Port of tomorrow
Seaports are mirroring developments in the global economy

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Rotterdam: global port/Gateway to Europe

Throughput port of Rotterdam strongly related to global trade and German industrial production (1960-2018)

Source: Port of Rotterdam

Source: Port of Rotterdam & Kieler Zahlen

Source: Port of Rotterdam & Kieler Zahlen
The Port of Gdansk has unveiled its plans to build a USD $3.1 billions port in a bid to double its cargo volumes from 50 million in 2019 to 100 million tonnes a year.
Forecasting is difficult: in the early 1970’s Rotterdam prepared for continued growth….

Source: Port of Rotterdam
Future growth in the port of Rotterdam will be negative: only slow growth for containers….

Source: Port of Rotterdam
“Personal Vision” for 2042: port of Kiel is growing according to trend, growth Nord-Ostsee-Kanal is slightly below trend.

Source: Kieler Zahlen
decarbonisation
deglobalisation
digitalisation
deskilling/new skills
disruption/geopolitics
diversification of ports
decreasing externalities
Decarbonisation

• Dutch seaports produce nearly half of Dutch CO₂-production
• The port of Rotterdam is responsible for nearly a quarter of Dutch CO₂-production
• Decarbonisation is the most dominant transition shaping ports towards 2042
Investment of €1 trillion in EU climate policies
2014 | Coal peaked

2016

2018

2020

2022 | Natural gas peaks

2023 | Oil peaks

2026 | Transport energy demand peaks

2028 | Wind power surpasses hydro

2030 | Wind power surpasses coal

2034 | Natural gas demand peaks

2036 | Nuclear peaks

2038 | Solar PV overtakes biomass in primary energy

2039 | Manufacturing energy demand peaks

2042 | Half of the world's fleet of road vehicles - light and heavy - is electric

2044 | Solar PV overtakes oil in primary energy

2048 | World grid capacity triples from 2016

2050 | 50% energy mix is non-fossil

Green slope: share of non-fossil energy sources in the energy mix

Energy transition timeline

2014 Coal peaked

2016-2050

2018-2050

2020-2050

2022-2050

2023-2050

2026-2050

2028-2050

2030-2050

2034-2050

2036-2050

2039-2050

2042-2050

2044-2050

2048-2050

2050-2050
Seaport Kiel loses throughput due to decline in coal

The cargo throughput in the seaport of Kiel, Germany, fell by almost 2% last year. This was mainly because fewer coal were handled. For example, the old coal-fired power station on the Förde-Ufer was decommissioned.

The throughput in Kiel fell to seven million tonnes, says port director Dirk Claus. A large part of it consists of general cargo in ferry transport between Northern Germany and other countries on the Baltic Sea, the Baltic Gulf and the North Sea, together about six million tonnes.
Decarbonisation policies: towards zero emission in 2050

• New energy sources: (offshore) wind, solar, green hydrogen, green LNG, etc.
• New feedstocks: bio-based: algae, seaweed, etc.
• Circular economy
• CO₂-taxing
• Carbon Capture Storage and Usage
• Energy efficiency
PATHWAYS TO A DECARBONISED PORT

CLOSED CARBON CYCLE
- Synthetic chemicals from waste streams
- Large scale water electrolysis (H₂ production)
- Large scale availability of 100% renewable electricity production
- Heat grid extension
- Rapid adoption of best available technologies (energy efficiency)

BIOMASS AND CCS
- Synthetic fuel & biobased production
- 100% biomass & waste-fired (+ CCS)
- Large scale availability of sustainable biomass
- Carbon capture and storage

TECHNOLOGICAL PROGRESS
- Large scale CCS (for power plants and refineries)

BUSINESS AS USUAL
- Paris Agreement

"Decarbonization pathways for the industrial cluster of the Port of Rotterdam. Wuppertal Institute. Simplified for clarity reasons."
Stena Line sails more economically thanks to artificial intelligence

Stena Line will equip more ships with artificial intelligence (AI). A pilot in which the AI technology on board the "Stena Scandinavica" predicted the most efficient route proved to be extremely successful. Fuel consumption was reduced by 2 to 3% during the test, as was recently demonstrated at the KVNR Membership Day in Capelle aan den IJssel where the results of the pilot project were presented.

In 2018, Stena Line equipped its first ship, the "Stena Scandinavica", on the Gothenburg-Kiel route, with this system to support the captain and officers. "The AI model simulates a number of scenarios based on various
Digitalisation policies: towards a smart port in 2042

- Artificial Intelligence
- Big data
- Internet-of-things
- Blockchain
- Robotisation
- Autonomous shipping, etc. etc.

- **New skills** needed: but also **de-skilling** of port workers
- Rotterdam: **port-innovation ecosystem**: opportunities Kiel!
- Founded by top universities (University Kiel), vocational institutes (Fachhochschule Kiel), government and business cooperation (high-tech military and civil shipbuilding).
Deglobalisation: regional instead of global in 2042

- Trade wars: changing the economic geography of manufacturing
- Structural slowing down of global trade since 2010
- Near-sourcing/re-shoring: production close to the market
- 3D-printing, Industry 4.0 (digitalisation)
- Dematerialisation
- An aging population consumes relatively more services
- Circular Economy (stretching of product life)
- Negative public opinion associated with globalisation and containerisation: MSC Zoe, Boxes in the countryside, local products
MSC Zoe lost 342 containers on januari 2, 2019
Disruption/geopolitics
Decreasing negative externalities: port-city relations

• Clean air, no noise or smell, no port-related congestion
• Attractive environment for working, living and recreation.
Figure 4. Cruise ships docking in Barcelona emit 5 times more sulphur than the city’s 560,000 cars every year.

Source: Transport & Environment, 2019
Emission of $\text{SO}_x$ from cruise ships and LDVs in selected cruise polluted European ports in 2017.

<table>
<thead>
<tr>
<th>Ranking</th>
<th>Port</th>
<th>Number cruise ships</th>
<th>Port call time (hours)</th>
<th>$\text{SO}_x$ from cruise ships (kg)</th>
<th>Number of registered LDVs</th>
<th>$\text{SO}_x$ from number of registered LDVs (kg)</th>
<th>Ratio of $\text{SO}_x$ from cruise ships and LDVs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Barcelona</td>
<td>105</td>
<td>8,293</td>
<td>32,838</td>
<td>558,920</td>
<td>6,812</td>
<td>4,82</td>
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<tr>
<td>32</td>
<td>Rotterdam</td>
<td>18</td>
<td>1,538</td>
<td>7,714</td>
<td>225,210</td>
<td>2,745</td>
<td>2,81</td>
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<tr>
<td>40</td>
<td>Kiel</td>
<td>24</td>
<td>1,661</td>
<td>6,260</td>
<td>109,052</td>
<td>1,226</td>
<td>5,28</td>
</tr>
</tbody>
</table>

Source: Transport & Environment, 2019
Scrubber cleans exhaust gases

Clean fuel systems at Stena Line

Stena Line's cargo ships Transit and Transponder use clean fuel systems. The engines of the ferries that cross three times a week to the British town of Killingholme ran on fuel oil. Thanks to scrubber technology, the exhaust gases contain much less sulfur oxide (a combustion gas from fuel oil).

Stena Line is also looking for alternative fuels and emission techniques for the rest of their fleet. For example, the company is investigating the possibilities of using cleaner LNG (liquefied natural gas). One ship from the fleet, the Stena Germanica that sails between Gothenburg and Kiel, is being converted for the methanol fuel (costs: 22 million euros). It will be the first methanol-powered ship in the world. And the ferry ships that moor in Hoek van Holland are ashore.
German ports want more shore power

The German Minister of Economic Affairs Peter Altmaier and representatives of five German Länder have signed a letter of intent in Kiel to promote the use of shore power in the German seaports.

This should contribute to cleaner air in the port cities and climate protection. The statement contains few concrete objectives and no hard planning. There is, however, a reference to a subsidy program of 140 million euros, which should come into effect next year.
Color Line starts Oslo-Verona rail service via the port of Kiel

The Norwegian Color Line has started a weekly rail service between the northern German port city of Kiel and the northern Italian Verona. The service is in line with the ferry services between Kiel and Oslo.

Regarding the track, the service is provided by Kombiverkehr. Goods must be delivered for ferry transport in Oslo on Friday afternoon and tracked in Kiel, arriving in Verona at six o'clock on the following Tuesday morning.
Decreasing negative externalities: port-city relations

• Clean air, no noise or smell, no port-related congestion
• Attractive environment for working, living and recreation.

• Attractive economic opportunities city of Kiel
• New skills needed for port of the future: digital/soft skills/etc.
• Diversification: use top universities for a leading role in digital and sustainable solutions.
Conclusion: Ports of Tomorrow are:

- Decarbonised and on target towards 2050
- Digitalised: ports are smart and intelligent and use local knowledge infrastructure
- Deglobalised: more related to the larger regional/European economy than to the global economy
- Diversified: high-tech innovation, smart manufacturing
- Attractive placed to work, live and recreate!

*Kiel is working hard to realise these goals towards 2042!*