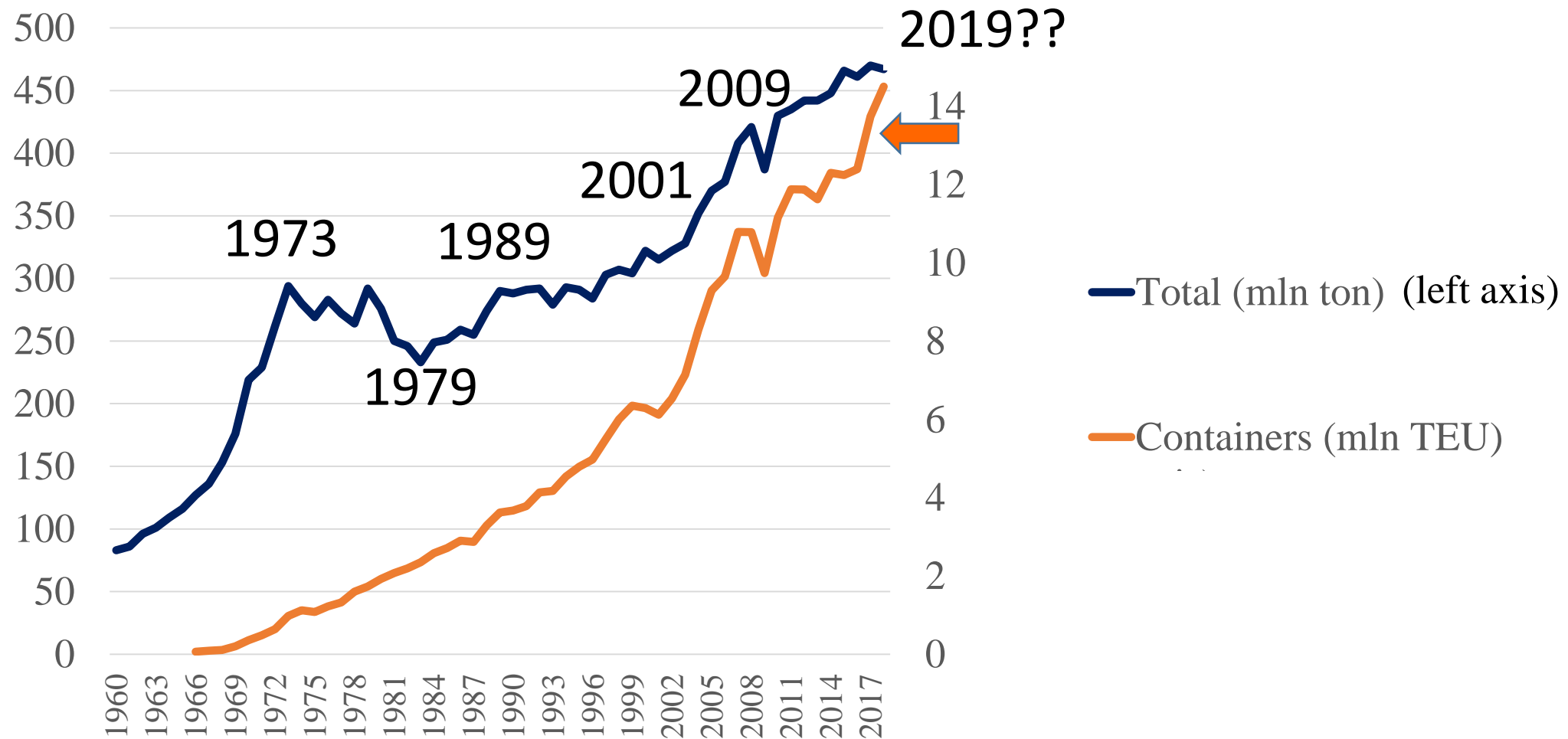# **Port of tomorrow**
Seaports are mirroring developments in the global economy

Dr. Bart Kuipers

Erasmus Center for Urban, Port and Transport economics
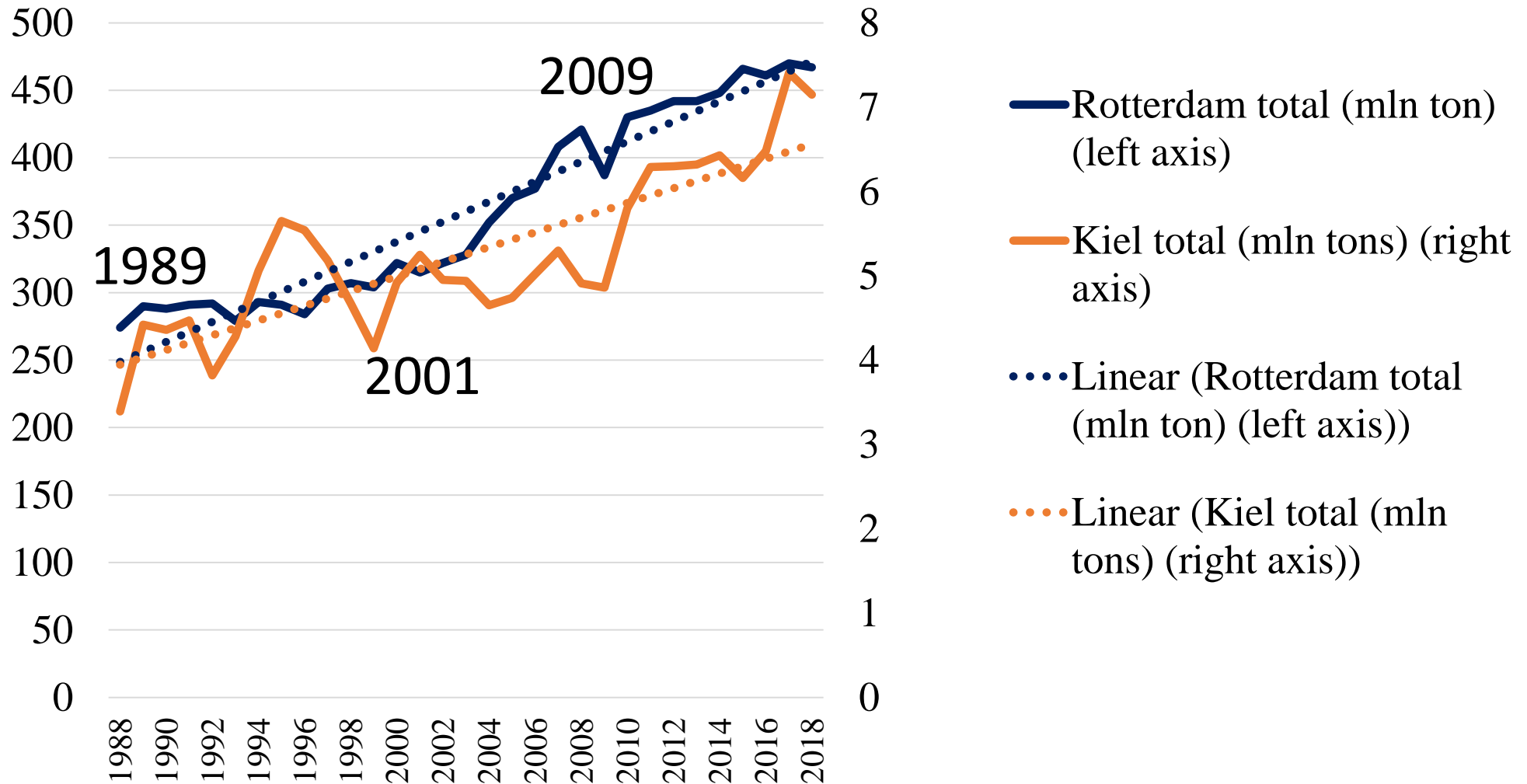
Rotterdam: global port/Gateway to Europe

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

Source: Port of Rotterdam
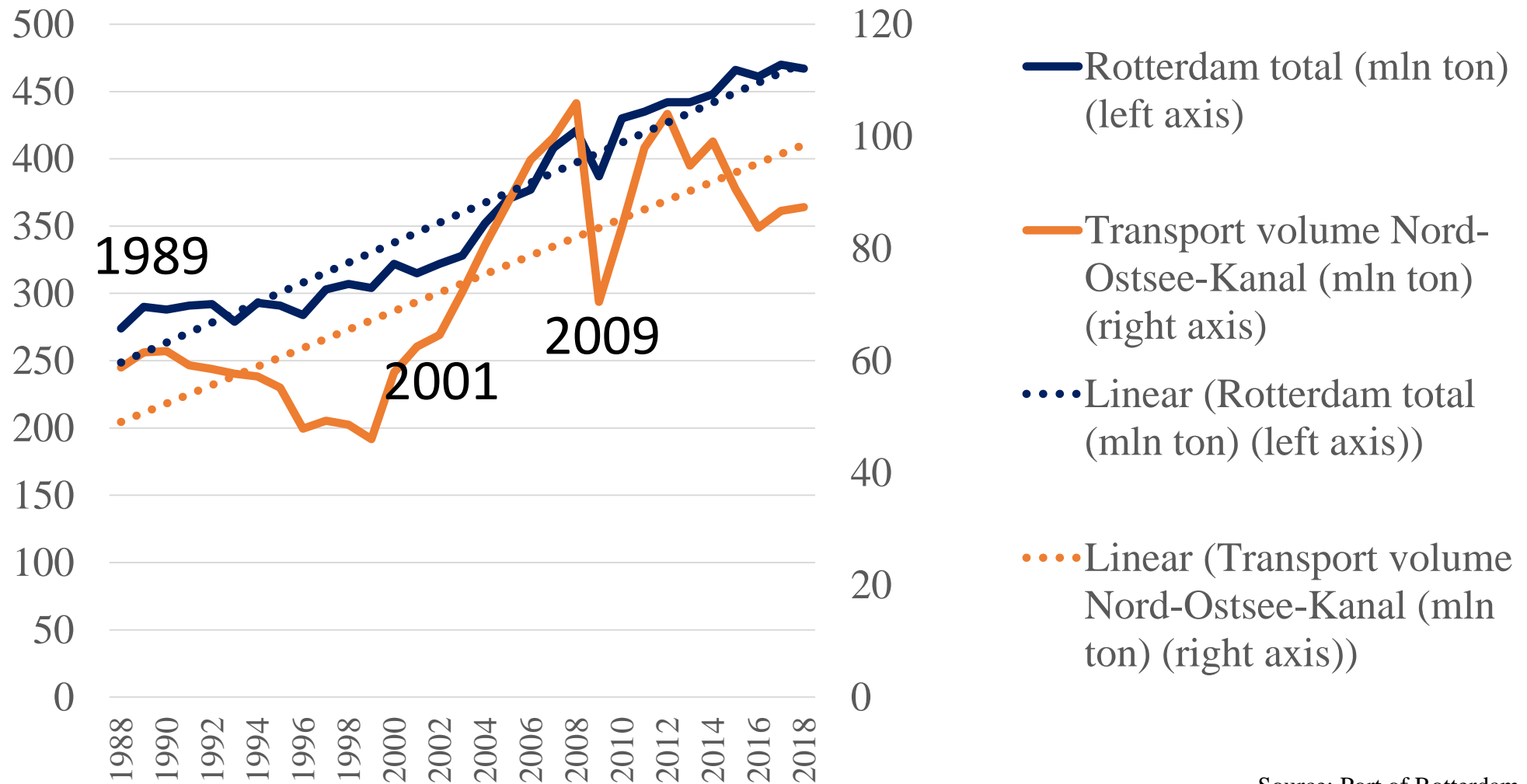
Performance ports of Kiel and Rotterdam, 1988-2018, million ton.

Source: Port of Rotterdam & Kieler Zahlen

Performance Nord-Ostsee-Kanal and port of Rotterdam, 1988-2018, million ton.
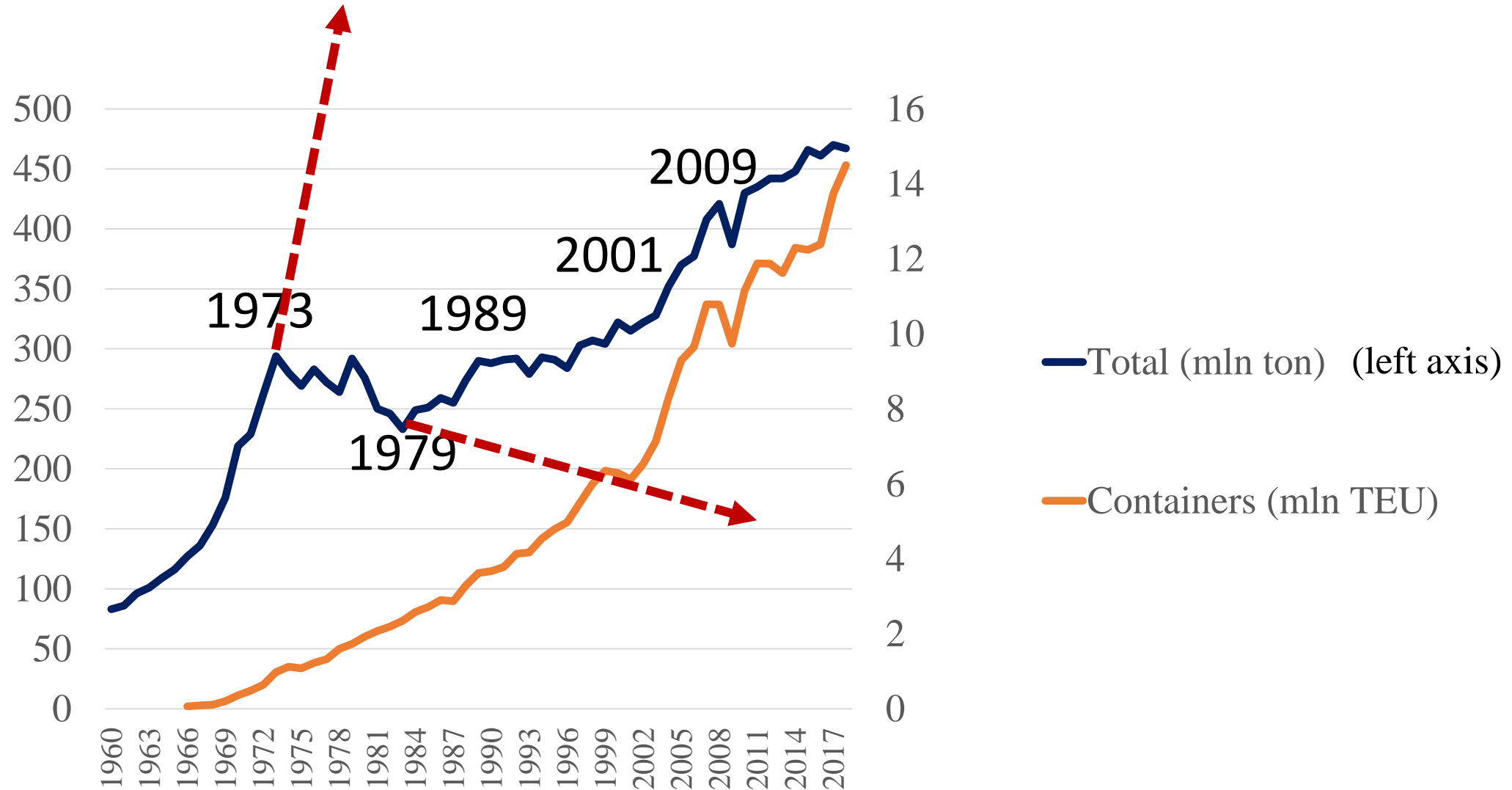

Source: Port of Rotterdam & Kieler Zahlen

Port of Gdansk Outlines Expansion Plans

By Matteo Natalucci • 7 November 2019, 15:11 GMT • Automation and Optimization, Port Profiles, Ports and Terminals

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

NIEUWE WATERWEG

ROTTERDAM

1650 ha.
102.500 inw.

580 ha.
36.000 inw.

400 ha.
25.000 inw.

DORDRECHT

HARINGVLIET

GREVELINGEN

2000 ha.
125.000 inw.

6000 ha.
375.000 inw.

HOLLANDSCH DIEP

VOLKERAK

ZEVENBERGEN
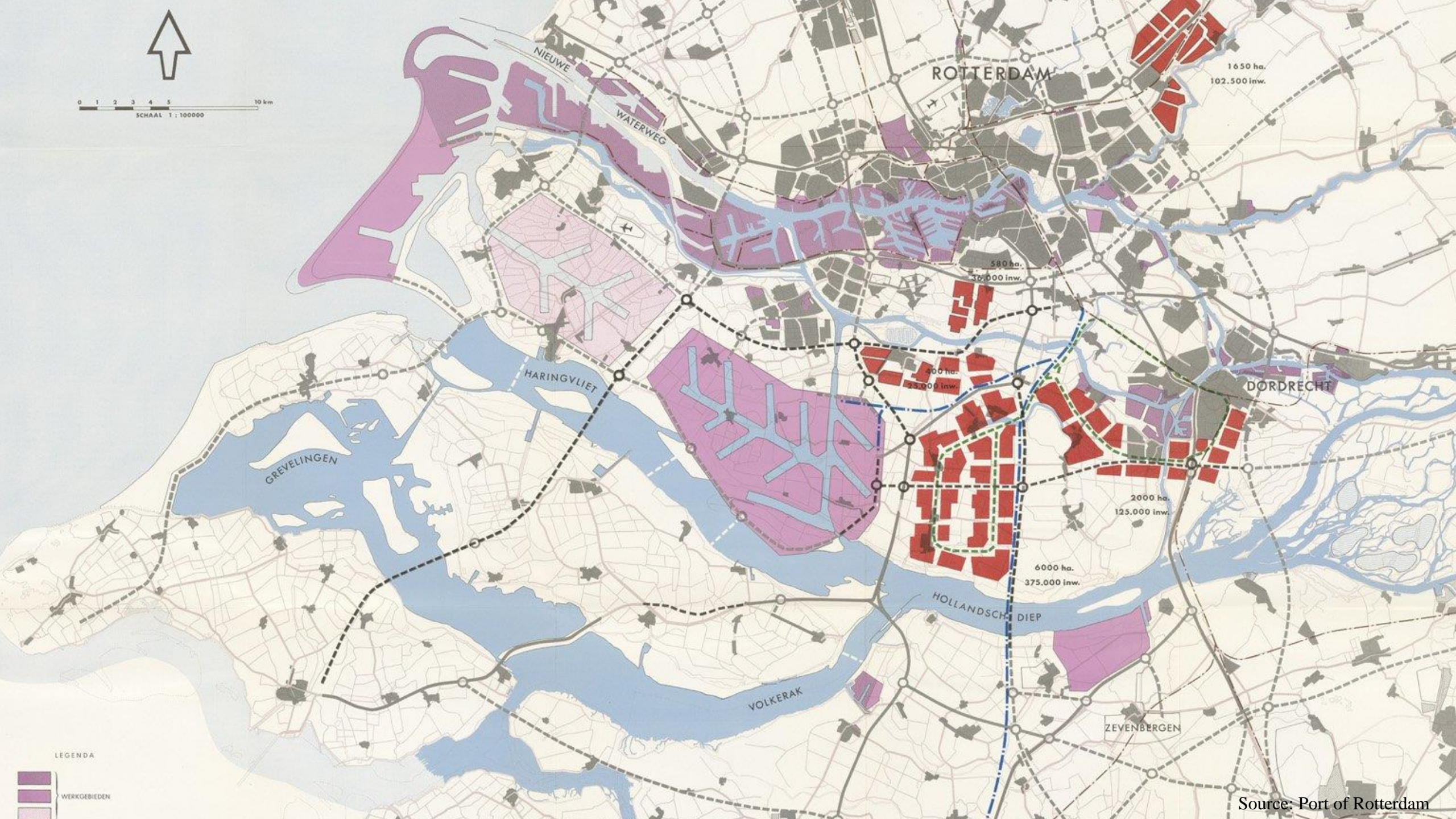
LEGENDA

WERKGEBIEDEN

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

1960 1963 1966 1969 1972 1975 1978 1981 1984 1987 1990 1993 1996 1999 2002 2005 2008 2011 2014 2017

1973
1979
1989
2001
2009

Total (mln ton) (left axis)

Containers (mln TEU)
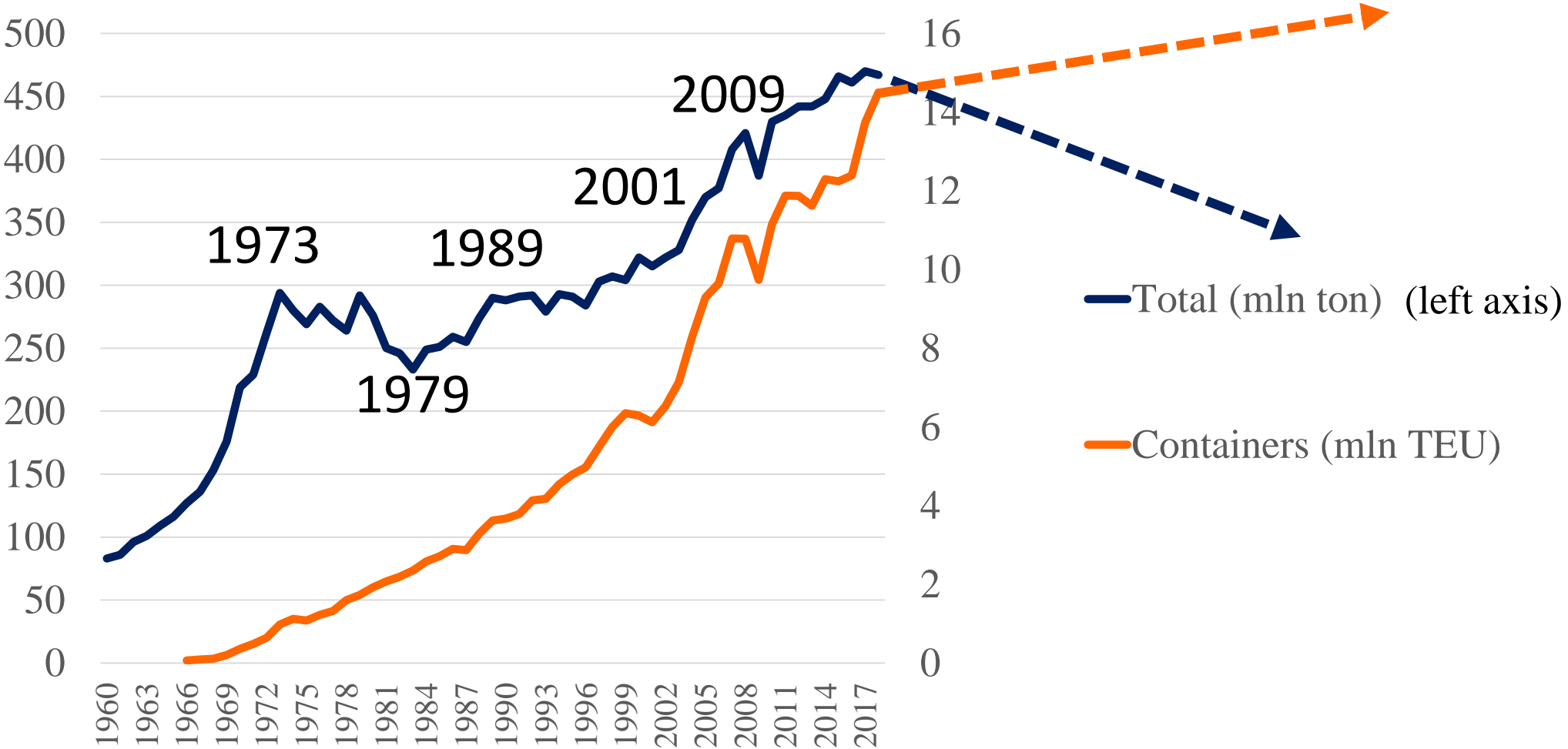
"Personal Vision" for 2042: port of Kiel is growing according to trend, growth Nord-Ostsee-Kanal is slightly below trend

Transport volume Nord-Ostsee-Kanal (mln ton) (left axis)

Kiel total (mln tons) (right axis)

Linear (Transport volume Nord-Ostsee Kanal)

Linear (Kiel total (mln tons) (right axis))

Source: Kieler Zahlen

D
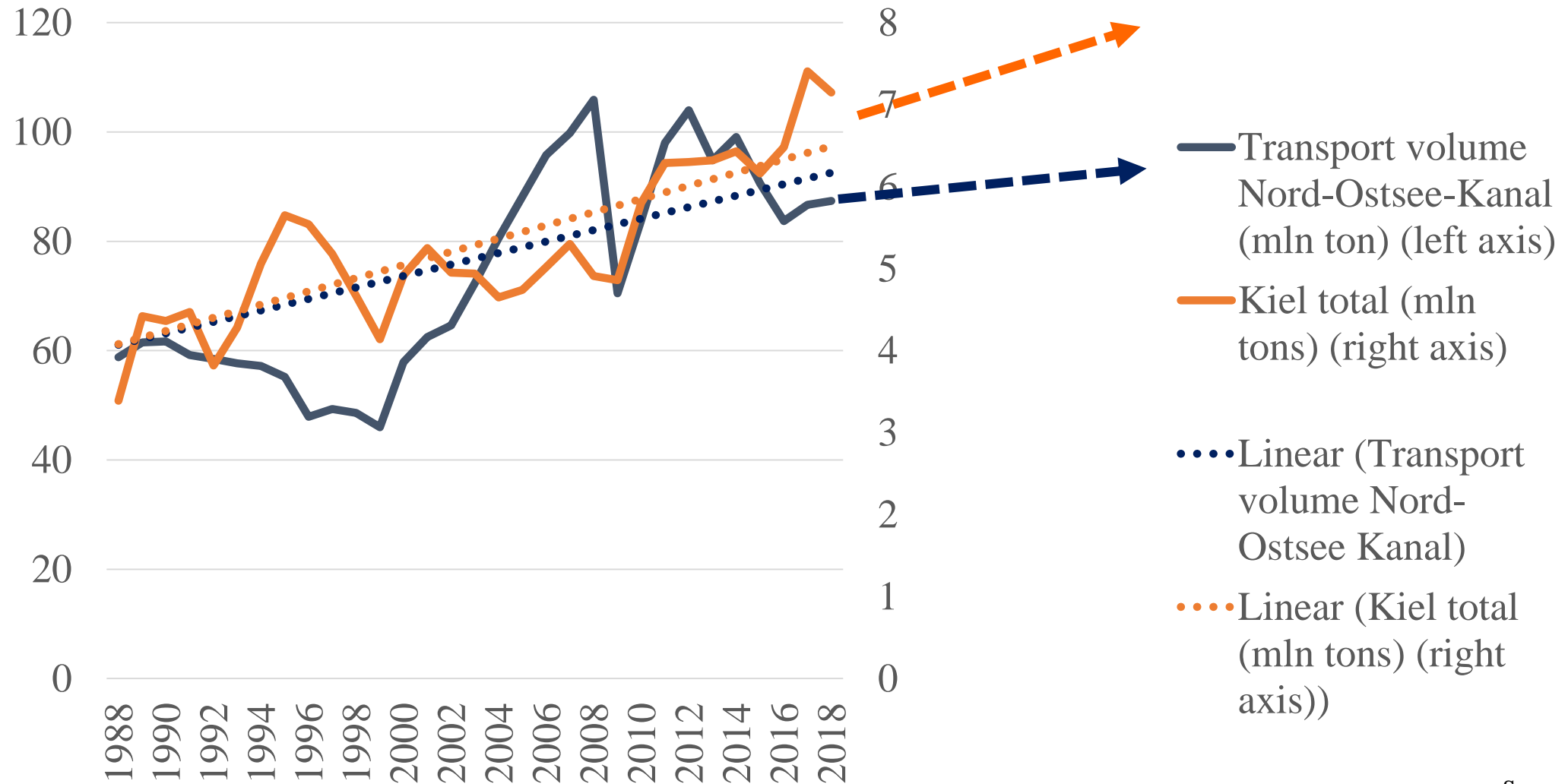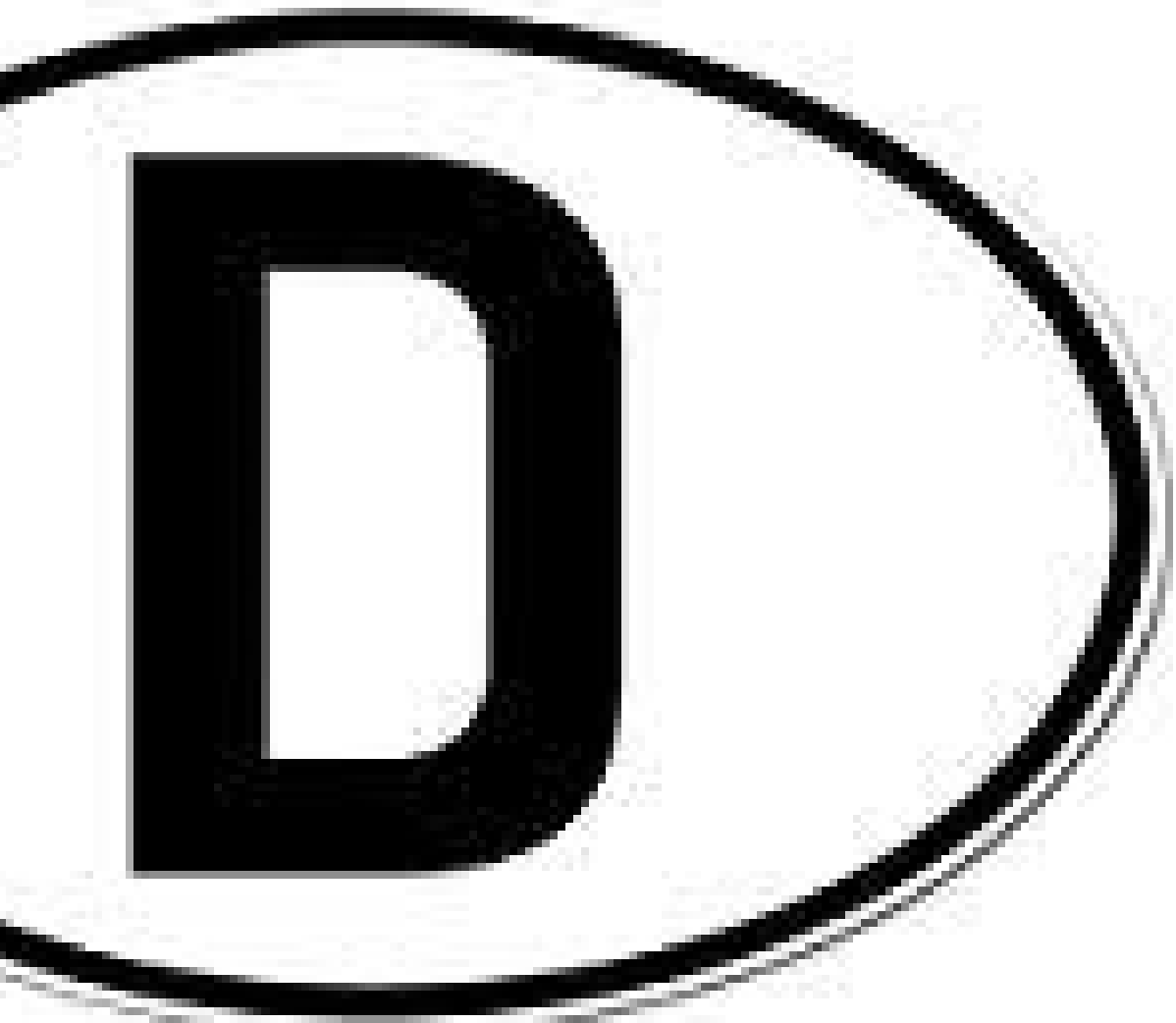
decarbonisation
deglobalisation
digitalisation
deskilling/new skills
disruption/geopolitics
diversification of ports
decreasing externalities

Decarbonisation

- Dutch seaports produce nearly **half** of Dutch CO_2-production
- The port of Rotterdam is responsible for nearly **a quarter of Dutch** CO_2-production
- Decarbonisation is the most dominant transition shaping ports towards 2042
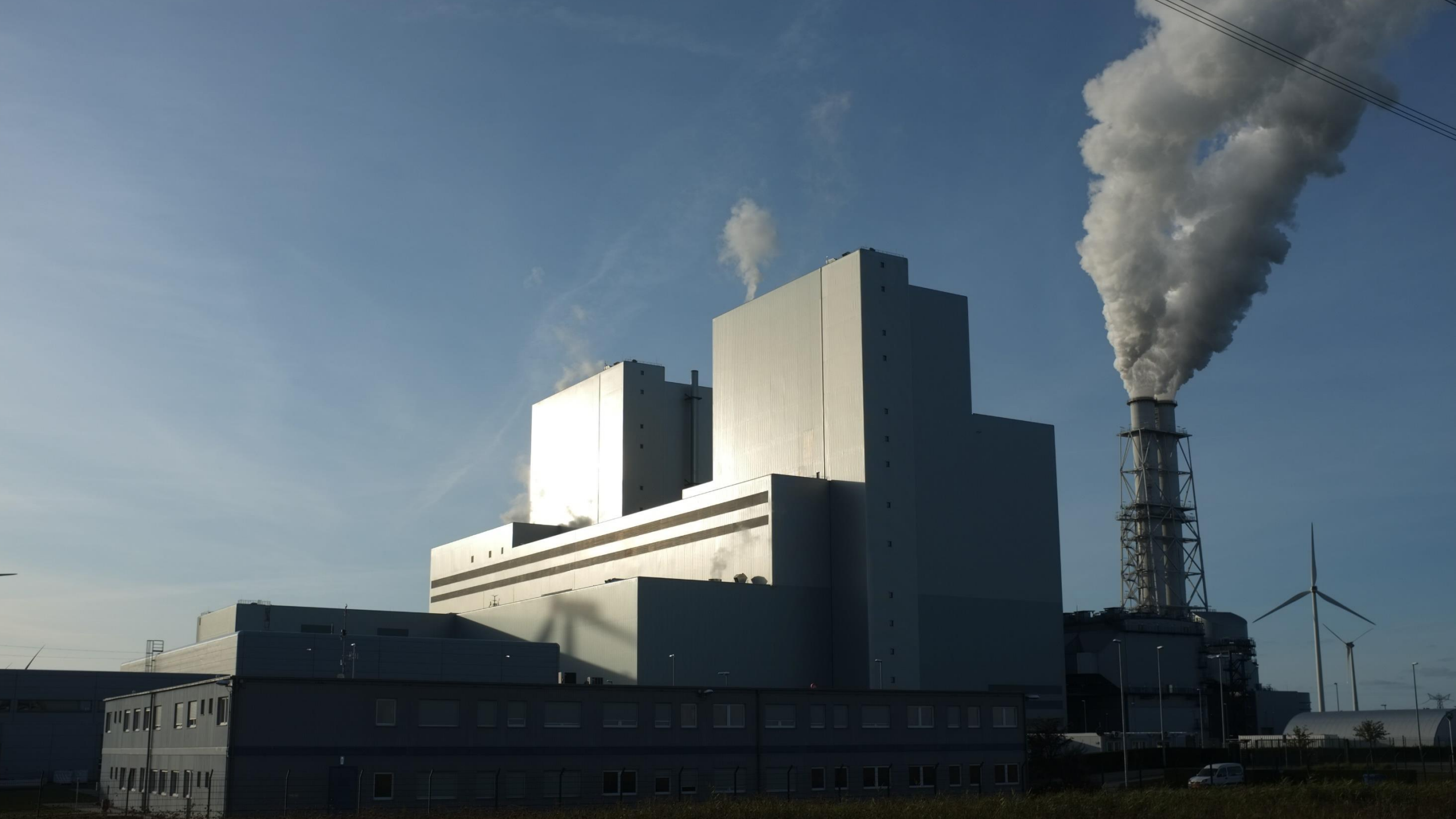
PARIS 20 5

PERSON *of the* YEAR

TIME

GRETA THUNBERG

THE POWER OF YOUTH

Investment of €1 trillion in EU climate policies

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

Legend:
- Energy peaks
- Non-fossil share
- Energy transitions
- Energy milestones

2014 Coal peaked

19% of the energy mix is non-fossil

2023 Oil peaks

2034 Natural gas peaks

2039 Manufacturing energy demand peaks

2042

2050 50% energy mix is non-fossil

2032 Peak primary energy supply

2035 Peak final energy demand

2033 Nuclear peaks

2026 Transport energy demand peaks

2024 Light EVs reach cost parity with internal combustion engine (ICE) vehicles

2031 Wind over-takes hydro

2033 Half of all light vehicle sales electric

2038 Wind supply x10 more than 2016

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

2047 Heavy electric vehicles start to outnumber ICE heavy vehicles on the road

2023 PV install-ations 1TW

2026 Gas over-takes oil

2028 95% of world population has electricity access

2034 Non-fossil capex overtakes fossil capex

2035 World grid capacity doubles from 2016

2040 PV install-ations 10TW

2044 Solar PV overtakes biomass in primary energy

2044 Non-fossil expend-itures overtake fossil expenditures

2049 Solar PV overtakes oil in primary energy

2048 World grid capacity triples from 2016

2023 Seaborne container trade exceeds crude oil trade

2035 Maritime energy demand peaks

2038 Seaborne gas trade exceeds coal trade

2042 Half of mari-time energy use is non-oil

Percentage of energy mix non-fossil

©DNV GL

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.

FOLKERT NICOLAI ✉   17 januari 2020 11:45

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

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

- CO_2-taxing

- Carbon Capture Storage and Usage

- Energy efficiency

PATHWAYS TO A DECARBONISED PORT

98% CO₂ REDUCTION 2050 vs. 2015

98% CO₂ REDUCTION 2050 vs. 2015

75% CO₂ REDUCTION 2050 vs. 2015

CLOSED CARBON CYCLE

BIOMASS AND CCS

TECHNOLOGICAL PROGRESS

SYNTHETIC CHEMICALS FROM WASTE STREAMS

SYNTHETIC FUEL & BIOBASED PRODUCTION

LARGE SCALE WATER ELECTROLYSIS (H_2 PRODUCTION)

100% BIOMASS & WASTE-FIRED (+ CCS)

LARGE SCALE AVAILABILITY OF 100% RENEWABLE ELECTRICITY PRODUCTION

LARGE SCALE CCS (FOR POWER PLANTS AND REFINERIES)

LARGE SCALE AVAILABILITY OF SUSTAINABLE BIOMASS

30% CO₂ REDUCTION 2050 vs. 2015

BUSINESS AS USUAL

CARBON CAPTURE AND STORAGE

HEAT GRID EXTENSION

RAPID ADOPTION OF BEST AVAILABLE TECHNOLOGIES (ENERGY EFFICIENCY)

PARIS AGREEMENT

"Decarbonization pathways for the industrial cluster of the Port of Rotterdam"
Wuppertal Institute
Simplified for clarity reasons.

Flettner rotor

Wing sails

DynaRig

Kites

Source: DNV GL

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).

Venezuela erupts

How to defend Taiwan

India's internet tycoon bets big

Drones: hovering with intent

Slowbalisation

The future of global commerce

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
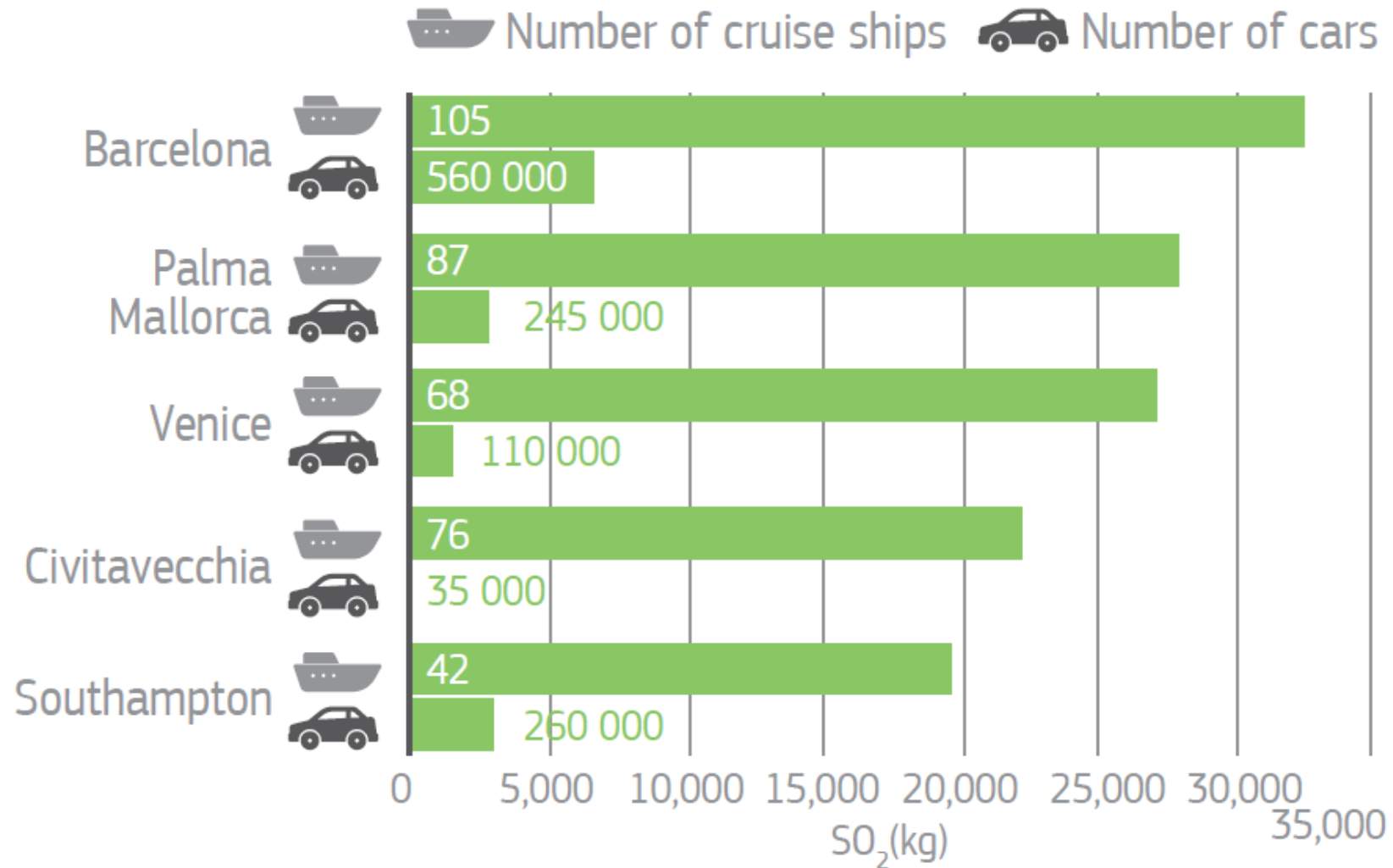
DRIVERS
ENTRANCE

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

🚢 Number of cruise ships   🚗 Number of cars

City		SO_2 (kg)
Barcelona	🚢	105
	🚗	560 000
Palma Mallorca	🚢	87
	🚗	245 000
Venice	🚢	68
	🚗	110 000
Civitavecchia	🚢	76
	🚗	35 000
Southampton	🚢	42
	🚗	260 000

0   5,000   10,000   15,000   20,000   25,000   30,000   35,000

SO_2(kg)

Source: Transport & Environment, 2019

Emission of SO$_x$ from cruise ships and LDVs in selected cruise polluted European ports in 2017.

Ranking	Port	Number cruise ships	Port call time (hours)	SO$_x$ from cruise ships (kg)	Number of registred LDVs	SO$_x$ from number of registred LDVs (kg)	Ratio of SO$_x$ from cruise ships and LDVs
1	Barcelona	105	8,293	32,838	558,920	6,812	4,82
32	Rotterdam	18	1,538	7,714	225,210	2,745	2,81
40	Kiel	24	1,661	6,260	109,052	1,226	5,28

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.

ROB MACKOR ✉   11 oktober 2019 11:38

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

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.

FOLKERT NICOLAI ✉   18 oktober 2019 11:45

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!