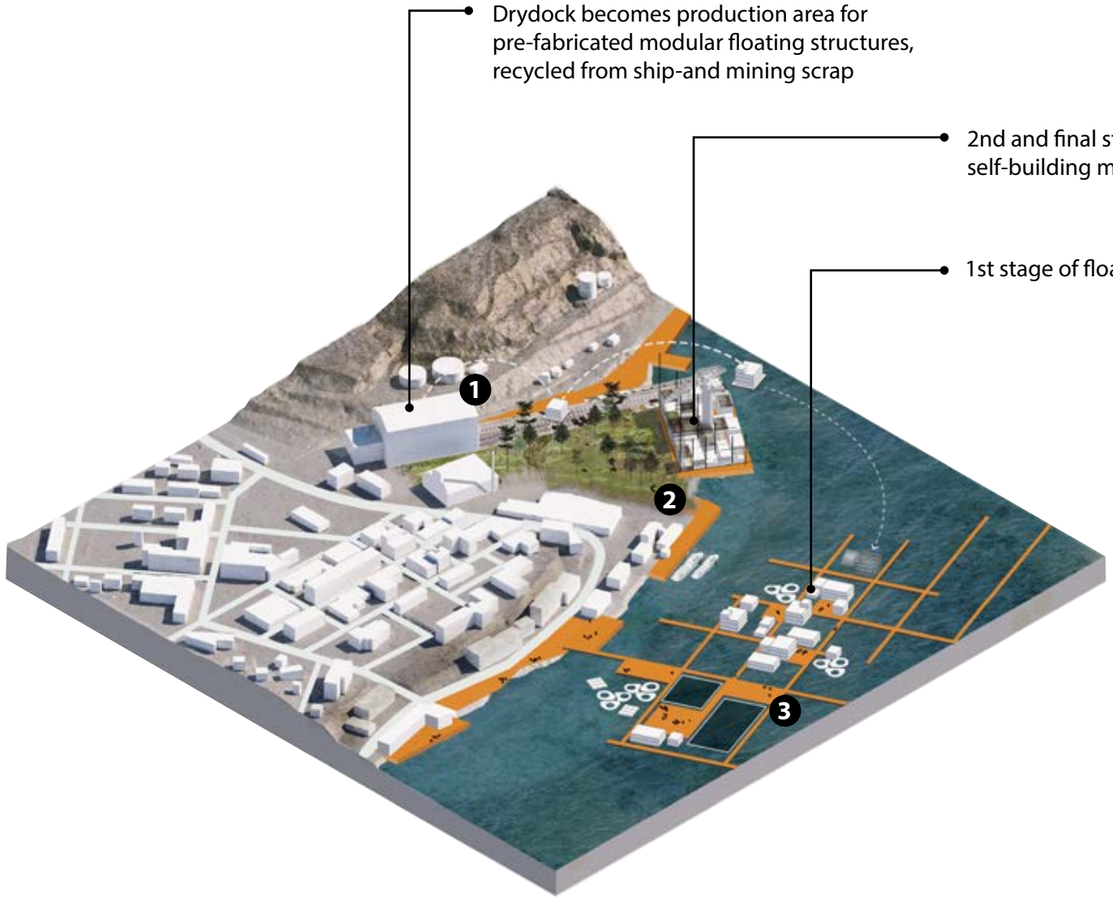
KIMEK Shipwarft Waterfront Redevelopent
Shipping Repair and Service
moved to Floating Logistic Port
Temporary reuse of KIMEK Building,
e.g. Cultural Events, Art, etc.
Start Bioremediation of Shipyard
Reuse of Heavy-Load Crane into 1st Stage
of new Adaptable Mixed Use Makers District

2020 2040 2060 2080

URBAN PORT 2060
DESIGN STEPS

▼ *Figure / 106* **Design Steps Urban Waterfront 2060 /** *Höller*





Synergistic Adaptive Ecosystem Implementations 2040
(Floating Urban Port)

1st Stage Urban Floating Port
Hurtigruten Cruisship Quay moved to Floating Urban Port
Underwater Mobility Infrastructure Urban Implementations, e.g. Recreation, Event Halls, Water Taxi

KIMEK Shipwarft Waterfront Redevelopent
Shipping Repair and Service moved to Floating Logistic Port
Temporary reuse of KIMEK Building, e.g. Cultural Events, Art, etc.
Start Bioremediation of Shipyard
Reuse of Heavy-Load Crane into 1st Stage of new Adaptable Mixed Use Makers District

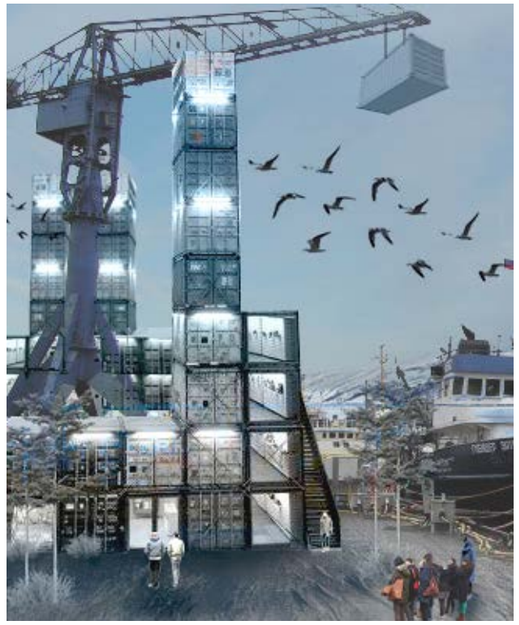
Synergistic Adaptive Ecosystem Implementations 2060
2nd Stage Urban Floating Port
- Implementation of Hyperloop

KIMEK Shipwarft Waterfront Redevelopent
- Drydock and Lifting Mechanism reused for the building floating structures from upcycled ship-materials/scrap metals
- Fully operating Adaptive Loading Crane-Makers District

1st Stage Floating Urban Expansion made in Drydock

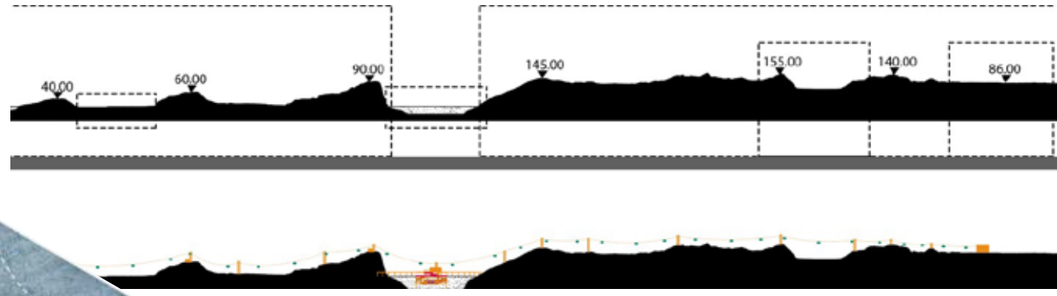
2020 2040 2060 2080

URBAN PORT 2080
DESIGN STEPS



▼ *Figure / 107* **Illustration of the transformation of the loading crane into a self-adapting-Makers District /** *Höller*

▼ *Figure / 108* **Implementation of the Cable Car from the Airport to the New Floating Urban Port /** *Höller*



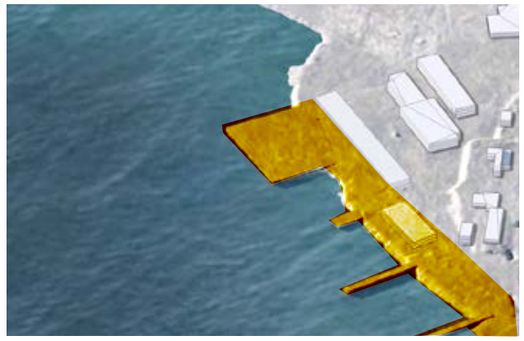
▼ *Figure / 109* **Design Steps Urban Waterfront 2080 /** *Höller*

WETLAND PORT
FROM FRICTION TO FICTION

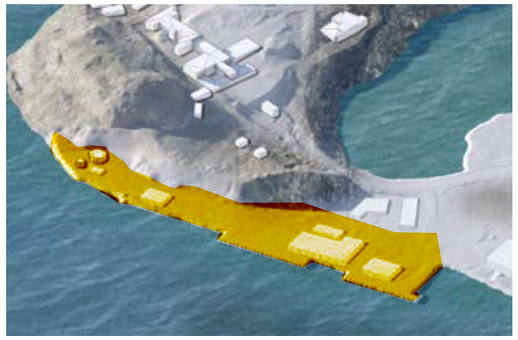
▼ *Figure / 120* **Intertidal wetland and the connection between living and aquaculture /** *Höller*

▼ *Photo / 140* **Bird´s eye view on Soldata-Bukta and Prestøya Peninsula Kirkenes**

WETLAND PORT
EXISTING SITUATION



Deep-Sea Quay and Fishing Dock
The area is currently used by the Port of Kirkenes, where cargo-ships and tankers tranship their goods for further terrestrial transport towards the hinterland. Furthermore the storage and anchoring facilities for the regional fishing industry is located here.



Cruise Ship Port and Kirkenes Processing Center
The area is used by the Hurtigruten Company as a landing place for their cruiseships. The location is only accessible, if you arrive or leave via the post-ship route. Next to the quay, other maritime logistic as well as storage and processing facilities are located here.

Commercial Area on reclaimed land
As explained within the analysis chapter, the location of the current commercial and retail area in Kirkenes was reclaimed to gather extension space for the urban environment. The area is a mix of logistic companies, local commercial enterprises and smaller family businesses. The area is strongly contaminated, because of the industrial activities but also because of the dumping of waste and mining materials for the reclemation process.

Intertidal Flatland along Soldata-Bukta
The intertidal flat, which formerly seperated the Prestøya peninsula and the city, has decreased in size. The area is flooded two times a day due to tidal activities and therefore it is an important ecological area within the urban environment.

▲ *Figures / 110-113* **Existing Infrastructures Wetland Port /** *Höller*

Important Stakeholder

HUMAN PARTCIPANTS

Port-Interns:
Port employees
Owners of port:
Sør-Varanger Municipality (current Port-Authority)
Port-agency:
Nye Henriksen Shipping Service AS

Public Sector:
Port authority (Sør-Varanger Municipality)
Environmental Ministry
Legislators
Urban development authorities

Market Players/Corporate Bodies:
Port-related industries:
Shipping logistics
- Solar Norge Avd. Kirkenes
- Nor Lines AS (Samskip AS)
- Bring Transport AS

Rail, Truck, Air-Logistics:
- Solar Norge Avd. Kirkenes
- Kirkenes Transportsentral AS

Ship building/repair/supply:
- KIMEK AS
- Kirkenesterminalen AS

Fishing and Fishing supply
- Kirkenes Processing AS
- Fishing Companies and Industry
- Free agent and local Fishermen
- KIMEK AS Supply
- Kirkenesterminalen AS

Cruise ship companies
- Hurtigruten
- Havila (2021)

Other Businesses
Tourism sector, e.g. Hotels, Tours
Leisure businesses, e.g. Restaurants, Bars
Research/Universities (e.g. UiT, Barents Secretariat)
Food Industry
Planning/Engineering/Architecture
Creative Sector (e.g. Terminal B)

Civil Society
Permanent residents
Seasonal/periodical residents (e.g. Fishermen)
Short-term guests (e.g. Shipping Crews)
Tourists

Indigenous Society
Sámi

NATURAL PARTCIPANTS

Biotic / Terrestrial:
Birds
Plants

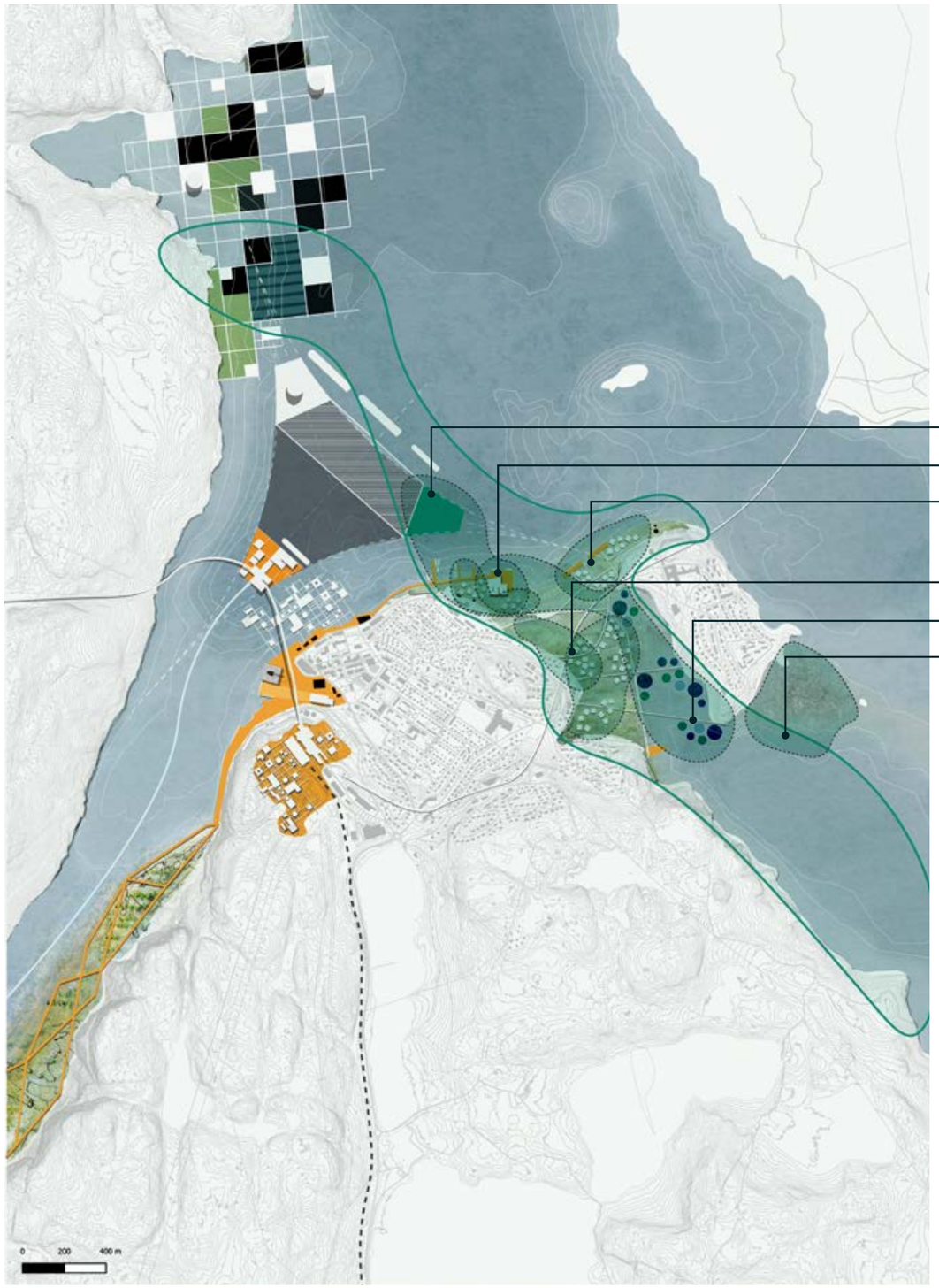
Biotic / Aquatic:
Fish
Plants, Algae
Mussels
Crabs

Abiotic / Terrestrial:
Soil and Sediments

Abiotic / Aquatic:
Water
Sediments

WETLAND PORT
MAIN GOALS AND CONCEPT

▼ *Figure / 114* **Design Fiction Wetland Port** / *Höller*



Integration of local food production and the re-use of waste-water and solid waste from shipping activities and urban activities
Renaturing of reclaimed industrial area into intertidal wetland to accomodate birding, aquaculture, living, recreation and water-purification
Development of local food-hub as cultural/societal implementation along the waterfront and buffer/ meeting zone of local-global interactions of port and city.
Floating fishing port with storage, freezing and supply activities

Floating Fishing Port
Food-Hub
Wetland Living
Wetland Water-Treatment
Local Aquaculture
Intertidal Birding Area

Achived Sustainability Goals:

Climate Change Adaptations:
1. Including joint port-city measures to prevent inundation and flooding of the port, connecting infrastructures *and the city**
2. Promoting the renaturalization of riverbanks and coastlines to erosion and climate change impacts
5. Making resilient and carbon neutrality a priority

Energy Transition, Circular Economy and *General Circularity:**
1. Promoting cooperation between socio-economic, *societal/ cultural and ecological/natural stakeholders** to bring their activities together and identify potential synergies
2. Give priority to circular economy and *circularity in general** to promote and investigate exchange or recycling of materials, energies *and other potential, natural or humanmade flows**
3. Commiting the port-city region to achieve a low carbon, low resource society (e.g through renewable energies)

Renewed Governance:
1. Guarantee better representation for all stakeholder needs, especially civil society and *natural participants** in decision-making
4. Developing collaborative approaches, drawing on scientific, technological, *cultural and natural* knowledge* from scientific community, civil society *and indigenous or alternative societies**

Investing in Human Capital:
1. Mobilizing private and public stakeholders in port-city sectors to promote professional training and personal development for citizen

Synergistic Players:

Renatured wetland used to clean **waste-water from shipping-, urban activities** by **algae-and fishing aquaculture** within a circular loop to develop a fair, local and unique food-product.

3. Provide training in preperation and *re-education possibilities**
4. Promote interactions and projects between schools, *universities**, training institutions and the professional world

Port-Culture and Identity:
1. Developing all types of open spaces within Port-City Spaces to promote developments and activities
2. Integrate spaces and functions open to everyone into port facilities, enhancing the visibility of port activities
3. Port-Center
5. Organizing temporary and permanent cultural events in port-city areas

Food Security and Quality Food:
1. Develop smart sytems for monitoring and controlling maritime and terrestrial food resources
2. Combating food waste by improving storage capacities or *circular reuse approaches**
3. Promote fair trade, organinc and local (special) productions
4. Port areas as dedicated zones for commercial fishing and encourage innovative food research and production projects into port-city regions

Promoting Living, Recreation and Cultural Amenities in Port-City Interface *and Region:**
4. Promote architectural and landscape integration of port facilities

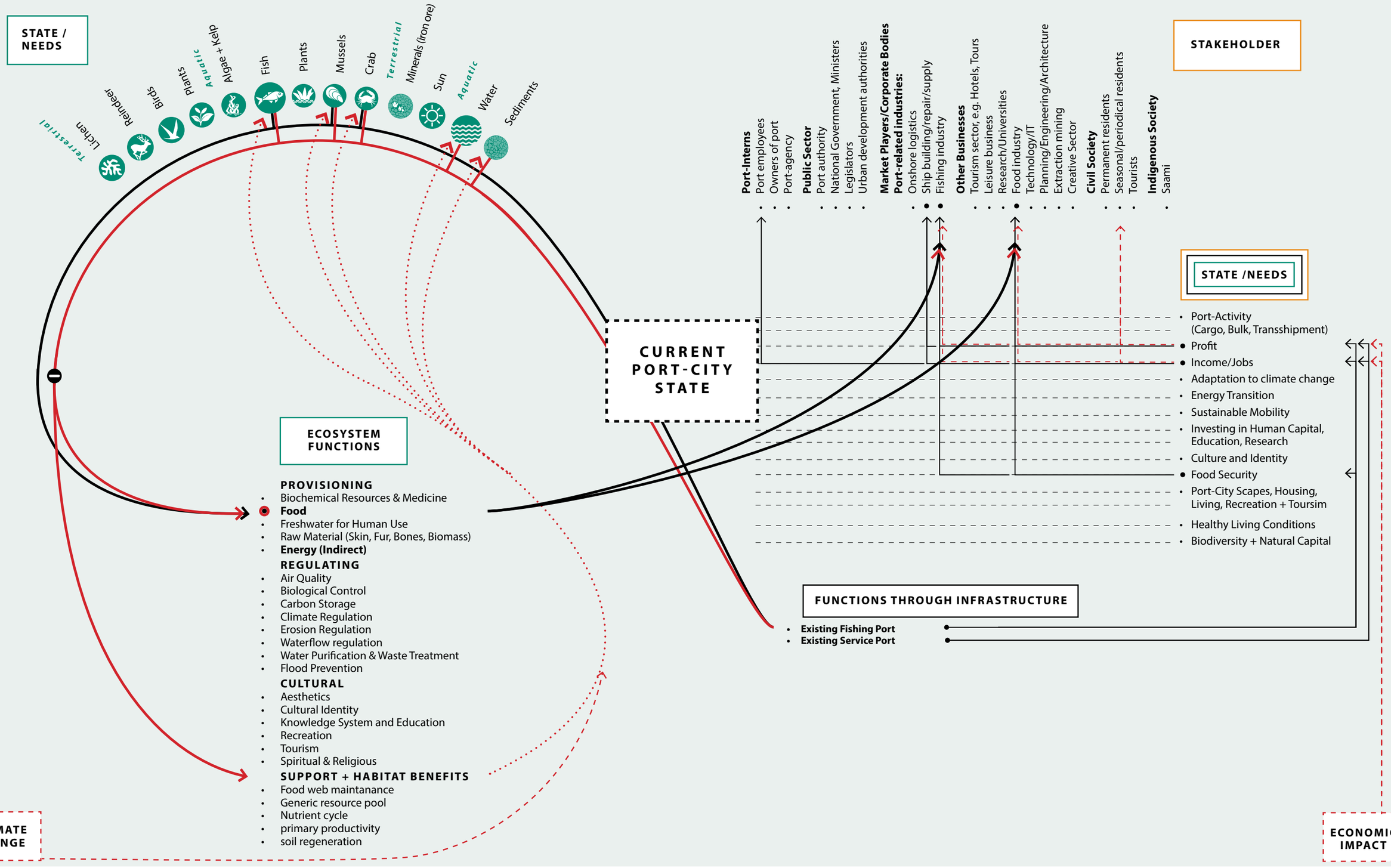
Healthy and attractive living conditions for residents, *temporary visitors (e.g. fishermen, shipping crews) and other members of the society:**
1. Independent, transparent measurements of air, water, soil quality, noise impacts, light pollution
2. Optimizing the use of water (fresh and sea water)
3. Promote green port facilities
5. *Healthy port-city environment through healthy nature**

Biodiversity and Natural Capacity:
1. Improving and maintaining water quality
2. Regual survey of biodiversity in port-city regions
3. Prevention of destroying sensitive natural habitats when developing on and offshore spaces
4. Supporting civil society and indigenous/alternative societies to protect, *strengthen or even include natural participants**
5. Restoring and developing biodiversity *beyond protection towards integration** in the port-city region

WETLAND PORT

SYNERGISTIC LOOP

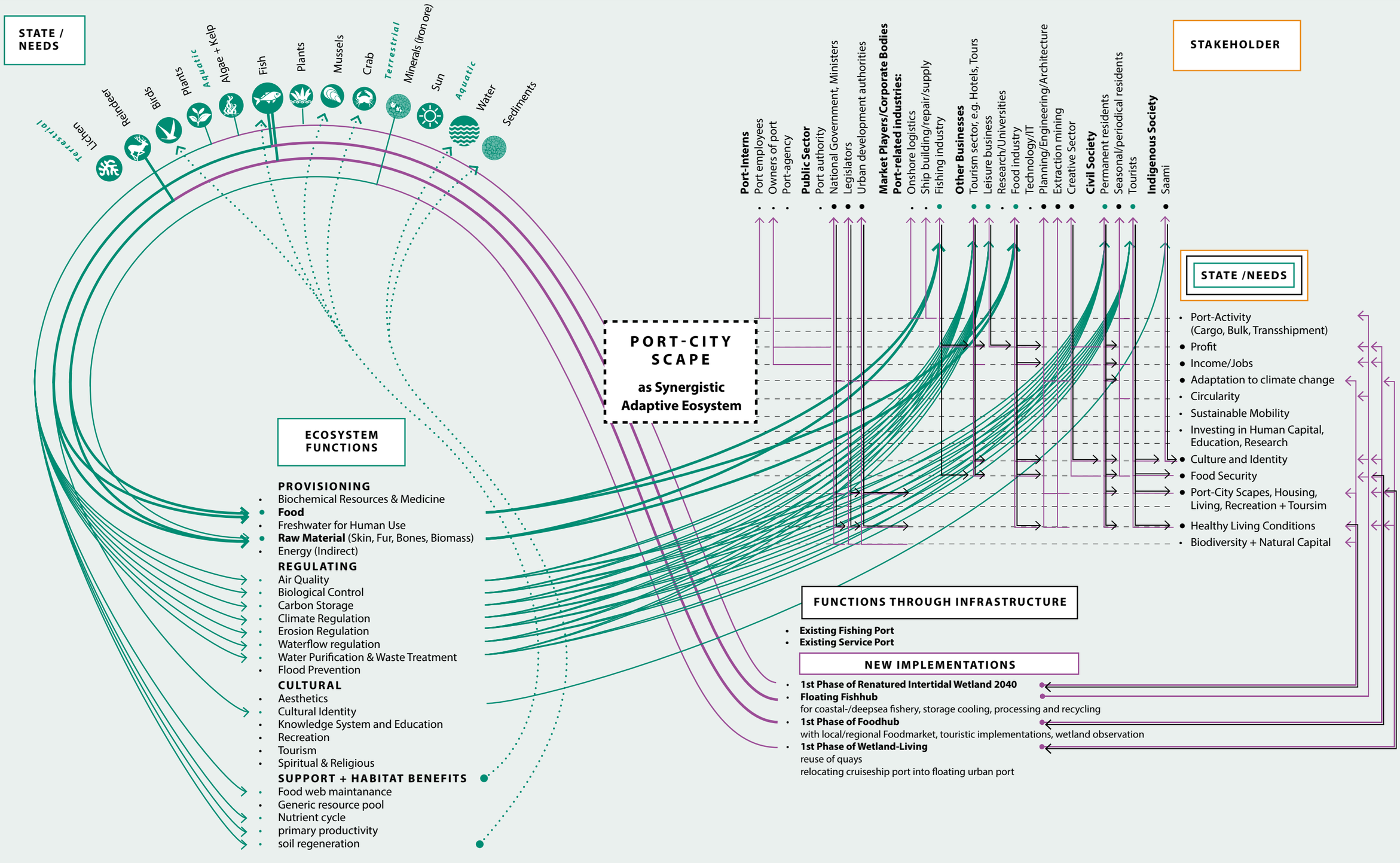
▼ *Figure / 115* **Current/Planned Port-City State** / *Höller*



WETLAND PORT 2040

SYNERGISTIC LOOP

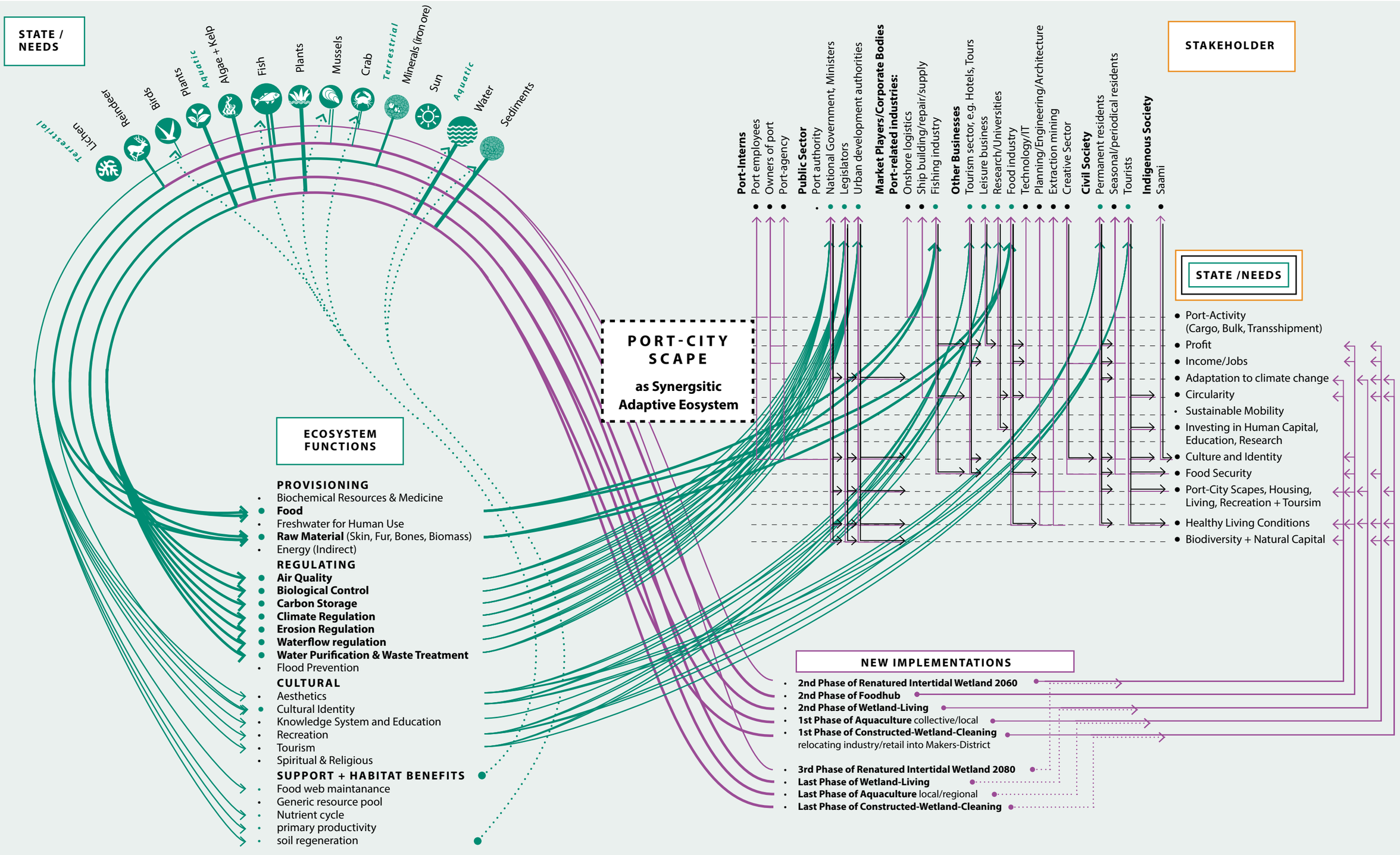
▼ *Figure / 116* **Synergistic-Loop 2040 Wetland Port** / *Höller*



WETLAND PORT 2060/2080

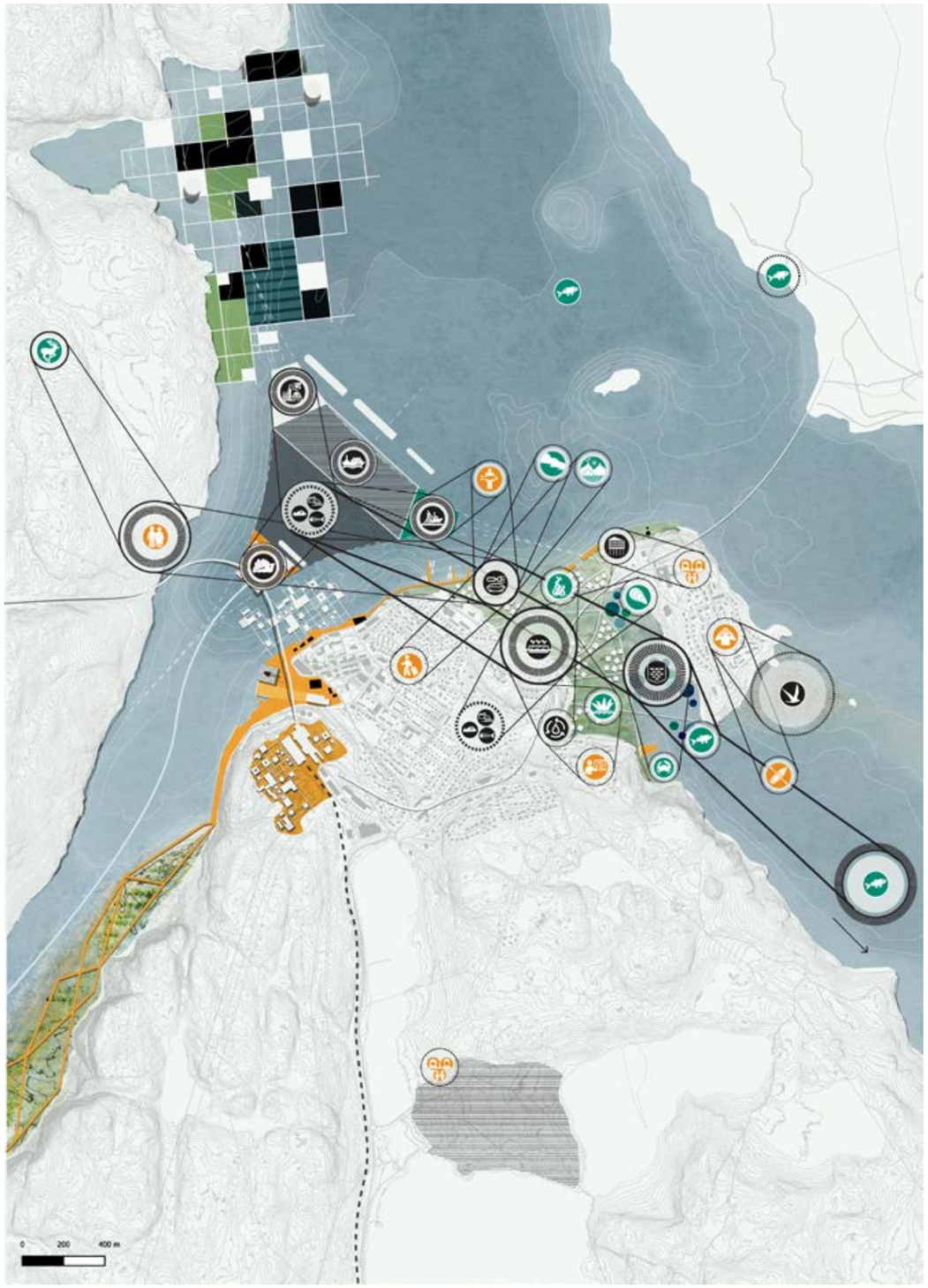
SYNERGISTIC LOOP

▼ *Figure / 117* **Synergistic-Loop 2060 and 2080 Wetland Port** / *Höller*

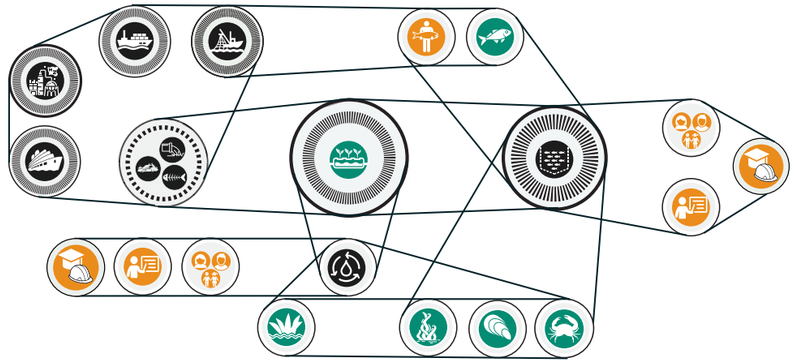


WETLAND PORT
FICTION-SYNERGIES

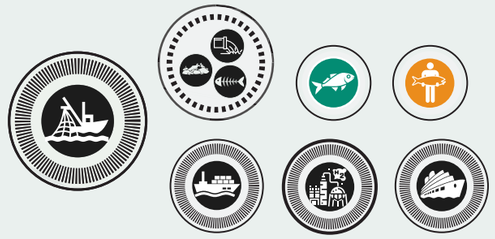
▼ *Figure / 118* **Synergistic Adaptive Wetland Port - Design Fiction /** *Höller*



Renatured Productive Wetland and Waste-Water Processing Cycle
Synergistic Abstraction with its three different sub-areas



1. Floating Fishing Port and Processing Center



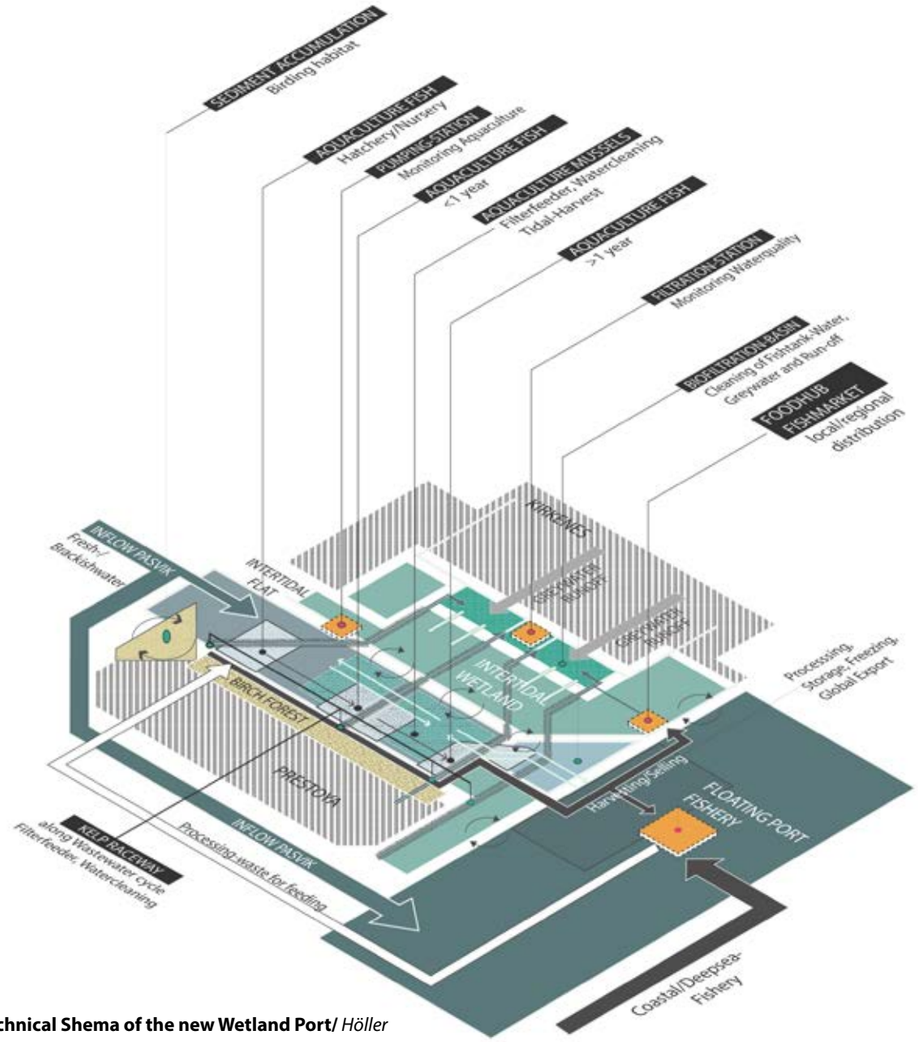
The floating fishing port for the regional fishery industry of the Barents Area includes neccessary infrastructures such as quays for ships, stroage and cooling facilities as well as a processing center, which prepares the caught fish for the further regional or global export. Furthermore the floating structure has an integrated waste-cycle center, which collects the and sorts the waste into organic/nutrient waste, such as from fishery or waste-water of the cargo-and cruiseships and into non-organic waste such as oil, plastic, cardbords, strongly contaminated water and others. The waste-processing center collects, then circularizes the materials towards the respective city-facility, which transforms them into reuseable urban materials.

2. Urban Aquaculture

Kirkenes nowadays focuses mostly on the provision of services for the regional fishery industry, but has only a few local fishing activities, which are mostly related to recreation and tourism. To encounter the regional/global dominance of fishery in Kirkenes, an area for local urban aquaculture within the renatured wetland and Soldata-Bukta is proposed. One goal is to relieve the city from its depencency on regional/global players and industries. The COVID-19 pandemic showed, that if foreign shipping and fishing crews are not allowed to board the harbour, activities and jobs for the local service and supporting industry decline. If there is a local counterpart to this industry a broader field of work for such service companies as well as a whole ne brench of job-opportunities evolves.
Another goal is the reconnection of fishing and fish-production with the local culture. Many coastal cities evolved through fishery. The centralization and the industrialization of fishery brought a large decline of fishing activites in those areas.
Last but not least Norway is a leading country, when it comes to alternative fishing, such as aquaculture. As described in the analysis, global warming has unpredictable impacts on the aquatic system. The large uncertainty of future fishing within the Barents Region can be encountered by such local and alternative production as well as relieve the pressured maritime ecosystem.

3. Wetland Cleaning - Living Machine

The current commercial area of Kirkenes, which is located on the reclaimed aquatic area between the city and Prestøya peninsual, will be redeveloped and renatured into a interdidal wetland area. This area includes a semi-natural living machine, which is used to recycle the waste water and other flows comming from the port-facilities as well as functions as a filter-area for the water used by the urban-aquaculture. The area can be seen as the circularizer, which transforms material flows from the port into urban-materials and creates an additional value-cycles between port and city.
Furthermore the research on but also the operation of such a cleaning machine in the arctic territory stimulates academic activities as well as jobs, for a sustainable and future-proof arctic port-city.



▲ *Figure / 119* **Technical Shema of the new Wetland Port/** *Höller*

Urban Food-Hub as Local-Global Connector
Synergistic Abstraction with its three different sub-areas

1. Arctic Food-Hub

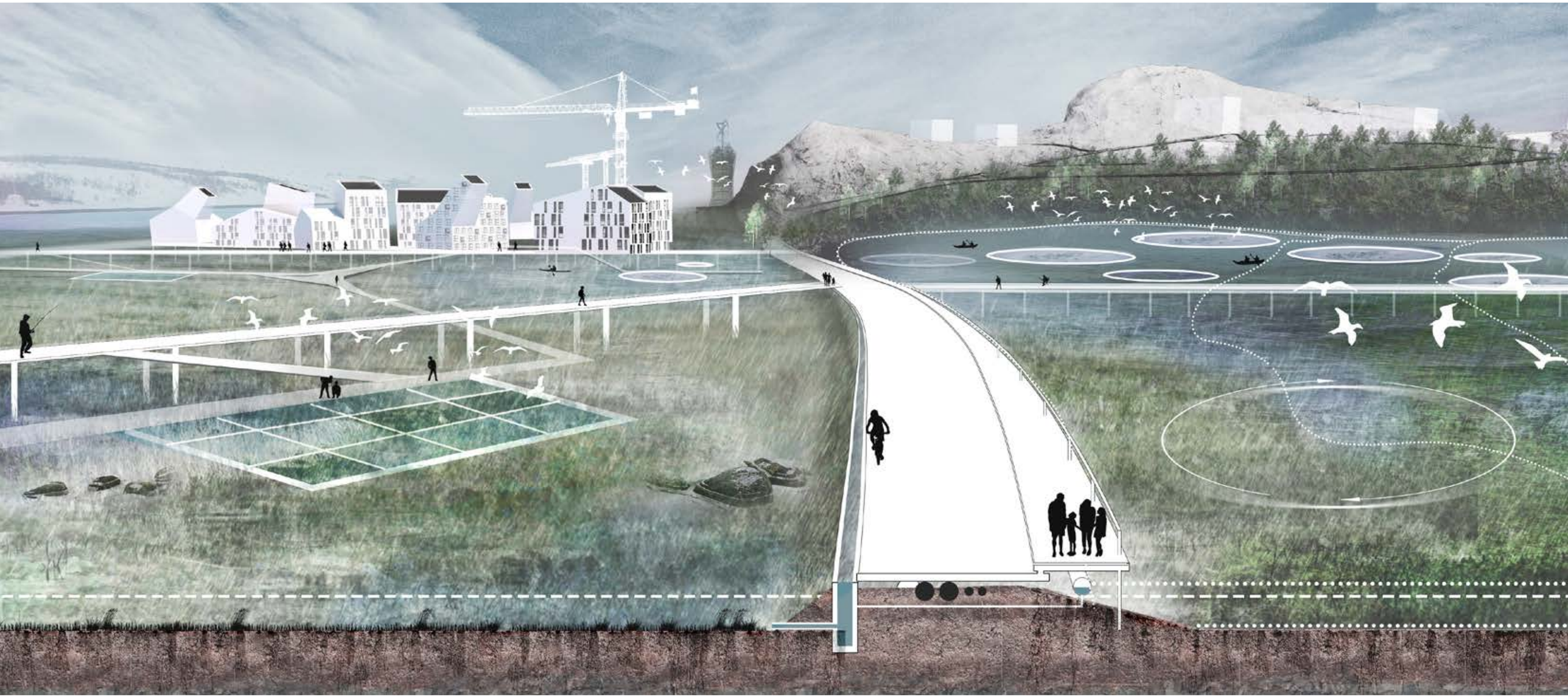
The Arctic Food-Hub will be located on the waterfront and be placed on the concrete-dock of the former Kirkenes Port, which will move towards the floating port. The food-hub is more then a connector between city and its maritime environment. It is a buffer between, but also meeting point of the territorial port-activity in form of fishery, cargo-logisitcs and cruiseship tourism and the multiple urban societies of Kirkenes. On the one hand, the food-hub allows for exchange between the local and the global. A regular foodmarket, where local food (e.g. fish, algae, crabs, etc) from aquaculture, but also from reindeer herding will be mixed with the deep-sea and coastal fishery-products, collected by the regional fishing industry. Furthermore it is a point of exchange, where inhabitants meet with temporary visitors, such as shipping crews, fishermen and tourists to celebrate the phenomena of the maritime and arctic landscape and culture.

2. Wetland Living

The number of inhabitants of Kirkenes is predicted to grow, but uncertainties in economy and climate restrict from making concrete and precises predictions. Instead of reclaiming more and more land within the natrural periphery of the city, the connection between natural and urbanized areas has to be the favoured development strategy. The emergence of the wetland living area, connects port, city and nature. Instead of building directly on the surface, the architecture of the residential area will propose buildings on stelts, which allows for the intermix of natural environments and functions with living on-top. In combination with local port-activities, the wetland living area creates a balnced, sustainable, flexible and health port-city environment.

WETLAND PORT
FICTION

▼ *Figure / 120* **Impression of the intertidal wetland and the connection between living and aquaculture** */ Höller*



WETLAND PORT
FICTION

Figure / 121 **Section wetland living and the reuse of mining waste as building material** */ Höller*

Iron ore tailings

–> Geopolymerization
–> Bricks for Construction

Utilization of mine tailings) to produce geopolymer masonry blocks is a novel way to meet the emerging needs.

Advantages of geopolymer over OPC (Cement)
- Abundant raw materials resources
- Energy saving and environment protection
- Good volume stability
- Reasonable strength gain in short time
- Ultra-excellent durability
- High fire resistance and low thermal conductivity
- Ability to immobilize toxic and hazardous wastes
- Superior resistance to chemical attack

The properties and durability of mine tailings-based geopolymeric masonry blocks

The major goal is to develop an environmentally friendly and cost effective method for recycling and utilizing mine tailings as construction materials:

Geopolymerization is a relatively new technology that transforms aluminosilicate materials into useful products called geopolymers

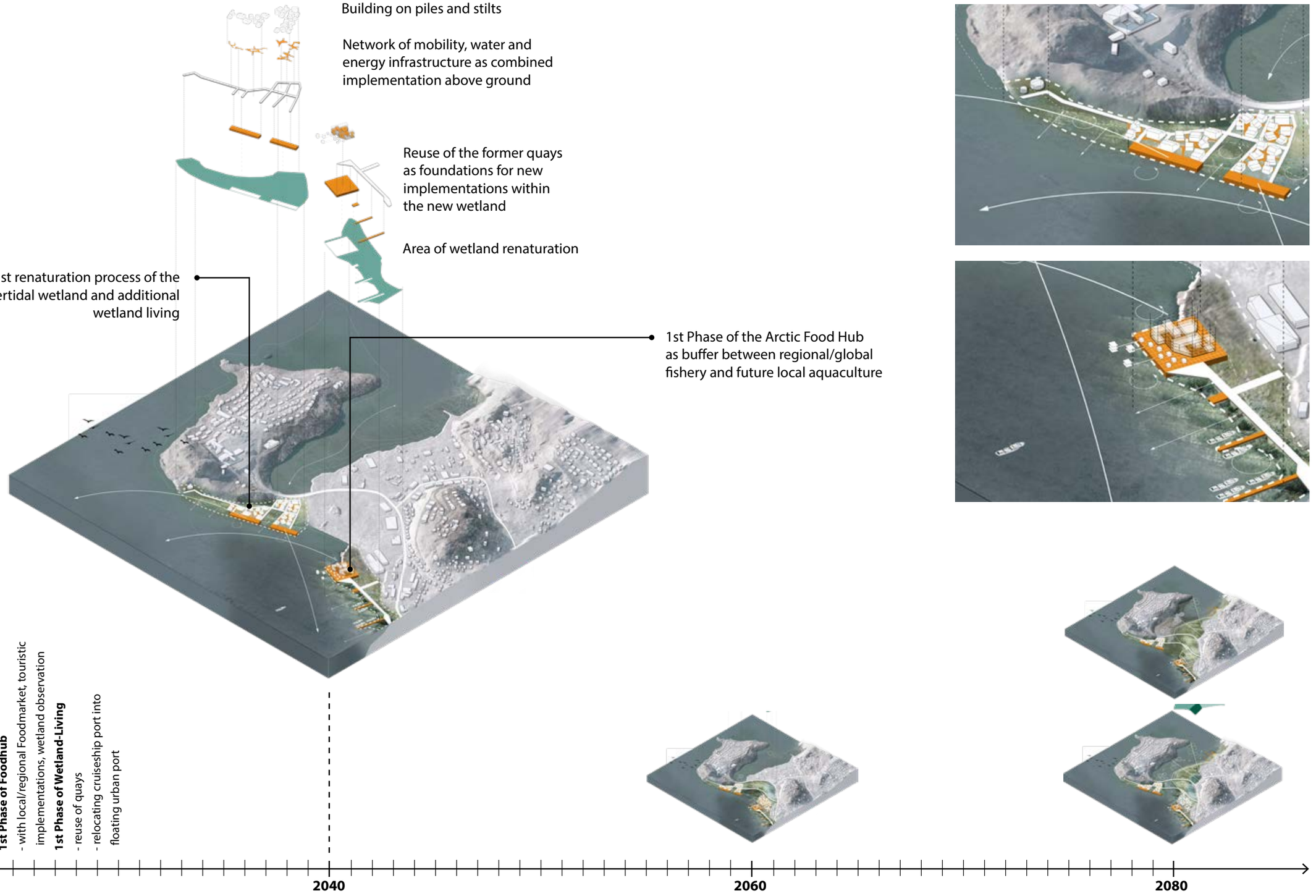
- Bricks
- Concrete for pavement
- Concrete for structures, e.g. bridges
- Highway base material
- Highway embankment material

The mining-waste, currently dumped into Langfjorden, can be recollected and upcycled into building materials for the new hosuing within the wetland port. On the one hand, the materialization, of reusing mining material can create cultural identity within the port-city. The long mining history, which hopefully becomes an unsustainable past, still can be seen within the architecture of the environment. On the other hand, the upcycing of the mining waste can produce an alternative economic sector, after the Sydvaranger Mine closed its doors.

WETLAND PORT 2040

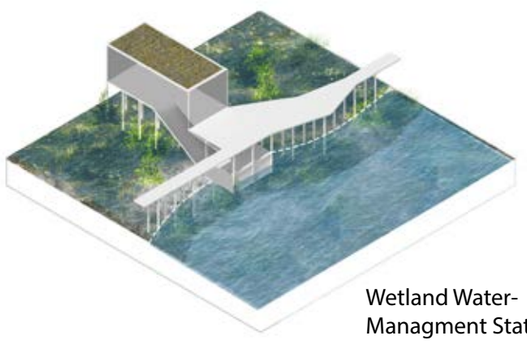
DESIGN STEPS

▼ *Figure / 122* **Wetland Port Design Steps /** *Höller*

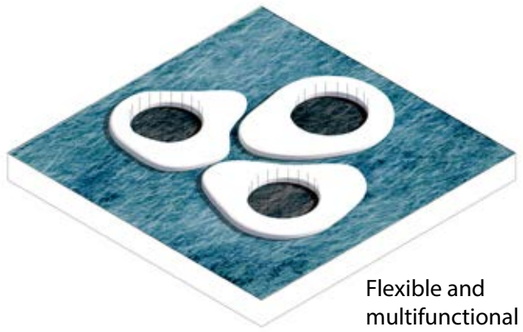


WETLAND PORT 2060
DESIGN STEPS

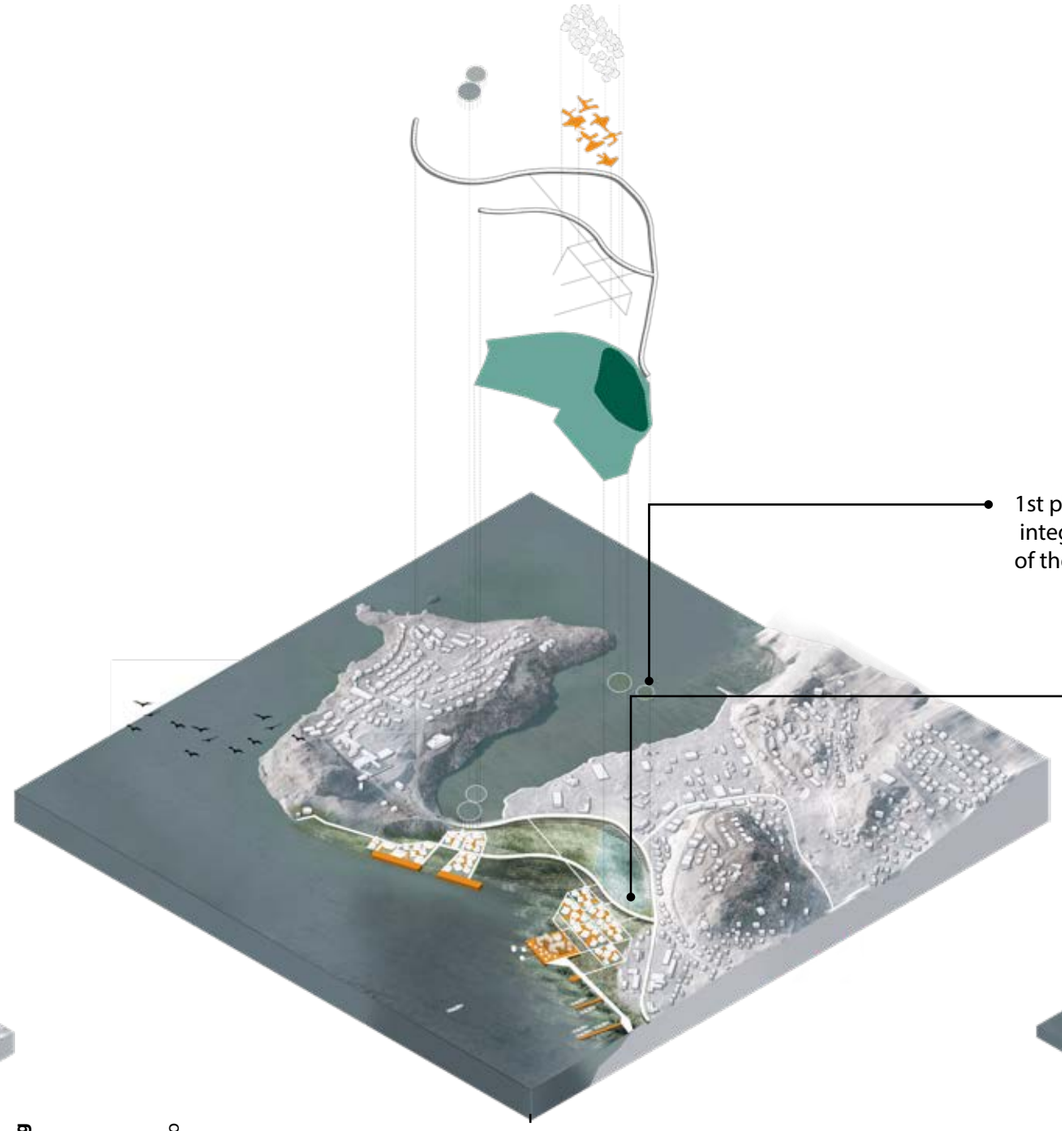
▼ *Figure / 123* **Wetland Port Design Steps /** *Höller*



Wetland Water-
Managment Station

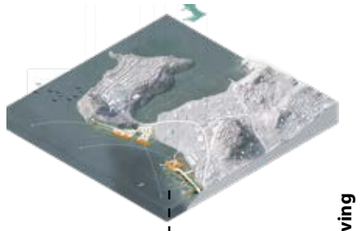


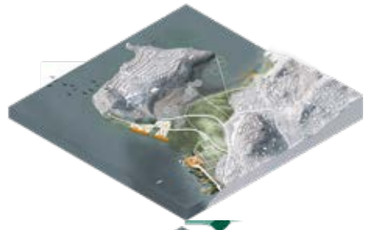
Flexible and
multifunctional
aquaculture

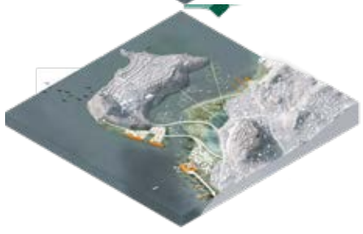


1st phase of the local aquaculture
integrated into the intertidal flat
of the area

1st phase of the wetland
cleaning machine for waste
and grey water purification
of city and port





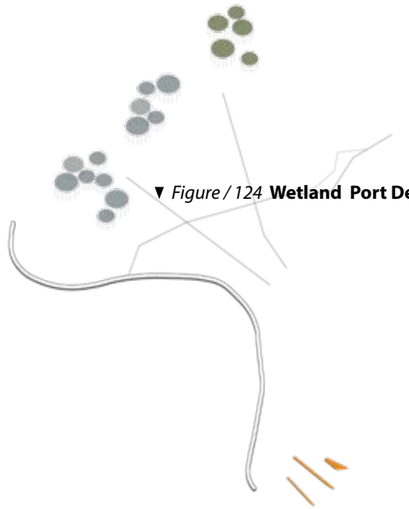


1st Phase of Renatured Intertidal Wetland 2040
Floating Fishhub
- for coastal-/deepsea fishery, storage cooling, processing and recycling
1st Phase of Foodhub
- with local/regional Foodmarket, touristic implementations, wetland observation
1st Phase of Wetland-Living
- reuse of quays
- relocating cruiseship port into floating urban port

2nd Phase of Renatured Intertidal Wetland 2060
2nd Phase of Foodhub
2nd Phase of Wetland-Living
1st Phase of Aquaculture
- collective/local
1st Phase of Constructed-Wetland-Cleaning
- relocating industry/retail into Makers-District

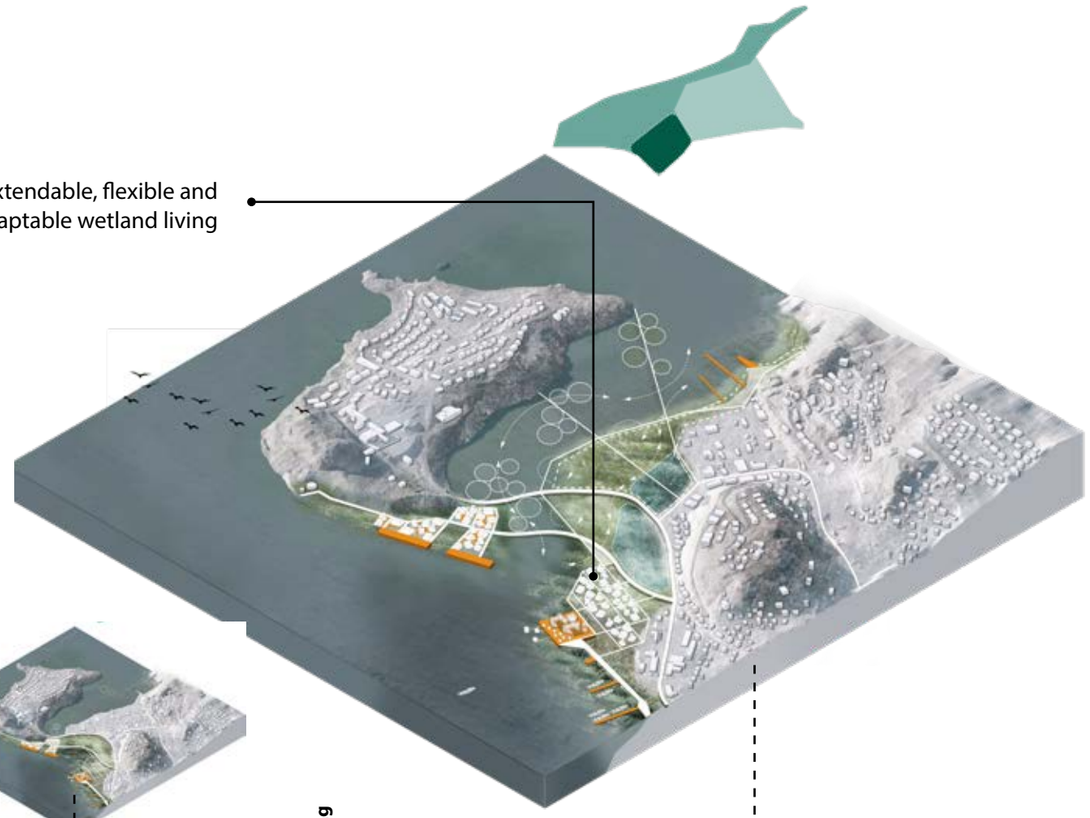
2020 **2040** **2060** **2080**

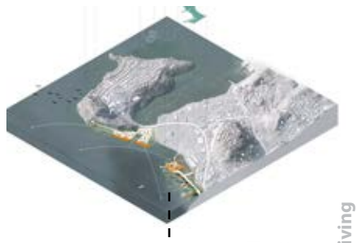
WETLAND PORT
DESIGN STEPS



▼ *Figure / 124* **Wetland Port Design Steps /** *Höller*

Extendable, flexible and
adaptable wetland living





1st Phase of Renatured Intertidal Wetland 2040
Floating Fishhub
- for coastal-/deepsea fishery, storage cooling, processing and recycling
1st Phase of Foodhub
- with local/regional Foodmarket, touristic implementations, wetland observation
1st Phase of Wetland-Living
- reuse of quays
- relocating cruiseship port into floating urban port

2nd Phase of Renatured Intertidal Wetland 2060
2nd Phase of Foodhub
2nd Phase of Wetland-Living
1st Phase of Aquaculture
- collective/local
1st Phase of Constructed-Wetland-Cleaning
- relocating industry/retail into Makers-District

3rd Phase of Renatured Intertidal Wetland 2080
Last Phase of Wetland-Living
Last Phase of Aquaculture
- local/regional
Last Phase of Constructed-Wetland-Cleaning

2020 **2040** **2060** **2080**

DESIGN
CONCLUSION

Kirkenes, Sør-Varanger, Finmark and the Arctic have been amazing places to study and to research. The richness of nature, the open-minded and diverse societal aspects of the Norwegian, but especially the nature-related, wise and innovative cul-ture of the Sámi have influenced the outcome of the design.
On the opposite, the contrast of the vast, perforated mining-landscape, the growing economic interests and the uncertain, but for sure questionable plans for the future of the city encounter all of the above.

The design tried to deal with all of the mentioned positive, negative, inspiring, integrating and contradicting elements, which let the project grow in its complexity.

It was the goal to let imaginative and creative design emerge a new port-city paradigm and an alternative reality of the proposed port-development within the city of Kirkenes, where nature, society and economy are aligned and balanced ac-tors. After a year of forth and back between research and design the end-result is a thought-trough, consistent, open-ended and imaginative design that tries to include, encounter and synergize many, if not most of the paradoxical elements the region and the port bring with them.

1. The Encounter of Reindeer Herding, Sámi Culture, Nature and the Territorial Need of Energy Production and Transshipment

Accountable for the sense-making between those totally different and contradicting functions of port and city, was the in-depth research on the process of reindeer herding and the natural/biological investigation on reindeer. Lichen, as a cur-rently scarce food-source for the reindeer and as a potential natural producer for hydrogen, becomes the synergistic connector. Even though the production of hydrogen out of Lichen is still a pie in he sky, the fictional design at least moves away from conventional and separating interface-thoughts, that would only manage the conflicts between industrial activi-ties and reindeer herding, towards the development of space for dynamic co-existence and potential synergistic interac-tion. The further it speaks out the controversial governance of the Norwegian authorities, which on the one hand drive sustainable development (emission-free fjords, renewable energy, sustainable living environments) within the country, by the unsustainable, polluting extraction and export of oil and gas around the world. Norway should refocus on ports as the new potential to even become more sustainable within the own country but also for sustainable and acceptable develop-ment of the Arctic Ocean. Port-Cities along the Norwegian coast have the chance to become strategic networks for the production and provision of hydrogen, which would give them a strategic advantage compared to other port-cities in other countries. And in the end, maybe such a strategic development can become the fusion of nature, economy and maritime culture that will provide the region with a long-term resilient future.

2. New Dimensions of Waterfront Redevelopment

The Urban Port focuses on the emergence of a new paradigm of the waterfront redevelopment. Instead of allow for re-urbanization, due to the migration of the former port-activities towards the new facility, the concept aims for new possibi-lities of port-activities, such as creative hubs, makers-districts, space for digitization and other innovative maritime busines-ses which can be become a fusion of urban and port activities. Furthermore, it envisions a shared waterfront between lo-cals and foreign guests by setting the city and the new floating cruise-ship terminal into contrast with each other. The area becomes a melting-pot of local-global, home and away, welcome and good-bye.

3. Port as a Balance between Global and Local

The Wetland Port tries to start a discussion about the connotation of local and territorial of port and city. Is the city the local part and the port the territorial?
The fact that this part of the design focuses on a gradual spatial transition between the global/regional fishing activity in deep-sea or coastal areas of the Barents Sea and the newly proposed local production of fish, algae and other maritime products buffered by the new food-hub, which works as an integrator between both, shows that a clear division between port (territorial) and city(local) is and should not be made. Moreover, port and city intertwine within the newly given space and become the "glocal".
Another example for that phenomenon are ships. Serving the global trans-shipment of goods, they are part of the city as soon as they enter the port. Similar as for the local built environment, the city should provide services for the ships as local, floating, temporary homes. Examples, where this relation is visible, is the provision of sustainable cleaning and recycling of waste and wastewater produced by the arriving ships. The wetland cleaning machine shows an alternative in which port, city, nature and culture are ultimately related to each other.

Reflecting again on the three parts of the design shows that, even if the outcome might be fictional and sometimes over the top, the creative design has the power to communicate certain needs and can give a start for new discussion. All in all, the design focuses on renewed governance and cooperation between the port and city institutions and their stakeholder. It demonstrates the power of fictional but also realistic spatial design to make the need as well as the additional benefits of cooperation and integration visible. It gives an alternative to conventional approaches, where port and city as separated entities are potentially able to emerge a certain for of sustainability, but miss the additional benefits which only occur by creative and imaginative sense-making.

DISCUSSION AND REFLECTION

By reaching the last chapter of the discussion and reflection , the journey into the filed of port-cities as well as into the Arctic environment takes a temporary ending. Within this chapter, a few topics, questions and thoughts will be concluded and brought to an end. Those topics either couldn´t be discussed within the thesis itself or the mindset on certain approaches has changed during the actual development.

01 Scientific and Societal Relevance

The increasing impact of climate change as well as the impacts of globally-driven developments and there-fore the question about balance between local place, and globalization concerns us all.
Port-cities are interesting phenomena. They serve the purpose of economy and function as cultural , societal and natural habitat for many million people and uncountable natural participants around the world at the same time. As stated at the beginning, this makes them especially vulnerable for the uncertainties ahead in times of economic imperatives, the glorification of unlimited growth fuels conflicts and frictions. Furthermore climate change impacts, i.e. sea-level rise, flooding events, storms, increasing temperatures and many more create a common burden for port-cities around the world. Furthermore, a certain tendency that the imperative of economic development creates an imbalance between economic interests of the port, embedded in and interdependent on larger, global associations and networks and cultural, societal and environmental values within the local port-city region. The identification of impacting and pressuring forces becomes more and more blurred due to the growing complexity of the interrelated systems. All the above result in the urge of the development of integrative, collaborative, sustainable, adaptive and resillient port-cities.
Nonetheless current spatial, technological and institutional structures don´t allow for a high grad of public and private cooperation to steer such a transition.

Therefor main goal of the research was the re-questioning of the static and local, waterfront-specific perception we have of the port-city relationship as well as to emerge operative force for urban planners and designers within the field of port-cities. Out-dated models, like the Port-City Interface, but also mainly economically driven conceptualizations of port-cities still ignore the increasing fuzziness of the traditional port-city boundaries as well as the lack of a strong and mutually supportive governance structure, including several potential stakeholders and actors within the blurry port-city land-/seascapes. This dichotomy of port and city leads not only to frictions in the city itself but also between the many theoretical and practical professions researching on port-cities.
Approaching the port-city as a complex land-/seascape from a spatial perspective, allows to overcome those universalizing approaches and monofunctional designs, focusing on conflict management between port and city. Elaborating on the encounters and resulting synergies between different agents by investi-gating flows and dynamics instead of focusing strictly on either the city, the port or the ecological shifts the focus on the in-betweenness of port and city and spotlights the port-city as the result of many plural-istic, contradicting heterogenic, complex and often confusing social, economic, and environmental dynam-ics. The realization of the richness for creative and imaginative designing of those scapes can help urban planners to gain operative force within the field of port-cities.

02 Relationship between Research and Design

The first paragraph will reflect on the overall approach that was chosen and will start a discussion about the suitability, pros and cons of the fictional design approach. The thesis is driven by an explorative and spatial approach, which lead to a mutual forth and back between design by research and research by de-sign. Even though it is hard to distinguish and isolate thedifferent steps, three mainparts can be identified within the process of this thesis:

1. Setting the frame
(design-decisions by research)

It is essential to state that the project not only sets the focus on designing and integrating a new port development into an existing urban/natural setting. It instead tries to support the investigated need for a changing perception on how to approach port-cities and what qualities urbanism, as a planning and designing profession can bring into the discussion. A significant part of the research was done within the theoretical field of port-cities. It needs to be admitted that, over the whole duration of the thesis, the view on defining and finding the right perception of Port-City Scapes changed constantly. The need for a changing perception, away from a static and separating interface towards a dynamic space of interrelations lead to the definition of the port-city as one ecosystem, in which natural, social/cultural and economic values of all institutional and non-institutional stakeholders, need to be aligned and integrated. Even though the definition of port-cities as one ecosystem shifts the perception away from the waterfront re-development as the only paradigm in port-city planning, it still neglects the fact that not all parts of the port and the city are suitable to emerge the maritime mindset, that qualifies for a port-city. The recognition of the importance of the liminality and the in-between, as key for spatial planning and designing to gain operative force, came quiet at the end of the project. The homogeneity, ambiguity and incomparability, the emerging conflicts, the needs and values, but also the strengths accumulated within those scapes, where port and city intertwine, create the real richness for the creative and imaginative process for designing the port-city. Reflecting on that late realization, I don't think that the overall outcome of the design, but also the path towards it would have changed. I rather think, that the late outfindings represent the experimental character of the thesis. By working on the thesis, I gathered new insights as well as build my own perceptions and views on the topic, which brought me a bit closer on being able to participate within the discussion about researching, planning and designing port-cities.

2. Analysis
(design-decisions by research)

By following a spatial, actors- and values-based approach, the second aspect was to analyse the local cultural, societal and environmental specificities of the city and the region to encounter the amount of re-search done in terms of quantitative modelling for global comparison by economic geographers or the definition of ideal-port city transition models by transport geographers. The problems of contemporary port-city development driven by the production of economic wealth, causing environmental deterioration as well as social and cultural issues, need careful research (Fusco Girade, 2013). In combination with the se-lection of the project area within an extreme Arctic setting, which also emerges the necessity of in-depth analysis of interactions between human-made and natural processes, leads to the decision, that only a de-sign project taking into account the bigger land-/seascape can deliver a realistic as well as a holistic fundament for designing. The investigated blurriness of the crumbling port-city entity leads to the development process under the condition of precariousness (Diedrich, 2013), which can drive the project towards a synergetic design approach taking ecosystem participants, urban/societal transformation and economic development equally into account. During this step of analysing, a large amount of knowledge was gathered, but for a long time, the work lacked of a concrete and reflecting synthesis of all the information about the area, culture, nature and the impact of the proposed port-development. This may led to a phase of confusion, not for the design process itself, but for the representation and communication of the out-findings the proposed design is based on. Reflecting on that, I need to say that the question of: "how to visualize the complexity of possible interrelations, of the paradox and heterogenic spaces, the values and stakeholders but also possible synergistic solutions within multiple and interrelated scales" could not be fully answered within the thesis.

3. From Friction to Fiction
(From research to design to research)

To continue the discussion about where analysis stops and synthesis starts, I came to the conclusion that the actual synthesizing process happened in-between researching about the location and the creative phase of cognitive thinking while designing and reimagining the port-city of Kirkenes. Every additional piece of information collected during the forth-and-back between research and design let the creativity and imaginary grow. The approach of using a design fiction therefore helped for the synthesizing process. Although this thesis is based on a critical and realistic analysis of plausible technological and scientifical facts and trends, fiction helped to free the project from the boundaries of reality and let a new form of port-city paradigm emerge. At the start of the thesis it was planned to use the proposed port by the munic-ipality as a base for a redesign. Reflecting on that, it was the best decision to let go this plan and focus on a complete fictional design of the port and therefore of the port-city. Without the idea of a conceptual floating port, many design but also learning aspects would have been missing. First of all, the creation of multiple mirroring waterfronts, where multiple contradicting functional, cultural, economic and environ-mental values of port and city encounter, would not have taken place. Therefore I question, that the reali-zation of the importance of those encounter-scapes for the port-city relationship would have happened. The project would have been restricted by the paradigm of waterfront redevelopment, as well as interrela-tions and shared and combined goals as well as synergistic opportunities between the local and the global would have not been identified. Because of the uniqueness of port-cities and their local specificities aroaund the world, Design Fiction has the potential to become a unversal non-universalizing approach for planning and desiging.

On the contrary, the strenth of desing fiction of freeing the planner from constraints is also one of its biggest downsides. The lack of restriction, when using Design Fiction as a tool, needs to be clearified from the start of the thesis. Explorative and imaginative projects often wander a small path between out-of-the box innovtion and the lack of validity and reality. Therefore it is important to always keep in mind to set the Design Fiction into a frame of plausible scientific and technological facts.

03 Discussions on the Synergistic Loop as a Strategic Design Tool

The Synergistic Loop as a strategic design tool derived from the realization that port developments and therefore large parts of the port-city still follow a monofunctional and infrastructural approach to ensure the operation of the port as well as to ensure a functioning economic relationship with its city/ region. But infrastructure is more then only pipes, cranes and cables. It can also be social, cultural and natural elements that serve for the economic, environmental and societal well-being of the port-city. Therefore the approach of ecosystem-functions and participation was used to formalize a tool that would help to achieve such a holistic, balanced and sustainable design of the port city. Similar to nature´s provisioning, environmental, cultural and supporting benefits for humans, the built environment of the port-city should follow a similar multifunctional approach.
At the end of the thesis it can be argued, if the Synergistic Loop really works as a strategic design tool. As a conclusion I would say yes and no. Even though, and as stated before, the synthesis and sense-making of the investigated flows, values and stakeholders within the port-city as well as the imagination of synergistic relationships between them, was a cognitive process in-between research and design.
The implementations and suitable have not solely be identified by using the tool. I would rather claim, that the Synergistic Loop is the visualization tool for the synthesis itself. It helped to keep track of the indentified interrelated stakeholders flows and values within the natural but also human realm of the port-city. Furthermore I claim, that it shows the logic behind the design decisions and visualizes the transformation of a separated port-city state towards a synergistic adaptive ecosystem.
To conclude, even though the tool was not really used for the actual design of the implementations it helped to structure and capture the complex thoughts during the creative sense-making process.

04 Discussion about the Port-City without Port

The project questions the planned and generic port-development within Kirkenes, investigates on the problematic of the short-term sustainability of the project and proposes a different, alternative scenario for the port-city of Kirkenes, through design fiction. At the end of the thesis it was proposed to elaborate on the potential long-term resilience of the alternative port development, but time did not allow for this step into an even wider future. Therefore the question of: what would happen to the design and the synergistic interrelations within the port-city, if the conventional port-function of cargo and container throughput or other shipping activities would disappear? Without playing through such a scenario, the question is not easy to answer.
The idea of rethinking port-city scapes as liminal spaces inbetween paradox and synergy, holds the answer in its name. Port-City scapes will always pend between a state of contradiction and a state of collaborative synergy. Therefore the desing proposes to plan for such a liminality by flexible and open-ended scenario thinking. Nonetheless, that does not meant, that the proposed spatial, technological and institutional implementations will stop to work, if the port-activity leaves Kirkenes. I rather rise the question, what are port activities? The idea of designing the port-city as a synergistic adaptive ecosystem aims for the constant transformation and the emergence of new alternative port activities, port-related businesses and creative port-city paradigms, when the spatial and institutional setting allows for such. As Hein (2020) states, port-cities must build on their past strengths to constantly reinvent themselfs. Therefor the question, if the synergies between port and city, driven by the proposed implementations of the design becomes unimportant. The more important question would be: do the implementations and spatial, institutional configurations allow for the emergence of new, potential synergistic relationships between port and city, if the contemporary port-function transforms into something new.
I would clearly answer with yes. It was not the highest goal to propose realistic and ready-to-buid ideas but to rather start a negotiation and rethinking process about an alternative vision for the future port-city of within Kirkenes.

05 Relationship between the Project Topic, Methods and Approaches, the Studio of Transitional Territories and the Master Track Urbanism

Due to its holistic character, Urbanism, as a theoretical as well as a practical science, operates in a wide field of expertise. These specialisms are united under the fact that this profession is dealing with social, cultural, economic and environmental aspects and how these influence societies ,the quality of the habitats, the built and unbuilt environments, every species inhabits. The project focuses on the implementation of ecosystem-participation/services to create an assessment as well as an explorative planning framework for a synergetic and co-beneficial future between direct and indirect actors within port-cities. Even though the TT studio mainly focuses on the territory of the North Sea, choosing the case of the port development in Kirkenes (Barents Sea/Sub-Arctic) was a good choice, because it creates the opportunity to elaborate on a project that focuses on port-city transitions within an extreme environment and a territory where economic interests, shifting natural conditions and crumbling traditional/indigenous lifestyles are in conflict. The main research hypothesis of aligning economic interest/development with the preservation of existing natural and urban structures but also the emergence of new resilient ecosystems and local/ regional mutual benefits, where port, city and nature are an integrative part of the same land-/seascape, is clearly within the frame of the Transitional Territories studio.

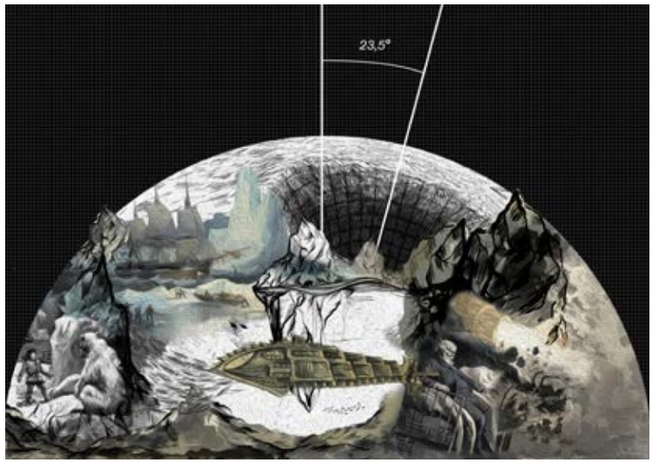
The theoretical background of both studio and thesis is set within the field of landscape urbanism, where trans-scalar, humanmade as well as natural processes either way constantly overwrite the land-/seascape creating a multi-layered palimpsest of historical, economic, social, cultural, and environmental characteristics (Sanchez, 2019).
The selected explorative/fictional approach as well as the scenario design, which aims to create awareness of environmental issues, potential socio-economic/ecological frictions as well as to project possible alternative futures (Viganò, 2016, p. 205) profits from the experimental setting of the Transitional Territories studio. Beyond traditional analytical and conceptual methods and concepts, the studio focuses on the in-depth research and explorative design of territories at risk and in transition. Especially in Kirkenes, the lack of negotiation and flexible and mutually supportive governance system, when it comes to the implementation of the new port development is creating the already explained frictions and increases the risk of further deteriorating socio-ecological concerns. To be able to understand the complex world we live in today, but also to be able to create alternative realities to tackle today´s challenges, imaging and articulating, which are essential to start the process of negotiation and planning, are the urbanist´s most essential and crucial tools.
“Instead of thinking of places as areas with boundaries around, (places) can be imaged and articulated moments in networks of social relations and understandings“ (Massey, 1993; quoted in Raffestin, 2012, p. 126).
The (experimental) freedom of how to approach the project within this studio allowed to overcome the aspect of uncertainty, which we are going to deal with while exploring and re-imagining the future of port-cities. Instead of solely problem-solving the thesis should work as a knowledge-producer (Viganò, 2016).

05 Reflection on Ethical Considerations

Indigenous Territory
Furthermore, investigating an area, which is inhabited by indigenous people, the Sámi, can be a risk. Mapping nomadic folks, as well as planning and creating strategies within their territory, needs to be done with respect and care. Especially when dealing with cultural or traditional aspects, e.g. social needs requires a lot of foresight and sensitivity. Also a careful preparation for possible collaboration, exchange, and interaction during potential stakeholder engagements, interviews, or similar needs to be taken into account.

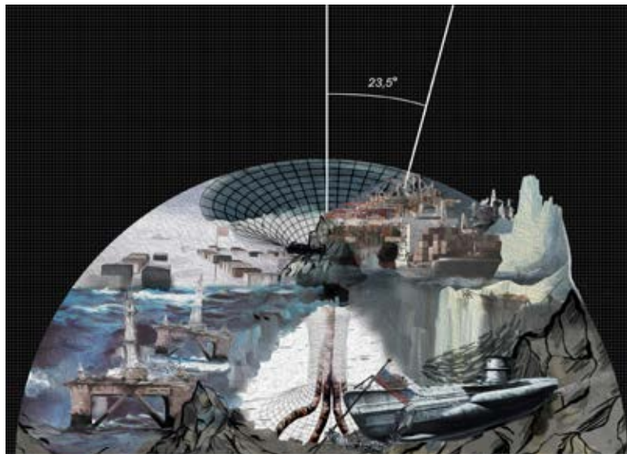
The Arctic
Even though Norway has a generally proper provision of data sets, government or census reports and more, there can be possible restrictions or a lack of data and forecasting scenarios. Picking a project area that has to deal with many uncertainties can be a challenging and complicated task. Dealing with many variables should be taken into consideration while approaching the project and while planning future steps. More limiting will be the data available for future port development and the operation in Kirkenes. There are several plans, visions, and reports available. Nonetheless, the project will deal with a high grade of uncertainty and complexity, resulting in extra time that needs to invested in mapping and analyzing future on-goings in the North.

▼ *Figure / 01* **Arctic as Scien Fiction** */ Höller*



▼ *Photo / 140* **Impression Kirkenes /** *Höller*

▲ *Photo / 141* **In a recently published study, the Norwegian Coastal Administration concludes that the port of Kirkenes is the best choice in Eastern Finnmark for base operations for the petroleum industry**



▲ *Figure / 02* **Arctic as Reality** */ Höller*

PHOTOS

- *Photo / 01* **Port of Hammerfest, oil- and gas terminal /** *retrieved from https://www.Arctictoday.com/file-photo-a-giant-flame-erupts-out-of-a-flare-tower-at-the-snoehvit-liquefied-natural-gas-lng-complex-in-the-town-of-hammerfest-in-northern-norway/*
- *Photo / 02* **Nuclear icebreaker Arktika (LK-60Ya-class lead ship) under construction in St. Petersburg /** *retrieved from https://www.reddit.com/r/WarshipPorn/comments/81s7do/nuclear_icebreaker_arktika_lk60yaclass_lead_ship/*
- *Photo / 03* **The Northern Sea-Route /** *Photo source: Nikkei Asian Review (© Universal Images Group/Getty Images)*
- *Photo / 04* **Nenets are preparing their travel by the Erkura river, in southern Yamal. Here they travel with sledges across the Tundra landscapes /** *Photo: Dorothee Ehrich, retrieved from https://Arcticsustainability.com/2017/03/15/Tundra/)*
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- *Photo / 06* **Lichen /** *Höller*
- *Photo / 07* **Reminder for the need for resilience in Kirkenes /** *Höller*
- *Photo / 08* **Polarlights near Kirkenes /** *Höller*
- *Photo / 09* **Landscape near Kirkenes /** *Höller*
- *Photo / 10* **Kirkenes, Northnorway /** *Höller*
- *Photo / 11* **First settlements, Kirkenes 1898 /** *retrieved from https://digitaltmuseum.no/021015804635/kirkenes-1898-til-hoyre-handelsmann-hans-petter-figenschous-handelssted*
- *Photo / 12* **Harvesting Carex vesicaria, Kirkenes, Sør-Varanger, Norway /** *retrieved from https://www.flickriver.com/photos/28772513@N07/tags/norge/*
- *Photo / 13* **Sámi migration Sør-Varanger before 1800 /** *Grensland Museum Kirkenes*
- *Photo / 14* **Vardø was the Pomor capital of Norway. The harbour of Vardø about 1900, with Russian and Norwegian ships /** *retrieved from https://www.ub.uit.no/northernlights/eng/pomor.htm*
- *Photo / 15* **The market place on the island Kildin, showing Sámi, Western Europeans and Russians exchanging goods, in the end of the 16th century, more than a century before the real „Pomor" trade had begun /** *From van Linschoten, 1601 / retrieved from https://www.ub.uit.no/northernlights/eng/pomor.htm*
- *Photo / 16* **Historic map Sør-Varanger, 1938 /** *Source: Kartverket, retrieved from https://www.kartverket.no/en/Maps--Nautical-Charts/Historiske-kart/*
- *Photo / 17* **Construction along waterfront /** *Grensland Museum Kirkenes*
- *Photo / 18* **Kirkenes bulk quay /** *Grensland Museum Kirkenes*
- *Photo / 19* **Sydvaranger Mining AS Logo /** *Grensland Museum Kirkenes*
- *Photo / 20* **Sydvarangers malmlastekai i Kirkenes /** *retrieved from https://digitaltmuseum.no/011013109377/sydvarangers-malmlastekai-i-kirkenes*
- *Photo / 21* **Kirkenes waterfront 1916 /** *Grensland Museum Kirkenes*
- *Photo / 22* **Bird´s-eye view Kirkenes Pre-WWII /** *Grensland Museum Kirkenes*
- *Photo / 23* **Bird´s-eye view Kirkenes after air-raid /** *Grensland Museum Kirkenes*
- *Photo / 24* **Abandoned mining facility /** *Grensland Museum Kirkenes*
- *Photo / 25* **Mining workers loosing jobs /** *Grensland Museum Kirkenes*
- *Photo / 26* **Employment statistics Sydvaranger /** *Grensland Museum Kirkenes*
- *Photo / 27* **Welcome to Kirkenes /** *retrieved from https://www.lifeinnorway.net/hurtigruten-day-7/*
- *Photos / 28* **Russian translations all around Kirkenes /** *retrieved from https://www.forbes.com/sites/davidnikel/2020/02/01/kirkenes-where-Arctic-norway-meets-russia/*
- *Photo / 29* **Barents Spektakel 2020 /** *retrieved from https://www.facebook.com/pikenepaabroen/photos/*
- *Photo / 30* **AMFI, One of the new shoppincenters to create new economy from cross-border trade /** *retrieved from https://thoneiendom.no/kjopesenter/amfi-kirkenes/*
- *Photo / 31* **Open pit mine close to Bjørnevatn /** *retrieved from https://frontiers-of-solitude.org/sydvarangeru-mines*
- *Photo / 32* **View along currently closed railway from mine to Kirkenes /** *Höller*
- *Photo / 33* **Ship loading mining bulk at the waterfront Kirkenes /** *retrieved from: http://www.tschudiArctic.com/page/1137/Bulk_Logistics*
- *Photo / 34* **Filled up with tailings after decades of iron ore mining, the narrow fjord just outside Kirkenes /** *retrieved from https://thebarentsobserver.com/en/ecology/2016/10/norway-votes-against-ban-dumping-mining-waste-sea*
- *Photo / 35* **View on the mining processing center from the end of the city center in Kirkenes** */ Höller*
- *Photo / 36* **The KIMEK Drydock as new "landmark" of Kirkenes /** *Höller*
- *Photo / 37* **Bird´s-eye view on the KIMEK company area /** *retrieved from Storvik & Co, (2016). KIRKENES - IN POLE POSITION. The Arctic Europe logistics, industry and HSE centre, retrieved from https://80deff4e-a840-4680-a5b8-9cb547aec710.filesusr.com/ugd/438410_ef916f4325354f2ab0124e71a413c4ed.pdf*
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- *Photo / 39* **Construction of the deep-sea quay in Kirkenes /** *Storvik & Co, (2016). KIRKENES - IN POLE POSITION. The Arctic Europe logistics, industry and HSE centre, retrieved from https://80deff4e-a840-4680-a5b8-9cb547aec710.filesusr.com/ugd/438410_ef916f4325354f2ab0124e71a413c4ed.pdf*
- *Photos / 40-42* **One of the many rebranding attempts of Kirkenes as the King Crab Capital in Norway /** *Höller*
- *Photo / 43* **Thon-Hotel in Kirkenes, waterfront /** *retrieved from https://www.nordic.cruises/thon-hotel-kirkenes-norway/*
- *Photo / 44* **Hurtigruten post-ship, dropping off passengers and tourists in Kirkenes /** *Höller*
- *Photo / 45* **Iron miners set for a restart in Kirkenes /** *Source: The Barents Observer, retrieved from https://thebarentsobserver.com/en/industry-and-energy/2019/03/iron-miners-set-restartkirkenes*
- *Photo / 46* **The world`s northernmost Chinatown /** *Source: Hellesiljeholm, retrieved from https://www.hellesiljeholm.com/The-Worlds-Northernmost-Chinatown*
- *Photo / 47* **Railway between Rovaniemi and Kirkenes is the most important project to develop East Finnmark /** *Source: Venstre, Norway, retrieved from https://www.venstre.no/artikkel/2019/09/08/jernbane-mellom-rovaniemi-og-kirkenes-er-det-viktigste-prosjektet-for-a-utvikle-ost-finnmark/*
- *Photo / 48* **China has big Arctic ambitions /** *Photo: Atle Staalesen / Source: The Barents Observer, retrieved from https://thebarentsobserver.com/en/node/5478*
- *Photos / 49-53* **Port developments planned /** *Sources: Statens vegvesen (2015), Sør-Varanger Kummune (2013, 2019) Norterminal (2018)*
- *Photo / 54* **Impression Kirkenes /** *Höller*
- *Photo / 55* **Reindeer heerding /** *retrieved from https://www.swedishlapland.com/stories/visut-a-story-of-the-reindeer/*
- *Photo / 56* **Reindeer** */ retrieved from https://www.independent.co.uk/news/world/europe/chernobyl-radioactive-reindeer-norway-a6903571.html*
- *Photo / 57* **Lichen** */ retrieved from https://www.treehugger.com/the-unexpectedly-weird-and-beautiful-world-of-lichens-4863470*
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- *Photo / 62* **A Sámi family in Norway around 1900 /** *retrieved from https://www.swedishlapland.com/stories/visut-a-story-of-the-reindeer/*
- *Photo /63* **Sámi reindeer heerding with helicopter /** *retrieved from https://psmag.com/news/save-the-reindeer-save-the-Arctic*
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► *Photo / 85* **For the first time ever, a bulk carrier with non-Russian flag is using the Northern Sea-Route as a transit trade lane, when transporting iron ore from the Northern Norway to China via Arctic and Russian waters /** *retrieved from https://barentsobserver.com/en/sections/murmansk-obl/mv-nordic-barents-makes-historic-voyage*

► *Photo / 86* **Decade mining facility /** *Grensland Museum Kirkenes*

► *Photo / 87* **Blocked view and restricted access towards the waterfront /** *Höller*

► *Photo / 88* **Stored fishery equipment** */ Höller*

► *Photo / 89* **Closed gates in front of the Sydvaranger Mine /***Höller*

► *Photo / 90* **View on port/fishing operations in Kirkenes /** *Höller*

► *Photo / 91* **Sydvaranger Mining Processing Center on top of Kirkenes /** *Höller*

► *Photo / 92* **Prominent hotspot in Kirkenes for taking pictures of he fjord /** *Höller*

► *Photo / 93* **Same hotspot a few meters away from the waterfront /** *google streetview*

► *Photo / 94* **Proposed, but never realized design of a new Barents House /** *Höller*

► *Photo / 95* **Barents House in Kirkenes /** *google streetview*

► *Photo / 96* **View on the beautiful Northern lights from a rare dark spot aling the waterfront /** *retrieved from https://barentsobserver.com/en/sections/articles/norwegian-investor-ready-build-barents-house*

► *Photo / 97* **Attempt to capture the Northern lights through the light pollution along the waterfront in Kirkenes /** *Höller*

► *Photo / 98-100* **Three of the most polluted areas along the waterfront in Kirkenes /** *retrieved from goolge maps*

► *Photo / 101* **Langfjorden, filled up with tailings from the iron-ore processing plant /** *Photo: Thomas Nilsen, retrieved from https://thebarentsobserver.com/en/ecology/2016/10/norway-votes-against-ban-dumping-mining-waste-sea*

► *Photo / 102* **A bird's-eye view of the Sydvaranger mining operation /** *Photo: Amelia Jaycen, retrieved from https://barentsobserver.com/en/2014/06/waste-shouldnt-be-stored-cheapest-possible-way-16-06*

► *Photo / 103* **Erosion** */ Source: Anna Schaverien, 2020, retrieved from https://www.nytimes.com/2020/06/05/world/europe/norway-landslide.html*

► *Photos / 104-110* **Pasvik Hydropower Dams /** *Google Earth, adapted by Höller*

► *Photo / 111* **Reindeer killed by railway between Helgeland region, Northern Norway /** *retrieved from https://www.theweek.co.uk/89996/106-reindeer-killed-in-norway-railway-bloodbaths*

► *Photo / 112* **Ecologist Ashild Onvik Pedersen examines a reindeer cadaver Svalbard, where more than 200 have been found dead (Norwegian Polar Institute) /** *retrieved from https://www.independent.co.uk/environment/reindeer-Arctic-climate-change-die-starvation-norway-a9026071.html*

► *Photo / 113* **The timing of the spring hatching is critical for moth larvae populations in the north. Pictured here are autumnal moth larvae, which survive the winter as eggs deposited in birch trees. Extreme larval outbreaks can occur when hatching coincides with bud burst.** *Credit: Moritz Klinghardt /* *retrieved from https://www.coat.no/en/Home/News-article/ArticleId/4385/Salvage-logging-of-mountain-birch-after-geometrid-outbreaks-ecological-context-determines-management-outcomes*

► *Photo / 114* **Mountain birch trees that have been killed by a moth outbreak in Eastern Finnmark, Northern Norway /** *Photo: Jacob Iglhaut / retrieved from https://www.coat.no/en/Home/News-article/ArticleId/4385/Salvage-logging-of-mountain-birch-after-geometrid-outbreaks-ecological-context-determines-management-outcomes*

► *Photo / 115* **Kola mining company's nickel melter in Nikel on the Kola Peninsula /** *Photo: Trude Pettersen, retrieved from: https://barentsobserver.com/en/nature/2015/04/murmansk-official-norway-polluting-murmansk-24-04*

► *Photos / 116-133* **Impressions:**
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Reindeer / Höller
Port of Kirkenes / Höller

► *Photo / 134* **Image of a Goathe or earth house /** *retrieved from https://www.laits.utexas.edu/Sámi/dieda/anthro/architecture.htm*

► *Photo / 135* **TANGE'S 1960 Tokyo bay plan. Tange attempted to impose a new physical cross-bay order on Tokyo which would accommodate the city's continued expansion and internal regeneration. /** *retrieved from http://www.noel-murphy.com/rotch/2016/03/11/tokyo-bay-and-the-economics-of-floating-cities/*

► *Photos / 136-137* **Aerial view on Tømmerneset /**
Sources: Nemkova & Fyta, 2016, p. 137, retrieved from https://issuu.com/aalandscapeurbanism/docs/shifting_Arctic_boundaries_opt

► *Photos / 138-139* **Port developments planned /**
Sources: Statens vegvesen (2015), Sør-Varanger Kummune (2013, 2019, Norterminal (2018)

► *Photo / 140* **Bird´s eye view on Soldata-Bukta and Prestøya Peninsula Kirkenes /** *retrieved from https://www.seattletimes.com/nation-world/norwegian-spy-jailed-by-russia-is-free-hes-angry-too-but-not-at-moscow/*

MAPS

- *Map / 01* **Arctic changes /** *Lukas Höller, Sources: https://e360.yale.edu/features/cargo_shipping_in_the_Arctic_declining_sea_iceArctic summer sea ice extent, based on historical satellite records and climate modeling through 2100. THE Arctic INSTITUTE Philippe Rekacewicz and Nieves Lopez Izquierdo: http://www.grida.no/resources/13343USGS, 'Estimates of Undiscovered Oil and Gas North of the Arctic Circle: https://theconversation.com/four-myths-about-the-supposed-oil-and-gas-bonanza-in-the-Arctic-69315*

- *Map / 02* **The Northern Sea-Route and the proposed Arctic corridor from Kirkenes to Rovaniemi /** *Höller*

- *Map / 03* **Infrastructure following the extraction industry /** *Höller, Data: Geological Survey Finland, Norwegian Petroleum Directorate, OSM*

- *Map / 04* **Rough illustration of raw materials and main industries in different parts of the Barents Region /** *adapted by Höller, Source: Joint Barents Transport Plan (2013, p. 25)*

- *Map / 05* **Cargo turnover in ports, Barents Region /** *adapted by Höller, Source: Joint Barents Transport Plan (2013, p. 39)*

- *Map / 06* **Traditional reindeer heerding /** *Höller, Sources: Nordregio, NIBIO*

- *Map / 07* **New industries planned around the Barents Region** *Sources: Nordregio; Finnish Transport Agency; Sami Parliament*

- *Maps / 08-09* **Projected change in annual and summer precipitation, 2071 - 2100 /** *retrieved from https://www.eea.europa.eu/data-and-maps/figures/projected-changes-in-annual-and-5*

- *Maps / 10-11* **Projected change in annual, summer and winter temperature for the forcing scenarions RCP 8.5 /** *retrieved from https://www.eea.europa.eu/data-and-maps/figures/projected-changes-in-annual-summer-1*

- *Map / 12* **Showing the projects subsumed under One Belt, One Road /** *retrieved from https://pictures.reuters.com/archive/CHINA-SILKROAD--C-ET1ED5A1MD43P.html*

- *Maps / 13-15* **Setting /** *Höller*

- *Map / 16* **Kirkenes, Northern Norway /** *retrieved from https://www.jpl.nasa.gov/spaceimages/details.php?id=PIA17312*

- *Map / 17* **Kirkenes, Northern Norway /** *Höller*

- *Map / 18* **Kirkenes, Northern Norway /** *Höller*

- *Map / 19* **First settlements, Kirkenes /** *Höller*

- *Map / 20* **Mining town around 1910, Kirkenes /** *Höller*

- *Map / 21* **Border-region Sør-Varanger /** *Höller*

- *Map / 22* **Kirkenes build-use and current port structure /** *Höller*

- *Map /23* **Port development /** *Höller*

- *Map / 24* **Future shipment and logistic flows /** *Höller*

- *Maps / 25-28* **Landformation /** *Höller*

- *Map/ 29* **Tundra / Taiga /** *(Biotope, n.d.) https://www.biotope.no/2011/11/pasvik-one-autumn-day-in-Taiga.html*

- *Map / 30* **Land-use /** *Höller*

- *Maps / 31-37* **Single land-uses from left to right: Broad-leaved trees, conifer forest, mixed forest, moor and heathland, peat-bogs, sparesly vegetated area, inland tidal flats /** *Höller*

- *Map / 38* **Land-use /** *Höller, Data: geonorge.no*

- *Map / 39* **Mammals Sor-Varanger /** *Höller*

- *Map / 40* **Reindeer migration Sør-Varanger /** *Höller, Data: geonorge.no*

- *Maps / 41-42* **Reindeer migration Kirkenes and Tømmerneset Peninusla summer - winter /** *Höller*

- *Map / 43* **Heerding districts Sør-Varanger /** *Höller, Data: geonorge.no*

- *Maps / 44-48* **Reindeer migration seasonal /** *Lukas Höller*

- *Map / 49* **Fish stocks /** *Höller, Data: Norwegian Directorate of Fisheries*

- *Map / 50* **Circulation of the Atlantic, Arctic Sea and Barents Sea /** *Eriksen, Rune, Gjøsæter & Primicerio, 2017, adqapted by Höller*
  Elena Eriksen, Hein Rune Skjoldal, Harald Gjøsæter, Raul Primicerio,Spatial and temporal changes in the Barents Sea pelagic compartment during the recent warming, Progress in Oceanography, Volume 151, 2017, Pages 206-226, ISSN 0079-6611, retrieved from https://doi.org/10.1016/j.pocean.2016.12.009. (http://www.sciencedirect.com/science/article/pii/S0079661116300854)

- *Maps / 51-52* **Overlap of biological valuable areas for cod, herring, haddock, and saithe (orange) spawning areas, and (green) larval areas** */ E. Olsen et al., 2009, p.99 / adapted by Höller, Cod, haddock, saithe, herring, and capelin in the Barents Sea and adjacent waters: a review of the biological value of the area*
  Erik Olsen, Sondre Aanes, Sigbjørn Mehl, Jens Christian Holst, Asgeir Aglen, and Harald Gjøsæter
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- *Maps / 53-55* **Fish movements in the Barents Sea** */ Hunt et al., 2013, p.57 / adapted by Höller*
  George L. Hunt, Arny L. Blanchard, Peter Boveng, Padmini Dalpadado, Kenneth F. Drinkwater, Lisa Eisner, Russ R. Hopcroft, Kit M. Kovacs, Brenda L. Norcross, Paul Renaud, Marit Reigstad, Martin Renner, Hein Rune Skjoldal, Andy Whitehouse, Rebecca A. Woodgate,
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- *Map / 56* **Birds Sør-Varanger /** *Höller*

- *Map / 57* **Birds Kirkenes /** *Höller*

- *Map / 58* **Pollution in Kirkenes due to port- and other industrial activities /** *Lukas Höller*

- *Map / 59* **Pollution Sør-Varanger: mining tail-dumping /** *Höller*

- *Map / 60* **Extract of kommunal-map of Kirkenes showing the two last remaining options for the potential new port development at Leirpollen or Slambukta /** *retrieved from https://kommunekart.com/?urlid=5b0cfe9c120649d183760d70f98acd42*

- *Maps 61 - 62* **Heavy fuel oil use (top) and Black Carbon emission in the Arctic 2015 (bottom) /** *Climate and Clean Air Coalition, 2019*

- *Map / 63* **Erosion and landslide susceptibility /** *Höller*

- *Map /64* **Pasvik Hydropower Dams /** *Höller*

- *Maps /65 - 66* **Reindeer migration Kirkenes and Tømmerneset Peninusla summer - winter /** *Höller*

- *Map / 67* **Heerding districts Sør-Varanger /** *Höller Data: geonorge.no*

- *Map / 68* **Potential route of the Arctic railway segregation large areas of the migratory routes of the reindeer and Sámi /** *Höller*

- *Maps / 69 - 70* **Zoom-in Tømmerneset, land-use and spatial impact of the port on grazing reindeers / summer-winter /** *Höller*

- *Map / 71* **Airpollution /** *Höller*

- *Maps / 72 - 73* **Comparison of the fish communities observed in the ecosystem /** *Survey done in 2004 (left) and the survey from 2012 (right) indicates a significant change in distribution. The Atlantic (blue) and central (red) communities (boreal fish species) have shifted north and east, taking over areas previously occupied by the Arctic (orange) community (Arctic fish species). / adapted by Höller*
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  By Maria Fossheim, Edda Johannesen and Randi B. Ingvaldsen // Institute of Marine Research Susanne Kortsch, Michaela M. Aschan and Raul Primicerio // UiT The Arctic University of Norway Andrey V. Dolgov // Knipovich Polar Research Institute of Marine Fisheries and Oceanography (PINRO), Murmansk, Russia

FIGURES

FIGURES

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» Szenarien sind Zukunftsbilder, die unter Beachtung zentraler Variablen alternative Entwicklungspfade hypothetisch (nicht prognostisch!) beschreiben, um Zukunfts-möglichkeiten zu identifizieren ... «

BOCK UND LIBBE, 2005, P. 85