EC-MARE TEAMING WEBINAR

Estonian Maritime Academy
19th February 2026

TEAMING

Teaming for Excellence (Horizon Europe / WIDERA)

- A funding instrument designed to create or upgrade Centres of Excellence (CoE) in Widening countries by partnering them with leading international research institutions.

Purpose

- Strengthen R&I ecosystems in Widening countries
- Build long-term scientific excellence & institutional capacity
- Enable strategic partnerships with world-class institutions
- Increase participation and success in EU research programmes

Results in May 2026

TAL TECH

***moderator*- Jaak Viilipus**

Taltech Estonian Maritime Academy

OPENING WORDS

REPUBLIC OF ESTONIA
MINISTRY OF CLIMATE

Kristjan Truu,

Deputy Secretary General

Maritime Affairs and Water Resources

TAL TECH

WHY EC-MARE?

Key message:

- Europe’s maritime sector faces simultaneous decarbonisation, digitalisation, and cybersecurity pressures. Estonia must rapidly build capabilities to meet Fit-for-55, IMO GHG and emerging cyber standards.

- New regulations require deep and costly transitions
- Energy systems are shifting (hydrogen, methanol, ammonia, batteries, hybrid)
- Ports & fleets need new skills, digital tools, and safer systems
- Estonia lacks a dedicated maritime innovation centre
- Need for regulations to support the change

TAL TECH

Roomet Leiger

EC-MARE project coordinator

Director of TalTech Estonian Maritime Academy

EC-MARE CONSORTIUM

Lead partner:

- TalTech

Norwegian and Finnish partners:

- VTT (FI) – digital twins, energy systems
- NTNU (NO) – cybersecurity, digital resilience
- BI (NO) – maritime policy & regulation

Estonian partners:

- EMC – industry stakeholders, Retrofit Hub
- Tehnopol – accelerator & SME support

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EESTI MEREAKADEEMIA

EC-MARE OVERVIEW

EC-MARE VISION

EC-MaRe will become the leading Baltic Sea center of excellence for maritime retrofit, accelerating adoption of green technologies, digital resilience and evidence-based regulation.

Mission:

- Enable large-scale uptake of sustainable retrofit technologies
- Provide interdisciplinary research + testbed ecosystem
- Strengthen Estonia's competitiveness and policy influence
- Build a new generation of specialists

€15M HEU + €12M MER + €3M BHG EE

Industry revenue through labs, services, pilots

Business Accelerator deal flow

Consulting & certification services

Goal: €3.5–4.5M annual revenue by Year 10

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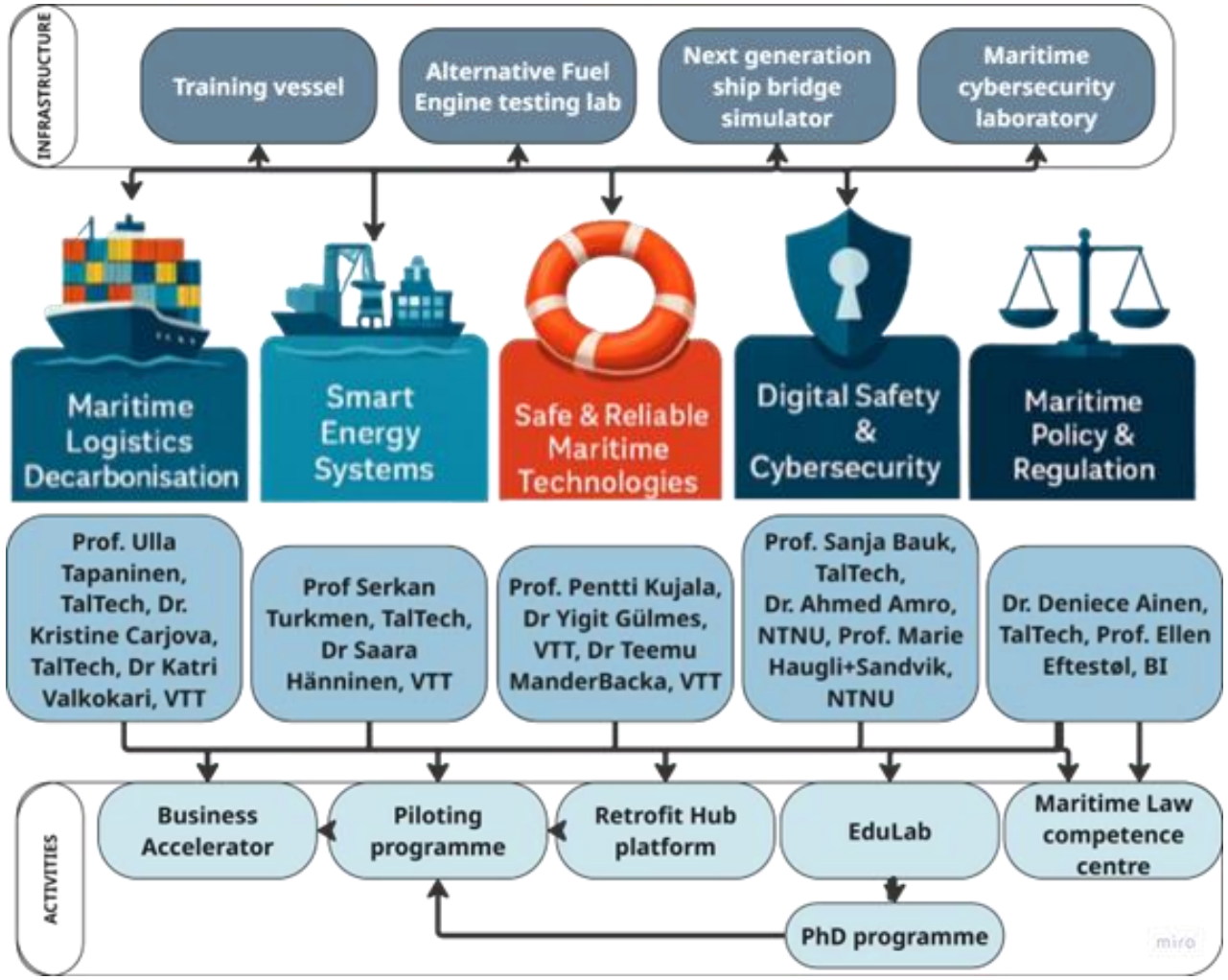
WHAT EC-MARE WILL DELIVER

- Fully operational Centre of Excellence with labs & simulators
- 5 scientific pillars generating breakthrough knowledge
- PhD School + skills academy
- Retrofit Hub for industry, policy & SMEs
- Full-scale pilots, digital twins & retrofit demonstrations
- A financially sustainable institution post-HEU



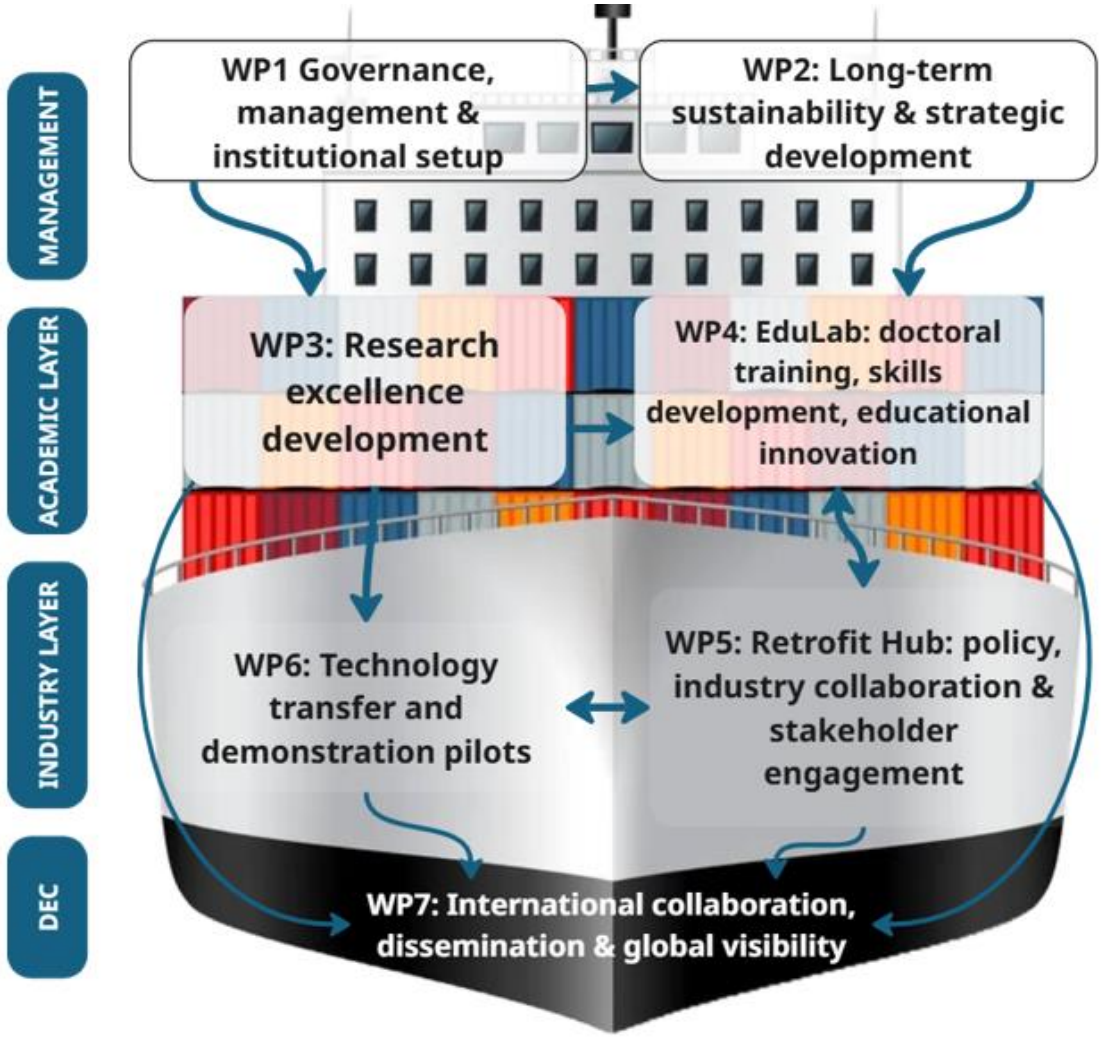
ACTIVITIES AND IMPLEMENTATION

Show the four infrastructure pillars:

- Alternative Fuel Engine Lab
- Maritime Cybersecurity Lab
- Ship Simulator (retrofit modules)
- Training Vessel (real-life testing)

Workflow:

- data → research → pilots → policy



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EC-MARE RESEARCH PILLARS

DECARBONISATION OF MARITIME LOGISTICS

Focus:

- Integrated emission-reduction strategies
- Holistic assessment of slow steaming, JIT arrival, OPS, efficiency
- Impacts on trade, competitiveness, ice conditions
- Models for fleet renewal + retrofit pathways

Outputs:

- Decision-support tools + optimisation models

Prof. Ulla Pirita Tapaninen

Head of Maritime Transport Research Group

MARITIME TRANSPORT RESEARCH GROUP
ESTONIAN MARITIME ACADEMY

- **Smart and Energy Efficient Environments (business studies)**

  How tightening environmental regulations affect shipping companies, ports and maritime markets?

  The studies analyse the present shipping business, and study how the new fuels, vessel design and operative changes will affect the shipping business models and operations.

- **Maritime and Port Governance (social sciences)**

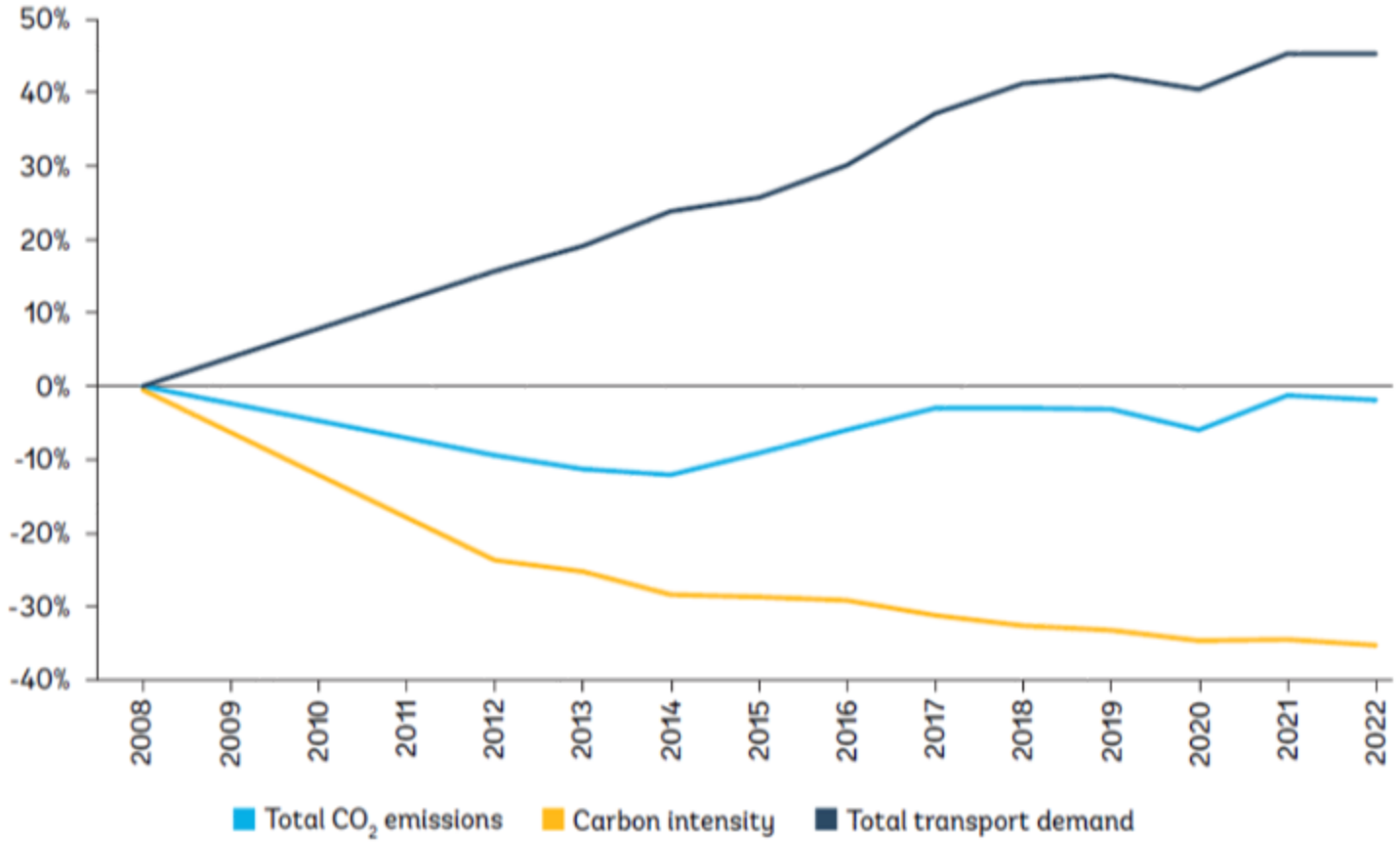
  The functioning and competitiveness of maritime cluster: shipping companies, port and maritime sectors in various shipping market situations: cargo and passenger volumes, economics, policies, law and public opinion.

8 Ph.D students, 3 post-docs, 2 adj. prof., 2 assistants

Full tenured professor *Ulla Pirita Tapaninen*
Book: *Maritime Transports 2020, Kogan Page*
Blog: *ullatapaninen.net*

TRENDS IN TRANSPORT WORK AND GHG EMISSIONS 2008

Figure E.1 Trends in transport work, carbon intensity and GHG emissions since 2008



Source: Smith and Francis (2024b); Clarksons (ongoing). Carbon intensity is the EEOI, which measures the CO2 emissions per unit of transport work.

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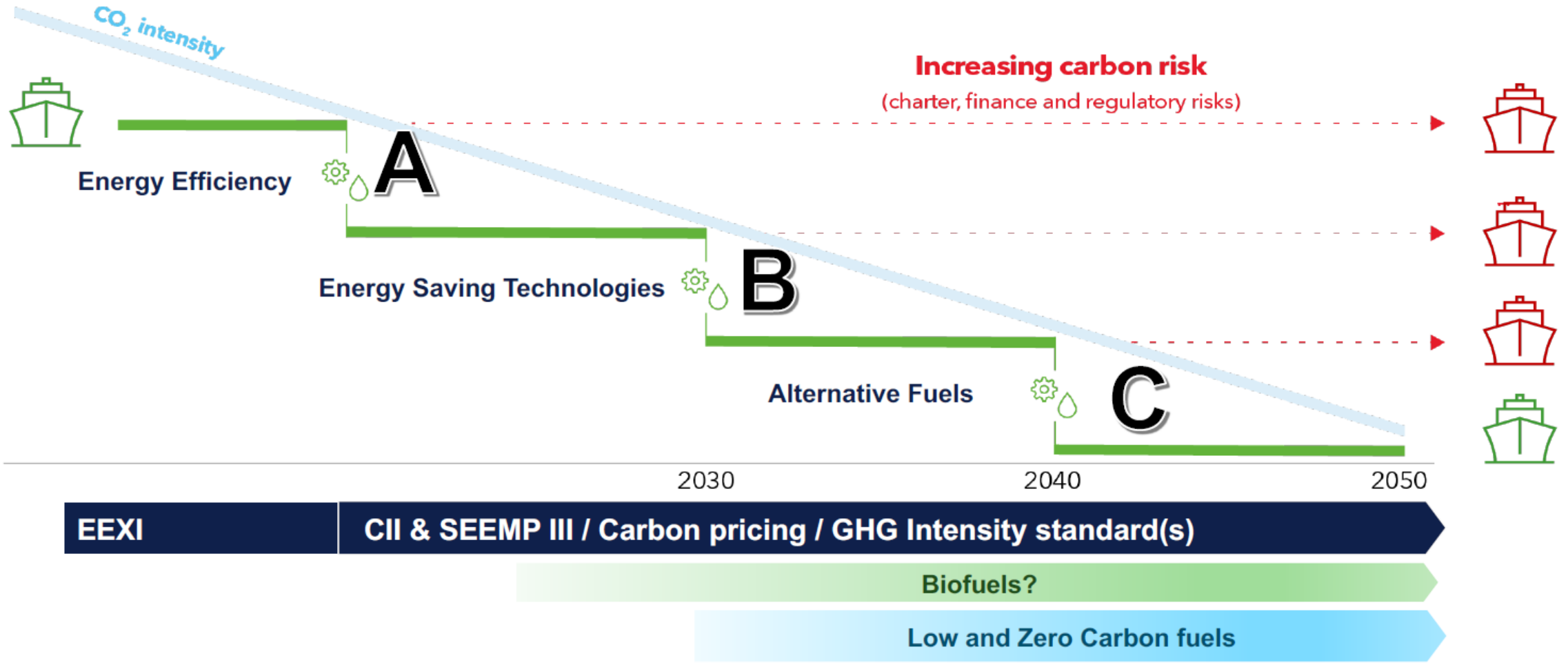
Develop your future readiness – ***as a muscle***



MARITIME LOGISTICS DECARBONISATION

Retrofit as a business case?

- Expected fuel prices
- Emission trading allowances
- Payback time vs age of the vessel

- Alternative fuels, technological and operational alternatives

- Alternative fuel bunkering / charging infrastructure
- Training and manning costs / savings

- Construction costs of a newbuild
- Construction costs of a retrofit

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A Retrofit becomes often more economical than a newbuild.

Smooth sailing

17 SEPTEMBER 2025

How Scania and Blidösundsbolaget are pioneering quiet and clean electric ferry power in the Stockholm Archipelago.

Since Midsummer, commuters and tourists in part of the Stockholm Archipelago may have noticed how quiet and clean one of their usual ferries is. The difference is striking compared with the normal clank and grind and diesel smells of the many boats that ply this beautiful area in and around the Swedish capital.

That's because the M/S Silverö ferry, which sails between the Vaxholm and other nearby islands, has been retrofitted with a fully electric Scania e-machine.

SAFETY, EFFICIENCY, AND RELIABILITY OF MARITIME OPERATIONS

Safe & Reliable Maritime Technologies

Focus:

- Risk assessment for alternative fuels + new tech
- Predictive maintenance & remote diagnostics
- Digital twins for retrofit evaluation
- Ice-class vessel safety evaluation

Outputs:

- Infrastructure: Simulation Centre for Maritime Retrofit

TAL TECH

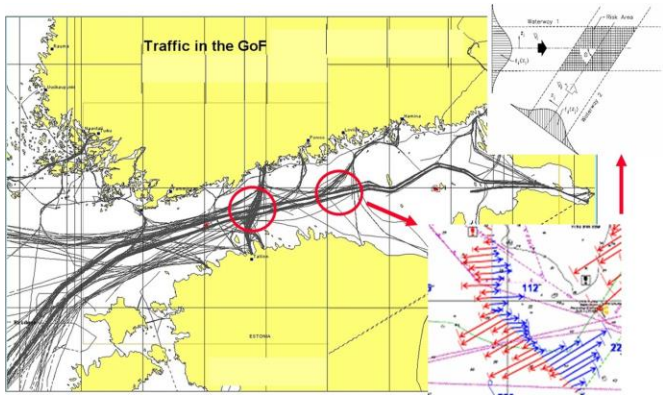
Prof. Pentti Kujala

Head of Waterways Safety Management Research Group

Safety, efficiency, and reliability of maritime operations

We provide expert knowledge in:

- Development and deployment of digital twins, real-time sensor systems and AI-supported models to improve the safety of the future autonomous shipping.
- Predictive maintenance & remote diagnostics and development of digital twins for retrofit evaluation
- Ice-class vessel safety evaluation
- Services include intelligent fairway design and sensor development, collision avoidance simulation tools and AI based solutions.
- Multi-disciplinary and ground-breaking approach to evaluate the hazard scenarios for shipping nearby the planned location of the wind farms in Estonian waters and how to mitigate the risks
- Infrastructure: Simulation Centre for Maritime Retrofit



Ongoing projects: DIGIMARIS - valuating the criteria for a new digital device for marine oil spill response teams in Finland and Estonia. Implementing time: 9/2025 – 2/2028, Funded by Central Baltic Programme.

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SMART ENERGY SYSTEMS

Focus:

- Hydrogen, methanol, ammonia, hybrid engines
- Energy-system modelling + safety + storage
- Ports as multi-fuel energy hubs
- Real-time emissions monitoring, AI optimisation

Outputs:

- Infrastructure: Alternative Fuel Engine Testing Lab

Prof. Pentti Kujala

Head of Waterways Safety Management Research Group

Smart energy systems

We provide expert knowledge in:

- New fuels such as hydrogen, methanol, ammonia, and ship electrification using batteries engines and hybrid solutions, energy-system modelling
- Risk identification, safety analysis and operational concepts for applying new fuels onboard the ships and risk analysis during the bunkering operations. Similar analysis also for battery driven ships.
- Risk mitigation based planning of the training to the vessel ship crew, port operators / authorities and engine maintenance staff to apply the new technology.
- Developing Baltic energy corridors, including interactions between shipping and new fuel logistics and Ports as multi-fuel energy hubs
- Real-time emissions monitoring, AI optimisation

- Alternative Fuel Engine Testing Lab, see the next slide

Ongoing projects, EU Horizon:H4PERION - Hydrogen FOR Performance Enhancement and Reliable Ice OperatioN. Coordinated by Wärtsilä.
ELECTRIC BLUE- Sustainable maritime transport: Technologies for eco-friendly shipping to support coastal communities. Coordinated by VTT.

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Alternative Fuel Engine Testing Lab, H2ICE

The aim of the new lab:

- The laboratory is designed to validate complete hydrogen based energy systems (engine, hybrid powertrain, fuel handling, power electronics and safety), not engines in isolation
- Focus on system-level validation of hydrogen based power and propulsion concepts, rather than optimization of individual components
- The laboratory will be built around two complementary test platforms:
  - 1. Single-cylinder / Modular research engine
  - 2. Full-scale multi-cylinder marine engine and system level test cells
- The facility is designed as a hybrid propulsion research environment, integrating: Common, DC bus and ship microgrid simulation, Combined operation of H2ICE gensets, fuel cells and batteries, Energy management strategies, redundancy and transient behaviour, Emissions minimization and operational optimization and safety logic combining engine room, hydrogen infrastructure and fuel cell systems
- This will support the development of complete hydrogen-fueled power systems for maritime applications
- The facility is developed in close cooperation with engine manufacturers, shipyards, system integrators, electrical technology providers and shipowners.

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MARITIME CYBERSECURITY

Digital Safety & Cybersecurity

Focus:

- Vulnerability modelling across vessels & ports
- Compliance with NIS2, Cyber Resilience Act
- Cyber-range training, pen-testing
- Secure digital twins & maritime networks

Outputs:

- Infrastructure: Maritime Cybersecurity Lab

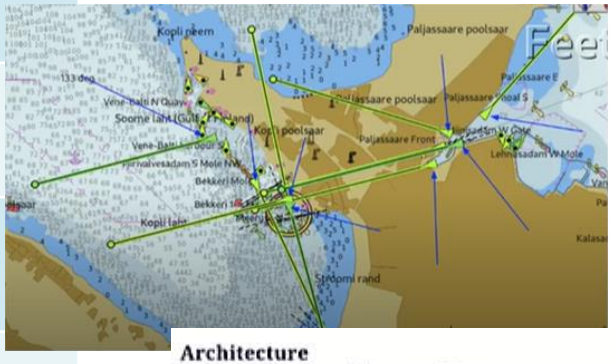
TAL TECH

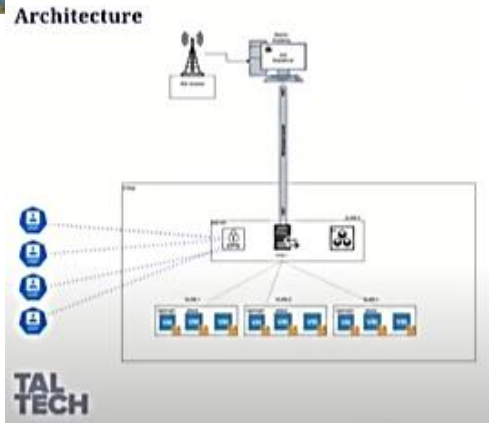
Prof. Sanja Bauk
Head of Centre for Maritime Cybersecurity

MARITIME CYBERSECURITY

We provide expert knowledge in:

- Threat modeling and risk assessment for maritime IT/OT systems
- Cybersecurity simulations for manned and autonomous ships
- MSOC threat monitoring and incident-response exercises
- Trusted data-sharing across maritime supply chains (eBoL & BCT-enabled)
- Research and experience with cyber-range training and table-top exercises (TTXs)
- Enhancing maritime retrofit projects by integrating cybersecurity
- Cyber awareness, hygiene, and management training for maritime teams — from crew to leadership
- Maritime Virtual Cyber-Lab for pilots and co-innovation





- **6 PhD students** in technical & human domains of maritime 'technical'cybersecurity, management, education, and awareness

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MariCybERA

Infrastructure: *Virtual Cyber Lab_ Simulating cyberattack at AIS targets in ECDIS*

MARITIME CYBERSECURITY

- Centre for Maritime Cybersecurity (2021)
- https://taltech.ee/en/estonian-maritime-academy/areas-of-advance/maritime-cyber-security.
- https://maricybera.taltech.ee/events/ (25+ seminars)
- https://maricybera.taltech.ee/blog/ (80+ events/releases)

Publications (SCI/SCIE/Scopus) 2022-2025	No.
Book	1
Book Chapters	11
Journal Papers	26
Conference Papers	33
Total:	***71***

PhD Thesis defended:
Gabor Visky, *Cybersecurity for Maritime Operational Technology: Challenges, Considerations and Solutions*, 22 October 2025. Sup: Prof. Olaf Manuel Maennel (TalTech), Prof. Risto Vaarandi (TalTech).
Master Thesis defended:
Julia Anna Grosschmid, *Assessing the Economic Impact of Cyberattacks in the Maritime Sector: A Taxonomy-Driven Case Study and Data Analysis*, 28 May 2025. Sup: Prof, Sanja Bauk (TalTech).
Awarded by ***Kapt. Uno Lauri Marine Culture Foundation***

MoU between TalTech/Emera & iTrust, SUTD /MariOT testbed/ 28 March 2025

SINGAPORE UNIVERSITY OF TECHNOLOGY AND DESIGN

TAL TECH

- Infrastructure: *Maritime Virtual Cybersecurity Lab*

MariCybERA

MARITIME CYBERSECURITY

Contents lists available at ScienceDirect

International Journal of Critical Infrastructure Protection

journal homepage: www.elsevier.com/locate/ijcip

Identifying cyber attack vulnerabilities in the main lubricating oil system of marine propulsion units

Yigit Gülmez [a,b,*], Olgun Konur [c], Muhammed Erbas [d], Sanja Bauk [a]

Journal of Marine Science and Engineering

Article

A National Maritime Cyber Security Operations Center (M-SOC) Concept

Aybars Oruc [1,*], Sanja Bauk [1] and Jianying Zhou [2]

Springer

Maritime Cybersecurity

IEEE Access
Multidisciplinary | Rapid Review | Open Access Journal

Received 7 April 2025, accepted 28 April 2025, date of publication 6 May 2025, date of current version 21 May 2025.

Digital Object Identifier 10.1109/ACCESS.2025.3567385

SURVEY

A Systematic Literature Review of Cyber Security Monitoring in Maritime

RISTO VAARANDI [1], LEONIDAS TSIOPOULOS [1], GÁBOR VISKY [1], MUAAN UR REHMAN [1], (Graduate Student Member, IEEE), AND HAYRETDIN BAHŞI [1,2]
[1]Centre for Digital Forensics and Cyber Security, Department of Software Science, Tallinn University of Technology, 19086 Tallinn, Estonia
[2]School of Informatics, Computing, and Cyber Systems, Northern Arizona University, Flagstaff, AZ 86011, USA

Corresponding author: Risto Vaarandi (risto.vaarandi@taltech.ee)

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ELSEVIER

Ocean Engineering

Volume 306, 15 August 2024, 118059

Systematic literature review of threat modeling and risk assessment in ship cybersecurity

Muhammed Erbas, Shaymaa Mamdouh Khalil, Leonidas Tsiopoulos

MariCybERA

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Journal of Marine Science and Engineering

MDPI

Article

Exploring Simulation Methods to Counter Cyber-Attacks on the Steering Systems of the Maritime Autonomous Surface Ship (MASS)

Igor Astrov [1], Sanja Bauk [2,*] and Pentti Kujala [2]

T&T Traffic Transportation

Simulating a cyber-attack on the MASS thrusters' controllers at low-speed motion

Igor ASTROV[1], Sanja BAUK [2]

MARITIME POLICY AND REGULATIONS

Focus:

- Evidence-based policy for decarbonisation & digital safety
- Alignment of Estonian/EU/IMO frameworks
- Regulatory impact assessments
- Development of guidelines & standards

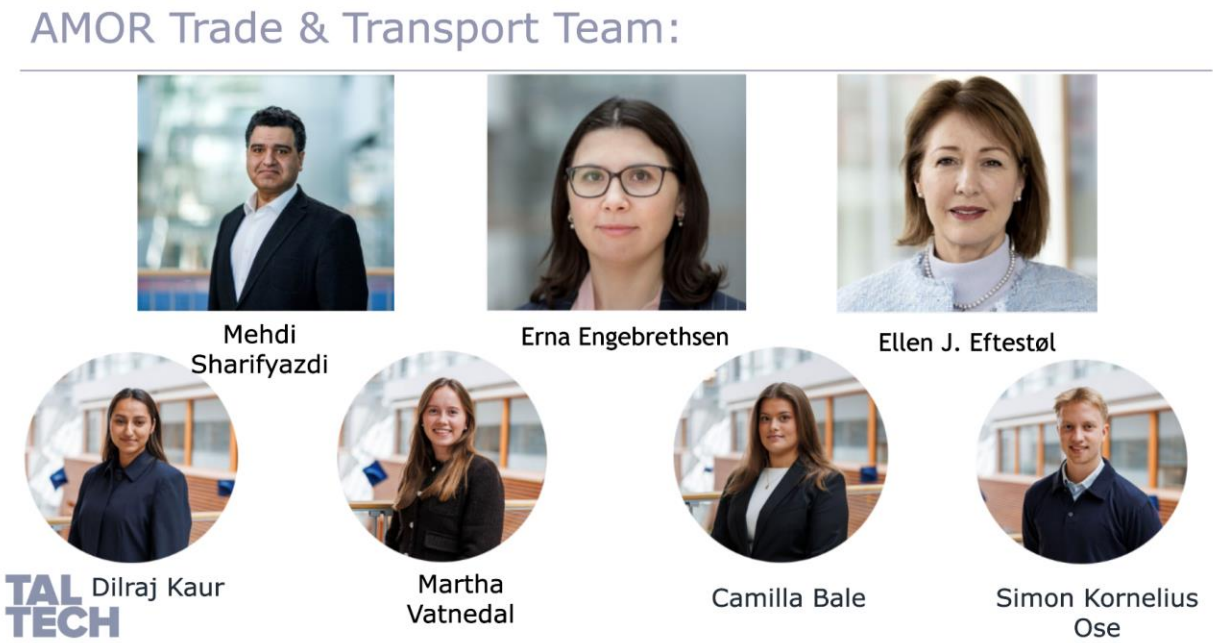
Outputs:

- Centre for Maritime Law

Presenter – Prof. Ellen J.Eftestøl, BI Norwegian Business School

Dr. Deniece Aiken, Maritime Law & Governance

MARITIME POLICY AND REGULATIONS



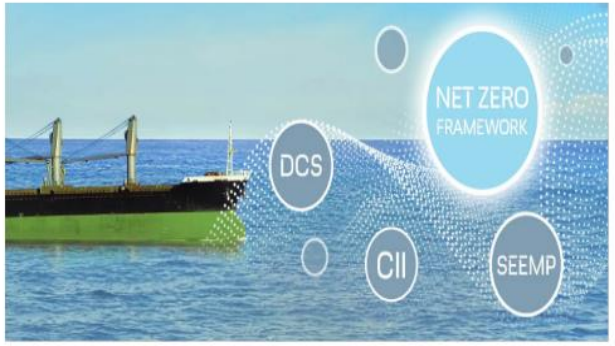
- **AMOR Trade & Transport (BI)**
- focuses on the impact of policy and regulations on transport and trade for cargo owners and transportation companies.
- By examining legal frameworks, risk dynamics, and economic consequences, the group aims to assess whether the measures achieve their intended effects, or whether they have unintended side effects, both generally, from a socio-economic perspective, and more specifically, from a business perspective.
- Utilizing legal, socio-economic, and quantitative analysis, AMOR Trade & Transport offers insights into adapting multimodal practices to new regulations and enhancing sustainable solutions in regional and global transport.
- AMOR | Trade & Transport | BI

MARITIME POLICY AND REGULATIONS

- **'retrofit'**
- 'is understood as ***a comprehensive transformation*** of maritime logistics, including investments in new and re-purposing or upgrade of existing assets, infrastructure and systems, integrating the reorganization of supply chains, decarbonization strategies, and digitalization.

EU "Fit for 55" package, strict emission cuts to reach net-zero by 2050

2040 Target: As of Feb 2026, the EU aims for a 90% reduction in greenhouse gas emissions by 2040 compared to 1990 levels



IMO The Net-Zero Framework (NZF) by or around 2050 ?

- Achieving maritime decarbonization and digitalization requires significant technical, operational, and ***regulatory transformations*** across fleets, ports, and supply chains, making this systemic approach urgent

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MARITIME POLICY AND REGULATIONS

- **Fuel Intensity Targets:** FuelEU Maritime enforces a gradual reduction in the GHG intensity of energy used on-board ships over 5,000 gross tonnage.
- **Onshore Power (OPS):** From 2030, container and passenger ships must use shore-side electricity while docked at major EU ports to eliminate emissions at berth.
- **The EU ETS:** Companies must surrender allowances for 100% of emissions 100% reported in 2026 and beyond

EU climate regulations

- **A global fuel standard** that requires ships to gradually reduce how polluting its ship fuel can be (i.e. how much greenhouse gas is emitted for each unit of energy used, across a fuel's life cycle); and
- **A pricing mechanism** with set prices on the GHG ships emit, to encourage the industry to lower emissions to comply with the global fuel standard.

IMOs proposed Net-Zero Framework

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EC-MARE ACTIVITIES

EC-MARE RETROFIT HUB

Components:

- Industry–research cocreation platform
- Digital Knowledge Platform
- Challenge workshops & thematic roundtables
- Business Accelerator for maritime startups
- Policy & regulatory forum
- Hub ensures rapid industry uptake

- **Industry–research cocreation:**
  - Matchmaking of industry challenges
  - R&D of solutions and knowledge exchange
  - Industry piloting/testing platform
  - Industry adoption and scaling

Raido Lember
Estonian Maritime Cluster

EC-MARE RETROFIT HUB

- **Industry co-finance:**
  - BHG-Estonia OÜ (Baltic Hydrogen Group Estonia) has committed €3M in complementary industrial contribution as a strategic industrial partner supporting EC-MaRe's hydrogen research and education infrastructure, and providing a link between R&D, infrastructure, system integration, and the market.

- **Industry stakeholders engagement:**
  - Estonian Maritime Cluster with its 60+ diverse members continuously provides industrial challenges and piloting/testing platform both offshore and onshore.
  - Intention to use laboratory facilities and participate in pilot projects by Wärtsilä, ABB, Bernard Motors, BLRT Tallinn Shipyard, Alexela, Port of Tallinn, Tallink, Estonian Shipowners Association, Baltic Workboats, SRC Methanol Superstorage, Stargate Hydrogen, Metrosert, PowerUP Energy Technologies, Skeleton Technologies, Galttec, H2Electro, Elcogen and others.
  - Diverse with full value chain for maximum impact in EU and global export markets.

BUSINESS ACCELERATOR

- **4-cohort accelerator program** designed to support and scale innovative startups:
  - Up to 24 startups total
  - 12 months program
  - Structured training program
  - 1on1 expert sessions
  - Top3 prize money
- **International visits and market exploration trips** for participating teams
- **Community building** and industry related matchmaking events
- **University Entrepreneurship** Training Program

Anne Liis Elbrecht
Head of Tehnopol Startup Incubator
Head of NATO DIANA Accelerator in Estonia

PILOTS & DEMONSTRATIONS

Pilots & Demonstrations translate EC-MaRe research vision into real maritime operations.

- Full-scale retrofit (with BLRT, ABB, Wärtsilä, etc.)
- Validation
- Digital twinning

Outcome: Real-world validation for safe industrial rollout

Focus Areas

- Hybrid propulsion & alternative fuels
- Decarbonization
- Simulation / Digital twin-based optimization
- Ship-side - Port-side energy systems
- Cybersecurity and cyber resilience

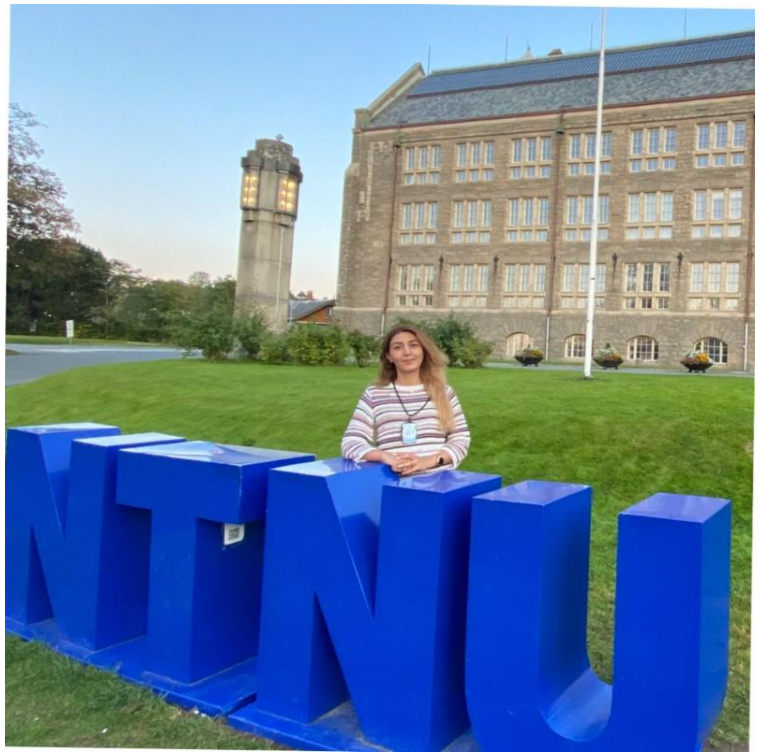
TAL TECH

Dr. Yigit Gulmez
Maritime Research Group, VTT, Finland

TALENT & TRAINING PIPELINE

- EC-MaRe PhD School
- Industrial PhD positions
- Summer schools & short courses
- Cyber-range training & simulator-based learning
- Mobility via VTT, NTNU, BI

- Goal: 300+ trained individuals by M72



Aida Akbarzadeh, Senior Research Scientist, NTNU, Norway

WHY EC-MARE MATTERS

A new Baltic Sea lighthouse for sustainable, safe, digital maritime operations.

Reinforces:

- Strong and diverse consortium
- High national & EU relevance
- Infrastructure + capabilities + pilots
- EU long-term sustainability and technology

leadership

Call to action:

- Join us in transforming the maritime future.

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Q&A