Fraunhofer CML

Dr.-Ing. Anisa Rizvanolli
Visit of Canadian Ferry Association (CFA)
March 19, 2026

The Fraunhofer CML – Innovating the Maritime Sector

Agenda

- Fraunhofer
- Project Highlights

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- **Fraunhofer**
- Project Highlights

Hamburg University of Technology and Fraunhofer CML

- **Institute of Maritime Logistics at the TUHH**
  - Education
  - University research
- **Fraunhofer CML**
  - Applied research for private and public clients
  - Port, shipping, logistics

TUHH
Technische Universität Hamburg

Fraunhofer CML

Fraunhofer-Gesellschaft

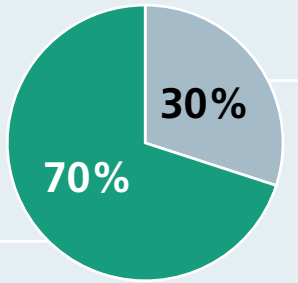
At a glance

Applied research focusing on key future-relevant technologies and the commercialization of findings in business and industry. A trailblazer and trendsetter in innovative developments.

Approx. 32,000 employees

75 institutes and research units

Business volume of €3.6 billion
Contract research totaling €3.1 billion



Base funding from Germany's federal and state governments

Industrial contracts and publicly funded research projects

Fraunhofer-Gesellschaft

The Fraunhofer-Gesellschaft's global network

8 legally independent foreign affiliates
1 *opening soon*

Active collaboration with partners in roughly **90** countries

5 representative offices build bridges to local markets around the world

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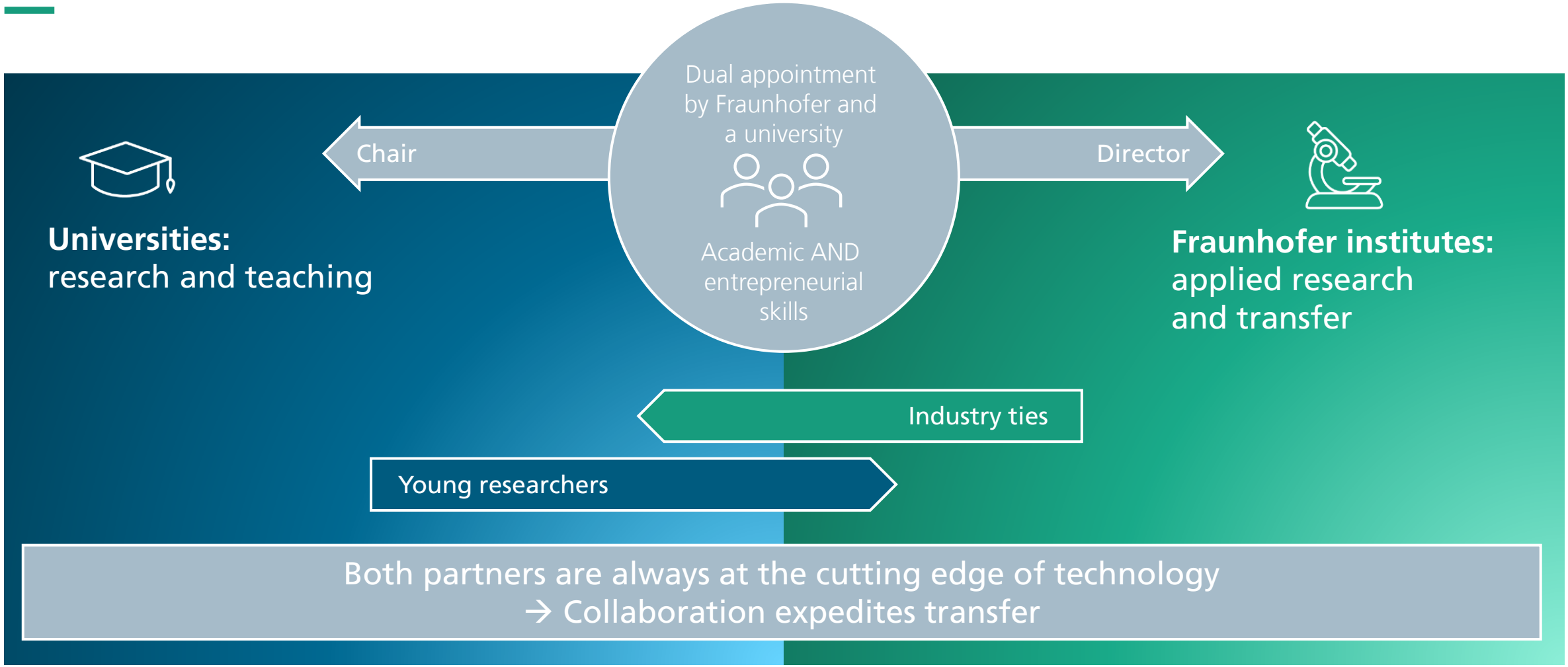
Fraunhofer and Universities

Synergies through complementarity



Fraunhofer CML

Innovating the Maritime Sector

- Founded in 2010 as a member of the “Fraunhofer family” at the Hamburg University of Technology
  - Around 100 employees
  - Engineers
  - Logistics specialists, economists
  - Computer scientists, mathematicians
  - Navigators

- Research Building
  - in Harburg's inland port
  - 2,400 m², including 800 m² of laboratory space

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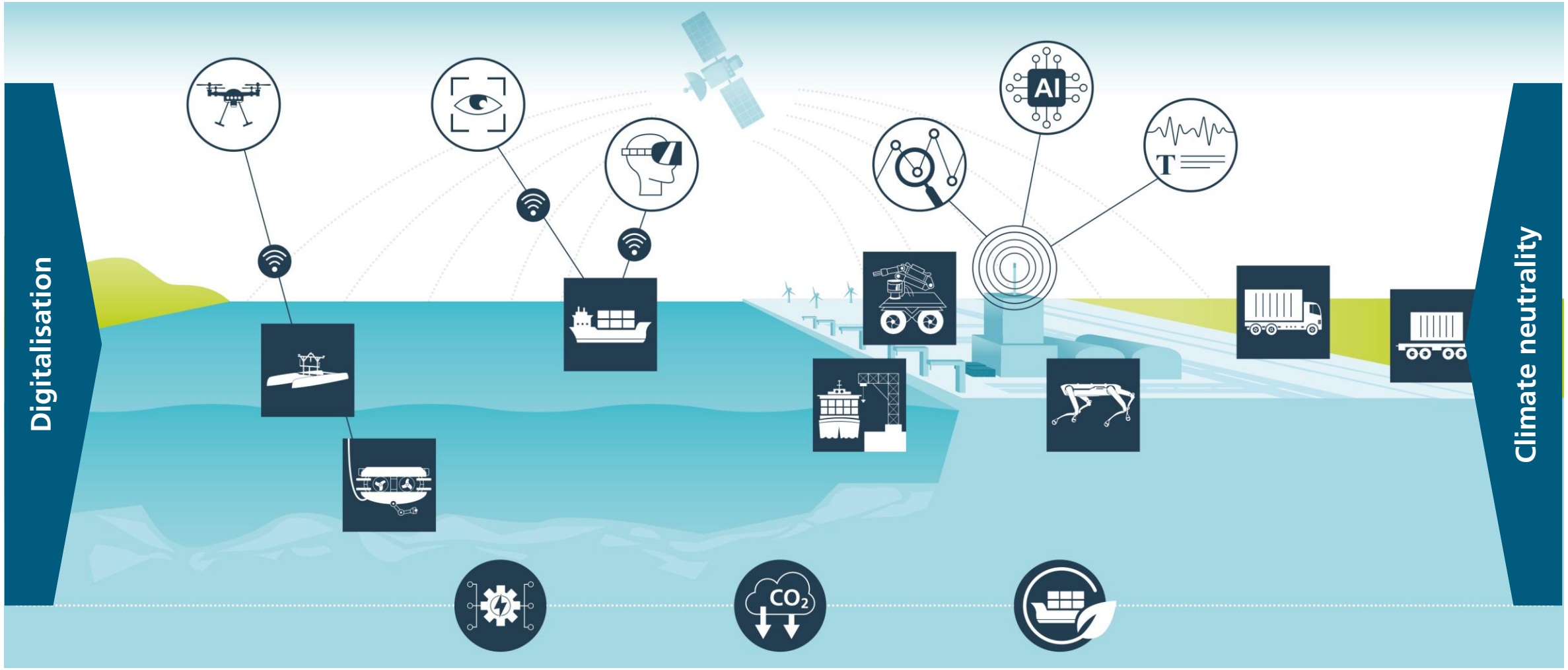
Innovating the Maritime Sector

Making shipping, ports and logistics safer, more efficient and more sustainable



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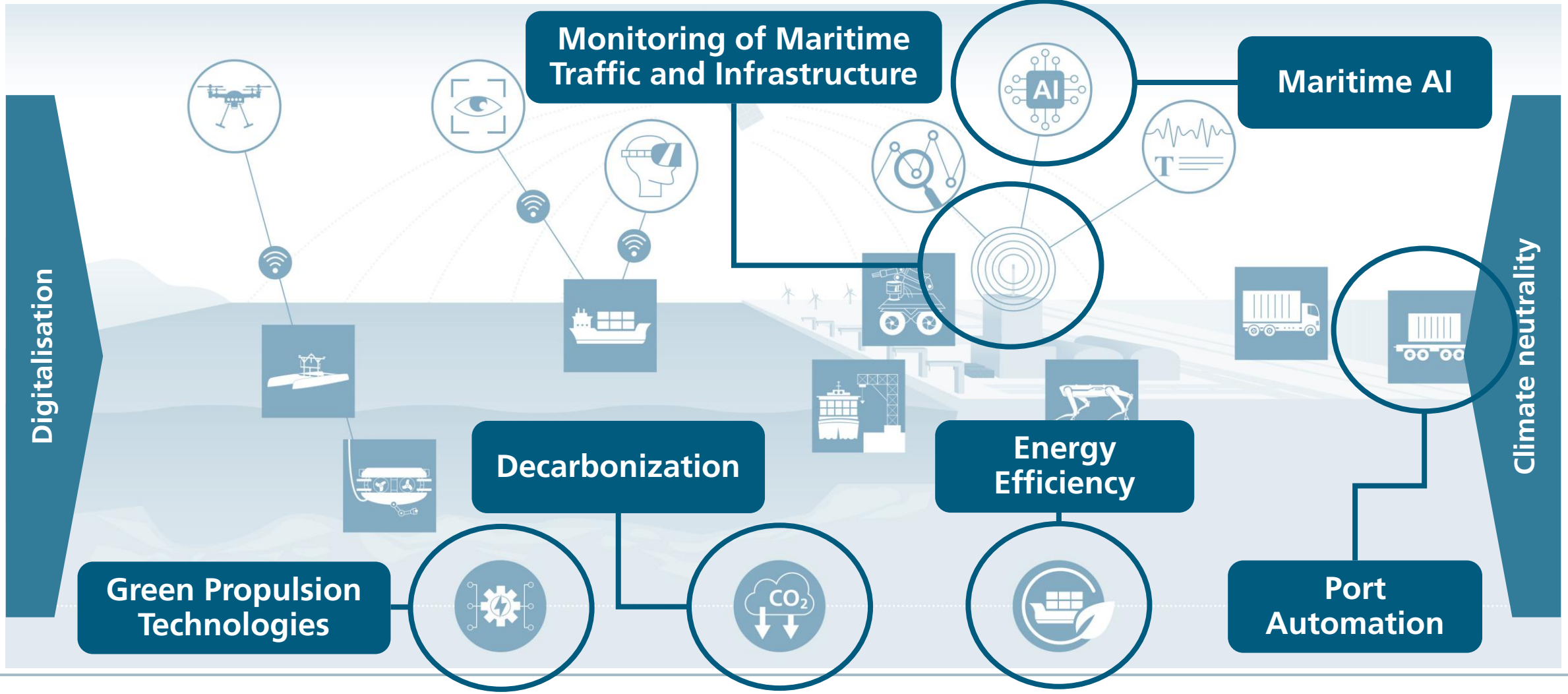

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Making shipping, ports and logistics safer, more efficient and more sustainable

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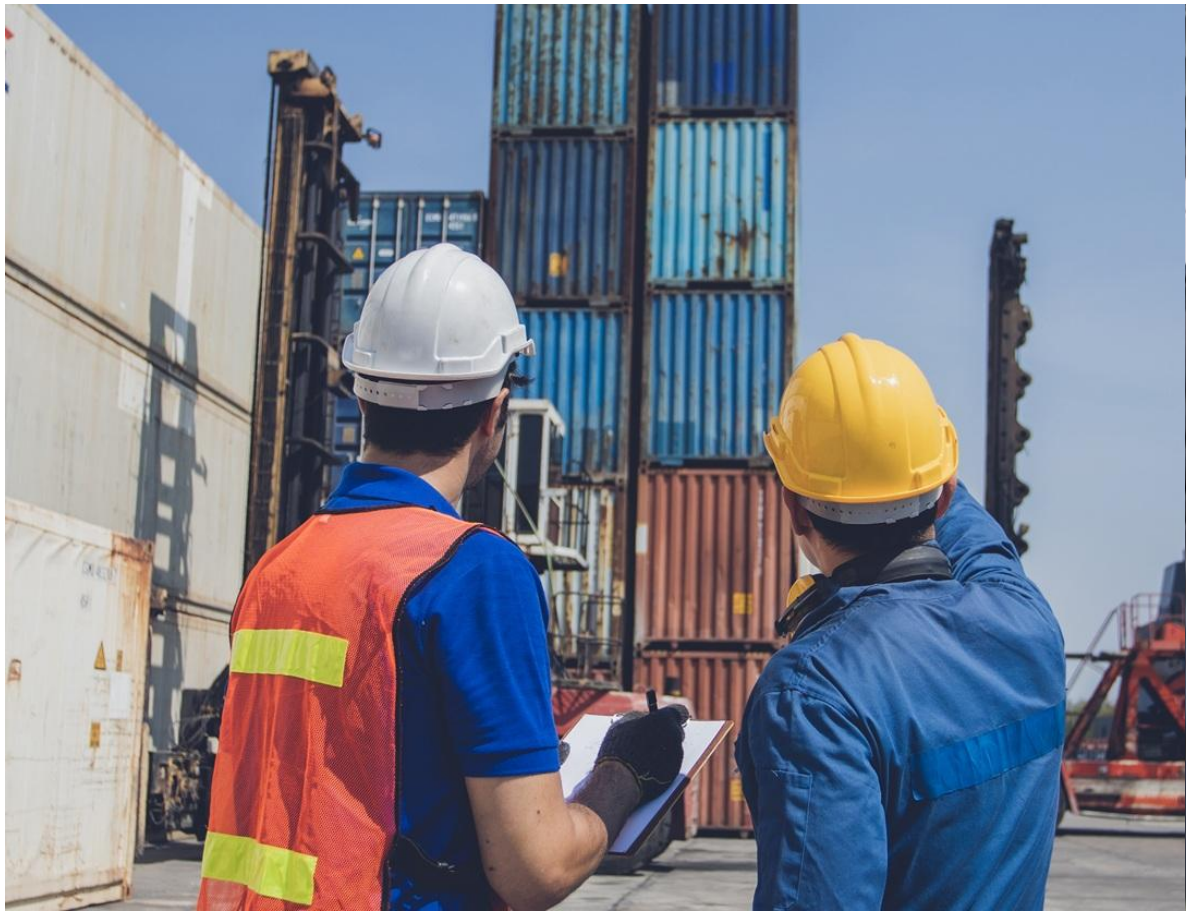
Maritime AI

Container damage assessment with automatic image recognition

COOKIE

Project description:

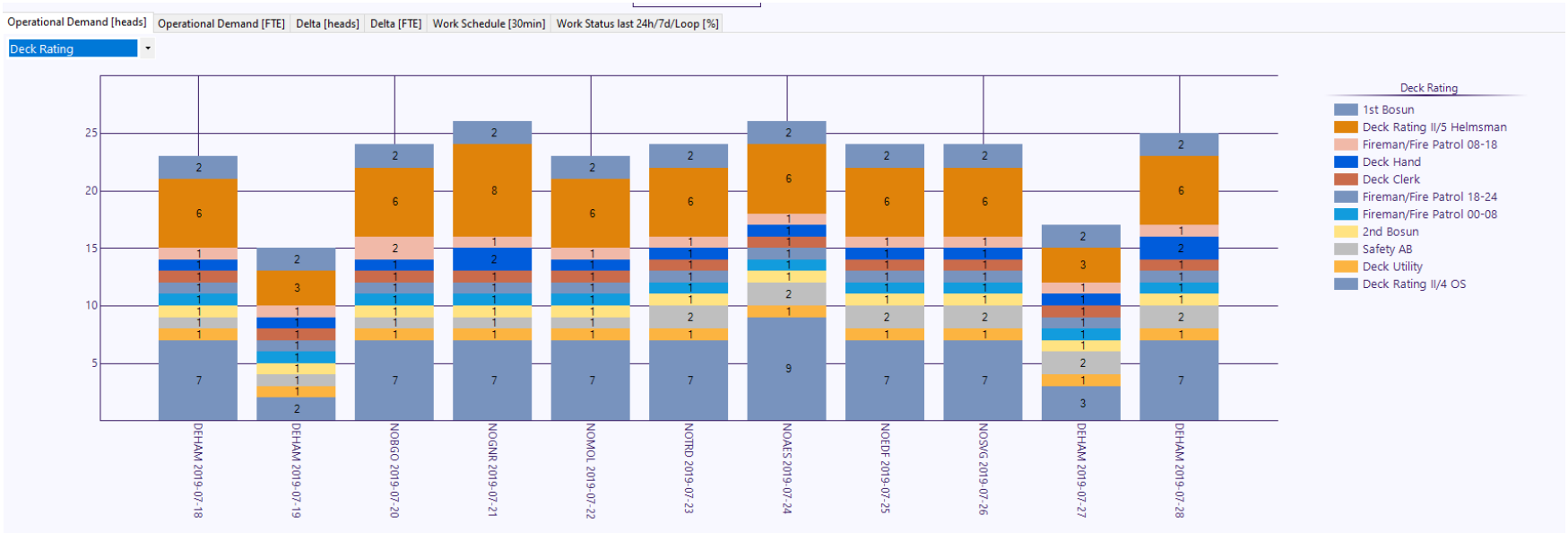
- Starting point: high effort for damage identification and classification
- Goal: Reduction of effort for damage identification and improved process management
- Task: Development and implementation of an AI-based pilot solution at HHLA HCCR



SCEDAS® Well-founded support for strategic decisions

Calculation of optimal personnel requirements and deployment planning

- Personnel & Qualifications
- Travel
- Maintenance tasks
- Regulation



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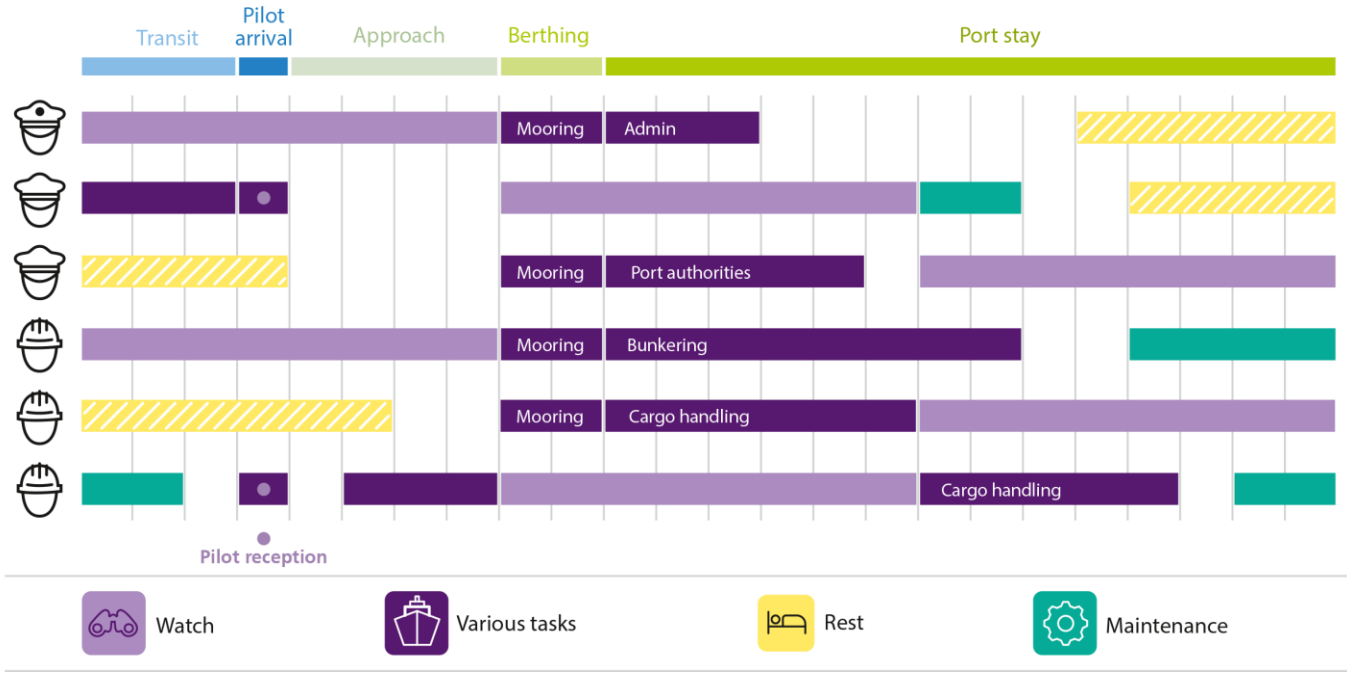
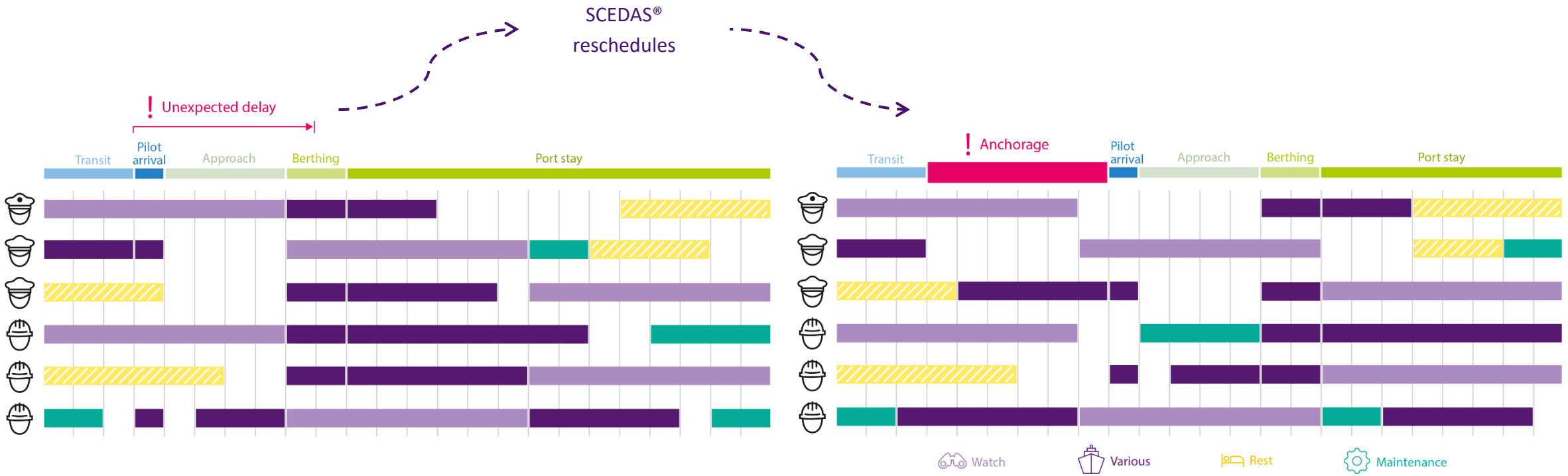


SCEDAS® Well-founded support for operational decisions

Calculation of the personnel plan on board at the touch of a button



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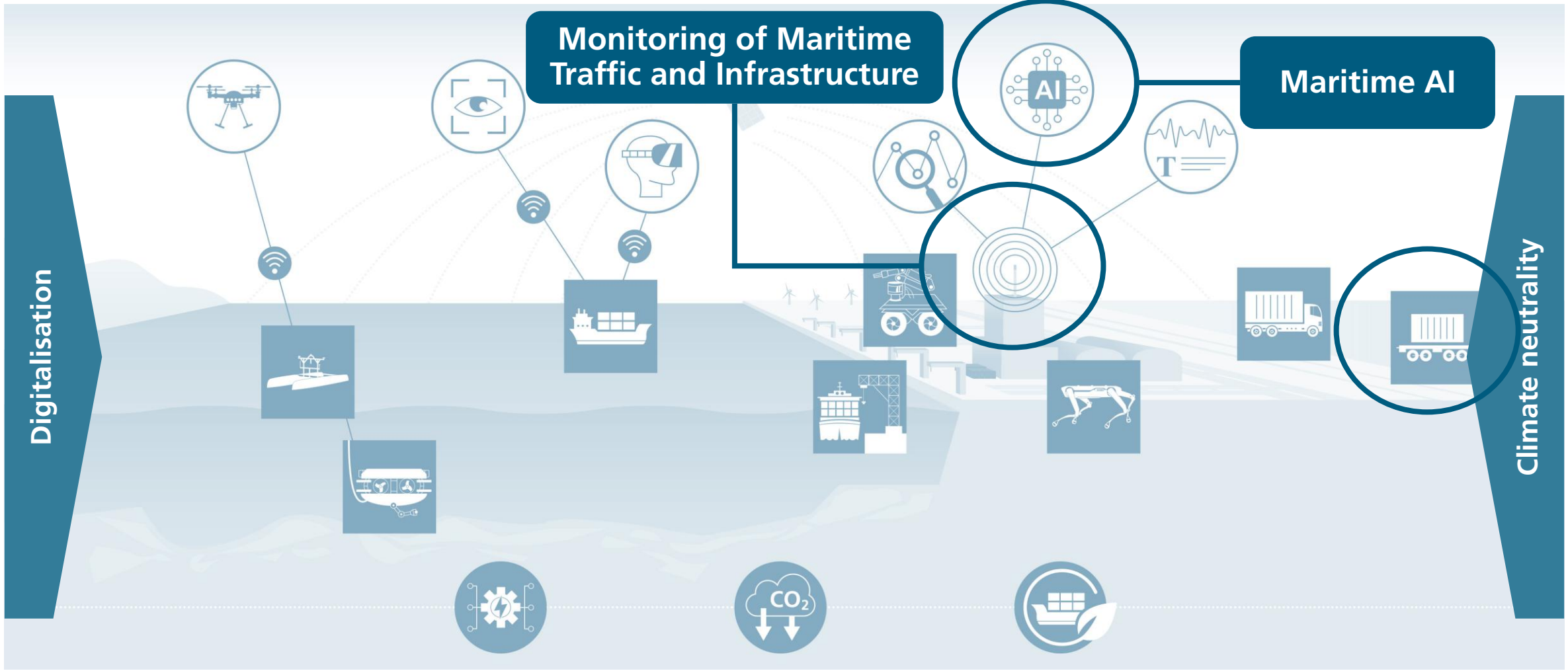

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Sensor Platforms for Intelligence, Surveillance and Reconnaissance (ISR)

ISR developments and trials for more maritime safety and security

Research Vessel VEKTOR

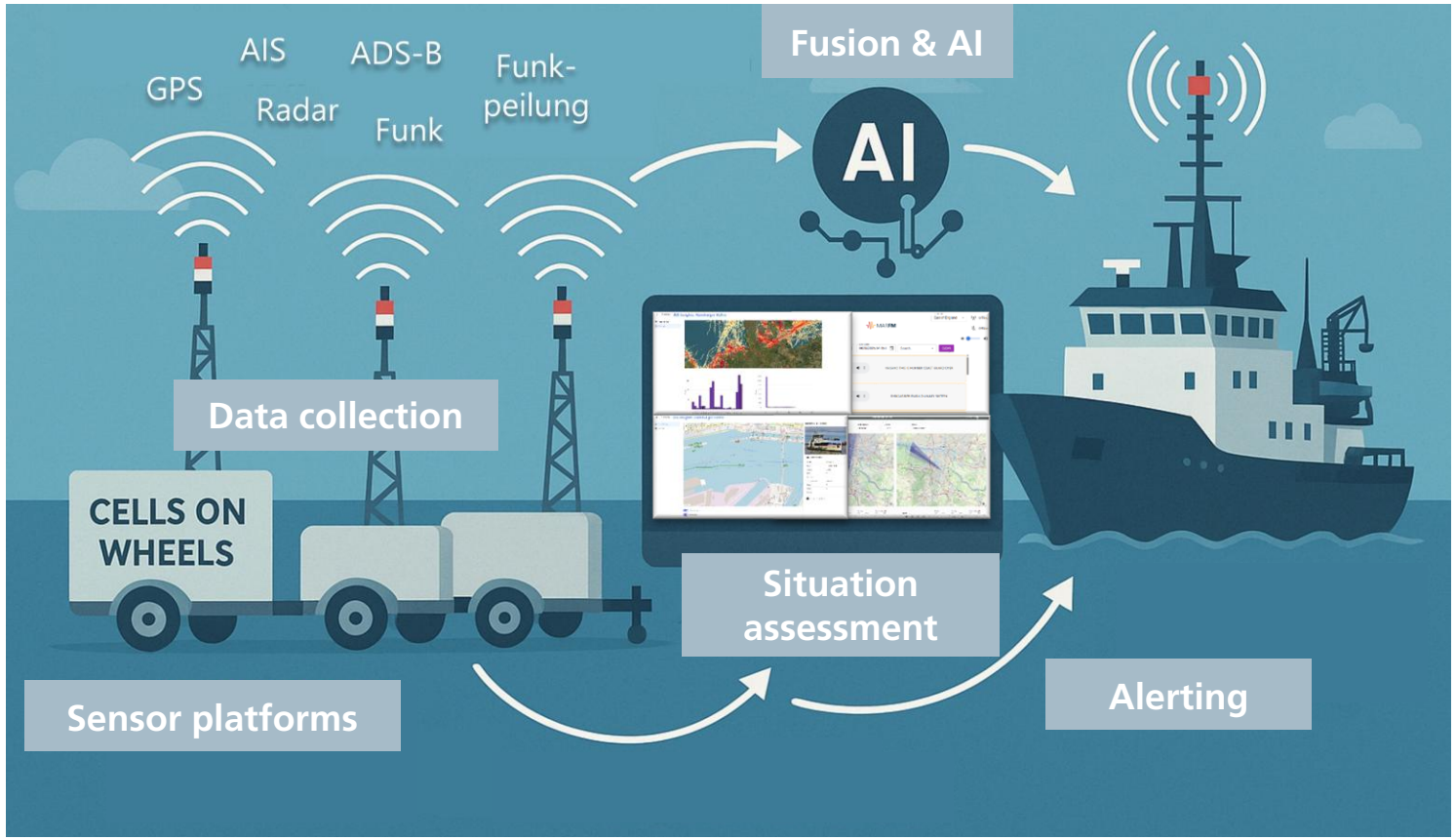
- Mobile sensor and data platform
- Deployable in coastal and inland waters
- Ideal for:
  - Sensor integration
  - Autonomy tests
  - ISR and mission module tests

Mobile Sensor Platforms Cells-on-Wheels (CoWs)

- Rapidly deployable along coasts, ports and waterways with pneumatically extendable mast
- Ideal for:
  - Distributed sensor technology
  - Shore-Vessel interaction
  - GNSS-interfered and congested environments

KIRMES – mobile AI for real-time security

for advanced research operations



1. Flexible and adaptive security concepts

2. Real-time situational awareness

3. Fast & predictive responsiveness

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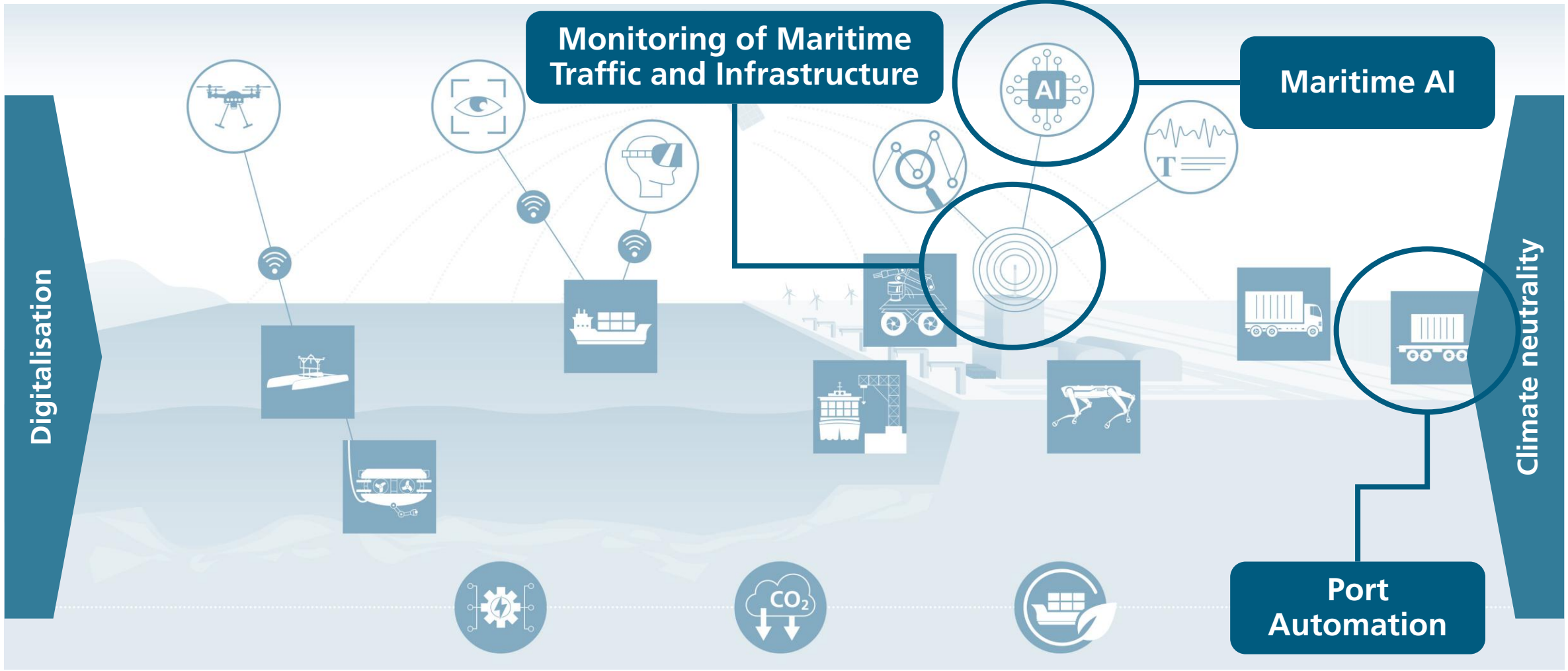

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Port Automation

Development and demonstration of pin handling by an autonomous mobile robotic system

Pin-Handling-mR

Project description

- The pins on the container train must be set before loading in accordance with the loading plan
- Labor-intensive task in a confined work area

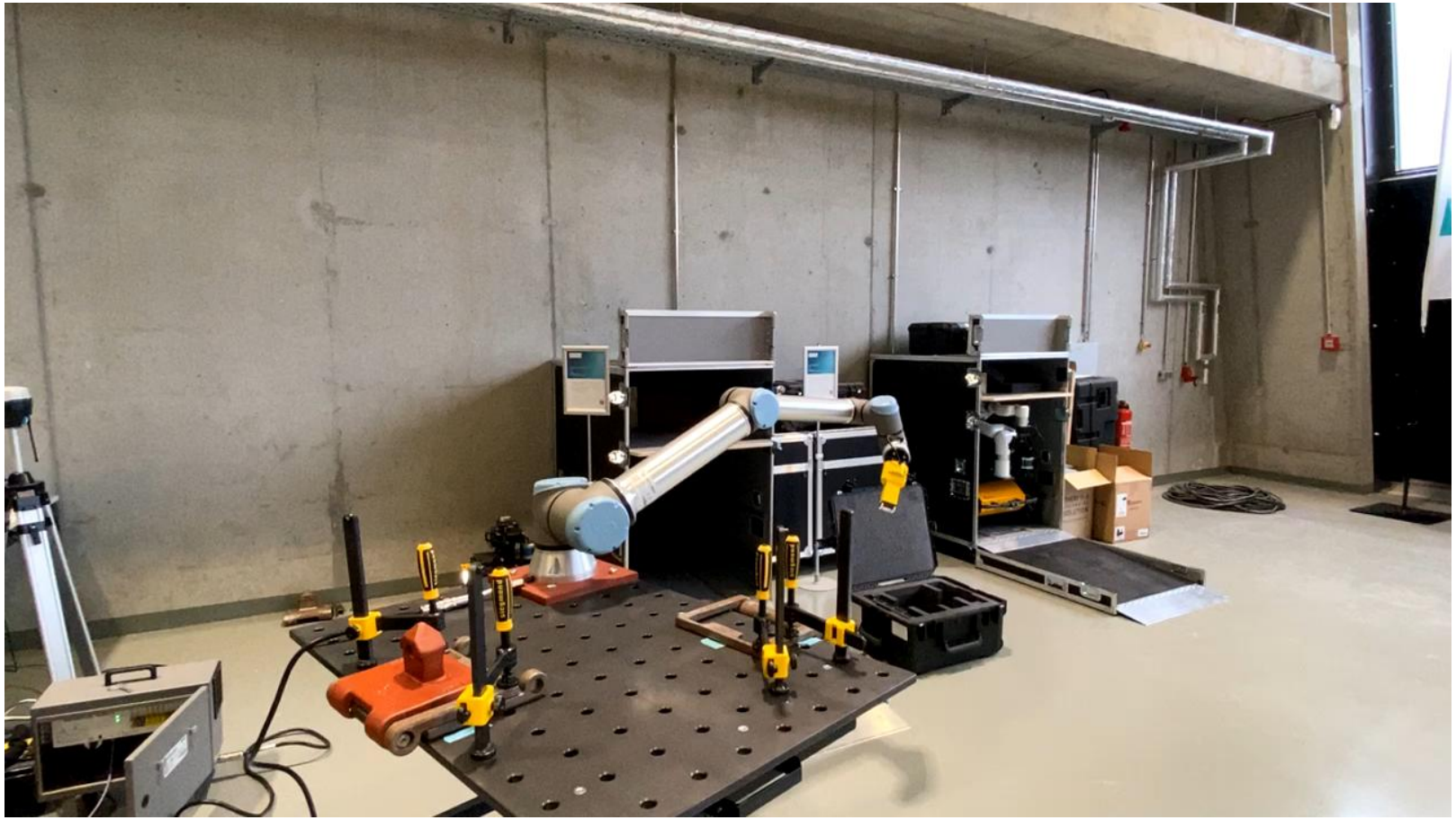
Solution

- Development of an autonomous mobile robot for pin handling
- Testing the prototype in the station of a container terminal

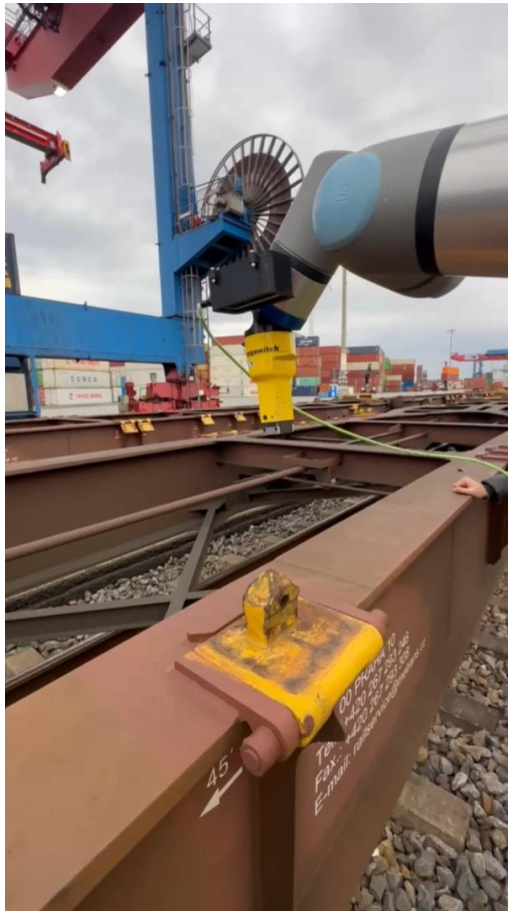
Bundesministerium für Digitales und Verkehr IHATEC Innovative Hafentechnologien HHLA HHLA Sky Fraunhofer CML

Port Automation

Development and demonstration of pin handling by an autonomous mobile robotic system



Manipulation tests at Fraunhofer CML



Field tests at CTT Tollerort

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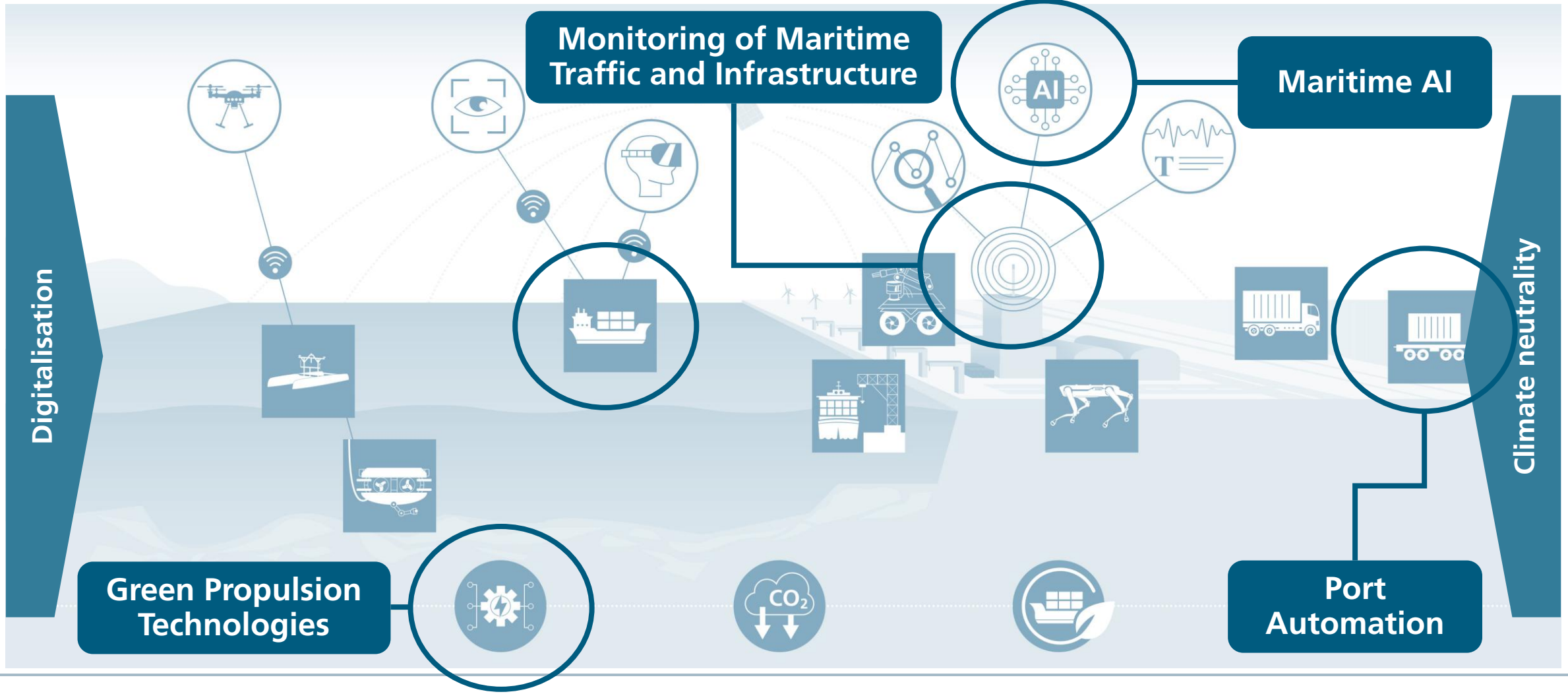

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Green Propulsion Technologies

Wind Energy as an Assistance Drive

Ship of the Beluga shipping company (2007): Towing kite propulsion, savings 10 to 15%

Scandlines ferry Berlin (2020): Flettner rotor reduces emissions by 4%

Vindskip study (2014): Hull serves as a sail, reductions up to 80%

Aquarius Eco Ship Concept (2011): combining solar and wind energy propulsion, reduction up to 40%

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Green Propulsion Technologies

Green Fuels

Stena Germanica (2015): Methanol powered ferry

Hydroville (2017): Hydrogen powered passenger ferry in Port of Antwerp

Jaques Saade (2023): bioLNG powered container vessel

NN (Exmar, 2025): Ammonia powered vessel

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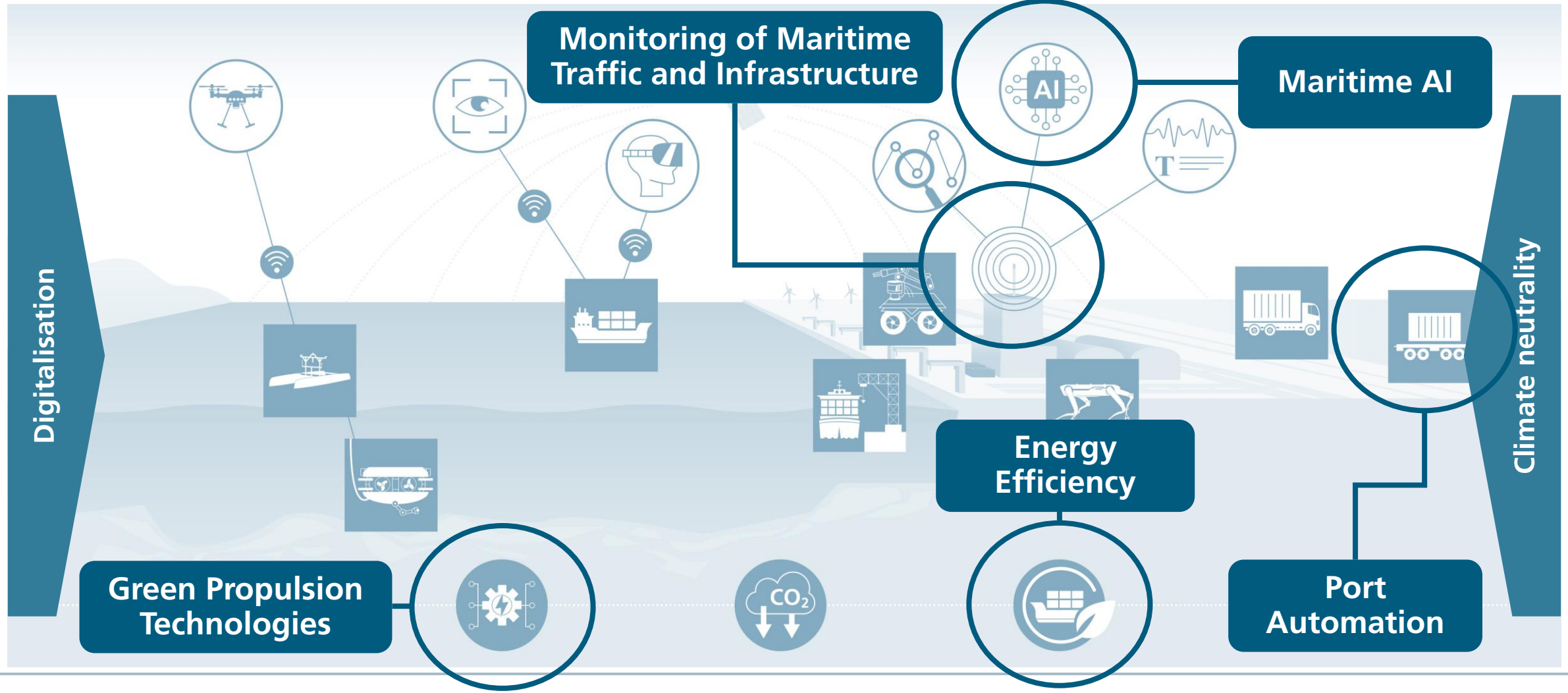

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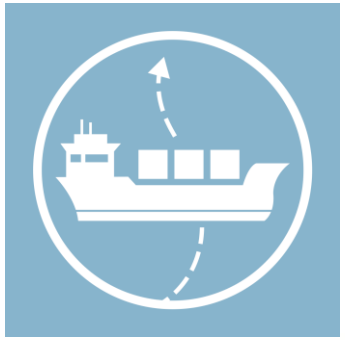
Routing - The MIRP demonstrator

Maritime Inventory Routing Problem



Customer problem

- Planning the best route for tankers, with various restrictions
- Capacity of ports and vessels
- Port - ship compatibility
- Restrictions on certain goods

Solution approach

- Development of customized mathematical model
- Adaptation of the form (e.g. QUBO)
- Benchmark on classical and quantum solvers
- Development of specialized algorithms
- Implementation of a user interface

Deliverable

- Formalization of the problem
- Quantum annealing: potential and limits
- Prototype developed

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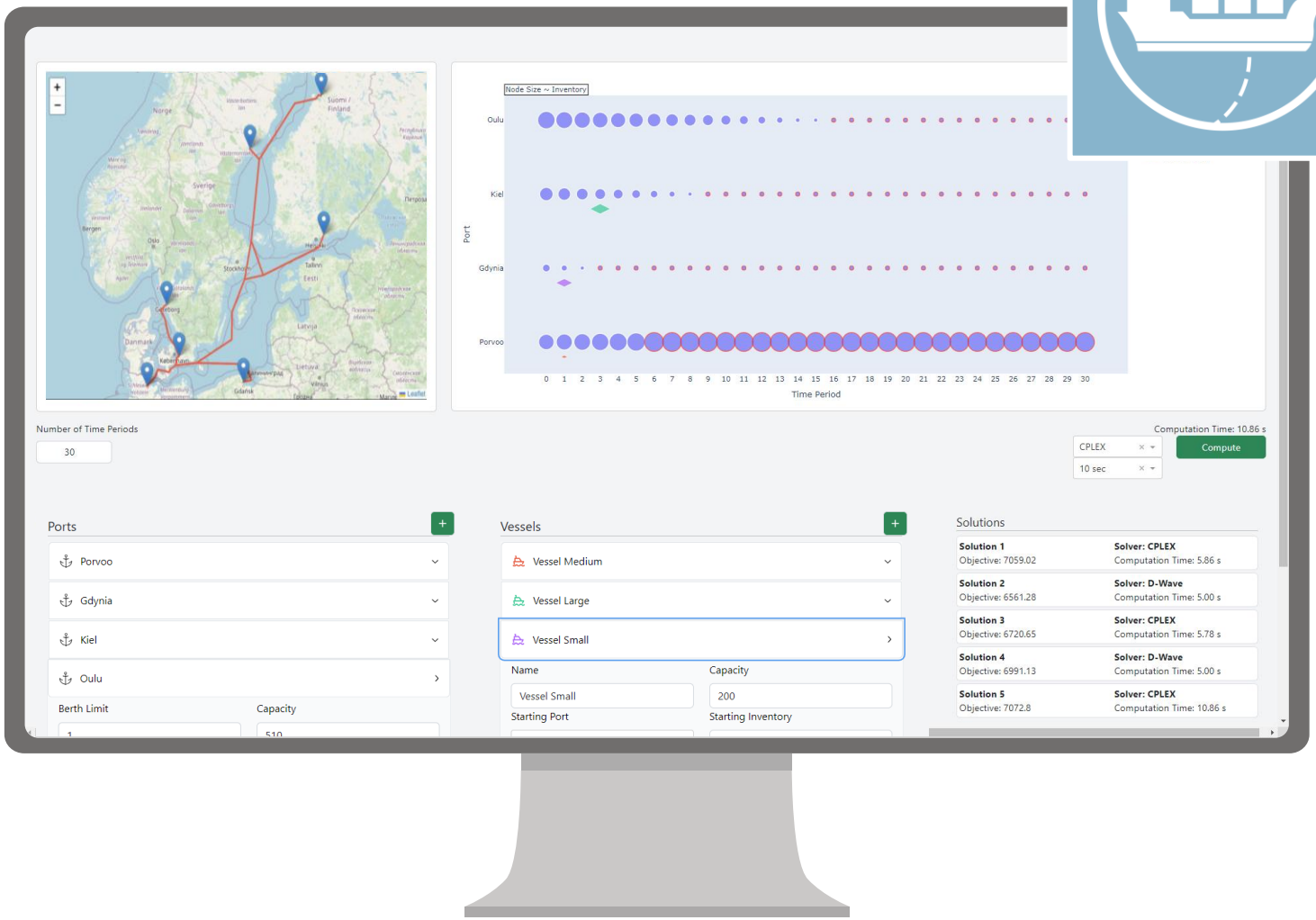
Routing - The MIRP demonstrator

Comparison of classical and quantum solutions

- Generation of problem instances through simple user input
- Visualization of the problem
- Optimization on the local computer (with CPLEX) or on D-Wave quantum annealer (many possibilities can be checked simultaneously)
- Visualization of solutions of the generated problem



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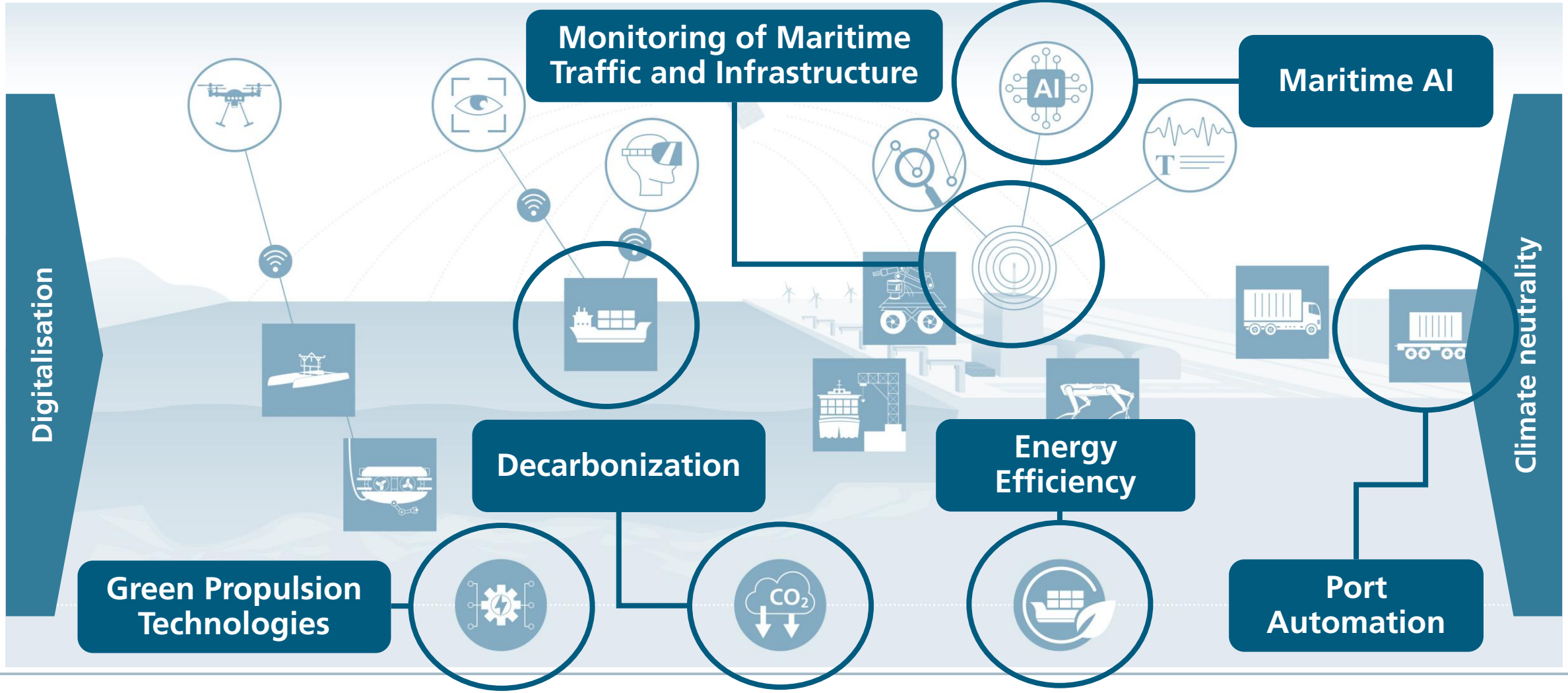

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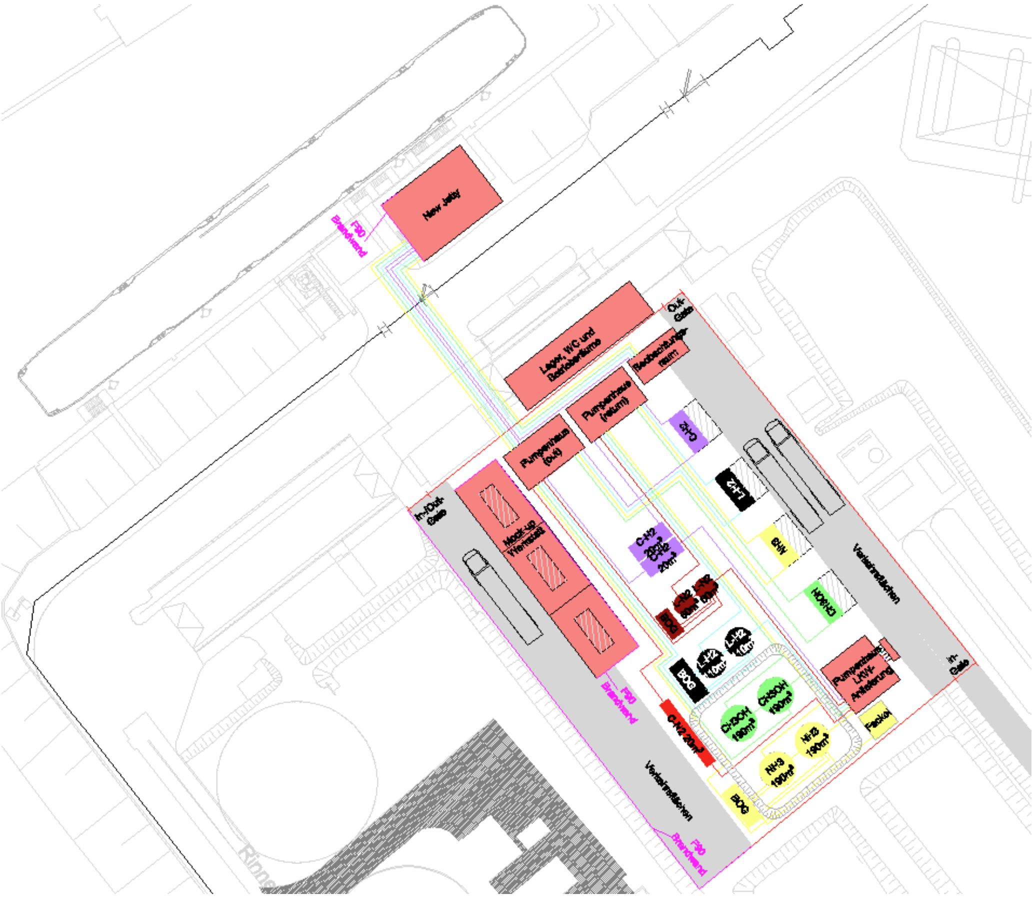
Worlds first multi fuel bunkering test facility @ITZ Hydrogen

Planned in the Port of Hamburg, operated by Fraunhofer CML



Layout of the multi fuel bunkering facility

Test facility for development of technical equipment and procedures for safe bunkering of green fuels (hydrogen (compressed, liquid) methanol, ammonia)

From land bunker to ship bunker via jetty

Mockups for development of…

- … compressors, valves, nozzles, cooling units for high volume velocity bunkering of CGH2, LH2, MeOH, and NH3
- … bunkering protocols and guidelines

  Source:

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Thank you very much for your attention!

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