# Hydrogeninfrastructure and maritime application

wintershall dea

entec

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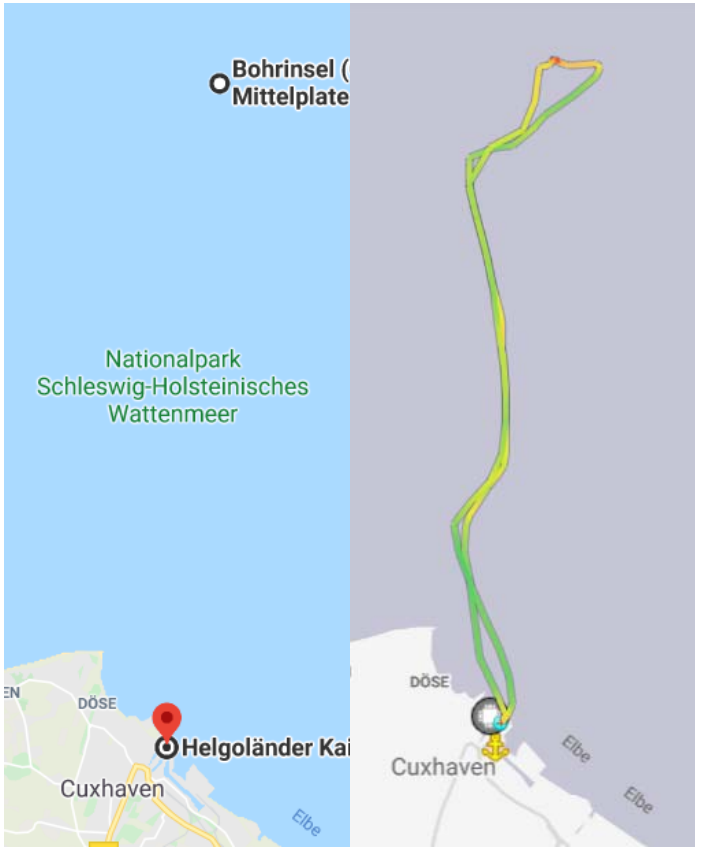
# Baseline

- The oilplatform Mittelplate is supplied by supply vessels across the offshore landbase in Cuxhaven that is organised by EnTec Industrial Services in Cuxhaven
- The transportation occurs through ares of the wadden sea by vessels of the shipowner Acta Marine
- The daily supply produces carbon dioxide emissions

Goal:

- ➢ Reduction of emmissions, especially in the sensitive areas of the wadden sea, nearshore areas, mooring time
- ➢ Evaluation of thechnical feasibility
  - ➢ Landward infrastructure for the production of hydrogen
  - ➢ Rebuilding the vessel with a hydrogenhybrid propulsion by fuel cell



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# Naval consideration
## Procedure

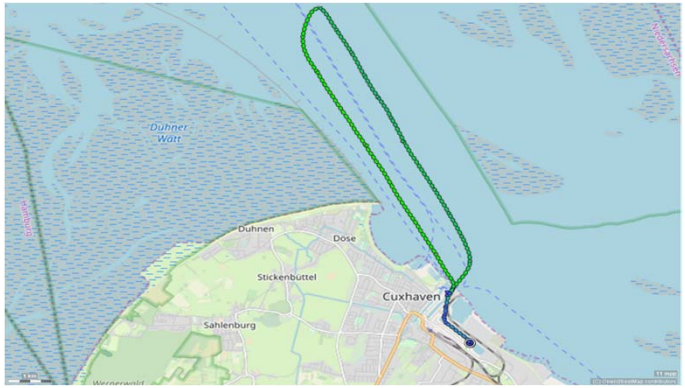
- Procedure
  - Survey of the demand of power output of the ship
  - Creation of the required profiles for the technical design for the propulsion
  - Component selection
  - Cooperation with the DNV GL/Flags :
    - Development of a concept that satisfies all safety-relevant requirements in order to be able to obtain approval in the event of an order

# Naval consideration
## Power consumption

Creation of a Speed Power Curve:

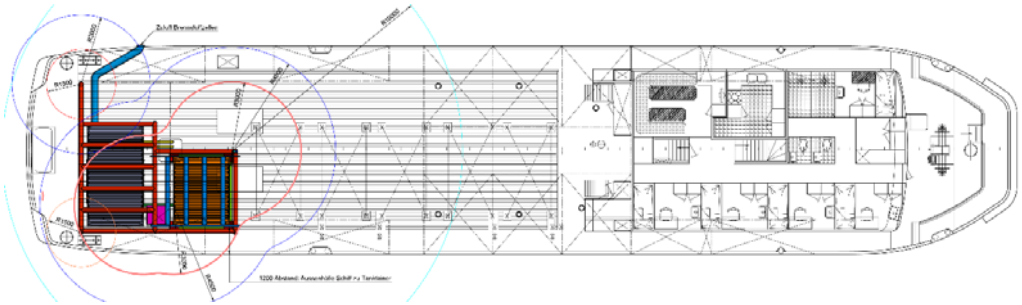
- Preparation:
  - Speed measurement on a motor shaft
  - Torsion measurement on a motor shaft
  - For later verification of the measured values:
    - GPS recording of the test drive
    - Recording of the displays in the ship (speed and motor/wave data)

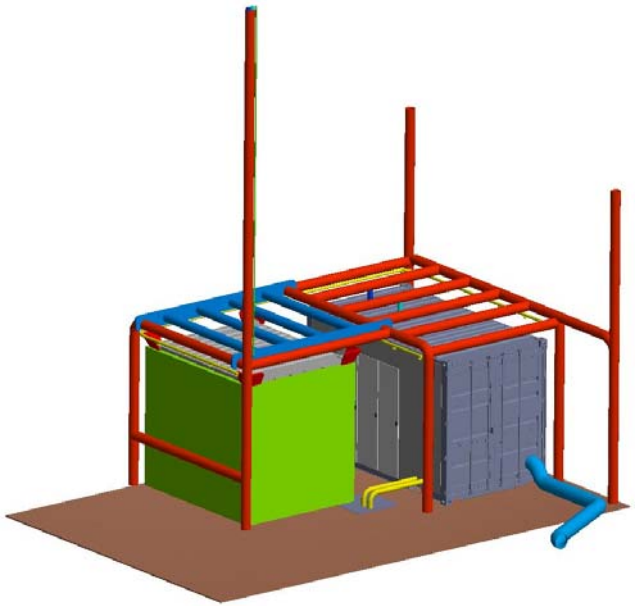
- Test drive in the required performance ranges
- Evaluation of measurement data




# Naval consideration
# Concept presentation

- Two containers are set up in the rear deck area
  - $H_2$ES (Hydrogen (**$H_2$**) **E**lectric **S**ystem)
    - 15 ft. Iso Container
    - Stays on board the ship
  - Tanktainer
    - 10 ft. Iso Container
    - Replaced after each driving cycle

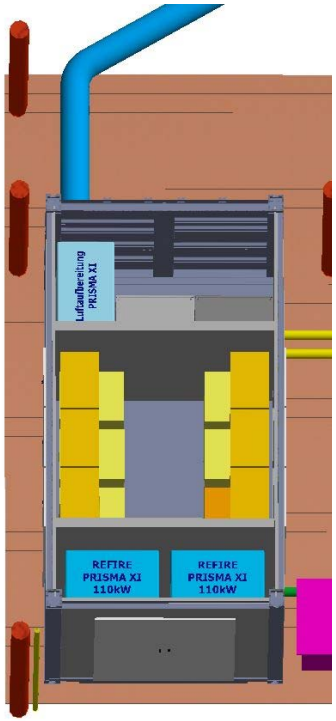




# Naval consideration
# Concept presentation

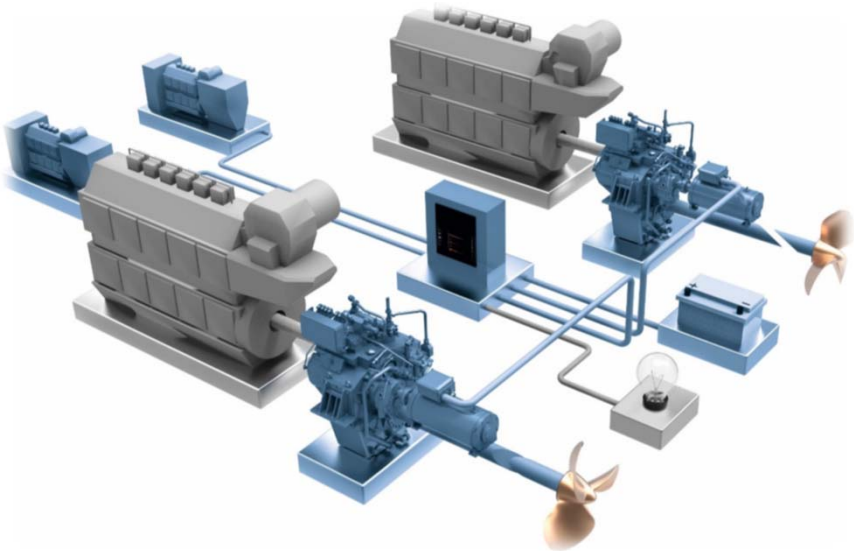
- $H_2ES$ components:
  - Fuel cells
  - Auxiliary units of fuel cells
  - Battery system
  - Power electronics for converting the DC voltage (battery/fuel cell system)
  - Control and safety systems for the operation of the H2ES
  - All required safety systems

- Tanktainer:
  - Complete tanksystem
  - All required safety systems



# Naval consideration
# Concept presentation

- Hybrid gearbox with flanged electric motors:
  - Gearboxes installed so far will be replaced



Quelle: „Hybrid-System explanation and graphics“ von REINTJES Powertrain Solutions

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# Naval consideration
# Certification

DNV GL:

- The licensing issues relate mainly to safety aspects
  - Approval in Principle (AiP) has been granted
    - Detailed technical description of the concept
    - Production of technical drawings and documents (general plan, single line diagram, hazardous area plans, etc.)
    - Execution of a HAZID workshop to identify a wide range of sources of danger

- Result:
  - In some respects, the technical design in the case of the contract must be further elaborated
  - It was considered "feasible" to implement this concept

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# Landwise consideration
## Technical Analysis

**Preliminary consideration**

- In-house production or purchase
- $H_2$-demand: 150 kg/d
- $H_2$-supply via 10‘-tank-container

| Tank-Containerdefinition | | |
|---|---|---|
| **Druck** | bar | 350[1] |
| **Inhalt** | kg $H_2$ | 190[1] |
| **Tatsächliches Volumen** | m³ | 8,4 |
| **Gewicht (beladen)** | t | 7 |

Scenario I: Electrolysis + intermediate storage + Compressor + Tank Container

Scenario II: Delivery of the filled Tank container

Scenario III: Delivery H2-Trailer + intermediate storage + Compressor + Tank Container

[1] laut Angaben des Herstellers Worthington würde eine Reduzierung des Druckniveaus auf 300 bar vorgenommen werden müssen, um eine ADR-Zulassung zu erhalten. Daraus würde sich das Fassungsvermögen auf 176 kg $H_2$ verringern

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- Baseline
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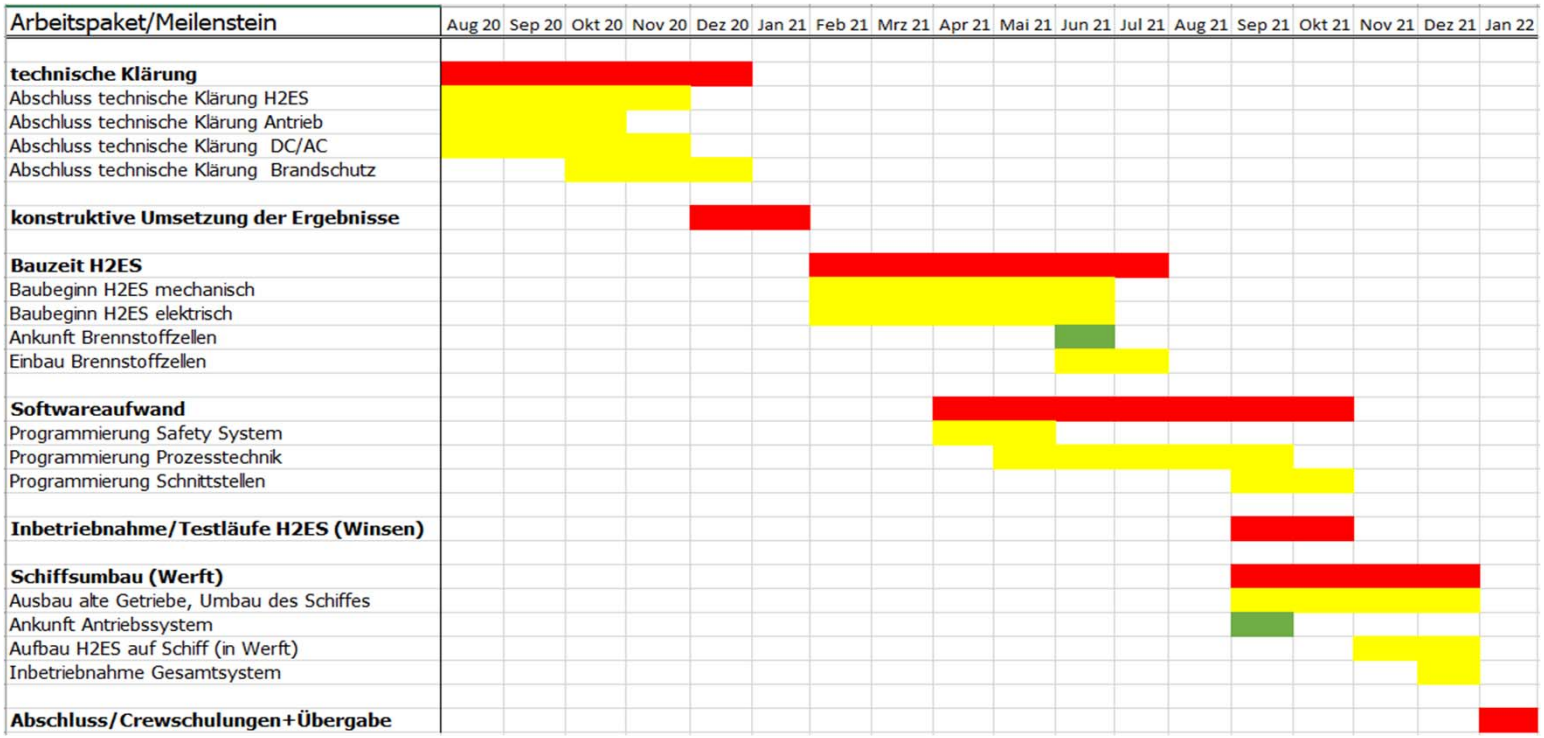
- Landwise consideration
- **Timeline**
- Result

# Timeline

Timeline for the conversion of the ship/construction of the container solutions



# Timeline

| Szenario I | | Monat 1 | Monat 2 | Monat 3 | Monat 4 | Monat 5 | Monat 6 | Monat 7 | Monat 8 | Monat 9 | Monat 10 | Monat 11 | Monat 12 | Monat 13 | Monat 14 | Monat 15 | Monat 16 | Monat 17 | Monat 18 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Anlagendesign + Detailplanung | | | | | | | | | | | | | | | | | | | |
| Baugenehmigungsverfahren | | | | | | | | | | | | | | | | | | | |
| Betriebsgenehmigungsverfahren | | | | | | | | | | | | | | | | | | | |
| Bestellung Bauteile | Elektrolyseur | | | | | | | | | | | | | | | | | | |
| | Kompressor | | | | | | | | | | | | | | | | | | |
| | Speicher | | | | | | | | | | | | | | | | | | |
| | Bündel | | | | | | | | | | | | | | | | | | |
| Civil Works | | | | | | | | | | | | | | | | | | | |
| Inbetriebnahme | | | | | | | | | | | | | | | | | | | |
| Schiffsumbau | | | | | | | | | | | | | | | | | | | |

| Szenario II | Monat 1 | Monat 2 | Monat 3 | Monat 4 | Monat 5 | Monat 6 | Monat 7 | Monat 8 | Monat 9 | Monat 10 | Monat 11 | Monat 12 | Monat 13 | Monat 14 | Monat 15 | Monat 16 | Monat 17 | Monat 18 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Anlagendesign + Detailplanung | | | | | | | | | | | | | | | | | | |
| Baugenehmigungsverfahren | | | | | | | | | | | | | | | | | | |
| Betriebsgenehmigungsverfahren | | | | | | | | | | | | | | | | | | |
| Bestellung Bündel | | | | | | | | | | | | | | | | | | |
| Inbetriebnahme | | | | | | | | | | | | | | | | | | |
| Schiffsumbau | | | | | | | | | | | | | | | | | | |

| Szenario III | | Monat 1 | Monat 2 | Monat 3 | Monat 4 | Monat 5 | Monat 6 | Monat 7 | Monat 8 | Monat 9 | Monat 10 | Monat 11 | Monat 12 | Monat 13 | Monat 14 | Monat 15 | Monat 16 | Monat 17 | Monat 18 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Anlagendesign + Detailplanung | | | | | | | | | | | | | | | | | | | |
| Baugenehmigungsverfahren | | | | | | | | | | | | | | | | | | | |
| Betriebsgenehmigungsverfahren | | | | | | | | | | | | | | | | | | | |
| Bestellung Bauteile | Kompressor | | | | | | | | | | | | | | | | | | |
| | Speicher | | | | | | | | | | | | | | | | | | |
| | Bündel | | | | | | | | | | | | | | | | | | |
| Civil Works | | | | | | | | | | | | | | | | | | | |
| Inbetriebnahme | | | | | | | | | | | | | | | | | | | |
| Schiffsumbau | | | | | | | | | | | | | | | | | | | |
| Frühester Abschlusstermin | | | | | | | | | | | | | | | | | | | |
| Spätester Abschlusstermin | | | | | | | | | | | | | | | | | | | |

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- Timeline
- **Result**

# Result

## Naval

- Performance requirements for the ship can be met
  - Emission-free propulsion of the vessel for the required period with the above parameters
- Approval of the propulsion system or the entire system with the ship is possible
  - DNV GL and flags have confirmed the approval in the course of an AiP
  - AiP is the basis for the further technical elaboration of the system

## Landwise

- Technically valid and feasible
- No concerns from the authorities
- Pollutant and noise emissions in the Wadden Sea can be reduced

➢ The study shows that a change in ship operations, including the supply infrastructure, is possible.

# Result

## Conclusion

Technically feasible

Ship feasible and eligible for approval
Supply feasible and eligible for approval

Emissions

CO2: Reduction of up to 418,000 kg/a
NOx: No emissions
SOx: No emissions
Sound: No emissions

Strong commitment

**Land:** Prime Minister lower saxony
Minister for the Environment
**Bund:** Funding
**City of Cuxhaven:** Mayor, AfW

## Lookahead

Development goals

- Use of maritime conversion expertise for other supply ships, government ships, maritime tourism, etc.
- Use and expansion of the filling station for refuelling:
  - Power Pacs for land power supply for ships
  - Trucks of local, regional and supra-regional companies
  - Public transport buses
  - Urban garbage and cleaning vehicles
  - Trains

Thank you for your attention