Vestland North Sea Blueprints



This newspaper is published by Bergen Kunsthall on the occasion of the exhibition "The Ocean", 28 August - 31 October 2021, in collaboration with the research and design course "Explorations in Ocean Space II – Vestland North Sea Blueprints", Bergen School of Architecture, Autumn 2020.

Curator: Axel Wieder Teachers: Nancy Couling, Vibeke Jensen Assistant: Julia Morrissey

Editorial design: Studio Boi \rightarrow studioboi.no

Copy editing and proof reading: Nancy Couling, Jasmine Hinks

Typeface: GT America by Noël Leu \rightarrow grillitype.com

Print: Schibsted Trykk Bergen Paper: 42,5g Nornews (Skogn)

Edition of 1500





All rights reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted in any form or by any means, electronic, mechanical, photocopying, recording or otherwise, without first seeking the written permission of the copyright holders and of the publishers.

Every attempt has been made to secure the rights to reproduce the text and images that appear in this publication. However, if any have been inadvertently overlooked, please contact the publishers.

Bergen Kunsthall is supported by the Ministry of Culture, the City of Bergen and Vestland County.

Additional project support for "The Ocean" by Bergesenstiftelsen, EGD, Fritt Ord, Grieg Foundation, Institut für Auslandsbeziehungen, Kulturrådet, MRC Skaland Graphite AS, Pro Helvetia, Sparebanken Vest, Sparebankstiftelsen SR-Bank, The Henry Moore Foundation, Westfal-Larsens Almennyttige Fond.

The research presented in this newspaper was used as a departure point for a series of concrete and visionary design proposals:

 \rightarrow explorationsinoceanspace.cargo.site

BAS – Bergen School of Architecture promotes an open, plural and diverse approach to architecture and urbanism that is strongly influenced by art, activism, social anthropology and ecology. Founded on Oscar Hansen's ideas on "Open Form" in 1986, BAS is the only private and academically independent educational institution in Norway offering a 5-year Master study programme in architecture. This approach is traditionally nurtured through collaborations with educational institutions and public/ private partners at the local, national and international level. Teachers and students are recruited from a wide range of educational and professional backgrounds and nationalities. All courses have teaching input by artists, and Explorations in Ocean Space also includes contributions from other specialist fields.

↓ Cover image Map of the North Sea and Inner Danish waters, together with ICES areas and squares, latitude North and longitude West and East.

Fishing	Judith Krüger Kaspar Lygre Gulbrandsen Inger Helen Øvrebø	4
Shipping	Tora Nitter Håkon Asheim Guðrún Harðardóttir Petter Ludvigsen Helene Sørland	24
Maritime Tourism	Jon Martin Seternes Elisabeth Wieërs Kirsten Remmers Kristoffer Apelseth Liadal	48
Oil and Gas	Marie Porrez Zoelie Millereau-Dubesset Karine Tollefsen Mads Senneseth	70
Renewables	Bjørn Are Leivdal Christine Hagatun Maren Mohn Kverneland Maren Roscher Thea Hundsnes	88

Fishing

Black Ocean ↓ Judith Krüger Kaspar Lygre Gulbrandsen Inger Helen Øvrebø

History – Fishing in Norway **From Doggerland to Klippfisk**



↑ EUROPE IN 16000 BC In 16000 BC the water limits were much lower and most of the North Sea was a landmass today known as Doggerland. Due to climatic changes over time Doggerland slowly sank back into the ocean. Dogger Bank – the highest part of Doggerland – stayed afloat until 7000 BC, until its last island was submerged by the Storegga slide. Huge landmasses along the Norwegian coast broke off, causing a massive tsunami which flooded Doggerland. This ground condition has a significant impact on today's fisheries; the Dogger Bank is a rich fishing ground, while the Norwegian trench is the deepest part of the North Sea. The first Humans are said to have reached Norway around 8000 BC when the ice shield had melted far enough to allow life near the coast. The first humans survived by fishing and hunting. Locations where the first cave drawings of boats, fishing or prehistoric fishing gear were discovered are surprisingly far from the water, due to the difference in sea-levels. After the ice had melted the compressed landmass slowly rose again. The map shows the maximum maritime limit of the ocean after the last ice age compared to today's landmass. Active use of fishing methods goes back to the Stone Age with continuous development until today's large range of gear types.

BERGEN CENTRE OF TRADE Before oil, fish had been the largest source of income for Norway. Bergen grew to be important as a secure port for trading stockfish. Large amounts of cod came Lofoten in the north of Norway to breed. The fish was caught and dried outside in the fresh air. The specific climate up north allowed this prosses of creating stockfish. Stockfish would be transported to Bergen and from there it could be sold to all around the North Sea. The first mention of stockfish can be traced back to the year 850 in the Icelandic Egil's Sage.





For 300 Years Bergen was controlled by the Hanseatic trade, starting in 1692 when the first boat with klipfish. In 1692 the first boat with Klipfish set sail to Brazil. Klipfish is salted cod cut open and dried in the sun. Today the export of klipfish is more important than stockfish - the main buyers are still Portugal and Brazil.



world for the goods.



The lack of fish due to overfishing, much bankruptcy in the 90s and the promises of good wages in the oil industry reduced the number of fishers in Norway. Not until 2005, when it was permitted to combine quotas from several vessels, was the fishing industry once again able to compete with the oil industry for labour. At the same time, technical improvements further increased vessel size and the catch per boat is constantly increasing.

POLITICAL CHANGE extinct.

In 2000 the Norwegian Reference Fleet was established. While at sea, 15 fishing vessels in Norway report the amount, size and condition of fish every day to the Institute of Marine Research. This enables a more accurate setting of the fishing quotas and minimizes the risk of severe miscalculations.

EDIBLE FISH the ocean.

Fish size \rightarrow Not only the quantity but also the average fish size in the catch are affected by polluted oceans.

The sizes of codfish caught from 1900 to 2000.

1900

Technical improvements and the lack of regulations led to a drastic rise in the number of fish caught in the 1950s. As well as the fish price itself, the general income in Norway was rising faster than the fish price per kg, forcing fishers to catch more fish for their financial security. Fishers had the monopoly on selling raw fish to protect their interests from the rich buyers that were exploring the market.

Today this has created a shift to the other extreme where the relationship between the industry and the fish sellers is heavily unbalanced. Fishers can ask for high prices for the limited resource they are selling, while the buyers have to compete with the whole

The collapse of herring fishing was followed by a change in political thinking; the main goal was no longer to enable larger catches, but to secure the supply of fish. But the new rules like the quota system or the closing of fishing zones could not prevent the collapse of the cod stocks. On the 18 April 1989 a ban on cod fishing was announced. The fish that had shaped Norway was about to become

The graphs below illustrate the severe human impact on fish, comparing the biomass of edible fish in the ocean from 2000 to 1900. Despite all the current efforts to practise sustainable fishing, 100 years of excessive fishing and pollution have left their toll on





11

1900

2000

2000

2 mt/km²

1900 The Institute of Marine **Research and The Norwegian** Directorate of Fisheries is established

1905

First motorised fishing vessels. By 1922 Norway hat with 15000 vessels europs biggest fleet

The Norwegian Fishermen's 1926 Association is founded vessel to use a sonar system to locate fish The Raw Fish Act, regulating 1938 the sale of cod and white fish to safeguard fishermen's interests Ministry of Fisheries is 1946 ()1958 () Herring ASDIC is introduced 1963 First Norwegian vessels to ()use a power block or purse seine winch 1970 Beginning of fishfarming 1972 First implementation of the quota system A 200 mile fisheries protec-1977 tion zone around Norway is introduced. maritim zone System of closing fishing 1984 zones in Norwegan water introduced 1987 () Discard of fish banned 1989 Ban on cod fishing 18 April 1994 The Norwegian Seafood Federation is founded

> The Norwegian Reference ()Fleet was established

Fishfarming overtook fishing in export value



↑ Tonnes of fish (x 1000) produced in Norway per year

2000

2007

Fishing gear

The design of fishing gear is diverse. One finds solutions aimed at the individual species based on the species' distinctive character regarding e.g. behaviour, nutrient migration and spawning migration. The changes in fishing activity throughout the year are related to e.g. biological and climatic conditions.

Passive fishing gear: Fishing gear where the fish must seek out the gear to be caught.

Active fishing gear: Where the fishing gear must seek out the fish in order for it to be caught.

① YARN

A fishing net is fishing gear that catches fish according to the snare principle. The fish gets stuck in the meshes in the net and stays there until the net is pulled. The net itself with stitches, called the yarn line, is tied by thin thread. Thread thickness and mesh size vary according to the type of fish. Traditionally, the yarns were tied with linen or hemp, which were then replaced by cotton. Today only synthetic substances are used. Can be used with a total length of up to 210 metres.

2 HOOK TOOLS

A line is a rope with fishing hooks attached at regular intervals along the entire lengh. The rope or tendon that attaches the hook to the line back is called a supply. The size of the hooks varies mainly between coastal and offshore line fishing. A stump is divided into a given number of lines and a line has approx. 200 hooks. The length of the stump will vary depending on the fish concentrations and bottom conditions.

③ BOTTOM TRAWL

This is a form of spinner fishing where the vessel is anchored in the catching process. The vessel is anchored when the spinner net is pulled back, after the launch is complete. As the name suggests, this is widely used by Danish vessels in the North Sea.

④ PELAGIC TRAWL

Fishing is characterised by the fact that the trawl net does not touch the bottom. Trawl doors specially adapted for pelagic trawling are used. The trawls can have up to 150 metres in vertical opening and almost 250 metres in horizontal opening. The mesh size of this type of trawl can be up to 256 meters.

⑤ PURSE SEINE

Ringnet is form of active fishing equipment that works according to the containment principle. Fish such as mackerel, herring, sprat, capelin and saithe, which shoal in spinner formation beneath the water's surface, are caught in this way. A large net – the purse seine- is held up vertically by floating buoys on the surface. The skipper guides the boat around the shoal so that the fish is locked inside, then the ropes through the rings at the bottom of the net are pulled tight, like the tightening of cords in a drawstring purse, preventing fish from escaping by swimming downward. The net is then moored on the side of the ship and the catch is taken on board with a large fish pump.



8

The sea is characterised by its large heat storage capacity. In general, it is known that the sea's ability to store high amounts of heat plays a crucial role in regulating the climatic conditions of the continents. The heat absorbed in one ocean area is transferred to other colder ones. Vertical temperature fluctuations are mainly determined by ocean circulation, with the exception of course of the surface layers in which the amount of solar energy and the mechanism of heat exchange between ocean and atmosphere plays a primary role. The temperature distribution with respect to the depth, reveals the existence of three zones below the upper layer:

200m depth.

increasing depth.



Heat storage

1. The surface zone, which is under the direct influence of solar energy. It extends from the sea surface down to

2. The thermocline zone, at depths of 200-1000m, where the temperature value shows a sharp decrease with

3. The deep-water zone below the thermocline, where constant low temperatures are encountered, with an average value of less than 4°C. This layer represents the largest part (~ 75%) of the water mass of the oceans.

The surface layer includes the light zone or euphotic zone which starts at the surface of the water and reaches a depth where there is enough light for photosynthesis by phytoplankton. Its lower limit is estimated to be the depth where the light compensation is equal to about 1% of its initial surface intensity and can be at a depth of 100m in clear waters. The fundamental process that takes place in the light zone due to photosynthesis by phytoplankton is the production of organic material from inorganic substances found in the aquatic ecosystems (primary production). The main environmental factors that determine the changes in primary production are the light conditions in the water and the availability of nutrients, hydrography, and temperature. In this ocean layer, huge nutrient consumption, oxygen production and carbon sequestration take place. This process is the base of the oceanic food web and determines the fate of the higher trophic levels.

WARMING OF THE OCEANS

Temperature in the sea fluctuates in a slower rate than in the atmosphere, nevertheless the oceans are warming. It is estimated that 84% of the global warming between 1955 and 2003 has been absorbed by the ocean, otherwise there would have been much more elevated temperatures on land with severe consequences. If the Atlantic Ocean had not become warmer or cooler since the 1960s, there would have been no increase in temperature - or at least an indication of increase

- at any depth, which is represented in the graph with the dotted line at 0°C. The shadowed area illustrates the range of natural temperature variation. Predictions of ocean temperature with models based only on natural elements such as sun and volcanic activity (white line), show that those factors alone would cause a slight cooling in some depths. Real temperature values (red line), however, suggest that significant warming is taking place especially at the surface layer (+ 0.28°C) and even down to 700m and deeper.

Interviews

INGER-MARIE SPERRE → Managing Director of Brødrene Sperre – One of Norway's largest producers of wild-caught fish.

"I am scared to death about either the temperature or Mr Boris Johnson"

Due to climate change, the mackerel have changed their habitat. For the last two seasons, it has been proven to be very difficult to catch mackerel in Norwegian waters.

This creates two problems: 1. If a fishing vessel has to go all the way to the Shetland Islands to catch fish the time of arrival at the factory will be delayed. Production time at Sperre Factory had to start at 23:00 instead of the morning last year. 2. The mackerels have moved into the economic zone of England. With Brexit, only English fishers will be allowed to catch there.

ATLE VARTDAL → Msc Naval Architect. Operation Manager from 1980 to 2016 and Shareholder of Ramoen AS.

Since its establishment, the company's vessels have been a part of the Norwegian Reference Fleet in close cooperation with the Institute of Marine Research The food chain of the oceans starts with solar energy and Phytoplankton. Phytoplankton is consumed by Zooplankton in the North Sea especially Calanus finmarchicus which is the start of the food chain for all other species in the ocean.

Calanus finmarchicus is moving to the North because of warming sea temperatures and the rising numbers of mackerel even follow into regions that are colder than their comfort zone. But the rising numbers of mackerel still can not find enough to feed on as recent samples show alarmingly thin mackerels.

With smaller amounts of plankton available, other species are also involved. The number of Capelin, one of the main foods for cod is sinking. If codfish do not find enough food they will start feeding on younger cod. At that point, it is not overfishing the cod that endangers the species, but the species feeding on its own kind.

DEFROSTING TANK AT SPERRE FISH Cod for klipfish production will be bought in large quantities, sold in large square bricks of frozen cod. The cod fishing season goes from January to March, but the frozen product allows production all year long. The frozen bricks will be slowly defrosted for 20 hours in late tanks until the fish is ready for the next steps of production. \rightarrow

Mackerel are usually only caught off the coast of Ålesund. Last year they found mackerel southwest of the Shetland Islands

↑ INGER-MARIE SPERRE

The whitefish industry is in a very good situation, but I am more and more worried about the pelagic species, I believe that the mackerel stock has been growing too much.

↑ ATLE VARTDAL

10

JAN ARVE BIRKELAND, → Local fisher in Bergen with fishing ground at Nordhordland

He sells small amounts of fish twice a week from his ship in Bergen. But his actual business is catch wrasse "cleaner fish", fish that eat salmon lice. Fish farms pay very good prices for those fish because Salmon lice are currently one of the most pressing challenges in the salmon farming industry. As salmonlice are part of the "cleaner fish" diet they are a natural way of keeping the numbers of infected salmon low.

INGE AVLØYP → Fisher and captain for over 40 years, he has quit his previous profession as a fisher, and is now working as a captain for a bigger shipping firm. When he was an active fisher, he experienced how vulnerable the fish are to overfishing. The ocean went black.

Also, the regulations from the government made it difficult to follow all the restrictions and new laws regarding fishing. The system is complicated. The government profits from taxes when fishers are buying and handling fishing quotas. The climate changes, the big boats win, they are more equipped to fish on the high seas.



I think the future of fishing is looking very good. This kind of fish (European hake) was very hard to catch 10 years ago but this year there are many. They have come back.

↑ JAN ARVE BIRKELAND

When it comes to the development of fishing, the industrialisation destroys the natural. It only secures workplaces for a short period of time.

↑ INGE AVLØYP

The Quay

The quay is the platform where a fisher and the ocean first meet and establish an interaction. It is the most important space on land; a place to have your gear, yourself and a safe place for the boat when it's not in use.

Today's coastlines – where the ocean meets human-land – have changed dramatically to serve human needs. As extensions from land into the ocean, quays connect the maritime and landbased human worlds, as the transition between ocean and boat, wet and dry, trawling and home.

How we meet the ocean: quays in the Bergen region

 $\downarrow \rightarrow$























One day of mackerel fishing, following MS Plöy



Off for the season

Pumping fish







The scale gets bigger



... and still bigger



...and bigger



and bigger.



The deck of a fish





The average professional fisherman is a man of 45 years, living in a detached house with a gross income of NOK 892,000 a year. As of 2019, almost 60% are married or cohabiting.

In the last decade, fishermen have caught between two and three times as much fish as in the interwar years. This decade has been characterised by overfishing, stock collapse and more and stricter management measures, but not least efficiency and rapid technical development.

Although the proportion of women in the primary industries is increasing little by little, it will be a very long time until they are as numerous as men. Women run very few of the largest farms. In both agriculture and fishing, women also have far lower incomes than men.





Machine for getting onboard





Fishing Vessels

COASTAL FISHING

- \rightarrow Coastal fishing is fishing in fjords, along the coast and on the nearby coastal banks.
- → Coastal fishing is operated from fishing vessels that are less than 28 metres in length or from fishing vessels with a cargo space size of less than 500 m3. Coastal fishing vessels fish with a number of fishing gear, such as cheats, pots, gillnets, nets, line, spinners, seines and shrimp trawls and mainly deliver fresh fish.
- \rightarrow In the past, it was common to distinguish between coastal fishing, bank fishing and deep-sea fishing. The distinction between coastal and bank fishing is not as clear today, as larger coastal fishing vessels also freeze catch on board and make longer trips. The most important coastal fishery in terms of quantity and value is the cod fishery, but the coastal fishing fleet utilizes a number of fish species and shellfish.
- → Coastal fishing takes place for both demersal and pelagic species. Until 1989, all coastal fisheries were open, i.e. there was no requirement for special permits to participate, but beyond the 1990s, coastal fisheries have also been increasingly regulated.

SEA FISHING

- \rightarrow Sea fishing is fishing that is conducted on the open sea and on the fish banks, unlike coastal fishing that is conducted in the fjords, along the coast and the nearby coastal banks (fish banks near the coast).
- \rightarrow Deep-sea fishing has become increasingly widespread as stocks in more coastal waters are fully exploited and partly overtaxed. In 1995, an international agreement was entered into to improve control of fishing beyond 200 nautical miles, see Law of the Sea.

THE DEEP-SEA FISHING FLEET

- \rightarrow In Norway, the fisheries administration sets the boundary between the coastal fishing fleet and the deep-sea fishing fleet at a boat size of 28 metres.
- → The deep-sea fishing fleet has space for supplies for stays of longer duration at sea, up to several months. The fleet is divided according to the fishing gear used, including the bankline, purse seine and trawler fleet (factory trawl). In addition, there is the long-distance fishing fleet, which is mainly trawlers, which fish in international waters or in other countries' fishing zones (for example off Greenland and New Zealand).







↑ ③ Space for moving



↑ ④ Space for sleeping



↗ This is an average fishing vessel on the northwestern coast, about 15 metres long and 6 metres wide.

fishers when not fishing. The boat contains three main areas, mechanical space, space for fishing and space for spare time/time off. The blue indicates the space the fishers can use in their spare-time. You have the deck as well, hoewever, here the inside space is indicated.

 \rightarrow The space used by

The smaller boats only fish near the coastline of Norway, while the bigger vessels fish in the North Sea. there are three times more small boats up to 15 metres than big boats, while the big boats catch most of the fish in total.

l j



Norwegian boats delivered catches worth NOK 21.1 billion in 2019 - an increase of 1.5% from the previous year. Cod is still the most valuable fish.

The number of fishermen in 2018 was 11,219, a decrease of 0.8% from the previous year.

The number of fishing vessels in 2018 was 6018, a decrease of 1.9% from the previous year.

The number of employees in the fish processing industry is 12,192, an increase of 1.5% from the previous year.





Fish species

The most common fish species in our waters are divided into two main groups. Pelagic fish species (P): Herring, mackerel, blue whiting and capelin. Demersal Species (and shellfish) (D): Cod, haddock, saithe, shrimp, redfish, halibut, tusk, ling, blue whiting, whiting, spotted catfish, sandeel, eyeball, plaice, whiting, crayfish, anglerfish and gray catfish.

Pelagic species live mainly in the free water masses as they occasionally occur at the bottom. The demersal species live mainly at the bottom, although at times these can live in free water bodies apart from the shellfish.

ANGLER

Lophius piscatorius

D 🔴

- \rightarrow The anglerfish fishery in the North Sea catches a large number of immature fish, which is a threat to the next generation of anglerfish.
- → Steer away: Northwest Lophius species are listed by the ICES as being outside biological limits. Greenpeace added the angler to its seafood red list of fish likely to be sourced from unsustainable fisheries in 2010.

 \rightarrow Also produced through farming.



TUSK/CUSK Brosme brosm

D 🛛 🕘 🕘

- → Eat with a clear conscience
- → There is now tusk that is MSC certified. You can eat this with a clear conscience
- → MSC label: Certified sustainable seafood, www.msc.org/no
- → You can eat this with a clear conscience-look for the label
- \rightarrow Good choice, but not too much \rightarrow Non-certified tusk is a good choice, but do not eat it too often.
- \rightarrow Catch methods: Tusk is mainly caught as bycatch in other types

of fisheries, and the fishing methods are trawl, net and line. \rightarrow Our recommendation: The fishing is considered to be sustainable, but still choose line caught tusk if you have the opportunity. Look for the MSC label for certified sustainable seafood and select it.



POLLACK Pollachius pollachius

D 😑

Ы

L

- \rightarrow Pike is a predator on various pelagic fish species and mesopelagic necton (salmon herring, shrimp and krill). In Norwegian waters and in the North Sea, pike spawn in the period March - April. → The International Council for the Exploration of the Sea (ICES) provides advice on pike in the North Sea based on criteria for
- a "data-poor" stock, ie there is no data base that can be used to estimate the size of the stock. Catch quotas are thus based on the trend of the last three years' total catch.
- → For 2018, ICES recommends that catches in the North Sea should not exceed 1,368 tonnes.
- → Pike are fished mainly as bycatch in commercial net and trawl fisheries in the Skagerrak.



LING Molva molva

D 🛛 🖊

 \rightarrow Ling is fished all year round, also as a bycatch in other fishing. There are no calculations on the stock size.

→ Eat with a clear conscience

- \rightarrow Now there are long ones who are MSC certified. You can eat it with a clear conscience!
- → Ling is a good choice, but be careful not to eat it too often. → Catch methods: Bottom yarn and
- bottom line. \rightarrow Our recommendation: Norway
- accounts for about half of the longline catches in Europe, but has no fixed quotas. The Institute of Marine Research has carried out projects together with the Norwegian Fishing Boat Owners' Association and Mørefisk to map the stock of ling further.
- \rightarrow Preliminary results are promising, but a precautionary principle must be used as a basis for assessment before final data is available. Therefore, be careful not to eat it too often. Choose MSC-certified long if you can find it at the fish counter.

ATLANTIC MACKEREL Scomber scombrus

Р 🔶

- → Today's mackerel fishing is within sustainable levels, and the stock is large, but the international management is not good enough. The large mackerel stock is fished by many nations, which have a common responsibility to take care of the mackerel.
- \rightarrow Eat mackerel, but not too often. \rightarrow Catch methods: Purse seine, pelagic trawl, net and trout.
- \rightarrow Our recommendation: Unfortunately, good international agreements are lacking today, and mackerel is in danger of being overfished. The EU and Norway have their quotas they fish, and Iceland and the Faroe Islands have their quotas on top of this. In total, too much is fished in accordance with the quota advice.
- → Therefore, do not eat mackerel too often. \mathbf{N}

ATLANTIC HALIBUT Hippoglossus

D 🔴 🕘

→ Halibut is divided into two populations, one south of Stad and one north of Stad.

16

- \rightarrow Good choice, but not too much → Halibut caught north of Stad is a
- good choice. Halibut from farming is also a good choice. → Steer away
- \rightarrow Steer clear of halibut caught south of Stad. The southern stock is believed to be significantly overfished.
- Catch methods: halibut is fished with nets, trawls, spinners or lines. Line fishing for halibut has less bycatch than the other fishing methods. Halibut is also farmed.
- → Our recommendation: Halibut is very sensitive to overfishing. It is not threatened with extinction in Norwegian waters, but the stock south of Stad is believed to be weak. North of Stad. the halibut population shows an increase and the condition is better.
- → Ask for halibut fished north of Stad, and avoid halibut fished south of Stad.



SAITHE **Pollachius virens**

D 🔴

- \rightarrow The saithe is one of our most important food fish and Norwegian saithe is now MSC-certified as sustainable.
- → Eat with a clear conscience Catch methods: Trawl, seine, line, \rightarrow
- spinner and cheat. Our recommendation: Norwegian \rightarrow saithe fishing is sustainable and all commercial fishing for saithe in Norwegian waters is certified by MSC. Ы



HERRING Clupea harengus

Р 🌒

- largest fish stocks.
- the fish counter.
- clear conscience. \searrow

EURO. SPRAT Sprattus sprattus

- Р –
- the individual fjords.
- tions.

SPOTTED WOLFFISH Anarhichas minor

- D 🔴
- → Steer away





- → Norwegian spring-spawning herring are found along the entire coast. Herring is one of the world's

 \rightarrow

L

- → Eat with a clear conscience \rightarrow Herring can be safely selected at
- \rightarrow Purse seine and trawl.
- → Our recommendation: The fisheries are MSC-certified and the minimum size for Norwegian spring-spawning herring is 25 cm. After having been at a high level for a period, the herring stock is declining. But the North Sea herring has full reproductive capacity and is harvested sustainably. → Herring can be safely selected at the fish counter. Both the Norwegian spring-spawning herring and the North Sea herring are MSC-certified. Eat herring with a



→ Sprat is a shoal fish that lives pelagically. It is rarely found deeper than 150 metres. Coastal sprat is found in the coastal and fjord areas along the coast of Norway, but rarely north of Helgeland. → Fishing for coastal and fjord sprat takes place mainly in the autumn with coastal seine vessels (less than 28 metres), and is used almost exclusively for human consumption, such as sprat sardines and "anchovies". The industry's quality requirements (size and fat content) determine when and where the fishing is to be opened and how it is to be carried out in

→ The decline in total catches from the 1970s may be related to changes in environmental condi-



 \rightarrow Fishing for wolffish is unregulated and there is a lack of knowledge about catfish in Norwegian waters. → Catch methods: wolffish is fished mostly as a bycatch with bottom line and bottom nets. Bottom

trawling can damage the seabed and lead to bycatch of other endangered fish species.

- \rightarrow A small amount is also produced through farming.
- Our recommendation: unregulated fishing and lack of knowledge about stock status means that you should avoid eating wolffish until more knowledge is in place. The wolffish species are vulnerable to overfishing because the reconstruction of the species takes a long time.



HADDOCK Melanogrammus aeglefinus

- D 🔴
- → There are two populations of haddock in Norway. Both the Northeast Arctic haddock and the haddock that you find in the North Sea and Skagerrak are in good condition.
- Eat with a clear conscience → You can eat haddock with a clear conscience.
- \rightarrow Trawl, spinner, line, net and cheat. → Our recommendation: Unfortunately, there is a decline in the spawning population in recent years, in addition to the fact that fish mortality has increased and quotas are set above the scientific advice. There are also significant discards of small fish in this fishery. But the future looks brighter if the stock is managed in accordance with adopted international rules.
- → You can eat haddock with a clear conscience, as it is MSC-labeled. Ask for this in your store.





COD Gadus morhua

- D 🔴 🔵
- → The cod is divided into different stocks that have different status. The world's largest cod stock, which lives in the Barents Sea, is in good condition and is managed sustainably. The stock in the North Sea is overfished.
- → Eat with a clear conscience
- \rightarrow Cod and cod from the Norwegian Sea and the Barents Sea are part of the world's largest cod stock and are in good condition. → Steer away
- → Coastal cod and cod from the North Sea and Skagerrak are significantly overfished.
- → Catch methods: Bottom trawl, spinner, line, net and cheat.
- → Our recommendation: Cod and cod from the Norwegian Sea and the Barents Sea are MSC-certified and sustainably fished.
- → Steer away from coastal cod and cod from the North Sea and Skagerrak, both of which are overfished. Instead, choose cod from the Norwegian Sea and the Barents Sea.
- → From 15 June 2019, all fishing for coastal cod, including recreational fishing, has been banned. This applies from the Swedish border to Telemark. If you catch cod on the hook in this area, you must release it into the sea again. Ŋ



SALMON (FARMED) Salmo salar

D 💛

Salmon is farmed along the coast from Vest-Agder in the south to Finnmark in the north. Farmed salmon that is environmentally certified through ASC have fewer consequences for nature and the environment than other farmed salmon.

- → Eat with a clear conscience
- → ASC mark: farmed responsibly. asc-aqua.org
- \rightarrow Look for the ASC mark as a sign of responsible farming.
- → Good choice, but not too much
- → Farmed salmon is a good environmental choice, but do not eat it too often.
- \rightarrow Catch methods: breeding.
- → Our recommendation: Salmon farming has many challenges that must be solved before the industry can call itself sustainable. Some of these challenges are unsustainable feed components, escapes, salmon lice and stray resources.
- \rightarrow The most important measures are that growth in the aquaculture industry is not allowed until these challenges have been resolved, and that the administration has

developed concrete indicators to minimize the negative environmental impact.

- → Regular farmed salmon is a good environmental choice, but do not eat it too often. There are large regional differences in terms of how big the environmental challenges are.
- \rightarrow In the Seafood Guide, we only have an overall, national assessment, which means that the farmed salmon ends up as yellow and not red.

Ы



Aquaculture - Salmo Domesticus

Modern aquaculture started in the early 1970s just outside Trondheim in a small coastal village called Hitra. Two local fishermen called Sivert & Ove Grøntvedt experienced a brutal decline in the local fish stocks and started experimenting with farming salmon. Aquafarming was not a new phenomenon at this time as there were already several other smaller projects along the Norwegian coastline. The breakthrough happened when the brothers realised that salmon was uniquely suited to farming as it does not need specially tailored nutrients when it is hatched. Salmon hatches with a yolk sac that supplies it with nutrients until it is able to digest smaller pieces of other finfish. This meant the fish could be fed from the start with bycatch and other easily obtained fish that were not necessarily relevant for the export market. Inspired by livestock breeding in agriculture, the emerging industry sourced genetic material from an abundance of local salmon stocks along the coastline. Through selective breeding the highest yielding "feed per kg of fish meat"-strains were developed.

In the 2020s the mechanical aspects of fish farming are still very much the same as they were in the beginning. The main difference today is that an overproduction in the 90s led to a huge wave of bankruptcies that facilitated a massive concentration of ownership in the industry. In the beginning the fish farms were usually owned and operated by hundreds of local farmers and fishermen situated in smaller villages along the coastline, while today they are owned by huge corporations. This change in ownership enabled a streamlining of production thus meaning a big potential increase in revenues. It also centralised the decision making processes, shifting them from the local farmers to the board of directors.

ECONOMIC IMPACT OF

107,3 billion NOK

BIGGEST MARKETS

MAIN AQUACULTURE

→ Salmon and trout

 \rightarrow EU (1,6 million tonnes)

OPERATIONS IN BERGEN:

minute.

AQUACULTURE IN NORWAY

 \rightarrow 2,7 million tonnes export

 \rightarrow (1,1 million salmon) 2nd cod

(wild), 3rd mackerel (wild)

Translates to 36 million fish meals

every day of the year / 25000 per

① STAGE 1: OVA → 5mm

- \rightarrow 0,2 gram
- \rightarrow 0-2 months

Hatches at 8C ambient temperature. Survival rate in the wild is less than 1%

② STAGE 2: ALEVIN

- → 25mm
- → until 50 days after hatching

Feeds on yolk sac. Will stay at the bottom of river/tank until yolk sac nutrients are consumed.

③ STAGE 3: FRY → 25-55mm

 \rightarrow 5 gram

2 months after alevin-stage in captivity In the wild: dependent on availability of local nutrients. Develops a total of 8 fins to be able to maneuver the turbulent streams of mountain rivers. Feeds on microscopic invertebrates.

- ④ STAGE 4: PARR → 10-25cm
- \rightarrow 15-45 gram

After 6 months in captivity Up to three years in wild conditions. Starts adaptation to salt water by turning a more silvery sheen while still keeping their vertical camouflage that helps them hide in the reeds of rivers.

5 STAGE 5: SMOLT

- → 15-25 cm after 8 months in captivity
- \rightarrow 1-3 years in wild conditions

This is when wild fish leave the river to start their life in the open sea. Once in salt water it feeds on capelin and herring.

6 FINAL STAGE: ADULT SALMON

 \rightarrow 70 cm average \rightarrow 4-6 kg

Less than 1% survival rate in the wild. 20-24 months lifespan in aquaculture.

GROW OUT COMPANIES IN THE BERGEN REGION*

- → Lerøy Seafood
- → Blom Fiskeindustrier
- → Austevoll Melaks
- \rightarrow Lingalaks \rightarrow Erko Seafood
- → Bolaks
- → Eide Fjordbruk
- → Engesund Fiskeoppdrett
- → Firda Sjøfarmer
- → Fjord Drift
 - → Langøylaks
 - → Marine Harvest
 - → Sjøtroll havbruk
 → Telavåg Fiskeoppdrett

* The biggest companies tend to run both their own roe production and hatching facilities to reduce uneccessary transport within the production line





Roe production \rightarrow On land

Smoltification → Fresh water tanks on land

Grow out → Open sea

18



Feeding the planet – but what are we really eating?

Due to rising levels of heavy metals found in wild fish stocks the fish farming industry changed their fish feed to be mostly agriculturally based. This in turn has drastically reduced the Omega 3 levels in farmed salmon. Wild salmon now outranks farmed salmon in heavy metal levels.

Wild salmon battles a less than 1% survival rate starting from its ovaphase. In aquaculture a survival rate of less than 75% is looked upon as a distaster. This does something with the genetic material of the Salmo Domesticus. It is bred to grow as fast as possible using as little feed as possible. It might suit profitability in the short run, but what happens in the long run when humans override natural selection and the plump and defomed salmon interbreed with the few remaining local fish stocks?

Furthermore this extreme concentration of biomass that a fish net represents supplies salmon lice with an unrivalled smorgasbord. The current talks are to limit the loss of the farmed fish – in effect reduce loss of revenue for the company that owns the fish. The less public topic is how does this extreme concentration of salmon lice affect the wild salmon stocks or even better the wild trout stocks which is never mentioned outside of niche academic research fora.

Not every salmon farming operation is unethical, but the few that are impart almost irreparable damage on the rest of the industry and also to the once pristine Norwegian coastal landscape.



SALMON LOUSE (LEPEOPHTHEIRUS SALMONIS)

Found naturally in Norwegian waters. Parasitic lifeform that feeds mostly on salmon. Feeds on the mucus or skin of the fish. In higher concentrations it will produce big open wounds that often get infected and result in the death of the host. In earlier life stages it can damage the formation of fins. Salmon nets are the perfect breeding ground for the salmon louse as it has an unnaturally high concentration of prey in its extreme vicinity.

The treatments to get rid of salmon louse usually end up doing as much damage to the fish as to the lice themselves. There is no easy fix to this problem when a large scale infection first appears. The introduction of lumpsucker fish and other fish that prey on salmon louse has been met with very mixed reviews. Especially due to the mortality rates of the anti-louse fish: 130,000 each day.

The current best way to ease the problem (other than aborting the whole aquaculture industry) is by introducing a quarantine period between the different batches of fish in the nets.

COMMON DEFORMATIONS IN FARMED SALMON

This is the result of a 75% survival rate when movement is restricted and salmon lice prey on almost every fish. There are strict rules about the concentration of salmon lice that is permitted on each fish before drastic measures are required. The demand is not for 0.

SALMO DOMESTICUS ↓

Deformed dorsal fin. A result of predation by salmon lice and low rates of natural selection.

20



The tail fins get shorter and stubbier due to a less varied use of the body as it developes. ↓



Gills are exposed and chest fin is deformed. ↓



SALMO SALAR ↓

Normal fin development ↓



Normal tail fin development



The gills are completely covered







However the sought after traits differ from what nature has already selected. A quick increase in growth and reduced nutritional requirements are favoured. They breed the fast growing plump fish and not necessarily the strongest and most agile candidates. The salmon has no need to be able to swim upstream when it spends its whole life in a tank and then a net.

The accelerated growth phase separates the greedy from the cunning. On average, wild salmon spends 3 years in a river before head

The density of (legal) biomass is a breeding ground for bacteria, viruses and parasites. Fish pellets now consist of over 50% vegetarian agricultural products and differ significantly

from the diet of a wild salmon. This is a strong parallel to industrialised farming on land

where cattle is raised in pens with restricted space for movement and fed synthesised feed to produce as much possible food for the least

ing to the ocean.

possible investment.

Genetic material is selected from local stocks.











SALMON LICE REGISTRATION SITES

T

Every salmon farm is required to deliver a report on the concentration of salmon lice once a week. Notice that there are no weekly registrations in the salmon rivers itself.

> PROTECTED SALMON RIVERS

Natural habitat of the Vossolaksgenom. Genetic material was sourced here for the first explorations of salmon farming.





Svart hav – Black Ocean

Svart Hav – Black Ocean, is a saying amongst Norwegian fishers that refers to a ocean depleted of fish. If you ask a fisher when they come home after a day at sea how the fish-catch was and they respond with "there was black ocean", you know there were no fish that day.

How will the future of the ocean be, taking into consideration our current ways of over-exploitation. Do we have a sustainable approach to our oceans? Toxicity levels in wild fish are on the increase. Levels of toxins are so high in certain species that they are best avoided altogether.

- → The limit of overfishing of wild fish is near.
- \rightarrow The ocean temperature is rising. \rightarrow Using the ocean as the previous generation did is no longer possible.
- \rightarrow Today we invest heavily in the aquaculture industry.

• High concentration Population of heavy metals Locations of active

Direct pollution of

water by industry

- salmon farming today Discontinued
 - salmon farming • Pollution of seabed
- New scenario: Land based operations for aquaculture. Roe-production and smoltification

20 40kr







CO2 and O2 CO2 ↓↑

Photosynthesis Remineralisation

 $\mathsf{Phytoplankton} \to \mathsf{Zooplankton} \to \mathsf{Small} \ \mathsf{fish} \to \mathsf{Large} \ \mathsf{fish}$

Pollutior Warming Acidity

↓ Sinking Organic material

 \downarrow



ocean carbon storage





200

300

400km

Shipping

Redacted ↓ Håkon Asheim Helene Sørland Petter Ludvigsen Guðrún Harðardóttir Tora Nitter



The Incredible Journey of [REDACTED]

The time is [REDACTED] on a beautiful [REDACTED] [REDACTED]

The crew has seen the entire world, but never set their foo on land. The most beautiful was [REDACTED] followed closely by

years. He has things happen at the high

t was wild

[REDACTED]

The days can really differ, even though the view is the same Unlimited ocean in every direction, the biggest differences

Mr. [REDACTED] has never been religious, for him it's about ports and freighters not thoughts and prayers. Many of his crew mates are religious, it helps them with their loneliness o [REDACTED] weeks at sea, we are only you spend a lot of time alone ch willingly and unwillingly. Religion is something mo seafarers keep to their cabins, like my friend [REDACTED] eat pork and taste alcohol, even though he is a muslim, and [REDACTED] drinks to fit it, but it goes against his baptist hey hope that god will forgive them and une

Port of Bergen

BERGEN

28



in 1350.



1588 "Scholeusstikket"



1603



1646



1768 Reichborn.







1950 It was the stockfish trade in particular that created the background for the first port acticity and urban expansion in Bergen. Vågen is normally ice-free in winter, and has always been a good harbour all year round. Along Bryggen at first, and eventually Strandsiden. Through the 15th and 16th century, Nøstet, Skuteviken and Sandviken were also used as ports, with their associated buildings. ①Laksevåg, @Møhlenpris, ③Jekteviken, ④Dokken,

⑤Nøstet, ⑥Strandsiden, ⑦Vågen, Bryggen and Sandviken, were largely developed at different times. Laksevåg was the last harbour area to be developed.

Sandviken and Skuteviken developed from the late Middle Ages and beyond in the 17th century until 1880s when there was a continuous row of sheds until Rothaugen.

Vågen, Bryggen and Strandsiden is the city's medieval area.

Møhlenpris, Jekteviken and Dokken have undergone major changes, from being land areas with fields and a natural shoreline, with pleasure grounds, to an area developed by Jørgen Thormøhlens in the late 17th century and various industrial entreprises, now totally utilised in connection with port-related activities.

Nøstet has evolved from being an area characterised by informal, organic built structures, boathouses and small wooden piers to a modern harbour area.

Laksevåg is the sub-area that was developed last. In 18th century, it was an important area for industrial development from the mid-1800s.



↑ Bradbenken before it was expanded between 1934-39

Throughout history, most of the

waste produced in Bergen has been thrown into Vågen. Much of this waste has been used as reclamation material to expand the city into the harbour. The waste was emptied directly into Vågen or else via the roads and sewers that all ended up there.

Port¹ [pawrt, pohrt] - noun \rightarrow A town or city with a harbour or access to navigable water where ships load or unload

1768

Throughout history

Before freezing and limited possibilities to store food, Europe needed to source stockfish from Lofoten. Since Bergen was situated mid-way it was the perfect place for transshipment. The Hansiatic office opened in Bergen

Sea farers fattighus Bergen



Copy of Isac van Geelkerck's fortification map of Bergen from 1646. The oldest known map of Bergen.



Bryggen in 1768, at the time when hansakontoret closed. Drawn by J.J.



1850

Triangeldoc



1851

The Bergen Steamship Company (BDS) was Norway's first privately owned shipping line. Until it was sold in 1984 it had a special position in the port of Bergen.

DET BERGENSKE DAMPSKIBSSELSKAB.



1875

sailors.

In 1875 Norway was the world's third

largest shipping nation with 60 000

1866-1914

Bergen tonnage in relation to transition from sail to steam



1909

The foundation for the modern shipping industry was settled when Norges Rederforbund, with prime minister Christian Michelsen as president, was founded.



1917

Plan for expanding the port at Dokken.



1928

Hilmar Reksten was one of Norway's largest shipowners of all time. He grew up in Nordnes, Bergen and established his shipping business in 1929. Reksten was accused of irregular activities during WWII, but in fact also assisted the resistance movement. He contributed financially to the Bergen International Festival, and in 1953 bought the world's largest machine-tanker, the Octavian. He ran his business with high risk, and had huge success until the oil crisis in 1973.



In the 60s the development of the offshore industry gave a new dimension to the Norwegian shipping industry.

1970

The shipping crisis in the 1970-80s led to oversupply of vessels and led to a lower number of Norwegian registered



1980

Norwegian International Ship Register (NIS) to keep some ships under the Norwegian flag and prevent Norwegian ships from flagging out. This led 1800 seamen to losing their jobs.

1999

From 1999 to 2006, the fleet fell back by 29 percent and the number of Norwegian seamen declined by 20 percent.

2004

In January 2004, the ship MS Rocknes capsized in Vatlestraumen south of Bergen. 18 people died and 45 km of coast line was polluted with oil- and diesel spillage.



2018

The Port Council, the highest body in the Port of Bergen, decided to move the freight port in Bergen from Dokken to Ågotnes in Fjell municipality.

2020

Norway has one of the world's largest fleets. Nearly 1,900 Norwegian controlled vessels and rigs operate worldwide. Norway has the world's fifth largest fleet measured in terms of value. About 40% of this fleet is owned and operated out of Bergen.

Where does it go? \rightarrow We don't know, but it goes to **Rotterdam first. What comes back** is peas for the Toro factory.

The paper you're holding in your hand might end up in Vietnam.





Bergen - Vietnam takes 37 days, and stops at 7 ports.



 \rightarrow





From Vietnam port it goes to where it is

Norway exports paper waste to 17 other countries than Vietnam.



Peas come from around 37 countries

 \rightarrow



Pea containers goes to Kokstad storage with a trailer. 1000 other vehicles pass through the port everyday.

 \rightarrow

What's in the containers? \rightarrow We don't open the containers. But we export a lot of paper waste.



Pea containers arrive in Bergen.

Norway exports pulp paper with ships to:

1. Netherlands

- 2. Vietnam 3. Germany
- 4. China
- 5. Denmark
- 6. Thailand 7. Belgium
- 8. Japan
- 9. Turkey
- 10. India 11. Indonesia
- 12. South Korea
- 13. Mexico
- 14. Spain
- 15. Taiwan
- 16. United States 17. France
- 18. South Africa
- 19. Sweden
- 20. Greece
- 21. Brazil
- 22. Austria
- 23. Switzerland
- 24. Malaysia
- 25. Colombia 26. Slovenia
- 27. Hong Kong
- 28. Portugal
- 29. Italy
- 30. Poland
- 31. Czech Republic
- 32. United Kingdom
- 33. Singapore 34. Gambia

Norway imports pulp paper with ships from:

- 1. Sweden
- 2. Brazil
- 3. Spain 4. Germany
- 5. United states
- 6. Denmark
- 7. Israel
- 8. United Kingdom

9. France

coal				
accompanied semitrailers				
unaccompanie semitrailers			accompanied semitrailer	
import vehicles				
liquid bulk goods				traile
goods		dry bulk		
goods		dry bulk		
containers		dry bulk		
containers larger than 40'		dry bulk		45' conta
containers larger than 40' containers 40'				45' conta
containers larger than 40' containers 40'			40' container of general cargo	45' conta
containers larger than 40' containers 40'			40' container of general cargo	
containers 40' containers 20'	□	dry bulk dry bulk	don't open the containers.»	

What arrives at Bergen Port in a typical week?

32



What arrives at Bergen Port in a typical week?

Oil



34

1 week of traffic at Bergen port (if all goods came in 40 tonnes containers)

٠

 \rightarrow construction materials

Tracking shipping in Bergen

Flags of Convenience - Where are ships registered?

Interview with Dale Rothenburg

Dale Rothenberg is a recently graduated artist from the Bergen Academy of Art and Design. He was born in the USA and did his undergraduate in Jazz piano at the Oberlin Conservatory in Ohio. In February 2014 he went on his first job on a cruise ship, stepping on board in Flor ida after a friend had told him about the job.

When you are out in the open sea on these Cruise Liners, are you aware of the heavy traffic around you? Can you for example see the container ships?

Yeah, it depends on what channel we are in. I would be going out of Amsterdam going up to Norway for the summer season and we would see a lot of oil platforms in the North Sea and then maybe not so many container ships but then usually crossing the Atlantic we were on a route that is shared with a lot of vessels so they are off pretty far on your side, but every time you would look out you would usually see one or two ships.

Every time?

38

Has your perspective of the world changed after you started working at sea, like understanding the scale of it?

Oh yeah, absolutely. I have done a lot of ocean crossings at this point. I worked on the Queen Mary 2 which does the Atlantic crossing. From Africa to Australia, a lot of eight or nine day crossings. Yeah, the sea is like endless but also not. It feels like in our modern times we have reached the end of the great expanse in some ways. It feels like we can limit the size of the sea very concretely in our heads.

Yes. They are either going the same way as you at a different speed or coming back. Yes there is usually some traffic around. But it really depends on where you are though. I did a world cruise and we went around Africa and because of the Suez-canal the current traffic around Africa is not very heavy but then if something happens with the Suez or the price gets too high the ships are able to go around Africa for lot less money that going to the Suez, so then the traffic becomes heavy, so it is really interesting global system.

I think what space feels like to us is probably what the ocean felt like for explorers five hundred years ago. Certainly a week is a long time to be crossing the waters but it is also limiting in some ways, you can actually capture the distance of it.

Especially then two-dimensionally.

Yeah, it is very deep oh my god. But in terms of two-dimensionality I think what space feels like to us is probably what the ocean felt for explorers five hundred years ago. Certainly a week is a long time to be crossing the waters but it is also limiting in some ways, you can actually capture the distance of it.

As an artist, do you feel obligated to inform and shine a light on environmental issues?

Yeah I definitely feel that there are a lot of circumstances that have made my project more relevant but yeah it is definitely my responsibility. It would be very easy to paint a negative picture of the cruise industry as it is a very negative drain on everything it touches. But there is a culture there among the workers that is interesting and hidden from most people. So yeah I am kind of striving to capture something more realistic and more multifaceted that just cruise ships are bad, which they are.

Right now I am dying to get back on a cruise ship, waiting for the industry to get back up and then at the same time I really think that they should not start up.

Do you feel that your fellow students that were graduating with you now, that they are interested in environmentalism or that it is a current theme in the art scene?

I think it is an issue that comes up more often, in my class there were few students that would explore the same kind of idea and there are definitely some teachers and classes that are shaped around environmental sustainability being explored through art. But there was not as much of it as I thought there might be I guess but I think it will continue to grow.

Yeah, as it is a very current issue.

Yes it is super relevant. My photography practice within the body of an art institution is very literal. It is accessible to people that might find other art inaccessible, which I like. I am not purposely going after that, but it is the byproduct of working with this kind of documentary style of photography in an artistic context. I am aiming for that right now, but it might turn into something else too.

From Africa to Australia, a lot of eights or nine day crossings. Yeah, the sea is like endless but also not.

I am striving to capture something more realistic and more multifaceted (...). Right now I am dying to get back on a cruise ship, waiting for the industry to get back up and then at the same time I really think that they should not start up.

Vessels

WHO OWNS MOST OF THE VESSELS?

% OF WORLD TOTAL

NORWEGIAN CONTROLLED OFFSHORE UNITS - BY FLAGS

TOP 10 SHIP OWNING NATIONS

WELCOME TO OWNERS ANONYMOUS

The arrival of containers in the early 1960s revolutionised the shipping industry. Containers could be efficiently stacked, allowing more and more goods to be transported across the seas.

CASH BUYER -NOUN

A cash buyer is a company specialised in the trade of end-oflife vessels to beaching yards. Cash buyers pay ship owners up-front before the ship reaches its final destination and is dismantled.

BENEFICIAL OWNER

The Beneficial Owner (BO) is the 'real' owner of a ship and the company that takes all commercial decisions.

UNITED STATES OIL FUND (USO) - NOUN

An exchange-traded fund that attempts to track the price of Crude Oil. USO invests in oil future contracts that are traded on regulated

futures exchanges.

RO-RO VESSEL

REEFER VESSEL

BULK VESSEL

CONTAINER VESSEL

Number of ships My name is John. I own the world's largest oil tanker fleet I was born in Oslo in 1944 but have a Cypriot passport. Before abandoning my Norwegian citizenship I was Norway's richest man. I live in London but go for holidays to Marbella.

30 20

NORWEGIAN-CONTROLLED FOREIGN GOING FLEET

Net worth \$ 11,5 billion

40

TANKER VESSEL

Designed specifically to transport liquids. For example, chemicals and oil.

Design that suits loading and unloading cargo trailers onto a ship with a ramp. For example, cars, trucks and car carriers.

Carries goods that have to be temperature controlled or frozen. For example, fish, meat and alcohol.

Designed for carrying dry cargo. For example, sugar, fertilizer, grains and coal. Uses a pump to unload.

Carries standard size containers. Can be up to 400m long. Travels at very high spead, average at 21 knots.

AVERAGE AGE OF VESSELS IN THE NORWEGIAN-CONTROLLED FOREIGN GOING FLEET

WHERE ARE THE VESSELS BUILT?

In its lifetime, a large container ship travels the distance to the moon and back about ten times.

END-OF-LIFE SHIP -NOUN

A ship that has reached the end of its operational life and is ready to be scrapped.

BEACHING -VERB

The process in which a ship is laid on a tidal mudflat. The vessel is grounded deliberately during high tide and breaking operations usually take place during low tide when the vessel is not submerged by the sea.

DRY-DOCKS -NOUN

Dry-docks are mainly used in Europe. The ship is driven to an enclosed, flooded dock, the water of which is subsequently pumped out. The ship is then dismantled piece by piece in a fully contained area, thereby minimising the risk of environmental pollution and allowing for the use of cranes to lift heavy pieces off the ship.

WHERE ARE THE VESSELS SCRAPPED?

CETACEAN -NOUN

→ A marine mammal of the order Cetacea: a whale, a dolphin, or porpoise.

ANTHROPOGENIC -NOUN

→ Something produced or caused by humans.

PINNIPED -NOUN

→ A carnivorous aquatic mammal of the order Pinnipedia, such as seals or walrus. \checkmark

At any given time there are 75,000 shipping vessels at sea

→ There are fewer than 400 North Atlantic Right Whales left in the world.

→ Over 300 whales and dolphins are beached every year

Overlapping habitats

Many cetaceans and pinnipeds have their natural habitats in frequently trafficked waters. Due to the ever increasing number of ships, and thereby, noise in these waters, their homes are deteriorating and slowly disappearing. The spaces they can occupy freely and without anthropogenic disturbance are steadily decreasing. Over the course of the shipping industry's rise, more animals are dying and their means of communication has altered. Collisions with vessels, beaching, net entanglement and general noise disturbance hinder their natural behaviour and habitats. Multiple species and stocks are endangered and their position in the ecosystem is in jeopardy. The shipping industry has to take a large part of the blame.

KILLER WHALE HABITAT Orcinus orca

The orca have their habitats mostly in the Atlantic ocean as well as most of the southern hemisphere. Orcas. or killer whales, hunt in a wolf-like pack making them very susceptible to vessel noise harming their ability to communicate with each other. All killer whales are protected under the Marine Mammal Protection Act, and two populations of killer whales receive special protection.

→ Killer whales roam most waters on our planet (shown in white) except the deepest parts of the pacific.

44

NORTH ATLANTIC RIGHT WHALE HABITAT Eubalaena glacialis

Reigning, as the name says, in the north of the Atlantic, the North Atlantic Right Whale is one of the worlds most endangered whale species. Only around 400 whales remain. Their mortality is mostly caused by entaglement in fishing gear, collisions with vessels, and noise pollution from vessels on the surface.

← Habitat of the North Atlantic Right Whale (shown in white).

← The blue whale can be found in six of the seven seas (shown in white)

except for the Arctic Ocean.

Noise pollution

FREQUENCIES

Scientists have discovered a clear relationship between growth in number of shipping vessels at sea and measurements of low frequency noise. This poses a problem for many marine mammals as they use low frequency sonar to locate each other, communicate and find food. As the shipping industry grows, their ability to survive reduces. An example of trying to adapt to this is that the North Atlantic Right Whale has increased its sonar frequency in order to communcate with others of its kind. Other whales use their sonar to locate prey or breathing holes in the ice. Thus, if a species cannot increase their frequency, it could prove to be fatal.

CETACEAN STRANDING

By Jeanna Bryner February 12, 2017 000000

Beluga whales, known as the "canaries of the sea", use their vocal sounds to form groups to hunt, migrate and interact with each other. Narwhals act in a similar manner, communicating using sonar, which is much more effective in water compared to air. A call to a mate can reach much further than other land-mammals could. In their Arctic habitat, they are still fairly alone, with little impact from the anthropocene. In today's climate, shipping routes aren't particularly accessible in the Arctic Sea - yet. However, as the ice caps melt, these routes will become more and more accessible causing a disturbance to the life of the beluga and the narwhal. The beluga require air to survive, but as noisy ships pass, they will migrate closer to the North Pole. This could lead to them being trapped under the rapidly freezing ice in the fall. The free air would then be impossible to reach except for a few holes in the ice they could find using their signals - if not disturbed. The more traffic we have in the Arctic, means that fewer whales will be able to survive and be part of the ecosystem. \rightarrow

UNDERWATER SOUND

Underwater, right next to the ship, sounds can be as loud as 170-180db. The threshold for bursting your eardrums is 150db, and the threshold for (human) death is 185+ decibels. Whales and other sea animals are usually not located right next to a vessel, but they are often close enough for the sound to be as loud as 60 to 90 decibels. In the workplace it is mandatory to use hearing protection when the decibels exceed 85 and recommended from around 70 db.

Sound travels about four times faster and further per second under water. This makes communication between marine mammals simpler over longer distances, but with the steadily increasing marine traffic, their noises of communication are being dulled out.

Dead or lifeless whales beach or strand in large numbers every year. Some individually, others in groups. If a whale is stranded individually it is highly likely that it is of natural causes, whereas a group found stranded at a beach or shoreline might indicate some form of human interaction. Whales colliding with an offshore vessel, whales being driven away by loud vessels, maimed whales seeking safety, and whales caught and released from fishing nets can be common causes of strandings.

Mass Stranding: Hundreds of Pilot Whales Returned to the Water

380 whales dead in worst mass stranding in Australia's history

More than 450 long-finned pilot whales became stranded in harbour in Tasmania with rescuers managing to save about 50 LATEST: 70 stranded whales released in Tasmania, but only 20 remain well enough for rescue

New Zealand whales: Why are so many getting stranded? By Gareth Evans BBC News 30 November 2018

Pollution and its contradictory solutions

The shipping industry as a whole is the most effective way of transporting goods. Thousands of containers can be carried on a single ship whereas a truck can only carry two. If you were to transport the same amounts of cargo with a truck it would take between five and ten thousand trips with a single truck.

This efficency comes at a cost.

As new regulations come into place, the ship owners are forced to limit how much sulfur their ship releases or where they are allowed to use the "dirty" fuel, the fuel that emits black smoke.

This sounds like a great step, but in the long run it is not effective. Many ships can run for 20 more years, as the regulations are only forced upon new ships. Throughout human history the number of ships at sea has risen steadily. During the industrial revolution when steam and later diesel engines came into play, it increased drastically. Although vessels have become larger and faster, the number of vessels has not decreased, causing both air and sound pollution.

Even though the levels of pollution coming from a single ship is forced down, the total number of ships at sea is increasing. This defeats the main intentions of the regulations.

Sixteen tanker ships pollute as much as all the 800 million cars on the planet

VESSEL BEACHING

One of the most important environmental aspects of shipping is what to do with the ships once they have reached the end of their life.

Up to 95% of a ship's body is made of steel which can be reused, sold and recycled. Unfortunately nine out of ten ships are sent to South Asia to be scrapped by the controversial beaching method. Ships are sent full force into a beach to ground it, leaving it to be dismantled by their workers always underpaid, often underage. Manually dismantling these ships lead to the release of dangerous materials such as PCB and asbestos. These materials are both breathed in by the workers and washed into the seas by the tides. An overall incredibly polluting process that could have easily been avoided had ship owners chosen to sustainably recycle their vessels for a marginal profit over selling it to Asia for three million euros per ship.

The Norwegian Maritime Industry recently signed up to the EU Ship Recycling Regulation. These comprehensive rules dictate that ships must be recycled in an EU approved ship recycling yard, and includes harsh punishments for practices such as beaching - running a ship aground and leaving it to rot – and sinking of vessels.

As our population and consumption grows, so does the shipping industry. Looking at huge amounts of research and data, it's hard to believe that there ever will be a good solution to this. The efficiency of ships is on the rise, while the regulations are getting stricter. Some companies are trying to develop green ships with close to zero emissions. MAERSK has said they want to become a zero emission company by year 2040, and while this sounds promising, many believe they will instead become a neutral emission company, meaning they are researching ways to "reverse" the climate impact they produce. Creating oxygen out of CO2 and so on, reversing the

The shipping industry is world leading in efficiency, meaning they transport the most cargo while producing the least amount of emissions.

damage they are doing.

On the contrary the industry is also so big that they are the worst in terms of polluting and if ranked as a country they compete in the top FIVE.

16 ships pollute as much as all the cars in the world. All 800 million of them.

BLACK CARBON

After CO2, black carbon (BC) contributes the most to the climate impact of shipping, representing 7% of total shipping CO2-eq emissions on a 100year timescale and 21% on a 20 year timescale.

As BC is a short-lived climate pollutant, reducing BC emissions from ships would immediately reduce shipping's climate impacts.

Even though its a short-lived pollutant, its capabilities to heat up the atmosphere is many times greater than CO2.

90% of all the ships are beached in India, Pakistan and Bangladesh.

SNJÓLAUG ÁRNADÓTTIR

comes to your mind?

qualifications for crew etc.

What was the latest news you heard about the shipping industry?

 \rightarrow The latest news I heard about the shipping industry relates to Eimskip (an Icelandic shipping company) selling two vessels for scrap in India, in breach of waste laws.

46

CHRISTOPHER OLAFSSON \rightarrow SHIP BROKER

When you think about the shipping industry, what is the first thing that comes to your mind? → John Fredriksen

What was the latest news you heard about the shipping industry?

→ Employees on strike in the North Sea and the closing of an oil rig as a result of this.

People on the street

BJØRN VIKTOR GISKE → PROJECT MANAGER - MAINTE-NANCE PLANNING. KONGSBERG MARITIME CM AS

When you think about the shipping industry, what is the first thing that comes to your mind?

 \rightarrow Upcoming projects underway to develop hydrogen fuel cell technology. Design unveiled for world's first compressed hydrogen ship.

What was the latest news you heard about the shipping industry?

→ Change, development, green shipping future. High focus on sustainable solutions.

TORE PETTERSEN → SHIP BROKER

When you think about the shipping industry, what is the first thing that comes to your mind?

 \rightarrow An old fashioned, male dominated industry which is unwilling to change in terms of environmental issues, work environment, and the methods used within the field.

What was the latest news you heard about the shipping industry?

→ Robert Macleod no longer C.E.O of Frontline

ANETTE PETTERSEN → KINDERGARTEN TEACHER

When you think about the shipping industry, what is the first thing that comes to your mind?

→ I think of an item I recently bought online. It was a beautiful jacket but it turned out to be too small so I gave it to my sister.

What was the latest news you heard about the shipping industry?

→ I am not sure, I think I heard something about future plans of moving the industrial harbour out of Bergen centre, and that a new neighbourhood will come there. I guess that makes sense.

How profitable the transport industry is and how sloppy the international regulations are when it comes to environmental issues.

↑ ØYSTEIN GUNARSSON

ØYSTEIN GUNARSSON → LOGISTICAL COUNSELLOR

When you think about the shipping industry, what is the first thing that comes to your mind?

→ How profitable the transport industry is and how sloppy the international regulations are when it comes to environmental issues

What was the latest news you heard about the shipping industry?

 \rightarrow A broken oil tanker outside Mauritius.

→ POSTDOCTORAL FELLOW AND LECTURER IN INTERNATIONAL LAW

When you think about the shipping industry, what is the first thing that

 \rightarrow The first thing that comes to mind when I think about the shipping industry is vessel-source pollution and problems associated with enforcement of international rules and standards. This also reminds me of flags of convenience - the practice of registering ships under the flag of a State they have little or no real connection to in order to avoid various rules on taxes,

The latest news I heard about the shipping industry relates to Eimskip (an Icelandic shipping company) selling two vessels for scrap in India, in breach of waste laws.

↑ SNJÓLAUG ÁRNADÓTTIR

GREENWASH -VERB

 \rightarrow A form of marketing spin in which green values and green marketing are deceptively used to persuade the public that an organisation's products, aims and policies are environmentally friendly and therefore 'better'; appeal to nature.

ANTHROPOCENE - NOUN

 \rightarrow The current geological age, viewed as the period during which human activity has been the dominant influence on climate and the environment.

Maritime Tourism

Toullution ↓ Jon Martin Seternes Elisabeth Wieërs Kirsten Remmers Kristoffer Apelseth Liadal

What is Maritime Tourism?

TOULLUTION

→ An invented word combining tourism and pollution. How do we shift from polluting (Toullution) to sustainable (Toutainable) maritime tourism?

MARITIME

→ Relating to or connected with the sea or its uses (as navigation, commerce, etc.). So in relation to tourism it can be everything from coastal driving, surfing, sailing, diving, cruiseship. As long as the activity has a connection to the sea.

TOURISM

→ Tourism is travel for pleasure or business; also the theory and practice of touring, the business of attracting, accommodating, and entertaining tourists, and the business of operating tours. So both foreigners and local people are considered tourists. Tourism comprises 4.2% GDP of Norway's economy

MARITIME TOURISM

→ People that are travelling along the coast are considered maritime tourists. We will focus on the space of the coastline and the space people are travelling in.

Tourism is a 186 billion (NOK) industry

4.2 % of Norway's GDP

by air by car by ship

27.9%

13.5%

50

Tourism is one of the fastest growing industries in the world. The way tourists travel affects not only their own journey – it changes the world around us. Progressively more space is occupied by and for tourists. These areas of land are ever growing, as is the impact they have on the environment. The impact planes, boats and cars have on the quality of air is well known but they also have a major impact on the land we live on. Roads slice through important ecosystems and airports limit the water intake of otherwise large green areas. The damage boats do to the bottom of the ocean and the quality of the water is irreversible. We already feel the effects of these consequences on land, even though they are not directly visible.

Tourism in Antarctica: Edging

'world's most expensive shopping trip'

Cruise Ships

Cruise tourism has experienced an enormous amount of growth in recent years. Since 1980, the average annual growth rate in the number of cruise passengers worldwide has been 8.4%. The growth has been very noticeable in Norway. Since 2014 the number of tourists has almost doubled. The main appeal is the nature along the coast line, with even the smallest coastal towns being one of the world's most popular cruise destinations. Cruises going from fjord to fjord and other small ports are also gaining popularity. The cruise industry has had a positive impact in many places, mainly economic. The spending of crew and passengers on shore provides many people near the port with jobs in tourism. Even more jobs are created from staffing by the cruise line and goods and services needed for their operations. The negative impacts, however, cannot be ignored. The pollution stemming from these ships is immense. They generate incredible amounts of different wastes including sewage, graywater, oily bilge water, ballast water, solid waste and even hazardous wastes.

It is nearly impossible to measure or calculate the amount of waste these ships produce because of how badly regulated the industry is.

Many attempts have been made to enforce environmental standards, unsuccessfully. In Norway there have been efforts to make cruise tourism more green but these efforts pale in comparison to the damage. The movement and sound of these ships damage the environment, as they disturb many natural habitats. Many of the employees do not reside in Norway and thus do not contribute to the economy of the country, with many of them not even allowed to leave a restricted area in the port.

Flagged ships do not prescribe a minimum wage, despite many effort to better regulate the working conditions. Some ships under the Panama flag obtain an exemption from giving workers a day of rest each week. The industry also has a marked impact on the space of a port, due to the size of the vessels and the space required for tourists leaving the ship. In some smaller ports in Norway the tourists outnumber the inhabitants. In many cases large amounts of cruise tourists scare away local Norwegian tourists, who, on average, spend more money in ways that benefit the local population.

Taking all sides of the industry into account, is it worth the high cost? With the limited benefits almost exclusively benefitting the cruise lines themselves, why are we sacrificing valuable resources, nature and space to accommodate this type of tourism?

54

We have been doing cruise lines for more than 150 years, the first one was in 1869 in Geirangerfjord.

Routes \rightarrow

↘ MONICA BERSTAD MÆLAND CEO of Ålesund Cruisenettverk

The floating city

According to an examination by Innovasjo Norge in 2019, 92% of the money that cruise tourists spend goes directly to the cruise ship owners. Only 8% of the money is spent in a way that benefits Norway. Τ

600,000 litres of paint was used on the Oasis of the seas. This is 12 times the ammount used on the Eiffel Tower. J.

The levels of noise pollution are high in cruise ships. In addition to the noise from the machinery, there's also noise coming from the entertainment activities. This disturbes marine life and mammals. Killer whales and dolphins can die from this, as their sensitive hearing gets harmed and debilitated. A loss for the ecosystem. $\mathbf{1}$

Cruise ships pose a serious threat to coral reefs: both due to pollution and their physical presence. In 2017 the british cruise ship MS Caledonian crashed into coral reefs outside Indonesia and destroyed 17,222 sqft of the reef.

5310 km of electrical wiring: enough to cross america.

A 100 MegaWatt grid that is run by six massive generators.

These generators create enough power to supply 105,000 homes. 1

The generators consume 12 tonnes of diesel every hour. The weight of 2-3 elephants.

About 270 people went missing on cruise ships between 2000 - 2016. According to CLIA the average number of people that go overboard on cruise ships is now 19 each year.

On luxury cruise ships the cruise lines collect information about your likes and dislikes and store it in a database. This information is shared with the crew, along with a picture of you. They use this to cater to your needs.

A floating city of ~8000 people

Most cruise ships burn heavy fuel oil (HFO), which is the dirtiest fossil fuel available. Currently, heavy fuel oil contains 35000ppm sulphur, which is 3,500 times more polluting than road diesel. The generators consume 288 tonnes of diesel every day. The weight of two grown blue whales.

Cruise ships owned by Carnival cruise alone emitted nearly 10 times the ammount of sulphur oxide (SOX) of all the cars in Europe. A pollutor that the UK's Health Protection Agency classified as "toxic and corrosive" in a general information notice. This is only one of many particles that cruise ships let in to the air. T

The European Federation for Transport and Environment claim on it's site that the air pollution from the shipping industry accounts for 50,000 premature deaths each year. At an annual cost to society of more than 58 billion euros. Bill Hemmings, marine expert at Brussels-based Transport and Environment group says about the cruise ships "... they use a lot more power than con-

tainer ships and even when they burn low sulphur fuel, it's 100 times worse than road diesel."

56

According to a report by the environment organisation Friends of the Earth: the cruise ship industry is responsible for dumping more than 1 billion gallons of sewage in to the ocean each year.

A report by EPA (US Environmental Protection Agency) estimates that a single 3000-person cruise ship dumps about 150,000 gallons of sewage in the ocean each week. That's almost 8 million gallons each year for a ship this size. The equivalent of 12 olympic swimming pools of sewage for one ship. T

Each day the cruise ship produces 50 tonnes of ice cubes. The same weight as 7 Tyrannosaurus rex.

It's not uncommon that people die while at sea. Those who die on board are placed in a morgue on the ship. This is located on one of the lower "hidden decks".

Model of all the apartments in the boat. There is no 13th floor because of superstition.

called central park.

of what they should be paid.

The scale inside the boat is not "human". The typical modern cruise ship weighs 200,000 gross tonnes, with a construction of aluminum and steel.

The apartments on the cruise ship are positioned to create an introvert space in the centre of the boat. On the "Oasis of the seas" this space houses a park,

It has recently been unveiled by NRK that Hurtigruten, a Norwegian cruise line, docks outside of Norway, in Cuxhaven. They do this so they don't have to pay their workers by Norwegian tarifs. Instead they get paid a fraction

- → Cholera
- → Water fleas
- → Mitten crab
- → Toxic algae \rightarrow Round goby
- \rightarrow Comb jelly
- → North pacific seastar
- → Zebra mussel
- Asian kelp \rightarrow

J

European green crab

A cruise ship produces enough grey water to fill 32.2 tank trucks daily. This water contains anything from chemicals to heavy metals.

-	all states	1900
-	of the local division of the local divisione	-
of Street	-	-
all and	and in such the	allowed
star-st	star-el	and the second
-	and provide the	and the second diversity of
-	and provide	-
-	of Street	of Street, in
1000	of Street	al property in
-	and procession	of Street
-	and Street of	al .

During the Covid-19 crisis large fleets of empty cruise ships have been spotted floating around popular cruise destinations. T

Some of the crew have been trapped on these boats until things go back to normal. Or they're fired.

The ship graveyards that used to be filled with cargo ships are also filling up with cruise ships.

In the start of October 2020, 5 luxury cruise ships were spotted in the graveyard in Aliaga, Turkey.

Distribution of the market shares in the cruise industry Ť

Carnival Corp. = 41.8% Royal Caribbean = 23.8% Norwegian Cruiseline = 9% MSC Crociere = 8.6% Genting Cruiselines = 3.6%

Other = 13.2%

National roads

In recent years Norway has made big investments to promote in land car tourism over any other type. The construction of major new roads and other infrastructure is meant to make this way of travelling more appealing. Along these 18 scenic roads you can find many new art, architecture and design projects. These projects aim to make the already existing attributes of nature and cities more attractive. The promotion of these roads comes at any cost, for example big tax breaks for Hollywood movies who make use of the scenic routes.

A large network of bridges and tunnels unify different pieces of land like a sewing thread pulling different pieces of fabric closer together.

These roads, leading past the coast and over fjords give the sense of making a journey, which is an important step in making tourism more green. This way of travelling encourages local contact, and gives tourists the illusion that they making less impact, compared to air and sea travel where a sense of time and place are blurred.

Most of the population longs to travel to further and more extreme places. Travel agencies and cruise companies make impossibly large and varied journeys seem simple and possible. But in reality the cost is high.

Coastal roads offer the opportunity to admire a beautiful and ever-changing landscape while also making the journey and its size more tangible. Although cars still impact the environment, it is less than air travel and cruise ships; since it is on a smaller scale, a closer experience to nature and also supports the local Norwegian economy.

Large spaces are cut out to make room for the enormous ships. The groups of tourists that emerge from inside these monsters is of a similar scale; the impact they have on the often small towns selected for stops is immeasurable, but not for the economy and local businesses. As cruise ships become increasingly better at selling a 'full experience', the amount tourists spend on land at local businesses is on a steady decline. The crowds need to keep growing to produce the same profit. In comparison, the coastal roads will not be enlarged over time, hence a limit to the scale of tourism is set. Car travelers require more goods and services than a cruise ship passenger. The future of maritime tourism lies in the activities that the water can provide (like surfing, swimming, diving, fishing...) and not merely the travel over these same waters.

The way Norway is advertised has changed drastically over the last 10 years. Instead of sunny mountains and women in traditional dresses, now they show the rugged nature and the powerful weather, even though its rainy.

↑ INGER HELEN Manager at Hotel Brosundet

I think in the future travel will only be for a select group, it's the way it has to be. The way tourism is growing now is not sustainable.

↑ VEBJØRN ANDRESEN CEO, 62° Nord

1,000,000

800,00

600,000

400,000

200,000

ATLANTERHAVSVEIEN

 \rightarrow 320,000 cars annually

TROLLSTIGEN

 \rightarrow 160,000 cars annually

TROLLTUNGA

- \rightarrow 100,000 people annually
- \rightarrow 10,000% increase (last 8 years)

NUMBER OF CRUISE TOURISTS

PREIKESTOLEN

- \rightarrow 2000 cars a day
- \rightarrow 230,000 people annually

Tourism timeline

1789 T

ERIK PAULSEN Danish artist portrays Norway in his travel journey

1836 ↓

J. C. DAHL

Danish artist works in Bergen; considered the first national romantic painter in Norway and the father of Norwegian landscape painting.

1872

WILLIAM SLINGSBY

Travelled to Norway to have first ascents on several of mountain peaks inspired a lot of other Englishmen to climb peaks in Norway.

1875

T THOMAS COOK CRUISE First cruise arranged to Nordkapp.

1883

KEISER WILHELM CRUISE inspired by a German exhibition took a team of 200 artists to recreation trips to the Fjords. More than 20 trips.

1886 \downarrow

DNT

Den norske turistforening (known in English as the Norwegian Trekking Association) was established for people to explore nature.

1890

J LAKSELORD Wealthy English noblemen travelled to Norway for recreational fishing. Known as lakselord or "Salmon lords".

1895

CLAUDE MONET VISITS NORWAY

1905

Norwegian independence.

1908

Norwegian Ski Federation and Norwegian Mountaineering Association formed- building up Norwegian nationalism. Key figures like Elias Hogrenning, Kristian Bing and Kristian Tandberg had several of first ascents

1908

NORSK TINDEKLUBB norwegian mountain club established that took back mountains and buildin up norwegian nationalism key figures like Elias Hogrenning, Kristian Bing and Kristian Tandberg had several of first ascents.

1915 T **CAPACITY 200**

1919 8 HOURS RULE

	1914-1917 ↓ WW1
	1926 ↓ STELLA POLARIS Huge luxury cruiseboat with capacity for 200 people.
	1934 ↓ HITLER SOGNEFJORDEN
ł	1940 ↓ GERMAN INVASION
ng S	1950 ↓ DEN NORSKE AMERIKALINJE came back after the war with cruises.
	1960 ↓ FREE TRADE

1960 Raising the roadnetwork

1969 J
OIL FOUND
1980

Filipino workers in the cruise industry

1989 \downarrow COLDWAR OVER

CRUISESHIP > TRIP

2006 \downarrow

SCHENGEN

2009 CAPACITY 6500 CRUISE

2010 \downarrow INSTAGRAM

2020 PANDEMIC

60	
----	--

20

.

- CANOE TRIPS BICYCLE TRIPS
- CANOE SPOTS \oplus FISHING SPOTS

▲ CLIMBING SPOTS

What happens in Norway?

Cruise ship scale

62

The newest model of cruise ship will be able to carry 6000 people on one ship. That's only the passengers, not the crew. [...] It is important that we ask ourselves 'do we really want three of these ships docking at the same time?'. This is why it is so important that cruise tourism is regulated and controlled.

A CRUISE SHIP COMPARED TO FLØYEN, BERGEN

↓

1 to 2 hours

5 to 8 hours

8 or more hours

↑ MONICA BERSTAD MÆLAND CEO of Ålesund Cruisenettverk

Bergen tourism

Not only due to the large amount of freight ships, but also the large numbers of cruise passengers. Bergen port is the busiest in Norway. Over 300 cruise ships bring almost half a million tourists to the port each year. Although cruise tourism has a long history in Norway, the amount of cruise passengers has almost doubled in the last 10 years.

From the moment the city was founded in 1070 the port has played a major role in the development of the city. Throughout the years of development theport was not only central for the city's functions but also literally the centre of the city. The exponential growth of tourism has however caused a shift for the city centre; no longer a meeting place for locals and merchants, the port is more an attraction for cruise tourists. Businesses around the port have quickly adjusted to this radicalchange. Less than ten years ago, thefish market was used primarily by locals, but now fish is sold mainly to tourists.

Shop owners thus adjust their offerings to accommodate these tourists, selling mainly local products that tourists can take home with them. Recent restrictions on bringing food aboard has meant most now offer small lunch packages – one of many examples of how small changes in the tourism industry have a direct impact on the local harbour.

In addition, the port itself has changed to accommodate the tourists with large walkways from the boat to the port. In 2012 the tourist information centre/Fish me fish market in the middle of the port was built. Will this be a trend that continues into the future? Or will the city take space back for its inhabitants?

In our search for the changes that have been caused by tourism in Bergen, we talked to many local shop owners. Very noticeable in our research is the disconnection between the numbers of cruise tourists and the feelings and experiences of people in the port. We've learnt that most of the money cruise tourists spend goes to the cruise line themselves. With the cruise line making 20 billion NOK in 2019 from spending by cruise tourists, and Norway making only 1.8 billion in the same year. Spending per tourist is decreasing, having almost halved since 2014. Cruise lines are becoming more successful in monopolising the tourists' money through the sale of packages, different promotions to keep tourists on board, or limiting what the

passengers can bring on board.

Despite all these numbers, shop owners and services personnel have an overall positive view of these tourists. Perhaps this can be explained by the fact that the people interviewed are all from a branch of industry that receives a lot of income from the tourist. Also compared to other Norwegian ports, Bergen is a stop where the tourists spent a lot of time. Directly related to the amount of money they spend, this could mean a much larger economic impact in Bergen compared to other ports. It could be that despite the jarring numbers, the personal experiences might be overwhelmingly positive. Perhaps the tourists are wellmannered, big spenders, very polite, bringing an all-round lively atmosphere to the port. Perhaps tourism seems like a fond memory, taking workers back to a time before travel restrictions and the pandemic. Another possibility is that with all the radical changes made to accommodate this large volume of tourists, it is difficult for them to imagine being able to survive without

their presence.

Popular instagram spots in Bergen and nationality of photographers

Tourist spots (red) and cultural institutions (black) for both locals and tourists in Bergen \rightarrow

"Another problem that means locals don't shop here anymore is the parking situation. There is no parking space close to the market anymore, so they have to walk almost 30 minutes."

↑ Fish market shop owner

Who uses Bryggen?

 \rightarrow Bryggen with no cars

 \rightarrow Bryggen with people

Bergen portraits

SOUVENIR SHOP EMPLOYEE

When talking to the souvenir shop employee she told us that this year has been a very special year. Because of the pandemic there have been a lot fewer tourists, mainly the cruise tourism is noticeably absent. According to her, Bergen and especially Bryggen needs tourism to survive. When asked about her personal opinion on the tourists she tells us; "It's ok. It is insane how many people are here during summer. There are a lot of people. It's between 7000 and 9000 people from cruise-ships, minimum 5000 people per day."

CAFÉ EMPLOYEE

After living in Bergen for almost ten years, he believes that the changes in tourism have been minimal; "There are more tourists but not very much more." The absence of the cruise tourists hit his business hard; "If cruise ships are not coming back we can just close." He believes that the effects of this pandemic will be very present over the next few years; "yes of course I think it will change a little bit. There will be less tourism from cruise-ships but I think there will be other tourists travelling to Bergen. I think the tourism will come back but not so many tourists at one time."

SERVICEMEMBER RESTAURANT

"This year there have been more Norwegian tourists compared to cruiseship tourism. The cruise tourism is definitely going down but there was a lot of tourism all summer. So we haven't missed them at all. There were so many Norwegian people travelling to Bergen" a server tells us when asked about the effects of the lockdown. However, she does point out that the cruise tourists are great for business. When asked about her personal opinion on the cruise tourists she remains positive; "It doesn't bother me. Bergen is a beautiful city. We want everyone to come to see the city and everything we have here." We asked her about the amount that cruise tourists spent compared to the Norwegian ones; "This

summer has been a great summer. I guess Norwegian people spend a lot compared to people from cruise ships. Some tourists also come here to just get the experience of Norwegian food and ask us something about Bergen. I guess it is a little bit of everything."

FISH MARKET SHOP OWNER

Working on the fish market for 30 years this shop owner has seen a change in the tourism; "I can't remember how many it was in the beginning, because they started here in the late 80s. But there were just a few during the season and it was in the main season, May to August. But the numbers increased and the season is much longer now. The last winter even had some cruises. Not many, just a few." Not just the tourism but the fish market itself has changed a lot he tells us; "If we are talking about the fish market it was more like a basic fish market for local people. Now it is more prepared food. I remember in the 90s for example, it was sold a lot to passengers from the cruise ships. They bought packed salmon, caviar or that kind of seafood that was possible to transport home. Now we don't do that so much because they are not allow to bring any seafood on board. Even

when it is sealed, it is because of the strict hygiene regulations. That is a big difference. Before we sold a lot to tourists and locals but now it is more that they come to experience eating the seafood here." He worries for the future because of the pandemic and also the sustainability of the industry. "I'm afraid that it will change because of Covid-19 but also because of the environment. I'm afraid that some of the businesses will not be the same. There are big boats with small cabins and sometimes up to 7000 people. It's very tight. I'm afraid myself about going on a boat but that is my own opinion.

FISHING SHOP EMPLOYEE

↓

When asked about tourists the fish shop workers tells "Not much tourism here in my job but in Bergen in general is a lot." He goes on to tell us that most people visit him for equipment and repair services. We were wondering if the pandemic affected his job; "Not this job. I have more local customers for boats and camping equipment. We have more customers this year, less tourists but more locals."

66

Nearly 7 out of 100 Bergen residents work in the travel and tourism industry. However, most of this employment is in the 'accommodation and transport' sector, a sector in which cruise tourists spend very little money.

Money spent by cruise tourists

Shopping and food/drinks Activites Accommodation and transport

Cruiseship conversations

THE CREW

Do guests get an insight into the life of the crew?

• Only if you are interested in it and specifically ask about it

Is the crew international?

The team on a cruise ship is international, but not as international as many might think. Many Germans work for Aida because it is a German shipping company. Most of our crew comes from India or the Philippines. The cruise lines work with recruiting agencies that take care of recruiting. For example, we mostly had musicians from the Balkan region, this is because an agency in Serbia was commissioned to recruit the musicians.

Is the crew international?

• I have only come across a handful of Norwegians, and they are usually officers (I am not Norwegian). On an average ship, most of the crew is from the Phillipines, China, and India. The officers are usually Greek, Italian, American, British, German, etc. The staff are usually from Eastern or West-

How many crew members work on board?

ern Europe, sometimes the Americas.

The number of crew naturally depends on the size of the ship. At Aida there are 4 classes of ship. Cara class. Sphinx class, Hyperion class, Helios class (from small to large). On the Aidaprima (Hyperion) we were about 900 crew members and 3250 passengers fit on board. On the Aidablu (Sphinx) we were about 600 crew members for 2200 passengers. On the Aidacara (Cara) we were only about 300 crew members on 1180 Passengers. On the Aidanova (Helios) there are approx. 1500 crew members per 5000 passengers. The number of crew members also depends on the concept of the shipping company. There are luxury shipping companies where the ratio of crew and passengers is even 1 to 1.

How many crew members work on board?

The largest ship I have worked on has had about 2,200 crew members on board to serve about 6,700 guests. The smallest ship I have worked on has had about 750 crew members on board to serve about 2,100 guests. Some of the older, smaller ships may have just 200-300 crew members working at a time. but I usually work on the larger ones. At the end of each cruise, as the thousands of guests change over, a small percentage of the crew goes home and another group joins the ship.

THE BOAT

How is the accommodation on a cruise ship?

Very clean, well-kept and very modern. You always get the feeling that you are in good hands and taken care of around the clock.

What do you like best about vacationing on a cruise ship?

That I can see the world with a floating hotel without having to worry about my safety or the cleanliness of mv accommodation. In addition, by travelling together and sharing the same experiences, friendships develop very quickly on board.

How are the living conditions for the crew on board?

Of course, the crew doesn't live like the guests do on board. Depending on the size of the ship, the crew is accommodated on deck 1-3. The crew shares a cabin for two, only the officers have a single cabin. The higher the rank, the greater the comfort of the accommodation. Basically, the cabins for the crew are small and practical, if you are lucky you will get an outside cabin with a porthole so that you have daylight in vour cabin.

How are the living conditions for the crew on board?

• If you're an officer, you have a large cabin to yourself with a window, and you can use all of the ship's amenities like eating in a restaurant or going to the spa. If you're a deckhand, you're living below the waterline in a cabin with two or three other crew members, and you are only allowed in crew areas while off duty like the crew mess and crew bar. Evervone else falls somewhere in the middle, and privileges vary depending on the cruise line. The crew areas are basic. Usually there is a main crew corridor, and everything is connected to it - the crew mess, the bar, the medical center, the HR department, the gym, the garbage room, and stairwells going down to the cabins.

THE PANDEMIC

Did you have to cancel tours?

Unfortunately, we had to cancel our trips to Norway on the Aidacara in mid-March, as Norway has started to close the ports to cruise ships due to the corona pandemic. For 14 days we lay in the port of Hamburg without guests on board and didn't really know what to do next. My assignment was originally planned until mid-Mav. So I had to spend half of my assignment at home because I had to disembark on March 31, 2020. Actually, all trips had to be broken off or cancelled. The crew on board the ships was gradually dismantled. Only the emergency crew, i.e. the crew members who are really necessary for the maintenance of the ships, should remain on board. All those who work in the hotel/guest service sector were sent home.

Have you spent time during the Covid-19 pandemic at home?

I was supposed to be back on cruise ships this autumn. Instead I'm stuck in Bergen, and even worse, there are no cruise ships here so I can't get more work. I am desperate to get back out to sea, but so conflicted because I believe it's far too dangerous to start the cruise industry up again (just look at the Hurtigruten mishap). The entire industry relies on contract workers, and there are no job protections, so the cost of this shutdown has been unfairly spread onto the workers. At the same time, there are also huge costs that the cruise lines are incurring, and already some have filed for bankruptcy and sent their ships to the scrapyards.

Were you able go back to work?

Aida had originally planned the restart with two ships for August, so crew members were brought on board again for these two ships. You have to be aware, however, that they wanted to use 2 of 13 ships again, which means of course you cannot employ a large part of your crew at the moment. So during the Corona period and now I am not busy on a cruise ship. So the situation for us as a crew is very difficult at the moment, because even if things are slowly starting again, you simply don't need the mass of staff as before.

What is the current situation for employees on cruise ships?

• The situation has been bleak. Many workers were stuck onboard after the initial travel shutdowns. Efforts to repatriate workers have been difficult, because neither the countries nor the cruise lines want to pay to fly them back to their countries. As a result, many workers have remained in their contracts for extended periods of time, in some cases over a year if they began their contracts in 2019 (this is illegal due to SOLAS international safety regulations). Some ships have been sailing around the world, dropping off their workers in the Phillipines, India, China, and other countries, before being left with skeleton crews to man the ships. There are clusters of ships remaining near Manila so they can quickly pick up new workers again if they need to. During this period of unrest, there was a noticeable uptick of hunger strikes and suicides onboard.

↑ YVONNE (28)

↑ SANDRA (24)

• YVONNE (28) German cruise tourist

SANDRA (24) German cruise worker shop assistant on board

DALE ROTHENBERG (30) Musician on cruises

68

I can see the world with a floating hotel without having to worry about my safety or the cleanliness of my accommodation.

GERMAN CRUISE TOURIST

I am critical of is the aspect of shore excursions. Most trips are organised by the travel companies and benefit them the most. [...] Only the travel agencies and their selected partners get their money's worth.

GERMAN CRUISE WORKER SHOP ASSISTANT ON BOARD

I am desperate to get back out to sea, but so conflicted because I believe it's far too dangerous to start the cruise industry up again

↑ DALE ROTHENBERG (30) MUSICIAN ON CRUISES

During this period of unrest, there was a noticeable uptick of hunger strikes and suicides on board.

↑ DALE ROTHENBERG (30) MUSICIAN ON CRUISES

THE FUTURE

How do you think cruise tourism will change in the next years?

• I think before Corona the cruise industry was a form of mass tourism. Ever larger ships with ever greater capacity were built. Some of the cruises were sold very cheaply. I think Corona will cause a rethink, as these masses of guests no longer work in the smallest of spaces. I think that smaller ships with a family atmosphere will be more popular in the future. I personally also find that working on smaller ships is more pleasant. Hygiene has always played a big role on cruise ships. At least at the moment, it must be ensured that the Corona hygiene rules are followed. I hope that more work will be done on environmental friendliness. A lot has changed in the cruise industry. There are also very strict rules and requirements, e.g. regarding waste separation. I think that a lot of development and expansion is still necessary here. Another aspect that I am critical of is the aspect of shore excursions. Most trips are organised by the travel companies and it benefits them the most. It used to be more popular to go on trips on your own, I think that local shops and restaurants could suffer losses. Only the travel agencies and their selected partners get their money's worth. The crew usually go ashore on their own during their break, I think that Corona could deprive them of a lot of freedom if the shipping companies only allow organised excursions in a closed group.

What do you think has been the effect of the pandemic?

• This pandemic is the single largest challenge the cruise industry has ever faced, and the next five to ten years will be completely defined by its immediate grounding. Previously, the industry had been moving towards larger ships of 100,000-180,000 gross metric tonnes, and selling the smaller and older ships down the line to budget lines. During the pandemic, these budget lines have had no buying powers, and in some cases have gone bankrupt. As a result, the large cruise lines are selling their older and smaller ships to be scrapped for their metal. Five thirty-year-old ships with plenty of sailing life left are currently being disassembled in Turkey. With far fewer small ships remaining, the cruise lines will focus their itineraries on ports that have the infrastructure to support larger ships. This is the future that the pandemic has both caused and revealed.

Oil and Gas

Abyssus ↓ Zoelie Millereau-Dubesset Karine Tollefsen Mads Senneseth Marie Porrez

Oil and gas industry – a 70 year history

1958

NO OIL IN THE NORTH SEA «The chances of finding coal, oil or sulphur on the continental shelf off the Norwegian coast can be discounted.»

→ The Norges Geologiske Undersøkelse in a letter of February 1958 to the Ministry of Foreign Affairs

The first UN conference on the Law of the Sea opened in Geneva in February 1958 with the aim of developing a legal regime for the world's oceans. In connection with the conference, the Ministry of Foreign Affairs asked the Geological Survey of Norway (NGU) to assess the likelihood of finding mineral raw materials on or under the country's continental shelf.

1959

GRONINGEN DISCOVERY

The discovery of a huge gas field in August 1959, in Groningen in the Netherlands, opened up the whole of North-West Europe to the hydrocarbon industry, both on and offshore, turning the spotlights on the North Sea.

1962

BLACK GOLD RUSH FOR PHILIPPS PETROLEUM The American Phillips Petroleum Co was the first oil company to contact the Norwegian government.

In October 1962, the company sent an application to the Norwegian authorities, requesting permission for exploration activities in the North Sea and asked for an exclusive right on much of the Norwegian Continental Shelf in return for an investment of many millions of Norwegian kroner.

The authorities refused, judging that it was out of the question to hand over the entire continental shelf to one company. If these areas were to be opened for exploration, more companies would need to be involved.

1964

NORTH SEA SPLIT Under the 1958 Geneva convention on the Law of the Sea, launching offshore oil and gas operations called for a

clarification in international law of who owned the continental shelf in the North Sea. The Norwegians thereby acquired sovereignty over a sector of the North Sea which almost equalled southern parts of Norway. Before offering any licences, the legal situation needed to be cleared up by a formal law, in order to establish Norway's sovereign rights and to ensure that the resources belonged to the State.

1965

 \rightarrow See image 1

ALMOST ALL BLOCKS ON OFFER On 9 April 1965, the Storting (parliament) adopted rules for petroleum exploration and production on the Norwegian continental shelf below the 62nd parallel (the northern limit of the North Sea). The Norwegian sector was divided into 36 quadrants, each subdivided into 12 blocks. \rightarrow See image 2

JENS EVENSEN

As a senior official in the Ministry of Foreign Affairs, Jens Evensen played an active role when oil companies began to show an interest in North Sea exploration during the early 1960s. He helped to negotiate final agreements on North Sea boundaries, with the UK and Denmark in 1965. The same year, he played a key role in safeguarding the government's interests by preparing the first draft of a policy framework for the oil sector.

1969

Ekofisk – The Big Discovery «We drilled only a few feet into this and circulated around, to see what it was. And that was the beginning of it all, really. It was Ekofisk. But it took many years before I realised the significance of it»

↘ Henry Munkejord

Employee in Ocean Viking in 1969

1970s

BEGINNING OF THE OIL AGE «I was very little then but I do remember the scepticism that lasted a long time. Although we found oil, people

didn't believe it would be possible to make any money out of it.»

▶ Mette M. Bølstad, writer of the Norwegian series Lykkeland

1977

BRAVO BLOW OUT IN THE EKOFISK AREA

On 22 April 1977, an uncontrolled escape of oil and gas had began on the well B-14 of the Ekofisk field. This accident put pollution on the agenda, and speeded up the creation of an oil spill clean-up organisation.

1980

EXPLORATION CAMPAIGN IN THE NORWEGIAN SEA AND THE BARENTS SEA

In 1979, part of the Norwegian Continental Shelf above the 62nd parallel (northern limit of the North Sea) was opened to petroleum activities by the government. From 1980, explorations in the Norwegian and the Barents Sea began, and the first dicoveries followed. \rightarrow See image 3

1980 (March)

ALEXANDER L KIELLAND PLATFORM ACCIDENT On 27 March 1980, the Alexander L Kielland accommodation rig on the Edda Field (Ekofisk area) capsized. With the loss of 123 of the 212 people onboard, this accident is still the worst industrial accident in Norway's history.

This tragic event helped to highlight safety and security issues and risks associated with offshore petroleum operations.

1990

CREATION OF THE FUND The Government Pension Fund Global is established in 1990 to invest the surplus of revenues of the Norwegian petroleum sector.

The idea behind this consideration was not only to promote the longer duration of resources but also to soften the fluctuation of oil prices that, at the time, were exposed to the international oil crisis. It also serves as a financial reserve and as a long-term savings plan so that both current and future generations get to benefit from Norway's oil wealth.

«Petroleum activities have played a key role in the development of today's welfare state in Norway, but it was really only in the early 1990s, when the Oil Fund was created that Norwegians really profited from it financially.»

↘ Synnøve Hørsdal, producer of the Norwegian series Lykkeland

1993 NORWEGIAN SEA

1999

Stavanger harbour.

society.

2001 PETORO company.

portfolio.

ment.

2005

The Frigg field is the largest field on the Norwegian shelf where disposal of

1972

STATOIL - THE FIRST NORWEGIAN OIL COMPANY

Leaving oil production to foreign companies was out of the question for the government. On 14 June 1972, Statoil is established as the Norwegian State Oil Company. The same day, it was also decided that the State would have a 50 per cent ownership on each production licence. Statoil became the leading company in the Norwegian oil industry helped by Arve Johnsen, the first manager at that time, who asserted the company's interests well in competition with the major foreign oil companies.

DRAUGEN PRODUCTION IN THE

A PETROLEUM MUSEUM

The idea of creating a dedicated oil industry museum in Stavanger emerged in the early 1970s, long before it was possible to predict the significance of the oil industry for Norwegian society. In 1980, the Norwegian Petroleum Museum Foundation is established and enabled to begin a collection to document Norway's offshore history.

A national architectural competition is held in 1992 to design the museum. The winning project is the one presented by Lunde & Løvseth: a stone, glass and concrete building facing the sea in

The aim of this place is to allow the public to get an experience the understanding of the way this industry has influenced Norway's economy and

The privatisation of Statoil (now Equinor) in 2001 meant that the SDFI (State's Direct Financial Interests) responsibility has to be transferred to a new State owned management

Petoro is therefore established on 9 May 2001 to manage the Government

As a management company, Petoro is not an operator of any field and does not directly own a licence but it is in charge to manage the SDFI and has a control function surveying Equinor's production on behalf of the Govern-

FRIGG FIELD – FIRST CASE OF PLATFORM DECOMISSIONNING the facilities has been completed, after 27 years of gas production.

Nearly five years after dismantling started, what is left is two concrete jackets in the UK sector, and one in the Norwegian sector.

2007

SNØHVIT PRODUCTION STARTS IN THE BARENTS SEA

2019

JOHAN SVERDRUP PRODUCTION STARTS IN THE NORTH SEA

WHAT ABOUT THE FUTURE?

«The switch from hydrocarbon fuel to greener alternatives, such as solar energy, wind energy, and hydropower has led to a number of speculations about the oil age being over, but I think we can conclude with the oil age being over the maturation phase. In that sense, yes, it is going towards the end, but the final phase will probably last much longer than we think.»

▶ Bjørn Tollefsen, former Executive Vice President of Haugesund Mekaniske Verksted AS (Mechanical workshop-EPC and service provider for oil companies)

Oil and gas industry – production chain

LICENSING

- → To perform any kind of petroleum activities on the Norwegian continental shelf, a production or exploration license must be authorised first.
- → There are two different licensing systems in Norway: frontier areas, which are numbered licensing rounds for the least explored parts of the Norwegian shelf, and APA, which is awarded in predefined areas for mature parts. Each licensing round is equally important. They both ensure that every part of the continental shelf can be sufficiently explored.
- → The production license is awarded by the Ministry of Petroleum and Energy through the licensing rounds. This license covers a certain area and gives exclusive rights to perform oil and gas activities in that area.
- → Exploration licenses are awarded by the Norwegian Petroleum Directorate for the areas on the Norwegian continental shelf that are already open for petroleum activities, but where there is no production license awarded. This license, however, does not give exclusive rights for petroleum activities in that area.

IDENTIFYING

→ To be able to search and identify oil and gas, a seismic survey is performed. This survey is important, not only to discover new oil and gas fields, but also to extract the maximum amount from existing fields. The survey gives petroleum geologists a detailed understanding of the geological structures underneath the surface of the earth, which helps them not only uncover new fields, but the size of them.

SEISMIC SURVEY

→ A seismic survey is performed by sending sound waves into the rock formations underneath the seabed. These sound waves then reflect back to sensors either placed on the seabed or towed behind a seismic vessel on the sea surface.

EXPLORATION

- → Resources have to be proven before any oil or gas can be produced on the Norwegian continental shelf. This is done through exploration activities. To prove a possible deposit of oil and gas, exploration wells are drilled. The Norwegian authorities' exploration policy is important for long-term management of execution of exploration activities on the continental shelf.
- → In areas of the continental shelf where we have limited knowledge about the geology and a shortage of infrastructure, there may be a greater technical challenge than in the mature areas. There areas are called frontier areas and is where one would use the numbered licensing system. In these parts of the continental shelf there is less certainty about finding petroleum deposits, but there is also a great potential for large discoveries. To

avoid drilling dry exploration wells, this should be a step-by-step exploration.

→ In the areas where the geology is well known, there is not the same issue as there are fewer technical challenges and there is already developed or at least planned infrastructure. These areas are called APA and is the system of awards in predefined areas. Since these are mature areas, it is far more important to do rapid explorations completed at the right time rather than step-by-step exploration.

DISCOVERY

→ If an exploration well proves successful, a discovery is made. A discovery is either one, or several, petroleum deposits which through testing, logging, or sampling have proved the existence of mobile petroleum. To recieve the status as a field or to become part of an existing field, the discovery has to be approved by the government through a plan for development and operation (PDO). The PDO will also include an early phase design study, where the basic concept solution is shown.

DESIGNING AND CONSTRUCTING \rightarrow Once the PDO has been approved,

- the design and construction phase can begin. The contracts on the Norwegian continental shelf are called EPC (Engineering, Procurement and Construction) and are standardised through a cooperation with Norsok, which is lead by Norwegian Industry. The suppliers of the platforms have complete responsibility for each phase of the contract until it's completed.
- → The design process is built on a technical study basis where the concept and main parameters are determined by the company. This process consist of a basic design phase where all main parameters are being checked and controlled.
 → The construction phase of a project starts with the production
- of steel frame and deck sections. Technical equipment such as pumps, tanks, etc. are then placed on the deck according to the area drawings.
- \rightarrow When the modules are finished and placed on the MSF (Main Support Frame), the completion phase begins. Here equipment, control, and instrumentation are tested so that the platform gets a maximum completion degree when it's still on land. When the land phase is completed, the barge with the platform is towed to the offshore location and lifted on the steel substructure which is pre-installed at an earlier time. There are large lifting vessels that carry the last lift to the chassis, the weight of such a lift can be up to 30,000 tonnes.
- THE SERVICE AND SUPPLY INDUSTRY → The second-largest industry in Norway in terms of turnover is the Norwegian O&G service and supply industry. It provides services in all stages of the production chain, for example seismic vessels and rigs, advanced offshore supply and

service vessels, offshore maintenance services, engineering services and drilling rig equipment, etc. It is the service and supply industry that delivers the production facilities.

PRODUCING

- → As soon as the platform is completed and has been thoroughly tested, the production can begin. A production platform is usually divided into 3 modules: process module, utility module (power and other support systems) and living quarters. The reason why such a division exists is safety related, as hydrocarbons under pressure are high risk, there are firewalls between modules which are also gas tight.
- The oil and gas production in Norway today takes place in the North Sea, the Norwegian Sea, and in the Barents Sea. Petroleum is found in so-called reservoir rocks underneath the sea bed. During production these reservoirs are drilled into and due to the pressure that's being added, the petroleum flows up to the process facilities on the platform. Here the production is separated and finalised for transport.

WHAT IS PRODUCED ON THE NORWE-GIAN CONTINENTAL SHELF?

→ Crude oil and rich gas (crude natural gas) is produced from the different reservoirs. The produced oil and gas is then separated and treated in order to make them marketable products. Depending on the reservoir, the production can be anything from oil containing a low amount of gas to almost dry gas.

TRANSPORTING

- → To achieve the greatest possible value creation from the Norwegian petroleum production, good transport solutions from the fields are very important element. In addition to today's transportation system for gas, which consists of an extensive network of pipelines, there are several pipelines for oil and condensate that transports to oil onshore terminals.
- → At multiple stages of the production chain, oil and gas are being transported to storage, refineries, terminals, and finally to the point of sale. There are four different ways of transporting oil and gas from production to point of sale: pipelines, ships, trucks, and trains.
- → The produced oil and gas from a field need to be transported to the customer. Tankers are loaded directly with oil from many of the oil fields, but in some cases, the oil and gas are transported directly to the onshore facilities by pipelines. Dry gas is transported directly to the UK and continental Europe, while wet gas, liquefied natural gas (LNG), and oil are transported to ships at onshore facilities.

GAS PIPELINES

→ Norway is a significant country when it comes to the exporting of natural gas, the third largest exporter in the world. The export commodities of oil and gas equal about half of the total value of Norwegian exports of goods, which makes these commodities the most important for the Norwegian economy. The network of gas pipelines in in the Norwegian gas transportation system has a total length of approxomately 8800 kilometers; this corresponds to the distance between Oslo and Bangkok.

76

RECEIVING TERMINAL & SHORT-TERM STORAGE

→ Once the oil and gas has been produced, it is then transported to storage and receiving terminals. Usually, these industrial facilities are a part of a refinery or at least located close to one. The facilities serve as a temporary storage as well as a staging area where the oil is prepared for transportation to the refineries. Lard needs to be added to the crude oil before further transportation. This is a requirement from the refineries.

REFINING

→ When refining oil and gas, the natural resources are turned into products we can use in our everyday life. Refineries act as a main transformation-point for natural gas and crude oil, turning it into various consumer products. Refineries use different chemical reaction- and separation processes to make the crude oil into consumer products after receiving oil from storage facilities, such as: diesel, fuel, and several necessary manufacturing feedstocks.

BUNKER STORAGE

→ When the oil has been refined and is ready for use, it is then transported and stored in what is called bunker storage. These storage facilities are the final stopping point for the refined resources before the point of sale. Usually there is no processing on site, but blending of products may be done, such as ethanols or additives added to the final product before its is transported. Bunker storage in Norway stores the oil in rock caverns before it is loaded and exported to customers with tankers.

POINT OF SALE

→ Once the refined fuel leaves the bunker storage, it is transported to its final point of sale, which includes airports and fuel stations. Shipping, trucking, and other delivery lines provide the final, finished product, which can be delivered across the country. ① 2/4H EKOFISK
 ACCOMMODATION
 & ADMINISTRATION
 PLATFORM

0m →

70m →

⑦ SEISMIC VESSEL

0m →

70m →

② 2/4C EKOFISK DRILLING PLATFORM 3 2/4Q EKOFISK LIVING QUARTERS ④ 2/4FTP EKOFISK SEPARATION & PROCESS PLATFORM © 2/4X EKOFISK DRILLING PLATFORM ® 2/4FTP EKOFISK PROCESS & TRANSPORT PLATFORM

SSEL 8 2/4T EKOFISK STORAGE TANK

We are in a phase of change. A huge change (...) A regime-change, in relation to people's perception of hydrocarbons. (...) This change has led to a number of speculations about the oil age being over, but I think we can conclude with the oil age being over the maturation phase. (...) the final phase will probably last much longer than we think.

Bjørn Tollefsen is the Former Executive Vice President of Haugesund Mekaniske Verksted

COULD YOU TELL ME A LITTLE BIT ABOUT YOURSELF AND YOUR CAREER?

Sure! My name is Bjørn Tollefsen, I am 54 years old and have a degree in building engineering. I started working at Haugesund Mekaniske Verksted AS in 1990. Worked there full-time for 25 years, 9 years as an Executive Vice President, with responsibility for almost all the activities that took place in Norway and had up to 7000 people working under me. We made a turnover of a few billion Norwegian Krones. so I have been involved in the development of oil and gas since the 1990s.

Haugesund Mekaniske Verksted AS came into oil and gas in the mid-80s. That was when the North Sea Hall (indoor module construction facility for up to ten thousand tonnes) was built and has since then delivered services to the oil and gas industry. That shipyard would not have been there today if it wasn't for the discovery of oil and gas, because the shipbuilding phase along the Norwegian coast was basically over at that time. They had stopped building ships, and most of, or at least a lot of the yards were closed down. So, I would say that it has been an exciting journey to be a part of since the beginning, and there has been a build up of a lot of competence especially here on the west coast that is very unique also in a global context.

WHAT DO YOU THINK THE REASON FOR THAT IS?

The main reason for that would be the politics that have been pursued in relation to national management of the industry. This includes the tax regime, the license distribution regime, and not at least the decision process from the government. There are no fields in the North Sea, or at least not many places on the Norwegian shelf, that are being developed without having it approved by the government through a PDO.

WHAT IS A PDO?

PDO stands for "plan for development and operation", and is a detailed description of how they want to develop the field, as well as an impact analysis in relation to all elements, such as fishing, sea, environment, air pollution etc. In that sense, Norway has been a pioneering country in terms of systematising, making demands, and ensuring quality of what was to happen on the shelf.

MANY PEOPLE TALK ABOUT THE OIL AND GAS AGE AS BEING OVER, WHAT ARE YOUR THOUGHTS **AROUND THIS?**

Well, we are in a phase of change. A huge change, where we have seen a green wave coming over the last 5-7 years. A regime-change really, in relation to people's perception of hydrocarbons. Where we switch from hydrocarbon fuel to greener alternatives, such as solar energy, wind energy, and hydropower. This change has led to a number of speculations about the oil age being over, but I think we can conclude with the oil age being over the maturation phase. In that sense, yes, it is going towards the end, but the final phase will probably last much longer than we think even though some people talk about it being over in a few years, which I think is nonsense. I mean... that's not possible. We are talking about a controlled liquidation over the next 30-40 years. The largest gas fields in Norway have a certain production time, so Troll for example, probably still has 40 years left of gas production to Europe. I think this is really important to remember.

SO, YOU THINK WE STILL HAVE A LONG WAY TO GO?

Yes, absolutely. But at the same time, it is important to manage this phase towards the green shift in the best possible way. And this is already being done in several areas, including electrification of the shelf, where they obtain green electricity from land to drive the generators on the platforms. The production on the platforms gives an enormous CO2 footprint. So, when they electrify, the CO2 footprint is extremely small in comparison.

WHAT ABOUT THE REACTION AGAINST THE WIND TURBINES ON LAND THAT GIVES THE GREEN **ENERGY TO THE PLATFORMS?**

Yes, and then there is the case that when we get a lot of electricity from land, we will at some point have used up the flexibility that we have. We can then do the controversial thing which is to develop more hydropower, but containment of larger areas like that is not popular.

WHY IS THAT?

Because it affects bird life, it affects wildlife in general, and it is visually polluting. As well as a lot of noise. So, in other words, it's not that simple. Thus, they have tested this with offshore wind. Large offshore wind turbines that are placed out in the ocean.

Some of them in areas where the water depth allows them to be fixed to the ocean floor. When the water is deeper, however, like maybe over 40-50 metres, they may have to float. There are now operational fields on exactly this. Electrifying the shelf and making it greener. That way we get a footprint that is much better than it has been before.

DO YOU THINK THIS GREEN SHIFT WILL AFFECT PEOPLE'S JOBS?

No, I don't think so. Not if we look at the next 30-40 years, but it's difficult to look further than that. I think we will have a slightly different type of workplace, so those who, for example, work at a processing facility that previously received gas, will now work at a processing facility that makes diesel from recycled plastic. I mean, there will be a need for hydrocarbons for a really long time until we find another alternative. Plastic for example, comes from oil, and the latest technology, or the latest stock market bomb, is the company QuantaFuel. A company that produces diesel from recycled plastic. So, we would get a lot of different things like that. New industries will emerge. Out of this green wave we get several effects. I think the expertise that was used in the old process facilities can also be used in the new ones.

SO, BASICALLY, WE GET NEW TYPES OF JOBS?

Yes, exactly. For example, the supply boats that become redundant in terms of supplying and maintaining the platforms, would instead supplement the wind farms. You then get a different type of workplace, but by using the same skills. And partly also the same material. They may have to rebuild the ships to serve a different purpose. And that means that the shipyards which used to build modules, would rebuild ships instead. The end of oil and gas doesn't mean that everything is over or that everything shuts down, it means that we will have change. The competence that has been built up over several years will be used for other things. I think that is why it is extremely important not to paint this in black and white, but see that there is a change, and to make sure that we take advantage of that change. Every change is an opportunity.

DO YOU HAVE ANY PERSONAL THOUGHTS ON HOW THE DEVELOPMENT OF OIL AND GAS HAS AFFECT-ED US AS HUMAN BEINGS?

We have had an even increase in prosperity in Norway, especially over the last 20-25 years. It started to build up in the 70s, and built up even more during

78

SO, WOULD YOU SAY THAT YOU SEE OUR WEALTH AS SOMETHING NEGATIVE?

Well, in some ways, yes. We have an enormous consumption in Norway. A lot of money amongst people gives a huge consumption. So, yes, that is negative. There was a debate program on television yesterday. Obesity in Norway has exploded, and it is in a way a trigger from the prosperity, right? People have too much money, too much food, and therefore work a lot less. It's a bad combination, and unfortunately, some are unable to control it. We get lazier, we work less, and by working less, we get less creative. Without creativity and ideas, we get less development. It is in a way a problem for every prosperous society. The goods you manage to get actually become your downfall in the end. As humans, we tend to get a little high

the 80s, and during that period we got a wave of high spenders. A lot of people who had never had a lot of money before started to get money. And they spent all of it. Bought houses, cars, etc. In 1988 we had a downfall; families were going bankrupt. Ordinary families who had bought a lot more than they actually could afford. When we got through that stage and out in the 2000s, it has just taken off from there.

ourselves when we come into money as well, because we like to think that we know everything and that we are above other people, which is not good. Look at the Americans for example, who were 10-20 years ahead of us with the oil. They've managed to build prosperity, however they haven't done it as well as we have, simply because they haven't managed to distribute the goods as well as we have. Even though they have had a huge increase in wealth there as well, they haven't quite figured out how to spend their money. We see the awful things that manifests itself in for example discrimination and so on. I mean they almost fear for civil war over there, and I don't think that's a coincidence. It's most likely connected to the things I've mentioned now. So, if we don't secure ourselves well now, the same thing might happen to us in 15-20 years. It's the consequences of the prize.

WHAT WOULD YOU SAY IS A POSITIVE OUTCOME OF OIL AND GAS?

There has been a tremendous development in technology in a lot of different areas. Even though these areas are directly connected to oil and gas, it has been a trigger for further developing other things.

Sensor technology for example. In the oil and gas industry, sensors are used down in the wells, and the development of this technology has been extremely important because we use it in so many different things today. In the municipality we are for example talking about having sensors put out on the roads, so that we can immediately know when to start plowing during winter season. We all have smoke sensors in our houses, sensors on doors, security sensors, etc. None of this would have been possible if it weren't for oil and gas. We would have gotten it at some point, but this type of technology was mainly developed for the oil and gas industry, and we've gotten it faster because of it. This is obviously just one example, but we have gained a lot of technology thanks to the oil and gas industry.

WHY DO YOU THINK WE HAVE GAINED SO MUCH TECHNOLOGY FROM OIL AND GAS?

I believe the reason for that is because the earning potential has been so enormous that there has been a lot of money for technology development. And because of that, a willingness to invest in it as well. And that is also why it has developed our society, which is a positive thing.

↓ Impression of the stain of oil

12 169 973 777 665* = The funds market value (NOK)

Growth of the CH4 levels in the atmosphere's air since 1969

Growth of the CO2 levels in the atmosphere's air since 1969

ECONOMIC IMPACT

→ In Norway, 220 000 people work in the Oil and Gas sector. This accounts for about one in ten members of the working force. The sector provides 42.7 billion NOK to the municipalities mainly through the Oil fund. The industry has on average high wages, high pensions, and the highest management bonuses. This dependency and entaglement of oil and gas in every layer of society causes us to resist and ultimately accept the fact that we are willingly destroying our habitat in order to maintain our way of life. There is no longer a controvercy about climate change. It is therefore a conscious decision to maintain the status quo, because it benefits us in the short run by allowing us our level of welfare.

MORE SUSTAINABLE?

- \rightarrow The electrification of oil and gas rigs is the next big step in order to make oil more environmentally friendly. The logic of producing renewable energy and then using that energy to produce oil and gas is very controversial.
- → Norwegian oil and gas production accounts for 13.2 million tonnes of CO2 equivalents annually. If you also account for exported oil and gas it would be about 600 million tonnes, about 50 times more then our own consumption.

GAS EMISSIONS

- \rightarrow 15,000 individual boreholes have been drilled so far in the North Sea. Recently, German researchers discovered leaks from more than 50 % of a selection of abandoned wells.
- \rightarrow There is great concern that as much as 30,000 tonnes of methane gas (MH4) has been emitted annually in the North Sea alone. This is two times the total methane emissions from Norwegian oil and gas production. Methane is 84 times more potent a greenhouse gas than CO2.

FOLKLORE AND INDUSTRY

- \rightarrow In Norse mythology, the Draugen is a undead creature living in the sea. But it is also the name of a field in the Norwegian Sea.
- → If some Norwegian field names are just made up like "Ekofisk", a lot of them are directly inspired by Viking history, Norse mythology and Norwegian fairy tales.

 \rightarrow Therefore, there is a strong connection between Norwegian folklore and the Oil and Gas industry in people's minds that demonstrates how this industry is now part of the Norwegian culture.

NORWEGIAN WELFARE SYSTEM

 \rightarrow The aim of the oil fund is to ensure responsible and long-term management of revenue from Norway's oil and gas resources. Returns on the fund's investments account for more than half of the fund's market value. Inflows from the government make up about a third.

The graph shows the returns since the creation of the fund in 1996. (oljefondet.no)

SNØHVIT, A SUBSEA FACILITY → Norwegian Research group Sintef

- believe that Sub sea is the next frontier → In the Barents Sea, Snøhvit con-
- sists of only sub sea installations. This means that the field can be subject to other activity such as fishing with trawl. A trawl will pass over any installation without danger to equipment. However, there is great concern among environmentalist that spills could destroy breeding grounds for fish as well as other marine habitats. More data on the sea could mean that we take bigger risk to find resources. In the proposal for the 2021 fiscal budget, the Norwegian government allocated several hundred million NOK to research on precious minerals sub sea.
- DRILLING 150M YEARS BACK IN TIME → Most of Norway's petroleum resources are trapped in reservoir rocks deposited in large deltas formed by rivers that ran into the sea during the Jurassic Period.
- \rightarrow Black clay, a source rock that contains large amounts of organic residue was deposited around 150 million years ago at the bottom of a sea.
- → Reservoir rocks are porous and saturated with water, oil and gas in various combinations.
- \rightarrow The main reservoirs of the Gullfaks, Oseberg and Statfjord fields are in these large deltas. There are also large reservoirs in sand that was deposited on alluvial plains during the Triassic Period (the Snorre field), in shallow seas in the Late Jurassic (the Troll field) and as subsea fans during the Paleogene Period (the Balder field).

In the southern part of the North Sea, thick layers of chalk composed of microscopic calcareous skeletons of plants and animals form an important reservoir rock, as in the Ekofisk Field.

CO2 STORAGE IN THE SEA BED

→ Snøhvit produces 7 billion cubic metres of gas that is sent to Melkøya outside Hammerfest before being converted to Liquefied Natural Gas (LNG). The CO2 separated from the gas is then sent back into to carefully monitored underground pockets. 0.7 mtons of CO2 is stored annually in the pores of sandstone. Norway is leading the way when it comes to Carbon Capture and Storage (CCS). Its ambition is to store CO2 from other European countries. Norway has been storing CO2 in the bedrock since 1996 and there is great confidence that CCS is safe and effective. However, it also presents us with a paradox. Storing does not adress the issue of unsustainable growth, and it represents a temporary fix to a long term problem.

→ According to The Intergovernmental Panel on Climate Change (IPCC) CO2 storage (CCS) is the only way that we will reach the goals of the Paris agreement. Without it we will miss the mark by a landslide. In fact we will have to reduce the global CO2 emissions with 14% from CCS alone before 2060. It is CO2 from cement production that will be captured and stored. The use of cement has grown exponentially and every year one Mount Everest of cement is produced. Many advocate that we need to address our enormous consumption which is the cause of global warming and the massive depletion of our resources.

→ First birds

40 MILLION YEARS

480 MILLION YEARS → First insects

Draugen 6407/9-1

The Draugen wellbore 6407/9 was first drilled by Norske Shell in 1984 with oil production starting in 1993.

It stands out as the first production site in the Norwegian Sea, for its concrete foundations and the technical feat of the tow-out in 1993.

1990 **GBS FOUNDATION IN JÅTTÅVÅGEN**

In the dry dock in Stavanger's Jåttåvågen, the work begins on the platform's concrete gravity base structure (GBS). This will be the one that will be placed on the seabed.

The bottom of the gravity base structure consists of 7 storage cells or 'skirts' that are 9 metres high, they have to be high enough to ensure enough penetration in the seafloor. The soft clay layer on the seabed will be squeezed into all the spaces beneath the storage cells. These will store the crude oil that is produced. Here the oil awaits to be discharged to a shuttle tanker for shipment to land for distribution.

The structure for Draugen is not typical. After long consideration, a 'monotower' seamed the best possible structure for the Draugen platform. Particulary here, new technology and advanced solutions were necessary. Therefore Norske Shell, Draugen's operator, worked very closely together with the Norwegian industry.

1990

TOPSIDES ASSEMBLED

In the Rosenberg Verft yard, Stavanger, the topsides for the Draugen platform are constructed. It was originally designed to be a floating production platform. Therefore the topsides were a lot lighter. This seemed appropriate considering the fact that the whole structure consisted of a single concrete support shaft.

1991 WORK PROCEEDS

The concrete skirts are moved out of the dry dock into the fjord for further

construction. The concrete structure floats in the water while the work proceeds. After the skirts and beginning of the

monotower are finished, the concrete fundament is moved to Vats for further construction. Eventually, the topsides and its supporting structure are put together here, in the fjord in front of Vats.

1992 A NEW HOME BASE

In 1989 Shell chooses a new home base for future operations regarding Draugen. Until 1992 Stavanger was the main centre for exploitation on the North Sea, you could say it was the oil capital.

With Draugen being the first field opening up in the Norwegian Sea, there was a need for a new central city from which Shell could easily operate and manage the base functions for its new platform.

Therefore Shell moved together with 200 employees, their families, all office equipment, filing cabinets, and documents all the way from Stavanger to Kristiansund, 725 kilometres up north.

During one weekend in August '92, this shift to the north took place. It is one of the biggest moves in the history of Norway.

The population of Kristiansund grew by 400 citizens, which was a notable increase for the town.

← The topside would be 79 metres long, 59 metres wide, and 15 metres high.

1993 DRAUGEN TOWED OUT

At this moment in 1993, the Draugen structure would be the tallest ever to be towed out. After the topsides are united with the gravity base structure underneath, the whole platform is ready for tow-out.

For the tugs to be able to move Draugen all the way out into the Norwegian Sea, the structure had to rise a lot higher above the sea level. The storage cells which were filled with water to let the structure rest on the seabed, are now to be pumped out. With large volumes of water coming out of the cells, the platform starts to rise.

The weight is now low enough to start dragging the enormous platform.

The whole journey from Vats to block 6407/9 in the Norwegian Sea is 830 kilometres long and takes 10 days. The platform is towed out by 6 different tugs and today Draugen is still the platform with the longest tow out on the Norwegian Continental Shelf.

Once the monotower arrives at its place, the installation can begin. The skirts or storage cells on the bottom of the structure are placed on the seabed and they will ensure penetration in the soft clay layer. The clay is squeezed into the spaces beneath the storage cells. Now, even more water is pumped out of the skirts. This would secure good penetration, because of external water pressure which will drive the structure into the seabed.

* 00:40 19/10/1993 FIRST OIL PRO-DUCED IN NORWEGIAN SEA

NOW TAIL OF PRODUCTION

After 27 years of production, it becomes clear that the oil and gas production at Draugen is in the final phase.

Due to a changing environment, the question can be asked how we should approach future fields that will be shut down. Draugen could still be running for 15 years or maybe more (if measures are taken to prolong the life of the field).

MILLION SM³ OIL

But this timespan gives the possibility to already start thinking about an 'exit strategy'. How to react in a way which is appropriate for the changing climate?

In many ways, we will have to rethink our use of resources, the position we take in this world, and our way of life in general. Thinking creatively and responsibly about how to approach these dying petroleum sources is an important step in this process.

NEAR FUTURE

INCREASE OF FACILITIES DECOMMISSIONING

In the coming years, a lot more oil and gas platforms and facilities will need decommissioning and therefore it is very important to think carefully about a strategy to handle this increasing amount.

There will be a greater need for scrapping facilities because now there are only 5 in Norway. On the other hand, this will have a positive impact.

NEXT A NEW LEASE OF LIFE?

and biodiversity.

Reuse of platform structures in this way can be useful for example in places such as the Gulf of Mexico, where the seafloor is flat. Therefore Mexico has a dedicated Rigs to Reef program. Already more than 500 structures are converted into permanent reefs, enabling fish and other marine life to flourish.

and in the future?

But in general, it is important to think 0m → everything through and to review what we already know and look for other, maybe better options for what to do.

TOTAL TONNAGE TO BE REMOVED

There are several examples of ways people tried to do something positive with decommissioned platforms. In general, it is quite realistic to either reuse or recycle almost all elements from former oil and gas structures. Most parts will be graded as metal scrap.

From some platforms, all underwater structures and topsides are removed, so there are no residual manmade debris left in the sea. But for some underwater structures of decommissioned platforms, it can be interesting to set them up as a base for marine life

While artificial rigs seem a good solution for the Gulf of Mexico, new ideas on future possibilities for deserted platform structures are still a challenge in the North Sea which needs to be explored. What can corrective measures achieve and how can we avoid repeating past mistakes today

Draugen is also a unique offshore site of human history, technical achievement and touches of Norse mythology.

-1600m Τ

Decommissioning

FIRST CASES OF PLATFORM DECOMMISSIONING: FRIGG 24/3

- → After 15 years of production running low, the gas platform Frigg was shut down in 2004. The Frigg field is the first field on the Norwegian Continental Shelf to be completely decommissioned.
- \rightarrow It took nearly 5 years to prepare and approve the cessation plan. After being shut down in 2004, removing all elements of the topsides took 5 more years. All that's left now is the three concrete jackets that supported the former platform.
- \rightarrow During the process of preparing the cessation plan, it was clear that the steel jackets and topsides had to be removed. What was not yet clear, was what to do with the concrete jackets. There were different options, such as complete removal, dumping the concrete in deepwater, cutting them 55 meters under sea level (so sea traffic could pass at any time), abandoning the facilities on-site...
- → What eventually seemed to be the 'best' recommendation was to remove the platform deck and the steel equipment and leave the concrete supporting structure in the sea.

GAS PRODUCTION FRIGG

WHAT ABOUT THE FUTURE?

- → The most important consideration after this first experience with decommissioning was that the removal issue should be thought of as early as possible in the development phase! The number of fields to be decommissioned will increase rapidly in the coming years.
 - \rightarrow The concrete jackets of the abandoned platform Frigg on site 24/3

↓ FRIGG QUARTERS PLATFORM QP

MATERIAL RECYCLING

- \rightarrow When the disposal of the platform was finished, 90 000 tonnes of steel were brought to shore for scrapping. Some of this was brought to the Greenhead base in Shetland, while the other part was brought to Kværner's facility in Stord (Hordaland County).
- \rightarrow During this process, environmental charts were created in order to track where the materials were going. From all the materials brought to land, 98 percent were either reused or recycled.

Money spent on decommissioning

84

> 100

ABANDONED

↓ UK AND NORWAY IN THE NEXT 20 YEARS

Johan Sverdrup: Solution for the future?

WHO IS JOHAN SVERDRUP?

The platform was named after Johan Sverdrup, the mid 18th century politician considered the father of parliamentarism in Norway. Johan Sverdrup was also the founder of the Left party in Norwegian politics. The name was chosen by the Minister of Oil at the time, Ole Borten Moe.

CONSTRUCTIONS

Johan Sverdrup is constructed as a hub of four specialised rigs. The rigs have the capability to drill, produce and make well intervention operations simultaneously. Early in the planning it was decided that the rigs were to be electrified from onshore power, since emissions will be more expensive in the future. The decision was based on financial considerations only, since it makes little sense from an environmental perspective to electrify the rig from land – more than 90% of emissions occur down-stream.

Sverdrup also extended the use of digital solutions in both the construction and the field operations – an innovative use of well-monitoring systems operating via fibre optics is in place.

Real time data is achieved, and optimisation and automation of well operations cuts cost as well as increasing operational safety. CO2 IMPACT ↓

The C02 emissions from oil production at the Sverdrup field are significantly lower than the global average. Sverdrup is a new field that has just recently started production. Fields that are producing 20% above their peak production have three times more CO2 emissions. The longer the life of a field is extended, the more CO2 it will produce!

Older fields produce more water per unit of oil or gas increasing emissions substantially when water instead of oil is produced.

But mainly, the CO2 emissions are cut dramatically because the field is electrified from shore. This means that renewable energy from hydro power can be used in production. CO2 emissions per barrel of oil are 0.67 kg at Sverdrup, which is normally an average of 18 kg.

According to Equinor, the CO2 emissions during production at Sverdrup are only 4% of the average in the world. However, it is important to emphasise that one tonne of oil production produces about 3000 kg of CO2 when it's burned. This means production of Norwegian oil is on average 1.5 % of the total CO2 emitted from one barrel of oil. In order words, Sverdrup oil is about 2.6% more environmentally friendly than the average oil producer if you only compare carbon emission from production.

↓ CO2 emissions Sverdrup (per barrel of oil)

CO2 emissions average (per barrel of oil)

86

 $\mathbf{1}$

Renewables

The North Sea turning green? \checkmark Bjørn Are Leivdal Christine Hagatun Maren Mohn Kverneland Maren Roscher Thea Hundsnes

90

both local and global damage, making the development of renewable energy controversial. We aimed to cover the effects of renewable energy through scales from the personal, to the local community, to the national and international levels.

But what happens under and around the constructions, over longer periods of time? **Companies working with hybrid** wind-turbine and solar-panel systems argue that the shading from panels is not affecting ocean ecosystems, due to the movement of the water. But energy plants are frequently fixed over large areas and cause vibrations and sound pollution. These effects

Renewable energy is often considered a prerequisite for sustainable development. Research claims that if extracted correctly, it affects the global environment to an acceptable extent. Renewable energy is energy derived from the natural cycles of the earth and it is argued that renewable resources are continually replenished. Therefore, they are considered inexhaustible. The renewable sources considered in this project are the sun (solar energy), wind (wind power), water (hydro and wave, -power), hot springs (geothermal energy), and biomass (biofuels).

This overview of renewable energy sources results from consulting articles and research on different resources,

the technological challenges associated with their exploitation, and future development plans. Throughout the working process we observed the complexity and the lack of an overview of what is actually happening in the industry regarding scale, time and consequences. We therefore aim to provide such a summary, providing definitions and information concerning economics, with the main focus on the consumption of electricity in the North Sea countries: Norway, Denmark, Germany, the Netherlands, Belgium and the United Kingdom.

Although the renewable sources themselves are sustainable, their extraction requires large areas and often results in

← Sketch of solar panels offshore

Why is the North Sea a suitable place to harvest the renewable resources for energy production? Winds are strong, the sun is high, and solar panels are not shaded by surrounding buildings.

on the North Sea environment are rarely discussed. Materials used to generate electricity from wind and sun are not yet 100% recyclable. Since the 1950s we have produced graveyards of cars - now we see graveyards of obsolete rotor blades.

The large-scale use of renewable resources is still relatively underdeveloped, but picking up speed. Do individuals understand the scale of the planned wind farms located in the North Sea? When out of sight, local consequences within the ocean's ecosystems are easy to ignore. The ocean is vast – it is difficult to imagine how a "small" wind turbine can affect the whole seascape. But wind turbines are also giant structures at a scale difficult to comprehend, as illustrated the sections below. The result is a loss of human perspective.

ENERGY CONSUMPTION

The world we live in is made by the human, for the human. After a long history of coexistence, we have just recently started to understand the human impact on planet Earth. Time is running out.

If all modes of transport become electric – bicycles, cars, airplanes, ships - what will be the limit for overconsumption of the renewable sources?

SCENARIO MAPS

The ocean covers 70% of the earth, but is vulnerable. The scenario-maps show the reader the information required to visualize how renewable resources can lead us forward in "the right direction" for each country surrounding the North Sea in terms of spatial imprint as well as the consumption of electricity. It also raises the question whether the increasing demand for electricity should and can be accommodated, or if human consumption should be reduced. Is it possible to increase the standard of living without increasing the global environmental impact? The development of renewable resources is dependent on

92 political cooperation between companies and political leadership. We found that the majority agrees with statements such as: "We need renewable resources to prevent the global temperature rise". But it also became clear that economical rather than environmental considerations were and are, first priority in the renewable energy business, not only for big companies, but also for the political leadership. Equinor invests billions of dollars into renewable energy in the form of offshore wind-turbines and solar-panels, but still drills for oil. Norway produces more renewable electricity than they can use, but still exports and imports fossil energy to increase profits. The North Sea provides clear advantages for renewable energy production, but the local environment and global environments are threatened. Through ripple effects, everything in the ocean is connected.

DETAIL ①

PRIORITISING THE BIOSPHERE

The loss of human scale

SCALE RELATIONS OF RENEWABLE ENERGY

DETAIL 2

Dogger Bank

- → Dogger Bank is a shallow sandbank in the North Sea. It is located 100 km off the east coast of England. The moraine area is about 17600 km2 in size, and almost 300 km long. The depth of Dogger Bank ranges from 6 to 30 metres. With surrounding depths deeper than 40 metres.
- \rightarrow Dogger Bank is a complex area exploited for its many biological qualities. Especially the biotopes in the area have been greatly da-maged because of large trawlers. Doggerbank is also a popular fishing area and a spawning ground for herring, plaice and it has been discovered to contain large amounts of phyktoplankton, vital to the ecosystems of global oceans. The biological diversity is a feeding ground for bird and whale species, but it also attracts the maritime industries of bottom trawling and renewable energy. The latter, may in particular, put the complex ecosystems at Dogger Bank under pressure.

2015 \downarrow

German RWE, Scottish SSE, Norwegian Statoil (today Equinor) and Statkraft were awarded license to develope wind farms in the british sector. The farm will be the largest of its kind. For the preparations, two meteorological and oceanographic measurment masts were installed.

Total height of the masts are 93 metres.

2017 Τ of the North Sea.

Danish Energinet.dk and TenneT investigated the potential of an artificial island in the Dutch sector of Dogger Bank. This would be a centre where the energy from surrounding turbines would supply the mainlands

2019 ↓

Equinor and SSE got the contracts from the British authorities to develop three offshore wind farms. The total capacity of the area is 3.6 GW.

Extreme scenario

IMPRINT OF WIND-TURBINES 100% OFFSHORE **100% ELECTRICITY CONSUMPTION**

- COMPARISON OF VOLUME PRODUCTION

 - NUCLEAR ENERGY
 - HYDROELECTRICITY
 - GEOTHERMAL 🔸

 - SOLAR 😑
 - TIDE AND WAVE
 - BIOMASS AND WASTE
 - USE OF OWN ELECTRICITY
 - EXPORT 🔵

- FOSSIL ENERGY

96

- WIND

- - IMPORT •

Future scenario

IMPRINT OF WIND-TURBINES BOTH AT LAND AND OFFSHORE **100% ELECTRICITY CONSUMPTION**

ELECTRICAL PRODUCTION

NORWAY

DENMARK

UNITED KINGDOM ELECTRICAL PRODUCTION GERMANY ELECTRICAL PRODUCTION

BELGIUM ELECTRICAL PRODUCTION

NETHERLANDS ELECTRICAL PRODUCTION

97

↓ Timeline

Geothermal energy is energy in the form of heat, available in the rocks below the earth's surface. This energy can in theory be extracted wherever there is sufficient temperature, permeability and water. The energy is found in two main types, high and low temperature. Geothermal energy can be used for power production, process heating, heating, and cooling. In Norway, only geothermal energy in the form of ground source heat pumps is used.

BENEFITS

- → Renewable
- → Environmentally and climatefriendly: closed systems release small emissions into the atmosphere.

CONCERNS

investment.

wells deep.

gases.

→ Noise

substances.

→ Expensive: requires preparation to

→ Risk when drilling wells: must drill

→ Potential hazard: there is a risk

the ground might collapse.

 \rightarrow Greenhouse gases: the heating

that interventions may cause

earthquakes. Since the method is

based on draining groundwater,

medium is usually synthetic HFC

ucts: hot water may contain toxic

→ Toxic drilling mud and waste prod-

see if the area is suitable, equip-

ment & technology requires large

- → Available worldwide \rightarrow An alternative to nuclear power: if
- you drill 10-15 km into the ground. you will reach supercritical water which in theory can provide a performance equivalent to a nuclear reactor
- → An unlimited resource
- \rightarrow Reuse of existing oil and gas wells.

10 000 YEARS AGO

First use of geothermal energy occured by american Paleo-Indians in North America. People used water from hot springs for cooking, bathing and cleaning.

Late 18th century

The first industrial use of geothermal energy, where steam from natural vents and drilled holes was used to extract boric acid from the hot pools.

1904

The first geothermal electric power plant was invented.

1922

The first geothermal plant in USA with a capacity of 250 kilowatts.

1946

First ground-source geothermal heat pump installed.

1960

Pacific gas and electricity began operation of first large scale geothermal power plant in San Francisco.

1980

Geothermal heat pumps started gaining popularity in order to reduce heating and cooling costs.

Today

Geothermal power supplies less than 1% of the world's energy and power plants are operating in about 20 countries.

2050

It is expected to supply 10-20% of world's energy requirement by 2050.

98

WAVE ENERGY

 \rightarrow The most adapted areas to utilize the waves are where the waves are most common throughout the year \rightarrow Today there are 14 projects

BENEFITS

- enormous
- \rightarrow More energy in the waves than

- er and wave power.
- \rightarrow Create new jobs.

CONCERN

- developed.

- can be found.

FACTS

- → There are three types of geothermal power plants: dry steam, flash, and binary. While dry steam is the oldest technology, binary is the most popular.
- \rightarrow Geothermal energy sites aren't 100% reliable.
- → Geothermal pump systems can be used to both heat and cool your home, due to the insulating properties of the earth.

Wave energy

→ Waves occur when wind creates ripples on the sea surface. The energy in the waves depends on the wave height and the wavelength. The higher and longer the waves, the more energy there is in them. There is most energy in waves in deep water.

that operate with wave power in Norway, where most have developed their idea further from a basic technology. Wave power plant must meet the following three criteria:

1. Affordable to build, install and maintain 2. Produce enough energy. 3. Avoid being damaged in storms.

 \rightarrow The potential of wave energy is

the whole world needs.

→ Easy to predict wave patterns

several days in advance.

→ Do not affect the view to the

same extent as the wind turbines.

→ Researches combining wind pow-

→ Also be used to pump water and propel ships forward.

→ Requires expensive materials that withstand heavy weather. → Equipment and materials poorly

→ Not easy to create models in laboratories that can be exposed to similar conditions as at sea. → Necessary to produce and operate the test facilities for several

years before an optimal solution → Unknown effect on the environ-

ment, How the noise from the turbines will affect the life in ocean

\downarrow Timeline

1767

Surfing first recorded by European explorers.

1799 The earliest patent that used energy generated from waves.

1898

Several patents appear in California. One of the most successful was the "wave motor" shoreline system.

1907-1909 Various designs on wave motors were tested. Most notable was the Starr wave Motor of Redondo Beach.

1910 The first project using an oscillating water column.

1945

Navigation light buoy did not have to be connected to the main land's power grid due to wave energy.

1958 T

The largest wave ever recorded in Lituya Bay, Alaska, after an earthquake caused a rockslide and a tsunami. The tsunami measured between 30-91 metres with the wave becoming even higher.

1985-1989

Two wave energy project test facility at Øygarden in Norway.

2000

First wave energy plant to be connected to a national power grid was the Islay LIMPET in Scotland.

2008

Wave Farm in Portugal was the world's first commercial-scale wave farm.

Hydropower

Hydropower plants convert potential energy in falling or fast-running water into mechanical energy through water turbines, which then generate electricity.

BENEFITS

- → A renewable energy form → Pollution-free form of power
- production → Minimal emissions of greenhouse gases.
- \rightarrow Regulation of watercourses and reduced flood risk and provide a basis for draining water for irrigation.

CONCERNS

- \rightarrow The construction requires interventions in nature in the form of damming or lowering of water, changes in water flow.
- → Construction of roads and power lines.
- → Creates wounds in an otherwise lush natural watercourse with many high waterfalls, rapids and lakes.
- \rightarrow The interventions have an impact on fishing and biodiversity.

EXCURSIONS

We visited the water power plant developed by Tussa at Trandalen in Møre og Romsdal. They have used the particularly good natural conditions for the development of hydropower. The land area has an average height of around 400 metres above sea level. This provides positional energy for the precipitation that falls to the ground. In addition, there is a lot of precipitation in places. In Western Norway, the terrain is steep, which means that the fall height is large even over short distances and makes it easier to utilise the waterfall. They speculate on the electricity rate by keeping the water in the dam, and then releasing it when the prices increase.

↑ Architect: Knut Brekke Tussa have engaged architect Knut Brekke to design the building, also called the hat, in several of their projects.

When the water is in the sea it's worth nothing.

Terje Myklebust Power plant manager at Tussa

100

Emptying the turbine by releasing the water pressure. Normally this would go into the sea, but Terje Myklebust has made a playful way of showing the pressure released.

Nozzles (in plan) supplying the turbine with water

Turbine inside the hydro power plant

1200

1500

1750 and in the mines

1800 via belts and shafts.

1882

1885

\downarrow Timeline

Water mills to operate grinders.

The upswing saw revolutionised the timber trade and exportion for Norway.

30 000 brook grinders in Norway. Water wheels used for mechanical operation of sawmills, hammers and tampers. Crushers, bellows, bilge pumps and lifting devices at the ironworks

Water-powered circular saws and industrial companies powered by water turbines where energy was transferred

Norway's first hydropower plant was put into operation in Hamn on Senia. The system was only used for lighting.

First electricity plant. This supplies power to 120 light bulbs.

1892 r

1900

Hammerfest's electricity plant supplies street lighting to the city.

In the following years, there are several initiatives to expand hydropower plants.

welfare beyond the 20th century.

Hydropower and electricity production

became important for the increase in

1930 Major plans for the development of hydropower and the transmission network.

1945-90

Large-scale expansion of hydropower to increase living standards.

2012

1393 registrered hydropower plants.

Today

96-99% of all electrical energy in Norway is produced by hydropower.

Norway has 10 of the world's 27 highest waterfalls and most are now regulated for hydropower production.

 \checkmark

Most hydropower is owned by the state, counties and municipalities.

 $\mathbf{1}$

The 10 largest hydropower plants account for 25% of production capacity.

Source: https://snl.no/vannkraft

LAND ↓	TWh ↓	% AV VERDEN ↓	% VANNKRAFT I LANDET ↓
KINA	1064	27,5%	16,9%
BRASIL	393	10,1%	68,6%
CANADA	392	10,1%	60,1%
USA	290	7,5%	6,7%
RUSSLAND	183	4,7%	17,3%
INDIA	142	3,7%	11,9%
NORGE	130	3,6%	98%

KILDE: IEA

Electricity never arises from nothing. It is always nature that suffers

Terje Myklebust Power plant manager at Tussa 101

Wind power

Wind is the movement of air relative to the earth's surface. Wind is not visible to the eye, yet it is a powerful physical force that has been harvested for different kinds of energy throughout history. The term "wind power" or "wind energy" describes the process of wind turbines converting the kinetic energy of wind into mechanical power or electricity.

BENEFITS

Clean source: while producing electricity, the wind turbine itself does not emit any air or water pollution.

Research and technical development: the industry is becoming more prominent in the world's energy supplement. As the research advances it has also shown how wind power developers consider how to approach the habitats of possible areas for wind power. Some even suggest that the industry's interventions can adapt and facilitate ecosystems.

Cost: wind power is one of the cheapest sources of energy today, due to the effectivity of wind turbines and other technological advances.

Jobs: as the oil and gas industry could faces larger downsizing, the renewable industries such as wind energy can provide jobs.

Killing birds: to reduce the number of deaths of birds caused by wind farms, the Norwegian Institue of Natural Science financed a project to paint several of the turbine blades at Smøle windfarm black.

Recycle: about 80-90% of wind turbines made today can, in theory, be recycled.

CONCERNS

A large-scale implementation is required per wind turbine, approximately 800 metres of construction road and an installation space of half a soccer-field per wind turbine.

Noise: the noise of a wind turbine varies through the pre-construction, the construction and the operational period. The noise but also the physical implementations affect the life in and at the bottomof the sea. Observations have shown that the actual construction of a turbine makes more noise than when the turbine is producing electricity.

Distances: because of the large area required for a wind farm, they are often placed further away from the centre of populated areas. Thus, there is a need for larger cables to transport the energy for use on shore.

Aesthetics: on a clear day a wind turbine of 250 metres can be seen from a distance of 50km.

Recycle: the turbine blades are made from composite materials to make them as light and robust as possible. This also means that they are challenging to recycle, therefore most of them end up buried in landfills.

Life-expectancy: because of the extreme weather conditions the turbine is subjected to, the safest and most cost-effective solution is to replace it before 20 years have passed.

Production: the production and transportation of wind turbines emits a large amount of carbon dioxide.

WIND GENERATION AS A PROPORTION OF TOTAL ELECTRICITY GENERATION IN 2018

To power Norway using only wind energy would require 5819 wind turbines.

102

5000 BC.

used.

1st century

5th-9th century: The Persian wind mill. The sails are made of reeds and wood. The wind mill was used to pump water or grind grain.

13th-19th century inventions

19th century

\downarrow Timeline

Wind is harvested to propel boats along the Nile River. Wind is regarded as one of the oldest natural resources

The earliest wind wheel marked the first instance of wind powering machines, it was made to pump air into an

A selection of wind turbines that de-

1927↓

1922 ↓

Today, the North Sea

Offshore windturbines can be fixed or floating. They produce on average more electricity since the strength and consistency of wind is greater at sea.

The tower mill was a revolutionary wind mill as it could be built higher and have larger sails than previous

The first wind-invention that generated electricity constructed by American inventor Charles Brush. The term wind turbine is introduced.

Today

Modern onshore wind turbines have three turbine blades.

Solar power \downarrow Timeline

Without the sun's heat and light, the earth would be a lifeless ice-coated rock. The sun warms our seas, stirs our atmosphere, generates our weather patterns, and gives energy to the growing green plants that provide the food and oxygen for life on earth.

Through advanced technology, the sun can generate sustainable electricity and heat. The installation of solar panels gives electricity, while solar collectors generate heat.

BENEFITS

- \rightarrow Solar power is gathered from an inexhaustible source, meaning that we are taking advantage of energy that the sun will provide regardless
- \rightarrow The actual production of electricity is sustainble as it is collected from solarpanels and collectors
- → Reduction of carbon footprint
- → Reduces costs of electrical bill → Prevents export and use of fossil energy
- → If one solar panel runs at full capacity over a time period of two years it will reimburse its own production cost

CONCERNS

- → The solar panels and heat collectors consist of materials that are not yet recyclable → Expensive in relation to today's
- efficiency
- → Supply depends on climate and weather patterns

FACT

To sustain the whole of Norway with renewable energy from the sun, one would have to install 122 200 000 solar panels

In Norway that equals 23 solar panels per person.

7TH CENTURY B.C. ↓ Sunlight used to light fires with magnifying glass materials

3rd & 2nd Century B.C. ↓ Burning mirrors to light torches

1st to 6th Century A.D. \downarrow South facing windows

1767 ↓ World's first solar collector

1958

↓ Powering satellites

1891-1908

1954

1950s

passive design

↓ First commercial solar water heater

↓ Silicon photovoltaic (PV) cell

 \downarrow Solar water heating and

1962 First telecommunications satellite

↓ Japan installed first photovoltaic array on a lighthouse

104

1978 ↓ World's first village PV system

1980s ↓ First solar-powered aircraft, car and in Norway lighthouse

1998 ↓ Flexible solar shingles

2020 ↓ Planned solar power out in the North Sea

FUTURE \downarrow A common supply for the whole world

A nuclear power plant consists of one or more nuclear reactors. Nuclear reactors can be used for the production of electricity, but can also be used for a number of other purposes such as to power submarines.

Nuclear reactors are based on heat released through fission, or decomposition of atomic nuclei in the fuel in the reactor core. Fission is the most widespread method today, but there is also active research into the recovery of energy from fusion. Nuclear power is not renewable, but the great potential it has means that, in isolation, the production can be called sustainable.

industrial processes.

About 11 percent of the world's total annual oil and gas production is currently consumed as raw materials. Most of it is used in industry, while a small proportion is used in other sectors. Many products around us are wholly or partly produced from oil and gas.

Equinor and the Italian oil and gas contractor Saipem are developing a "floating solar park technology solution for near-coastal applications", to reflect the transition to clean energy. The solution is a modular system designed for easy fabrication, transport and installation on site.

What is nuclear power? \rightarrow There are strong arguments in the debate on nuclear power – should it be further invested or be replaced with other forms of energy?

GOOD TO KNOW

- \rightarrow If the amount of energy one person uses throughout their lifetime was produced using only nuclear power, their share of radioactive waste would be 150 grams.
- In 2018, there were over a billion people who did not have access to electricity. The global need for energy will increase, pointing to a continued dependency on nuclear power
- Nuclear power is being researched in many countries. India is researching the use of thorium together with plutonium, and it should in theory have a higher energy efficiency of the material, and it is more difficult to use for weapons
- Reactors of the same type as the Chernobyl reactor are still in use today, with some improvements, but based on the same system.

BENEFITS

- \rightarrow The amount of toxic waste from the nuclear power industry is very low compared to other energy sources
- \rightarrow Nuclear power is the largest source we have for "emission-free" energy.
- Plutonium can be recycled and \rightarrow used as fuel again and is less dangerous than most people think.
- Nuclear power plants require little land area.
- → Technology and stricter routines are constantly evolving, making energy from nuclear power safer.

CONCERNS:

- → Among many concerns, key ones relate to meltdown, weapons and hazardous waste.
- → Radioactive waste has a decomposition time of around one hundred thousand years, and how can it be safely stored during this time?
- \rightarrow It's expensive and takes a long time to build a nuclear power plant while investments in renewable energy provide dividends in the form of energy in a shorter time frame
- \rightarrow The risk of accidents, because we live in a time with more extreme weather and the possibility of terrorism.

What is oil and gas? \rightarrow We are constantly discussing environmentally friendly measures and investigating opportunities for new renewable energy. However, fossil fuels such as oil and gas are extracted at record speeds, including in Norway.

In addition to the fact that oil and gas play a key role in the global energy system, hydrocarbons are important input factors in a number of different

GOOD TO KNOW

- \rightarrow Today, gas accounts for about 15% of the world's energy consumption and 23% of the world's electricity production
- → Oil accounts for 41% of energy consumption and just under 4% of world electricity production.
- Gas and nuclear power have replaced most of the electricity production that oil previously accounted for, but still oil still accounts for 94% of energy consumption in the transport sector.
- → Norway supplies the EU with approximately 25% of their complete gas consumption.
- → Oil, coal and gas actually consist of dead plants and animals from ancient times.

BENEFITS

- → Well-developed distribution network (easy to obtain). \rightarrow Suitability as a fuel for means of
- transport. → High calorific value (many kWh out
- of every litre). → Convenient to use

CONCERNS

- \rightarrow Oil/gas is not renewable
- → Accidents can have catastrophic consequences for the local environment.
- Oil drilling can, among other \rightarrow things, lead to enormous oil spills.
- → The discharge has enormous consequences for corals, fish and crabs in the area.
- → Oil and gas extraction can create underground air pockets, which can contribute to increased earthquake activity in an area.
- → Greenhouse gases are emitted during shipping and large amounts of energy are required to refine oil for use.

The North Sea as a sustainable energy source?

- → Renewable energy sources are a term for energy sources that have their origin in nature's own cycle and which, within a human time perspective, are continously renewed and can thus be considered inexhaustible. The term has been frequently used in the public debate in the last 20-30 years. Within social sciences, it is rooted in welfare theory in connection with the preconditions that we should align ourselves with so that the next generation takes over resources at the same level as we have. This will be the case if the resources we use are renewable and if they are managed in a sustainable way.
- → Since the first oil discovery in 1969, enormous amounts of oil have been extracted from the Norwegian continental shelf. This has led to a large increase in prosperity throughout Norway, but it has also produced large quantities of CO2, contributing to the climate problems the world is now facing. There is a possibility that the North Sea can now go from being a supplier of pollution, to becoming a supplier of clean energy to the mainland. In addition, we are creating infrastructure for new energy production that can bring us one step closer to a renewable society.
- → A carbon budget has been established for the North Sea. a shelf sea on the NW European continental shelf. The North Sea acts as a sink for organic carbon and thus

can be characterised as a heterotrophic system. The dominant carbon sink is the final export to the North Atlantic Ocean. More than 90% of the CO2 taken up from the atmosphere is exported to the North Atlantic Ocean making the North Sea a highly efficient continental shelf pump for carbon.

TO WHAT EXTENT WILL RENEWABLE ENERGY CONTINUE TO AFFECT IM-PORTANT NATURAL VALUES?

- → Norway is one of the countries in the world with the best opportunities to produce environmentally friendly energy. Together with a large-scale investment in energy efficiency, renewable energy can replace fossil energy. But, the development of renewable energy must not be at the expense of important natural values. The shift from fossil to renewable energy requires that we as a society must change the way we make energy. For example, we have to use larger areas of land and sea than we have done before to produce energy. This creates conflicts, and there are many considerations that must be taken into account, both economic, technological and not least those related to the use and protection of nature. The loss of biodiversity is hap-
- pening at a dangerously fast pace, while climate change is threatening a global ecological disaster. Characteristic of many of the renewable energy sources is that

they are spread over large areas. In many cases, major encroachments are required to extract them, which means that the development of renewable energy in many cases becomes controversial.

HOW WILL POLITICS, TENSIONS AND POWER STRUGGLES IN THE WORLD **BE AFTER THE GREEN SHIFT?**

 \rightarrow Some countries have plentiful renewable resources, and these countries could become verv powerful. Oil and gas, for example, are concentrated in a minority of countries in the world, but renewable energy sources are in total much more evenly distributed. All countries have sun, wind and hydropower. Some have more than others, but the differences are not as great as with oil and gas.

Global action against climate change

United Nations Framework Convention on Climate Change (UNFCCC)

The United Nations Framework Convention on Climate change or UNFCCC is a secretariat formed in 1992. The aim of this entity is to be a common ground for the membered parties to negotiate a global response to the threat of climate change. Their ultimate objective aims to stabilize the greenhouse gas concentrations in the Earth's ecosystem, and therefore ensure that the different ecosystems can adapt to the ongoing changes caused by humans. To enable a sustainable development on Earth there is a common understanding that there must be a transition from fossil-fuel-based- energies towards energies where the resources are renewable. In this regard the UN-FCCC is a supervisor and adviser. They provide expertise and review the climate change information given by the parties that have ratified the convention.

As of 2015, the UNFCCC has 197 parties including all United Nations member states, United Nations General Assembly observer State of Palestine, UN non-member states Niue and the Cook Islands and the supranational union European Union. In addition, the Holy See is an observer state.

United Nations Climate Change

KYOTO PROTOCOL (1997)

The protocol recognizes that highly developed countries have a large part in the rise of greenhouse gas emissions. It set in place individual targets for each party to limit and reduce their emissions, and also to support developing countries.

THE PARIS AGREEMENT (2015)

The agreement to reduce carbon emissions by 80-90% towards the year 2050. The goal was set to keep the global rising temperature below two degrees Celsius compared to preindustrial levels. It also introduced the aspect of how to finance climate friendly solutions, thus to increase the political will towards a climate-resilient pathway.

CLIMATE FINANCE

The financial state of developed and developing countries is a factor in the transmission towards sustainable energies and tackling the effects of climate change. If a country is developed it will also have a higher capacity to cope with the consequences of a changing environment. The Convention states that developed countries have a responsibility to assist developing countries in the implementation of objectives mentioned in the Kyoto Protocol and Paris Agreement.

Interviews

society

 \rightarrow There may also be competition for "critical materials" needed to harness renewable energy, and in turn increase the risk of geopolitical rivalry. In order to be able to use some of the renewable resources on the planet, so-called critical materials are needed. Neodymium, used in magnets for wind turbines. is one such example. In the future, international trade in solar and wind power should largely involve more symmetrical relations between energy producers and states

that are consumers.

108

and greater enthusiasm in the field. \rightarrow A lot, studying sales and marketing. A green shift will put great pressure on the economy. \rightarrow I work with transport of oil, so it will potentially have a lot to say in the future - but in Norway we easily forget how dependent the world is on oil, gas and coal; If oil is phased out, it will make my profession redundant and I'll have to find a new iob/retrain. \rightarrow It's important that we travel less, consume less and are more in contact with nature.

from oil

YOUR LIFE?

THERE IS A LOT OF TALK ABOUT A GREEN SHIFT (A MORE CLIMATE-FRIENDLY ERA). DO YOU BELIEVE WE ARE IN THIS GREEN SHIFT?

 \rightarrow Transition to a more circular economy with more focus on carrying requirements than in today's

→ Norway as a nation will drill oil while it is still an industry to do so, but I believe that we will come to green technology in a few years.

→ Yes. With the illuminating climate challenges today, and footprints from fossil fuels, we have had a technological development in the last decade that has developed competitive alternatives in renewable energy that cover virtually all the same needs.

 \rightarrow No, even though we in Norway get electricity from renewable sources, drive electric cars and recycle, both we and the world are still very dependent on fossil fuels.

 \rightarrow Yes, it seems like people are starting to think a little more about the environment. Which is probably due in large part to the fact that lower expenses are compensated for by environmentally friendly measures.

 \rightarrow Politically, there is a lot of talk and little action. But I experience an increased focus and that people are gradually becoming more aware. \rightarrow Well, both. I think most people are more climate

friendly in everyday life now than they were 100 years ago. At the same time, we have huge emissions in the industry.

 \rightarrow No, we are in the planning of the green shift. We are now laying the groundwork for our next generation's green shift. We have two generations below us who must die out before any change can take place.

 \rightarrow If you add goodwill, I would say that we are just getting started. On the grounds that cars change fuel, sustainability in clothing production has an increasing focus, and the same applies to climate footprints when travelling. \rightarrow Feels there is more focus on being climate friendly, but the measures that have been initi-

ated are minimal \rightarrow Yes. Lots of measures have been taken already. An enormous amount has also been done on the

Norwegian shelf to become more green. In addition, the green shift is sponsored by revenues

WHAT DOES THIS MEAN FOR YOUR FIELD AND

→ I have chosen to quit the North Sea to become a student working on land.

→ If we're in a green shift, then I work in the aviation industry. Hopefully this will mean for my life, there are such things as cars that can be interesting. It is difficult as a consumer to know what's correct information and what is embellished in order to sell better.

→ It sets stricter requirements for contractors who will work on our facilities; Trying to contribute privately, recycle, burn wood and heat pumps, change cars to electric cars.

 \rightarrow A green shift for me means more work space

→ Shipping is an industry with a slow development. The IMO 2020 rules are an example where you could see that very few actors were positive or prepared to make the changes they demand. For the time being, shipping is a fairly environmentally friendly way of transporting goods, but if "all countries" start consuming even more locally, it will have major consequences. The transition to wind power instead of petroleum energy probably means that the demand for ships will fall in the long run, but then one is

dependent on more countries following suit. Norway has the cleanest oil and if we stop production, it only means even more pressure on the dirty (and more environmentally harmful) oil from countries that offer this today.

I am now in the generation that can see the de- \rightarrow velopment of the environment and surroundings that have changed during my lifetime. This is a good basis for thinking how it should/shouldn't be. As a leader. I shouldn't be afraid to speak the truth and plan the future.

WHAT SPECIFICALLY SHOULD WE DO TO ACHIEVE A MORE ENVIRONMENTALLY FRIENDLY WORLD?

- → Politicians will probably have to make it more competitive to make green choices. Both for companies and individuals.
- → Investment in nuclear power; get countries like China and India to recycle; modernising old oil fields; focus on hydropower; we can put wind turbines dead right away.
- \rightarrow Check what you are buying.
- → Circular value chains and regulation such as staffs/fines/prices of pollution and emissions.
- We should stop discussing what looks good \rightarrow in nature and what does not. If we want to go green, we have to put hydropower into rivers even though it is ugly.
- Spend more money on research and education to stimulate environments, both academically and in business.
- The richer parts of the world must subsidise greener solutions for the poorer parts. For example, switching from coal to gas - which for many countries is expensive.
- Political; paradigm shift. We need new attitudes, a new culture, to distance ourselves from neo-liberalism, an economic model that demands eternal growth. We must strive for a more circular economy.
- → We live in a society where the freedom of the individual is the strongest, but we need to change the mentality so that the human and planet as we know it is the first priority.
- \rightarrow Focus on biodiversity and the value of nature. \rightarrow Focus on global cooperation.
- Change the travel habits; e-commerce; Use \rightarrow and discard; abundant society, do we need everything?

IF YOU COULD TAKE SOMETHING FROM THE PAST INTO THE FUTURE, WHAT WOULD IT BE?

- \rightarrow I have the impression that people appreciated things more and lived more soberly.
- → More agriculture in Norway where it actually pays off to be a farmer.
- Build simple and durable, maintain what we have/wants nature.
- → The mentality we had before everything became cheap (i.e. use & throw).
- \rightarrow Lifestyle without a doubt.
- → The frugality one had before the oil to take care of their things and make it last longer.
- → Lifestyle: Norway was much more self-sufficient in food and resources before: now all small farms are forced to close down due to no support and centralisation; as a result, there are much more imports than necessary; lower taxes, so that people buy food and other goods in Norway.
- \rightarrow The knowledge of making things by hand and about traditional professions that have been replaced by machines. We are constantly chasing more efficiency.
- \rightarrow Understanding where food comes from, how much work it takes to get food on the table.
- I don't believe in bringing the past back into the future. Many have fought to erase parts of the mentality from the past. I hope someone in the spirit of Elon Musk invents 0 emission planes, and then cruise and cargo ships.
- → Simpler standard of living and less demands for luxury.
- \rightarrow The unity between neighbours and acquaintances.

WHAT WILL THE NORTH SEA LOOK LIKE IN 100 YEARS?

- → Unsure. Hope it will be a bustling wildlife that is not destroyed after too much oil drilling/exploration.
- Probably a lot of unmanned platforms that no one will take the bill to tear down.
- \rightarrow I hope that in 100 years the North Sea will have little pollution and be full of fish.
- → Discarded oil platforms are used for wind power, and local hydrogen production and storage. Perhaps large floating fish farms, which are escape-proof and without emissions to the environment, which take care of waste materials for use as manure on land
- \rightarrow The North Sea looks like a mega big city, with lots of underwater installations. There is also mining of minerals, which will make a big difference. Otherwise, there will be many wind turbines on the sea surface, with a bunch of cables hanging underneath.
- \rightarrow The North Sea will largely look the same as it does today. Extraction on the Norwegian shelf is the cleanest in the world, and technology development has contributed positively to the climate fight worldwide.
- \rightarrow I dare not think about what something will look like in 100 years. Emissions from greenhouse gases will probably destroy more than we think. → Black
- \rightarrow Hopefully oil production! This is one of the most important things that has happened on Norwegian soil! The country's economy is dependent on oil.
- \rightarrow Hopefully it looks better than today. A rich and diverse life in the sea.
- → If we consider that things change, it looks like an aquarium, bustling with life and crystal clear water; if we consider that things do not change, it will be empty. Destroyed by us humans, dirty oil rigs that suck out the last remnants of oil and gas, despite it not being good.
- \rightarrow In 100 years, the then old platforms will remain as some prehistoric monuments, there may soon be opportunities for some to be turned into museums. Otherwise, there are probably a lot of wind turbines and lots of new hydropower technology that supports our grandchildren's lives.
- \rightarrow I think we will be able to reverse the trend. It will be 3-4 degrees warmer, and some species will be extinct. We want species in the North Sea that today are only found in warmer regions.

Glossary

BIOECONOMY

→ Value creation based on sustainable utilisation of renewable biological resources.

CARBON CAPTURE AND STORAGE (CCS)

→ Capture of CO2 from large emission sources such as coal power plants or industry, which are stored underground instead of being released into the atmosphere.

CARBON-FREE ELECTRICITY

→ All renewable energy is labelled carbon-free, not all energy sources labelled carbon-free are renewable.

CARBON RISK

→ Risk for companies that are exposed to stricter climate regulations, change consumer behaviour, higher emission costs and more.

CIRCULAR ECONOMY

→ Waste as a concept disappears, and the resources remain in the cycle of the economy through reuse, repair, renovation / improvement and material recycling.

CLEAN ENERGY

→ All energy production produces some waste. Although the source is clean, the production energy, the building of the powerplant, making parts, the lifetime and how it is recycled are important areas to include. It is more about a cleaner form of energy.

CLIMATE CHANGE

→ Variation in the average weather over time.

CLIMATE RISK

→ Risk associated with consequences of physical climate change (extreme weather, drought, floods and more).

DOGGER BANK

→ A large sandbank in a shallow area of the North Sea. Dogger Bank has been identified as an oceanic environment that exhibits high primary productivity throughout the year in the form of phytoplankton. It has been proposed to designate the area a Marine Nature Reserve.

ELECTRICITY

→ A fundamental form of energy observable in positive and negative forms that occurs naturally or is produced.

ENERGY

→ The quantitative property that must be transferred to an object in order to perform work. Energy consumption is the total energy used in a period of time.

ENERGY EFFICIENCY

→ Using less energy to perform the same function at the same level of quality. Doing the same with less.

ENERGY TRANSITION

→ Replacing fossil fuels with renewable energy. This transition can impact many aspects of life including the environment, society, the economy and governance.

→ All energy sources have some impact on our environment. Renewable sources also have environmental impacts: visibility in the landscape, or there might be a risk of affecting pristine nature or the habitats of threatened species.

GLOBAL WARMING

- → Increase in global average temperature. Solving the problem is regarded as one of the most important challenges facing humankind in the 21st century.
- GREENWASHING → A form of misleading marketing where the theme is presented as
 - more environmentally friendly than is actually the case. An example is to emphasise the environmental benefits while disregarding disadvantages.
- INTERMITTENCY
- → One problem with renewable energy is intermittency. Wind power is only generated when it is windy, solar energy is generated only when it is sunny.

IMPRINT

→ Impress or stamp (a mark or outline) on a surface, a mark or outline made by pressing something on to a softer substance.

NORTH SEA

→ An arm of the Atlantic between the United Kingdom and the European mainland. About 520,600 square kilometres.

REGENERATIVE CITIES

→ An urban development built on an environmentally enhancing, restorative relationship with the natural systems from which the city draws resources for its sustenance.

RENEWABLE ENERGY

→ Energy that is collected from renewable resources. Renewable energy as naturally replenished and is often considered a prerequisite towards sustainable development.

RENEWABLE IMPRINT

→ Although the renewable sources themselves are sustainable/ natural, the irextraction has consequences both positive and negative in the local and global environment.

RENEWABLE SOURCES

→ Sun, Wind, Geothermal, Hydropower, Ocean (wave, tidal, current, ocean thermal), Biomass from plants.

SPACE

→ Many forms of energy need huge areas, for example solar or wind farms. One of the issues, if scaling up our renewable energy sources: where are we going to put them?

SUSTAINABLE

→ Produced and used energy in such a way that it meets the needs of the present without compromising the ability of future generations to meet their own needs.

THE GREEN SHIFT

→ A change process that is about increasing value creation with less overall environmental impact and emissions.

THE PARIS AGREEMENT

→ The first global climate agreement that commits all countries, and where the countries agree that the temperature of the globe should not rise more than 2 degrees before the century is over. In addition, they should do everything they can so that it does not rise more than 1.5 degrees.

THE TWO-DEGREE GOAL

→ Aim to limit the increase in global average temperature to 2 degrees above the level in 1870 (pre-industrial level).

www.nationalgeographic.com www.statkraft.com www.snl.no www.mcecleanenergy.org

110

In autumn 2020, the master research and design project "Explorations in Ocean Space" at the Bergen School of Architecture (BAS) investigated Vestland's long and oscillating legacy of relations to the sea. This is an exemplary maritime region where contracts and exchanges have been forged with the ocean throughout history. However as one of the world's most industrialised seas, the North Sea has been described as being virtually dead, while a bright future is envisioned for the burgeoning Blue Economy. "Vestland North Sea Blueprints" aims to capture these contradictions through spatial research from a range of perspectives in a newspaper format, seen as a potential atlas to introduce Bergen's oceanic context in the exhibition at Bergen Kunsthall. It serves as a data backbone and a starting point for further exploration. How have human spaces and histories been entangled with the sea in the Bergen region and how do we assess the current situation?

The research is organised around the five major maritime industries that have been vital to the local economy: fishing, oil and gas, shipping, tourism and renewable energy. But it also traces the global trajectories of these industries and how they have moulded space, culture, regimes of control and produced specific narratives. The project aimed to make a critical appraisal of Bergen's relation to the sea, to reveal fault lines, disjunctions and to identify emerging spaces of renegotiation. Each section of the newspaper relates the most relevant findings in an individual way.

BERGEN KUNSTHALL

