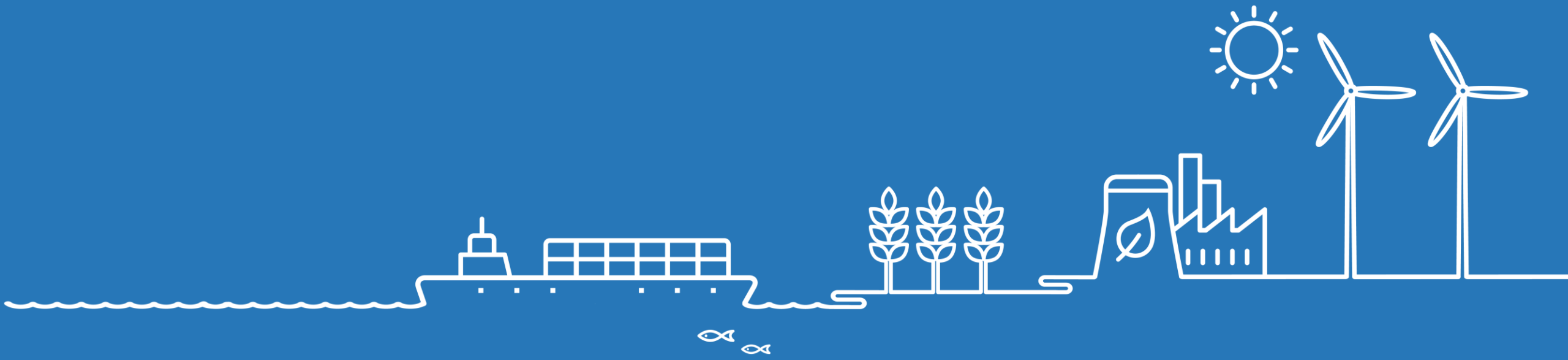
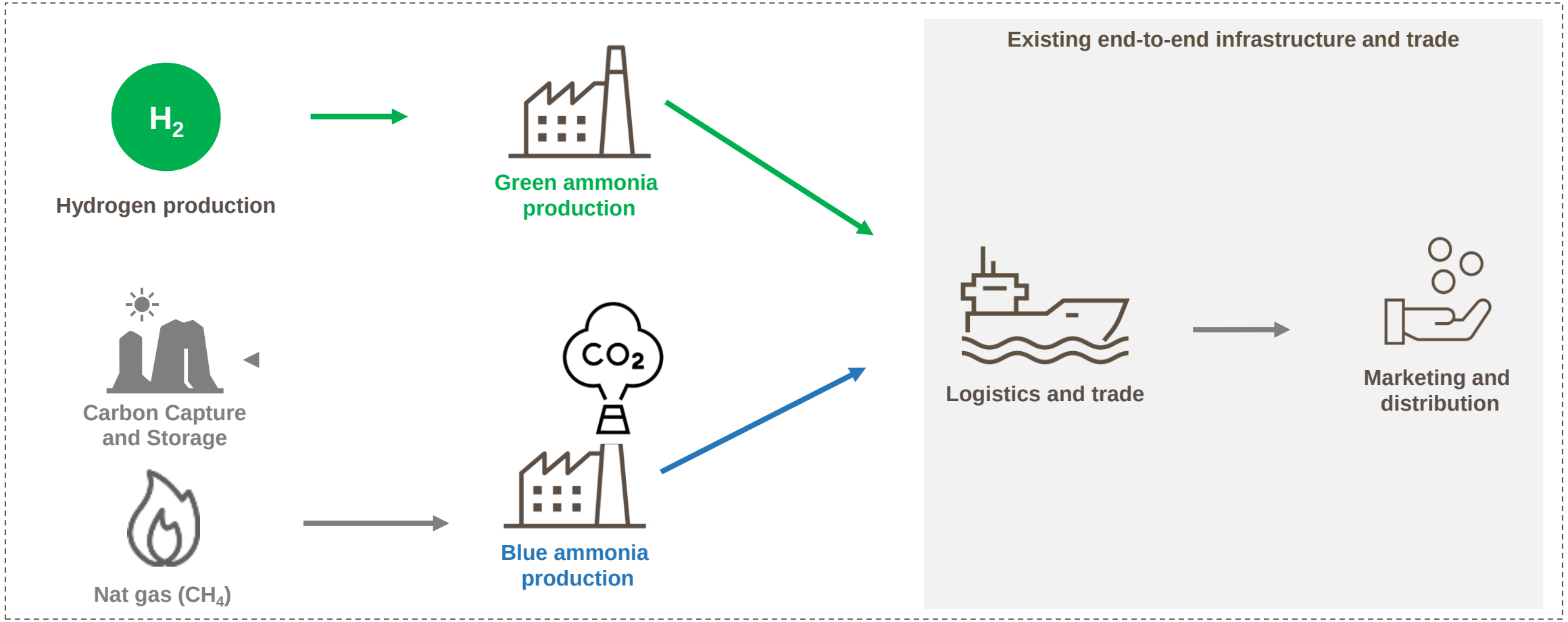
Yara Clean Ammonia



Yara Clean Ammonia established as a separate segment and business unit in February 2021 to focus on green and blue ammonia – Merging Ammonia Shipping & Trade with the Decarbonize Yara Team



YCA is a leading[1] global ammonia platform well-positioned to capture the market for clean ammonia

YCA in brief

A key **enabler of decarbonization of hard-to-abate industries**, connecting upstream projects with new customer applications

The #1 **integrated midstream platform in the ammonia value chain**[1], with asset-backed supply and a global footprint

Standalone entity **backed by majority owner and preferred partner Yara**, which has almost 100 years of ammonia experience

Company highlights

USD 3.0bn
Q1 2022 LTM Revenues

USD 159m
Q1 2022 LTM EBITDA[2]

>20%
Market share of merchant/traded ammonia in 2021[1]

4.1mT
Ammonia transported and sold Q1 2022 LTM

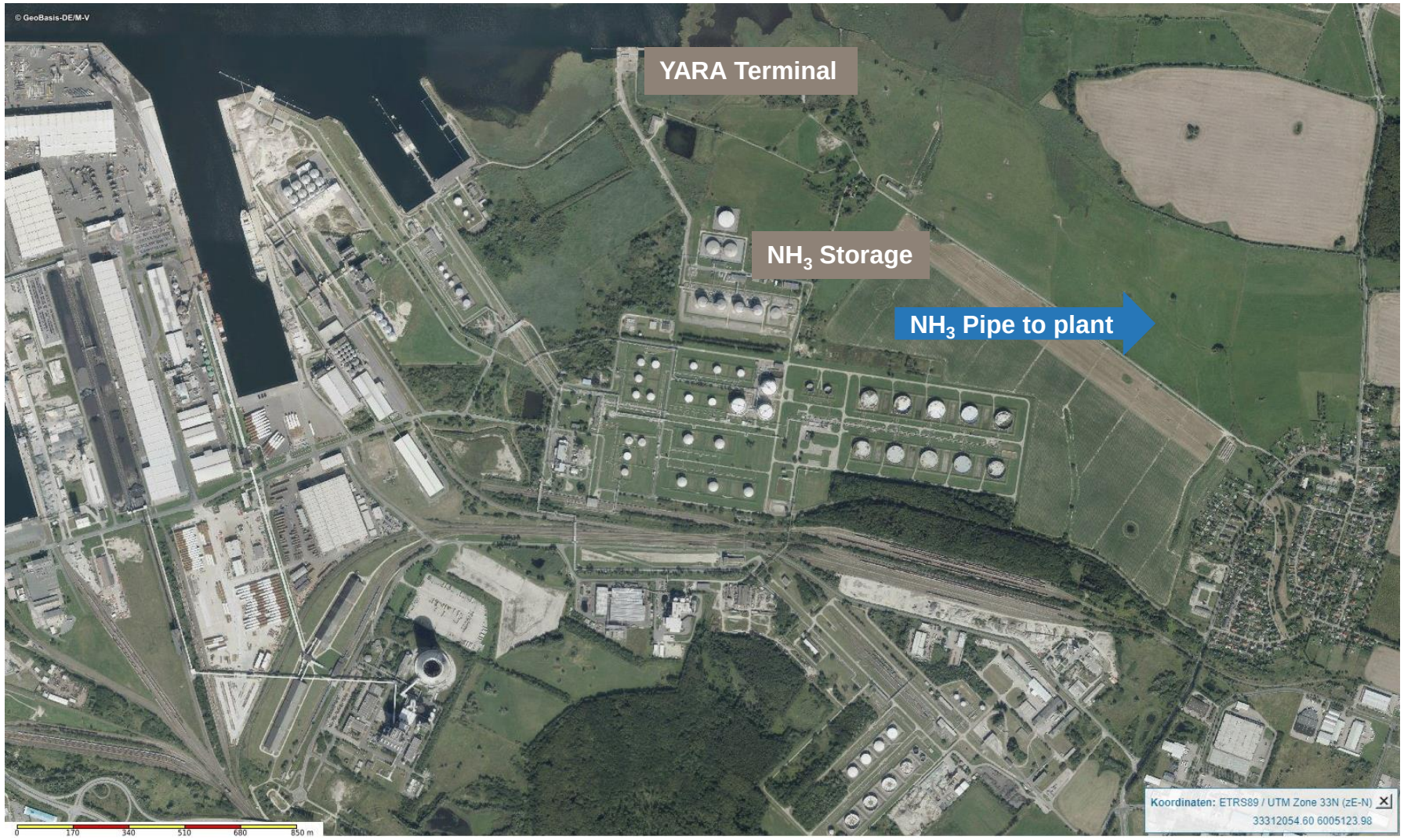
#12
Owned and leased purpose-built ammonia vessels

#18
Terminal access in key locations[3]

Source: Company information

1) Based on volumes of traded ammonia in 2021 - Argus market study (2022)
2) EBITDA is defined as operating income plus depreciation and amortization and interest income and other financial income
3) YCA has exclusive access, and manages and optimizes use of Yara's ammonia tank

Harbor Rostock



Infrastructure: Ammonia storage (46.000t), own land, water rights

YARA Rostock Harbor

Green / Clean Ammonia Import / Export Terminal

- Biggest Ammonia storage in Germany
  - Own Jetty < 30% capacity utilization
  - Ship size up to 20 kt
  - Ship Unloading rate 1000 t/h
  - Current Loading rate > 100 t/h
  - Future loading rate for ships 300 - 500 t/h
  - Currently 600.000 t/a Ammonia import up to 1.200.000 t/a possible
  - Current daily consumption 1600 t/d

Full service can be provided

- Sourcing and transporting of Ammonia
- Loading / Unloading Ammonia
- Storing Ammonia

CAMPFIRE

Project CF09 GreenBalticCruising

Development of a concept for the implementation of new propulsion systems for the use of ammonia as fuel in the Baltic Sea region

GEFÖRDERT VOM

Bundesministerium
für Bildung
und Forschung

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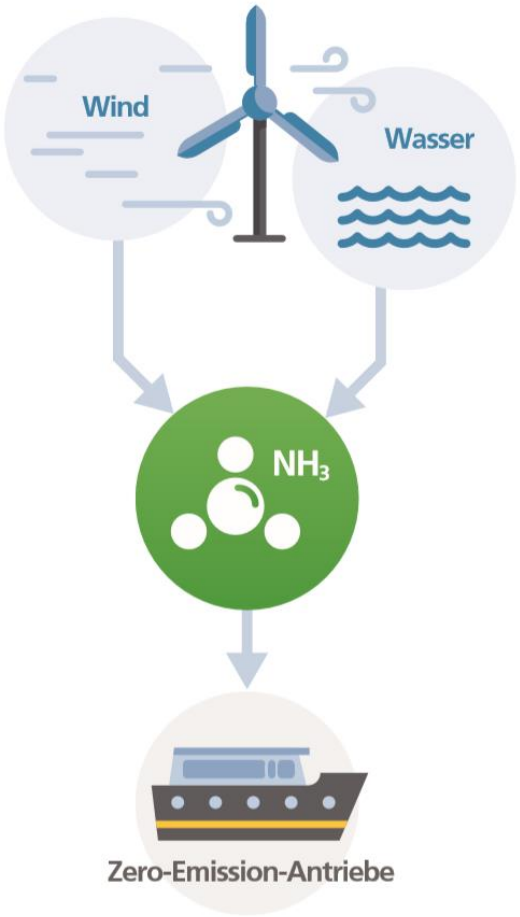
CAMPFIRE Alliance

Our vision: Development and implementation of green ammonia technologies to enable new economic pathways



- Decentralized production of **green ammonia** from air and water for storage of decentralized produced renewable energy
- Utilization in **zero-emission-drives for shipping** and land-based energy supply
- Technical solutions and safety for ammonia infrastructure and logistic
- Developement of legal framework

Bundesministerium für Bildung und Forschung

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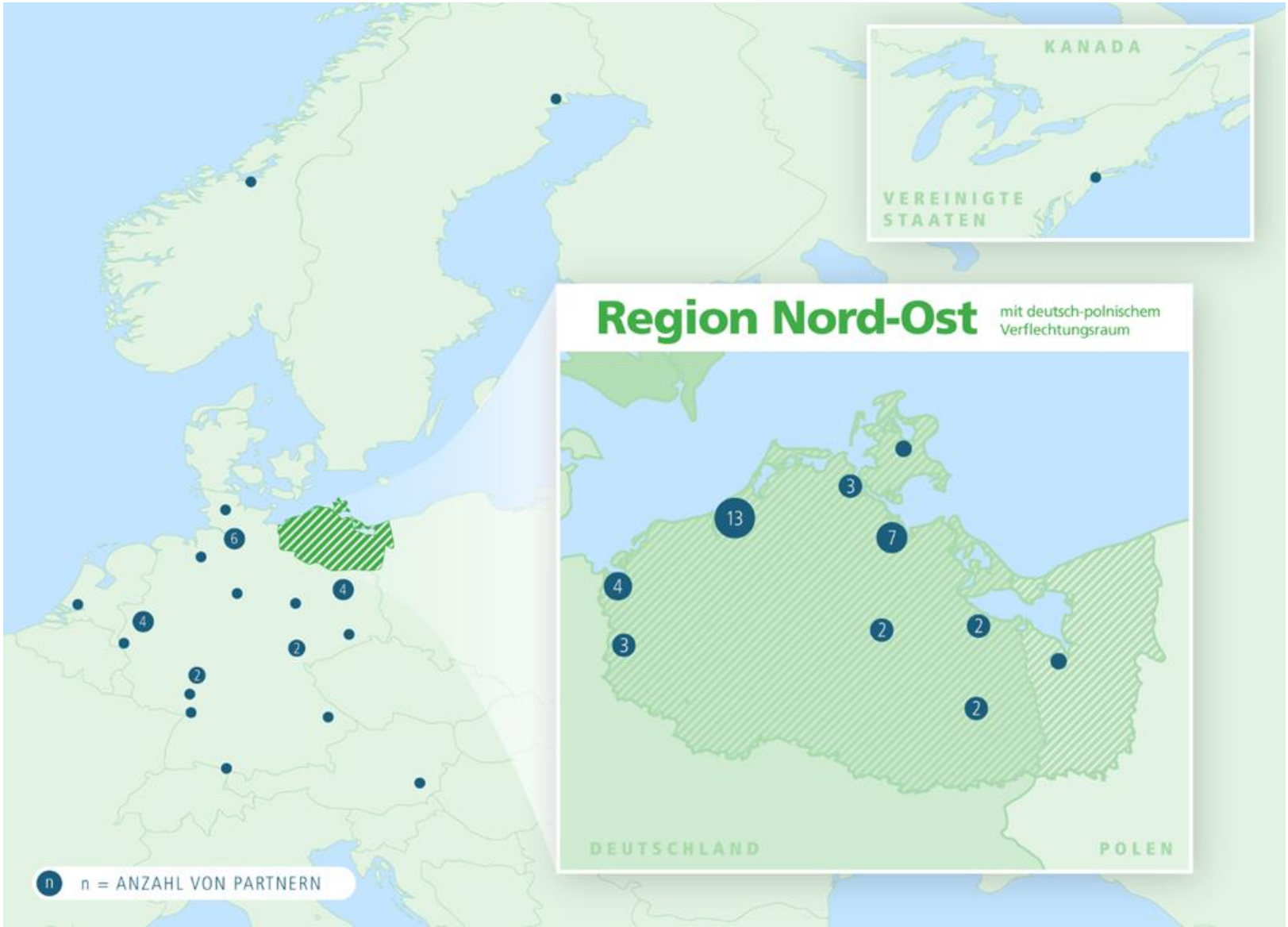
Leitprojekt TransHyDE

Geographical Partner Structure



The CAMPFIRE Alliance has 71 partners with focus in Mecklenburg-Vorpommern and Northern Brandenburg (Region North-East):

- 51 industry partners
- 5 international partners
- 20 research institutes

Aiming at development of a green ammonia ecosystem

23 collaborative projects, supported by funding over 55 Mio €

Federal Ministry of Education and Research

wir! Wandel durch Innovation in der Region

Leitprojekt TransHyDL

Federal Ministry for Economic Affairs and Climate Action

HORIZON 2020

Partners, January 2023

CAMPFIRE

CAMPFIRE Project GreenBalticCruising

Concept for the implementation of the new propulsion systems for the use of ammonia as fuel in the Baltic Sea region.

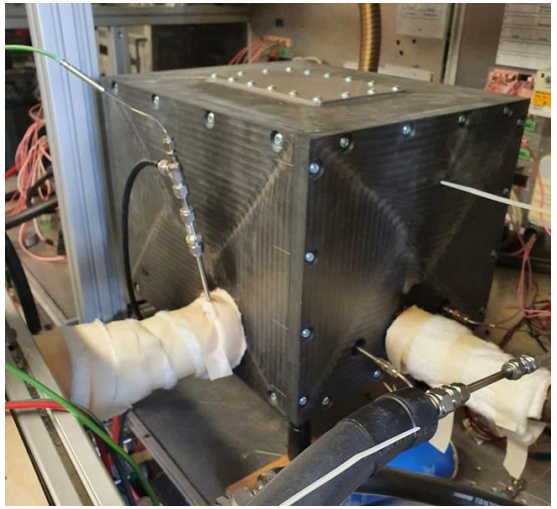
Technical evaluation for a new ammonia-based propulsion system for a cruise ship.

- Technical and economic analysis of a cruise ship for a trans-Baltic route with propulsion system of ammonia cracker and fuel cell compared to LNG.
- Concept for shore-to-ship, ship-to-ship bunkering and harbor infrastructure for ammonia in Rostock and Baltic Sea region
- Investigation of the strategies for the reduction of greenhouse gas emissions of the riparian states and legal approach for establishment of ammonia.

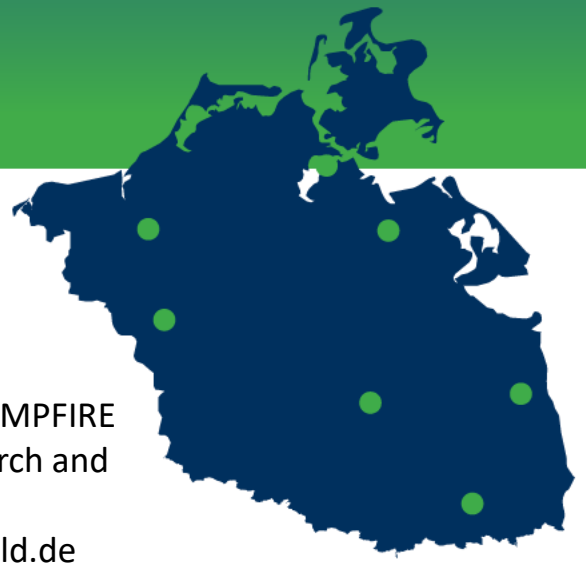
CAMPFIRE Project GreenBalticCruising

Opening the path to technology leadership and market capitalization of regionally produced ammonia technologies in the Baltic Sea region.

- Generalizable approaches to the main challenges on the way to a zero-emission ship
- legal and political framework, economic viability and availability of the emission-free fuel ammonia



CAMPFIRE | DANKE



Contact:
Dr. Angela Kruth
Spokesperson and coordinator CAMPFIRE
Leibniz Institute for Plasma Research and Technology e.V.
Email: angela.kruth@inp-greifswald.de

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www.wir-campfire.de

CAMPFIRE GreenBalticCruising – Feasibility of Marine Renewable Ammonia for Cruise Liners

April 6, 2023

Sebastian Prochnow - port strategy/environmental tasks
ROSTOCK PORT GmbH

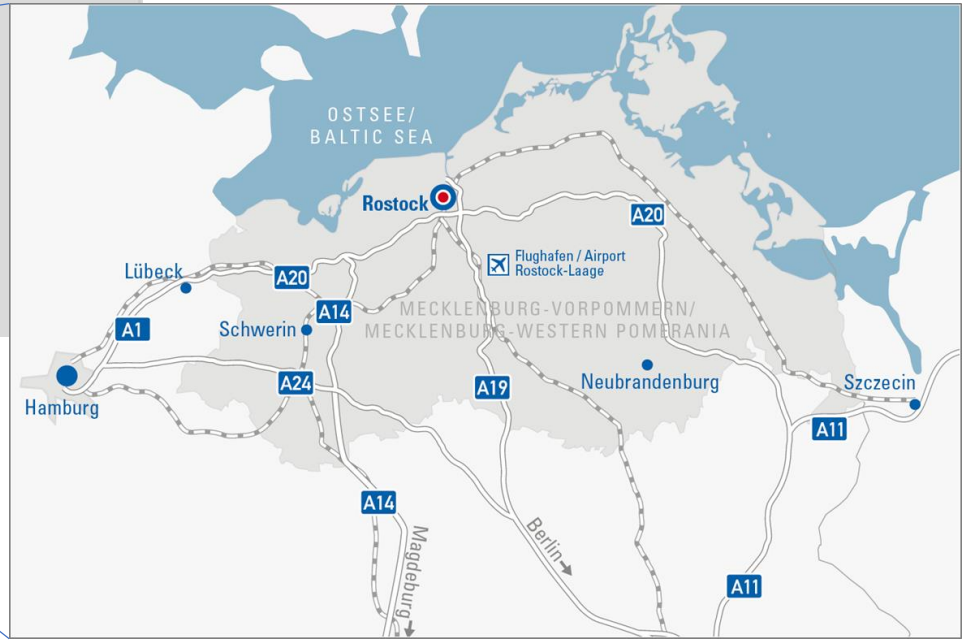




1. Introduction of ROSTOCK PORT

2. Partnership in CAMPFIRE „GreenBalticCruising“

Rostock seaport is located near metropolises in germany, Poland and Denmark



Hamburg, Berlin, Szczecin, Copenhagen are within 200 kilometers distance

Organisational structure of the seaport of Rostock

ROSTOCK PORT GmbH

port operator // owner of port infrastructures // landlord port authority
25,1% federal state of Mecklenburg-Vorpommern // 74,9% hanseatic city of Rostock

ROSTOCK PORT

General location marketing // maintenance of port infrastructures // external and internal port development

Renting of office premises // leasing of port areas // political lobbying

Cargo handling companies

Independent from the port operator

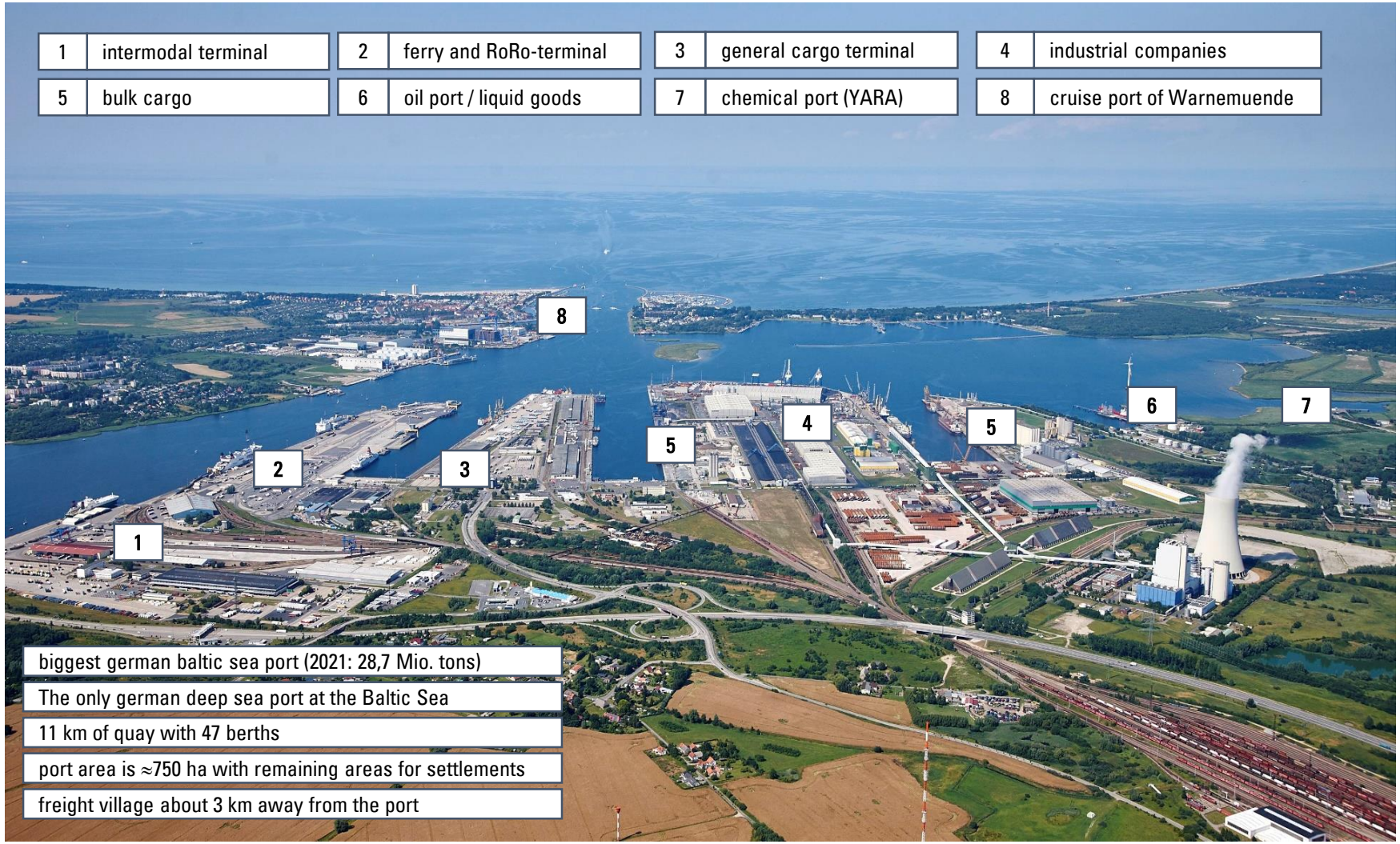
EUROPORTS
GOR
RZU
SB
Baltic Lloyd
GETREIDE AG

Logistics service provider

Independent from the port operator

FRACHTCONTOR.
DB SCHENKER
ScanRo Trailer Rent + Service
BALTIMAR SCHIFFAHRT & TRANSPORT GMBH

1	intermodal terminal	2	ferry and RoRo-terminal	3	general cargo terminal	4	industrial companies
5	bulk cargo	6	oil port / liquid goods	7	chemical port (YARA)	8	cruise port of Warnemuende



- biggest german baltic sea port (2021: 28,7 Mio. tons)
- The only german deep sea port at the Baltic Sea
- 11 km of quay with 47 berths
- port area is ≈750 ha with remaining areas for settlements
- freight village about 3 km away from the port

1. Introduction of ROSTOCK PORT

2. Partnership in CAMPFIRE „GreenBalticCruising“

Work package I → analysis of the ports in the Baltic Sea with regard to their current ammonia production and storage facilities

- as a result, it was determined that there is a well-developed ammonia storage and distribution structure in the examined area this is seen as a suitable basis for a future ammonia supply infrastructure
- the existing ammonia terminals were classified as basically suitable for loading bunker ships
- most cruise ports and ferry ports with at least three international ferry connections are within 100 nautical miles of the nearest ammonia terminal and can therefore be reached by bunker ship

Major challenge

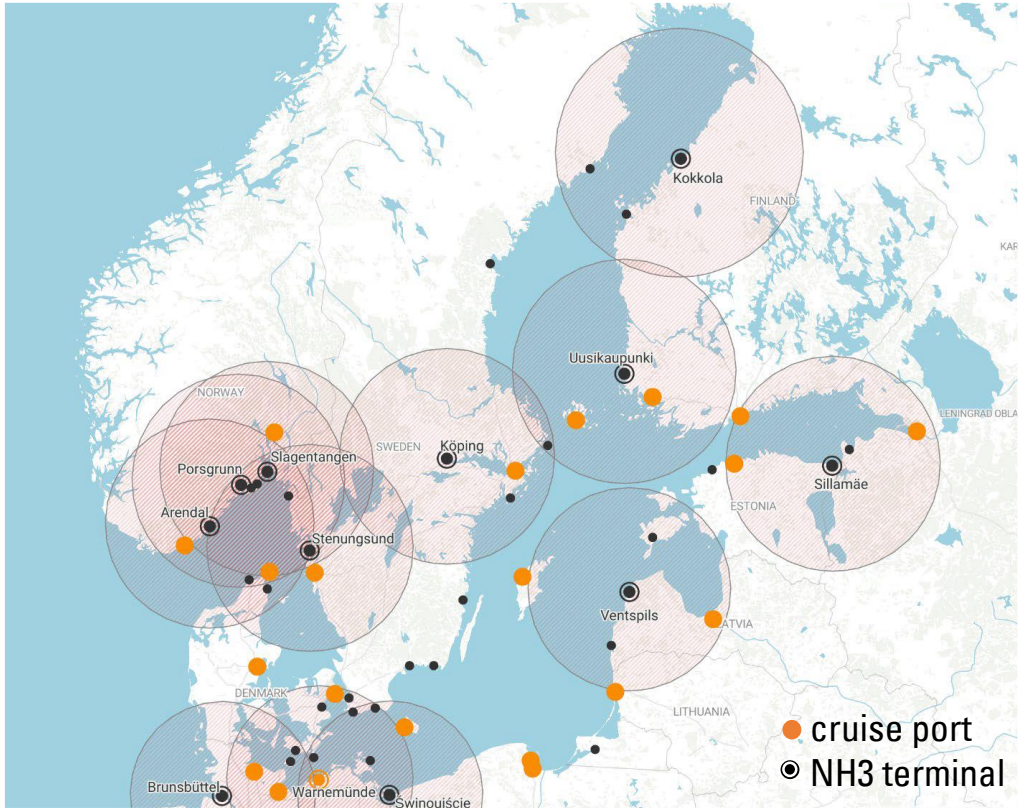
Sufficient distances between the potential bunker ports and the nearest residential areals. Due to the high hazard potential when handling ammonia, specified safety distances must be taken into account.

Work package I → analysis of the ports in the Baltic Sea with regard to their current ammonia production and storage facilities

- the distance of a cruise in the Baltic sea is approx. 1 700 nautical miles with 14 days of travel time, the consumption for a ammonia powered cruise vessel is estimated at around 2 000 tons
- for two bunker operations the capacity of 1 000 tones is necessary → seagoing bunker vessels will play the biggest role in ammonia powered cruise future
- Bunker quantities are lower for ferries. The longest ferry connections in the Baltic Sea region is approx. 400 - 500 nautical miles. The ammonia quantity per bunker operation is estimated at several 100 tons – despite of that only ship to ship bunkering is practicable
- Truck-to-ship bunkering could be an option for smaller ships because of the low capacities (15 tons per truck / ISOtainer)

Conclusion

In principle coverage of the Baltic Sea and the adjacent North Sea area by the existing ammonia terminals can be considered sufficient for ammonia powered cruise vessels and ferries. The biggest challenge will be the availability of bunker ships with the needed capacity.



Work package II → HAZID WORKSHOP – ammonia bunkering at the Warnemuende cruise port and the Rostock seaport

- with the help, guidance and experience of DNV a first hazard identification (HAZID) for possible bunkering scenarios was done within the project – with the participation of local experts and authorities, technology suppliers, the "GreenBalticCruising" consortium and other CAMPFIRE partners
- four scenarios were investigated → Ship-to-ship(Sts) and Truck to ship(Tts) at the Warnemuende cruise port, Sts and Tts at the Rostock seaport

- ship to ship bunkering – at berth P8 (cruise port)

- Truck to ship bunkering – cargo vessel at berth 34
- ship to ship bunkering – RoRo-Ferry at berth 64

Work package II → HAZID WORKSHOP – ammonia bunkering at the Warnemuende cruise port and the Rostock seaport

- the HAZID method includes the identification of possible hazard scenarios, the qualitative classification of the risk potential and, if necessary, the recommendation of safety measures

Consequence				Description	Never heard of in the industry	Occured in the industry	Occurred in the company	Occurred several times per year in the company	Occured several times per year in the location
				Range / Yr.	$< 10^{-6}$	$> 10^{-6}$	$> 10^{-4}$	> 0.01	> 1
P	S	E		Proability	1	2	3	4	5
Safety	System Safety	Environment	Severity Index	Descriptor	Remote	Unlikely	Likely	Very likely	Extremly likely
Zero injury	No disturbance	Zero Impact	0	Zero	L	L	L	L	L
Slight injuries, superficial injuries, no loss of work time	Disturbed - but safe - operation of the system	**Slight effect,** negligable effect on environment	1	Slight	L	L	L	L	L
Minor injuries, <5 working days lost	Essential safety barrier down but immediately restored	**Minor effect,** in compliance with regulations	2	Minor	L	L	L	M	M
Major injury, long-term absence	Essential safety barrier down unnoticed for a short period of time	**Local effect,** response required (inform authorities)	3	Significant	L	L	M	M	H
Single fatality and/or permanent disabiliiites	Essential safety barrier down unnoticed (operation continues)	**Major effect,** significant response required	4	Severe	L	M	M	H	H
Multiple fatalities	Loss of the system and loss of other systems	**Massive effect,** damage over a large area and/or long time	5	Catastropic	M	M	H	H	H

Risk Definition	
Low	Acceptable risk: no further safeguards are necessary, but some additional measures can be implemented if recognized good practice and cost-effective
Medium	Medium risk or ALARP (As Low As Reasonable Practicable): risk is tolerable if all reasonably practicable safeguards have been implemented. Additional or alternative safeguards will
High	Unacceptable risk: risk must be reduced by additional or alternative safeguards to implement before operation

failure modes and effects analysis (FMEA)

Work package II → HAZID WORKSHOP – ammonia bunkering at the Warnemuende cruise port and the Rostock seaport

- the aim of the work package II is to develop a feasibility study as a base for a future bunkering permit
- the following basic assumptions were made in the risk assessment:
  - the design and manufacture of the technical equipment corresponds to the standards, all regulations and intervals for testing and maintenance are observed
  - port facilities, infrastructure and local conditions are in good condition, allow safe operation and are regularly maintained
  - technical and operational security measures and processes are carried out in accordance with the framework conditions documented here
  - the bunkering takes place within the parameters of the study base on which the HAZID workshop is based
  - So-called single-failure cases are assumed, i.e. it is not assumed that two or more independent errors occur at the same time
  - the personnel involved are familiar with the bunkering procedures and checklists, follow them as a matter of principle and do not intentionally circumvent existing safety measures
  - terrorism and sabotage are not considered.

Work package II → HAZID WORKSHOP – ammonia bunkering at the Warnemuende cruise port and the Rostock seaport

- with the assumptions made no issues were identified related to safety, involved vehicles/vessels and environment that would make the bunkering of ammonia for the examined bunkering scenarios unfeasable
  - an exception is the TtS-scenario at the cruise port – due to the limited space at the terminal the feasibility is questionable and the workshop participants decided against an investigation
- this is the result of a study with the character of a conceptual investigation, detailed systems and processes are still unknown, such as
  - the need for further safety barriers
  - the presence of bunker equipment approved for the purpose
  - requirements regarding the type and scope of the personal protective equipment of the bunker staff

- Despite the possible feasibility, details and operational aspects must be clarified for the remaining scenarios
  - the necessary dimensions and number of the safety zones/distances have yet to be determined (will be done in another investigation) – in the present cases safety zones were assumed to be adequately dimensioned
  - the recommendation of DNV is that the HAZID should be repeated with the participation of the ammonia bunker supplier if a specific bunker project is planned

CAMPFIRE