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Accelerating Maritime Decarbonization through Integrated Energy Efficiency Technologies

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LSSTF 26, Hamburg/Germany, 25 June 2026

PROJECT 101147693 / FLEETfor55

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HYDRUS – Innovation Hub

HYDRUS ENGINEERING SA

✓ General information

HYDRUS ENGINEERING SA is a global engineering firm delivering integrated solutions in the maritime, oil and gas and energy sectors (established in 2009).

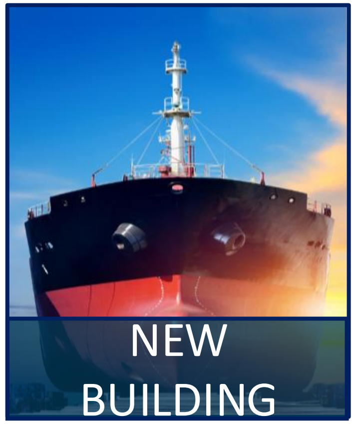
200 + people

8 directors

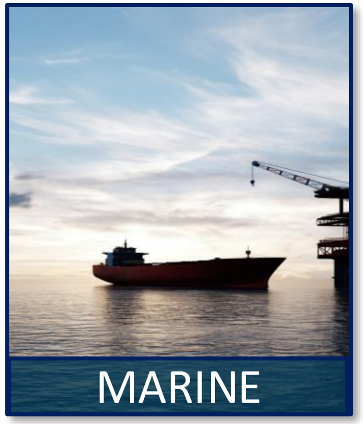
25+ managers

3 divisions

6 back-office Dpts.



- Plan Approval
- Site Office



- Attendances
- Procurement
- HSSQEE

- Operations
- Shipping
- Defence
- Innovation Hub

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HYDRUS – Innovation Hub

INNOVATION HUB

INNOVATION HUB is a sub-division of HYDRUS Technical Department focused on advancing maritime decarbonization through R&D on alternative fuels, electrification, energy efficiency, digital tools, and collaborative EU-funded innovation projects.

Coordinated by HYDRUS

Green Transition

- FLEET for 55 – Integrated EETs onboard ships
- NH3 CRAFT – Ammonia as fuel
- LH2 CRAFT – Liquid H2 storage system
- SAFe CRAFT – Sustainable Alternative Fuels (SAF)
- TRIĒRĒS – Greek H2 valley
- bluebarge – Offshore Power Supply Barge

Digitalization and others

- OPTINET – Digital Tool for Ferry Lines Optimization
- EcoMaRE – Digital Tool for Energy Performance Optimization
- NEREAS – Digital Tool for Performance Monitoring
- Healthy Ship – Smart Ship Design and Digitalization against health hazards onboard cruise ships

Shore Side Electricity

- elemed – Port of Kyllini
- ALFION – Port of Igoumenitsa
- EALING – 16 EU Ports
- CIPORT – Cruise Terminal of Piraeus
- Port of Volos
- ALFION - INFRA – Infrastructure at the Port of Igoumenitsa
- DECOMPRES (DECARBONIZING THE GREEK COMPREHENSIVE PORTS) – 4 Greek Ports

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About FLEETfor55

Supporting Fit-for-55 compliance in waterborne transport

- **FLEETfor55** is a Horizon Europe project creating a roadmap for sustainable Energy Efficiency Technologies (EETs) for waterborne transport.

- **Focus:** select, combine and assess mature (TRL 7+) technologies for both retrofit and newbuilding applications.

- **Outcome:** practical guidance for vessels to improve efficiency while meeting EU climate and maritime regulatory targets.

42 months

21 partners + **2** affiliates

7+ million €

Total budget: €9.89M | EU funding rate: 60%

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About FLEETfor55

Project Coordinator

HYDRUS
ENGINEERING EXCELLENCE

ABS

Atlantec
Enterprise Solutions

COLUMBIA
SHIPMANAGEMENT

DNV

DST

Epsilon

FINCANTIERI Si
evolving integration

FREIRE
SHIPYARD

FUNDACIÓN
VALENCIAPORT

CETENA

CERTH
CENTRE FOR RESEARCH & TECHNOLOGY HELLAS

magellan
circle

NTNU

National
Technical
University of
Athens

RINA

SEKAVIN

University of
Strathclyde
Glasgow

SUPERFAST
FERRIES

WATERMEAON
SUSTAINABLE BLUE INNOVATION

UNIVERSITY OF
PATRAS

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About FLEETfor55

11 market-ready use cases across vessel segments

Short-sea shipping	Containership, General Cargo, Ro-Pax	**Newbuild + Retrofit**
High-seas shipping	Tanker, Bulk Carrier, LPG Tanker	**Newbuild + Retrofit**
Inland waterways	Chemical Tanker	**Newbuild + Retrofit**

UC	VESSEL TYPE	NB/RT	SIZE (DWT)
1	Containership	NB	≈ 35,000 t
2	General Cargo	RT	≈ 31,300 t
3	Ro-Pax	RT	≈ 1,900 t
4	Ro-Pax	RT	≈ 6,400 t
5	Ro-Pax	NB	≈ 1,900 t
6	Tanker	RT	≈ 150,000 t
7	Tanker	NB	≈ 158,000 t
8	Bulk Carrier	RT	≈ 178,000 t
9	LPG Tanker	RT	≈ 30,000 t
10	Inland Chemical Tanker	NB	≈ 3,000 t
11	Inland Chemical Tanker	RT	≈ 3,000 t

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About FLEETfor 55

9 EET categories assessed and combined

Optimized Engineering Approaches/Systems

WHRS, VFDs, M/E tuning, Advanced HVAC

Carbon Capture System

Propeller ESDs

PBCF, Pre-Swirl Fins, Wake Equalizing Ducts, Gate Rudder

Hydrodynamic Efficiency Improvements

Ship Related (x41) | **Globally Applied (x10)**

Fuels

Biofuels, Synthetic e-fuels, Fuel Reforming/Cracking

Electrification (Production/Use)

OPS, ESS, Electric Propulsion, LED Lights, Solar Panels

Renewables

WAPS – Rigid Wing Sails, Suction Wings, Flettner Rotors

Operations & Digital Optimization

Weathering routing for voyage optimization, JIT strategies, Cargo Load Factor Optimization

The value is rarely in one technology alone; it is in the compatibility, interaction and verification of a vessel-specific package.

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About FLEETfor55

Enabling practical decarbonization decisions

Holistic EET roadmap

Optimized combinations of mature technologies for vessel-specific Fit-for-55 pathways.

Decision Support System

Digital platform for fast assessment, benchmarking and design evaluation.

Regulatory KPI assessment

Alignment with EU Fit-for-55 and IMO GHG indicators such as CII, EEXI and EEDI.

Technology Innovation Network

Connects EET providers, end users and maritime stakeholders for adoption and exploitation.

FLEETfor55 bridges technology, vessel design, regulation and market uptake.

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Regulatory urgency

Regulation turns efficiency into a strategic lever

EU and IMO measures create pressure across carbon intensity, fuel intensity, reporting and cost exposure.

2024
EU ETS maritime phase-in begins

2025
FuelEU Maritime GHG intensity requirements start

2026
EU ETS reaches full maritime phase-in

2030
IMO: at least 40% carbon-intensity reduction vs 2008; zero/near-zero energy uptake target

2050
IMO net-zero GHG emissions by or around 2050

Implication for shipowners

- Efficiency measures reduce fuel consumption and exposure to carbon-related costs (penalties)
- Compliance is moving from reporting to operational and investment decisions
- Retrofit (DD) windows become strategic moments to de-risk future fuel choices

Implication for designers/shipyards

- Newbuilds must preserve optional choice for future fuels and energy systems
- EET packages need to be embedded early in hull, machinery and electrical architecture
- Integration choices affect lifetime compliance margin

Implication for operators

- Operational profile determines actual savings
- Data quality matters for performance verification
- EET benefit range is related to crew training/familiarization, maintenance and voyage planning

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Vessel-fit-logic

Vessel-type benefit map: where different EETs tend to fit

Use vessel segmentation to prioritize rather than overgeneralize.

Vessel Segment	Typical Driver	Promising EETs
High seas bulk carriers / tankers	Large wetted surface; long voyages; stable operating profile	Alternative fuels, shaft generator PTI/PTO, WHRS, WAPS, selected hydrodynamic improvements, conditional CCS, selected propeller ESDs
Container ships	Higher service speed; schedule pressure; large deck constraints	OPS, alternative fuels, shaft generator PTI/PTO, selected hydrodynamic improvements, propeller ESDs, conditional ESS and WHRS where linked to PTO/CCS
Ro-Pax / ferries	Frequent port calls; hotel loads; fixed routes	ESS hybridization, full or hybrid electric propulsion, OPS, HVAC optimization, LED lights, alternative fuels, FCs, WAPS subject to retrofit complexity
Inland vessels	Short routes; low-speed operation; shallow-water constraints; frequent stops; shore infrastructure relevance	ESS, full or hybrid electric propulsion, OPS, alternative fuels, hydrodynamic improvements, renewables (solar panels), FCs
Short-sea bunkering vessels / general cargo	Predictable routes; port infrastructure relevance	Shaft generator PTI/PTO, hydrodynamic improvements, selected propeller ESDs, conditional ESS where PTO is effective, conditional WHRS

Important note: actual suitability must be confirmed through vessel drawings, operational data, class constraints and cost/savings simulation.

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Technology-combination logic

Avoid clashes and capture synergies

EETs package must be designed as a system, not as a shopping list!

High-synergy combinations

- Hull/propeller optimization + coatings + trim/speed optimization
- Wind assist + weather routing + voyage planning
- Battery hybridization + load management + shore power
- Waste heat recovery + machinery optimization + monitoring

Integration risks to manage

- Double-counting savings across measures
- Space/stability conflicts with cargo operations
- Maintenance and crew workload increases
- Technology lock-in that reduces future-fuel optionality
- Underperformance from poor monitoring or baseline definition

Decision criterion: select the package with the best risk-adjusted compliance benefit, not necessarily the highest theoretical saving!

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Constraints

Constraint identification: what can block or shape EET adoption

Make constraints visible early to avoid late-stage re-design or weak business cases.

Technical

Space/weight, stability, structural reinforcement, machinery compatibility, electrical load balance, class approvals

Operational

Route variability, weather exposure, port turnaround, cargo operations, maintenance burden, crew acceptance.

Commercial

CAPEX limit, payback expectation, fuel price/carbon price uncertainty, split incentives, charter duration

Regulatory & Assurance

MRV data quality, emissions accounting, safety case, flag/class interpretations, performance verification

Practical recommendation: separate hard constraints from manageable constraints; hard constraints eliminate options, manageable constraints define the integration plan.

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Retrofit vs Newbuild

Different levers & different degrees of freedom

Use the same screening logic but different implementation assumptions.

Retrofit pathway

- Start with measured baseline, known operating history and expecting lifetime
- Prioritize measures compatible with scheduled drydock
- Minimize downtime and structural/electrical disruption
- Seek modular upgrades with measurable payback
- Use monitoring to verify savings and refine operations

Newbuild pathway

- Embed EETs during concept and basic design (greater flexibility to ‘play’)
- Optimize holistically hull, propulsion and energy architecture
- Preserve future-fuel and shore-power option
- Design for lifetime regulatory tightening
- Greater ROI potential

Bridge between both: EET selection should support both near-term compliance and long-term decarbonization flexibility.

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Roadmap & Takeaways

Implementation roadmap: from screening to investment decision

Phase 0	Phase 1	Phase 2	Phase 3	Phase 4
Strategic framing	**Baseline & data**	**Feasibility screening**	**Concept design**	**Investment case**
Define regulation exposure, vessel population and investment objectives	Collect operational profile, fuel/emissions data, drawings and maintenance history	Shortlist EETs, constraints, package options and first-order economics	Run performance modelling, arrangement checks, class/safety review, cost estimate, compliance checks	Compare scenarios, risks, compliance value, payback and funding options

Recommended output: a ranked EET package matrix by vessel type, with constraints, CAPEX/OPEX, performance improvement, regulatory impact and implementation timing!

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Roadmap & Takeaways

Three (3) takeaways

1. Efficiency is the bridge

EETs provide near- and mid-term emissions/fuel consumption reductions while fuel supply, infrastructure and vessel designs mature.

2. Integration beats selection

The highest value comes from vessel-specific packages that manage technical, operational and commercial constraints.

3. Verification creates confidence

Robust baselines, KPIs and monitoring turn expected savings into bankable decarbonization outcomes.

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Thank you!

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