Journal of Marine
Technology and Environment
DOI:10.53464/JMTE.03.2026.01

ISSN (Print): 1844-6116
ISSN (Online): 2501-8795
https://www. jmte.eu

GREENING MARITIME EDUCATION AT CONSTANTA MARITIME UNIVERSITY: INTEGRATING SUSTAINABILITY INTO TEACHING THROUGH RESEARCH AND COOPERATION

Nicoleta ACOMI[1], Taner ALBAYRAK[2]

[1] Constanta Maritime University, Faculty of Navigation and Maritime Transport, 104 Mircea cel Batran Street, 900663, Constanta, Romania, ORCID: https://orcid.org/0000-0003-3564-6867, e-mail: nicoleta.acomi@cmu-edu.eu
[2] Piri Reis University, Faculty of Economics and Administrative Sciences, Maritime Business Department, Postane, Eflatun Sk. No:8, 34940 Tuzla/İstanbul, Türkiye, ORCID ID:0000-0002-4743-9235, e-mail: talbayrak@pirireis.edu.tr

Abstract: Constanta Maritime University (CMU) has educated officers and specialists for the maritime industry for many years, since the establishment of the Civil Marine Institute. This anniversary paper reflects on how the university adapts its teaching to the sustainability transition of shipping and ports, driven by the 2023 IMO Strategy on the reduction of greenhouse gas emissions from ships, the carbon intensity requirements of MARPOL Annex VI and the extension of the EU Emissions Trading System and of the FuelEU Maritime Regulation to maritime transport. The participation of CMU in the Erasmus+ project GREENPORT Alliances is presented as a case study that connects research, education and the port community. Several academic papers of the CMU team on port emissions, electric tugs, onshore power supply, on-board power management and the behaviour of educators and crews provided the evidence base for sustainability topics that can be integrated into existing courses and for a vocational course on sustainable maritime operations. The training course, centred on an eco-navigation simulator exercise, was piloted at CMU in four sessions between November 2025 and May 2026 with 20 deck officers, maritime pilots, tug masters, chief engineers and towage managers, evaluated with the Kirkpatrick model and the EQAVET quality cycle, and integrated into the CMU Training Centre portfolio. The experience is discussed through the COM-B model of behaviour change: research and trainer training build capability; the simulator, the institutional integration of the course and the journals and conferences create opportunity; and the comparison of the learners' own manoeuvres sustains motivation. The paper concludes that a lasting change of operational behaviour requires these three components to be developed together and outlines directions for the further greening of maritime education at CMU.
Key words: behaviour change, eco-navigation, maritime education and training, port emissions, simulator training, sustainability.

1. INTRODUCTION

Anniversaries of academic institutions and of their journals are an opportunity to look both back and ahead [15]. For Constanta Maritime University (CMU), whose origins go back to the Civil Marine Institute established in 1972 [1], the past five decades have been marked by a continuous adaptation of maritime education to technological change: from radar and satellite positioning to integrated bridge systems, electronic chart display and information systems (ECDIS) and, more recently, digital and cyber-physical ships and ports.

The current decade adds a new and pressing driver: the decarbonisation of shipping and port operations. The international and European regulations adopted since 2021 [2]-[6] have moved energy efficiency and greenhouse gas (GHG) emissions from the domain of ship design and policy into the daily decisions of seafarers and port professionals, as also illustrated by recent studies published in this journal [16], [17].

For maritime education and training (MET) institutions, sustainability can therefore no longer be treated as a separate or optional topic; it has to be embedded in the competences that graduates and practitioners use on the bridge, in the engine room and in the port.

The purpose of this paper is to describe how CMU responds to this challenge, with emphasis on the integration of sustainability topics into teaching, on applied research and on international cooperation. The GREENPORT Alliances Erasmus+ project [8], [9], in which CMU is a partner, is presented as a case study that connects applied research, course design, piloting with port professionals and dissemination, with a focus on an eco-navigation simulator session developed for pilots, tug masters, deck officers and port operations professionals [13].

Creative Commons Attribution BY 4.0 International Licence (CC BY-4.0)

Journal of Marine
Technology and Environment
DOI:10.53464/JMTE.03.2026.01
ISSN (Print): 1844-6116
ISSN (Online): 2501-8795
https://www. jmte.eu

The following sections recall the main milestones of the university (Section 2), outline the regulatory and operational drivers (Section 3), describe the GREENPORT experience, from its research basis and teaching topics to the pilot at CMU (Section 4), and discuss the lessons learned through the COM-B model of behaviour change (Section 5); Section 6 concludes.

2. FIVE DECADES OF MARITIME EDUCATION IN CONSTANTA

Civilian maritime higher education in Constanta began with the establishment of the Civil Marine Institute in February 1972 [1]. In 1973 the institute was merged with the military officers' school, forming the "Mircea cel Batran" Marine Institute under the Ministry of National Defence. In 1990, by Government Decision no. 113 of 6 February 1990, the Civil Marine Institute was re-established under the Ministry of Education, with the faculties of Navigation and Electromechanics. In 2000 the institute became Constanta Maritime University, by Government Decision no. 85/2000 [1]. The date of 6 February is celebrated as the day of the university.

Over this period, the educational offer has grown from the two traditional pillars, navigation and marine engineering, to programmes in electrical engineering, transport economics and management and, more recently, cyber security. Today the university offers 11 bachelor and more than 15 master programmes to approximately 3,700 students. Programmes for seafarers have been continuously aligned with the STCW Convention [7], while the university has kept close links with the Port of Constanta, the largest port on the Black Sea, and with shipping companies, pilotage and towage operators. This proximity to the port community is an important asset for the sustainability transition discussed below.

3. SUSTAINABILITY DRIVERS FOR MARITIME CURRICULA

3.1 International and European regulatory framework

In July 2023 the International Maritime Organization (IMO) adopted its revised Strategy on the reduction of GHG emissions from ships. The Strategy sets the goal of reaching net-zero GHG emissions from international shipping by or around 2050, with indicative checkpoints of at least 20%, striving for 30%, reduction of total annual emissions by 2030 and of at least 70%, striving for 80%, by 2040, compared with 2008 [2]. Earlier amendments to MARPOL Annex VI introduced the Energy Efficiency Existing Ship Index (EEXI) and the operational Carbon Intensity Indicator (CII), in force since 1 November 2022, with annual ratings from A to E [3]. The CII is particularly relevant for education because it depends on how the ship is operated: speed, routing, trim, use of auxiliary engines and time spent in port.

At European level, maritime transport was included in the EU Emissions Trading System from 1 January 2024, with a progressive phase-in of the obligation to surrender allowances [4]. The FuelEU Maritime Regulation, applicable from 1 January 2025, limits the GHG intensity of the energy used on board and requires, from 2030, container and passenger ships at berth in the main EU ports to connect to on-shore power supply [5]. The Alternative Fuels Infrastructure Regulation obliges Member States to deploy shore-side electricity in these ports [6]. Together, these instruments give emissions a direct cost and a compliance dimension, which companies pass on to their crews and shore staff.

3.2 Ports and port services

Ports concentrate emissions close to urban areas, and an important share comes from activities that ship-based regulations do not cover, such as harbour towage, pilotage, mooring and cargo handling. GREENPORT Alliances starts from the observation that emissions from port services are largely unregulated and that technical solutions, such as new tug propulsion systems or alternative fuels, require time and investment [8]. In the meantime, the way in which pilots and tug masters plan and execute a manoeuvre directly determines how much power the ship and the tugs use. Operational behaviour is therefore an immediate and low-cost lever for reducing emissions, and it can be developed through training.

3.3 Implications for competences

These drivers translate into competences that need to be developed both in initial education and in lifelong learning:

- understanding of the regulatory framework and of the indicators used to assess energy and emissions performance;
- energy-efficient voyage, passage and manoeuvring planning;
- efficient use of propulsion, auxiliary systems and tug assistance;
- awareness of alternative fuels and of their safety implications;
- data literacy for monitoring, reporting and verification of emissions;
- teamwork and communication between the ship, the pilot, the tugs and the terminal.

The comprehensive review of the STCW Convention and Code under way at IMO is expected to reflect part of these needs. MET institutions, however, do not need to wait for it in order to update their teaching.

Creative Commons Attribution BY 4.0 International Licence (CC BY-4.0)

Journal of Marine
Technology and Environment
DOI:10.53464/JMTE.03.2026.01
ISSN (Print): 1844-6116
ISSN (Online): 2501-8795
https://www. jmte.eu

4. THE GREENPORT ALLIANCES EXPERIENCE

GREENPORT Alliances (Erasmus+, project no. 101139879, February 2024 - January 2027) brings together ten partners from eight countries, coordinated by Piri Reis University, Türkiye. Besides Piri Reis University and CMU, the consortium includes AcrossLimits (Malta), the Antwerp Maritime Academy, the European Tugowners Association and the European Maritime Pilots' Association (Belgium), the "Nikola Vaptsarov" Naval Academy (Bulgaria), the Faculty of Maritime Studies of the University of Rijeka (Croatia), Mar.TE (Italy) and the Port of Aveiro (Portugal) [8], [9], so that higher education, the towage and pilotage professions and a port authority work together. The project aims to change the behaviour of current and future port services personnel by integrating sustainability, together with the EntreComp entrepreneurship competence framework [10], into new educational offers. Three training products are developed: a 4-ECTS academic course on eco-navigation and emissions tracking for maritime students, a vocational course for tug, pilot and port personnel, and a 20-hour train-the-trainer programme for maritime educators [9]. Within the consortium, CMU contributed to the research basis of the project, to the development and validation of the vocational course and to its piloting with port services personnel in Romania [26].

4.1 Research basis and teaching topics

The training products of GREENPORT were preceded and accompanied by applied research carried out by consortium partners. Between 2025 and 2026, the CMU team contributed to eight papers [18]-[25], which can be grouped in four strands (Table 1).

Table 1. Research strands of the CMU GREENPORT team and the sustainability topics they bring to teaching

Research strand	Main findings	Topics for teaching
Evidence reviews of port emission reduction [18]-[20]	Three themes for greener port services: • emission-reduction technologies, data-driven optimisation and governance (27 studies); • electric tugs cut emissions and noise but face high costs, limited range and charging needs (42 studies and an industry focus group); • onshore power supply is limited by grid capacity, compatibility and missing standards	• Green port technologies and port electrification; • Electric and hybrid tugs; • Alternative fuels and their safety; • Environmental management of port operations; • Case studies of green ports
Economics of shore power [21]	Under EU ETS carbon pricing, onshore power supply becomes economically viable, not only environmentally beneficial	• IMO and EU instruments (EU ETS, FuelEU Maritime, AFIR, MRV); • The cost of emissions in ship and port operation; • Shore power in commercial operation
On-board energy management, simulator-based [24], [25]	DP vessel generators work best at 75-90% load (thermal efficiency about 37%) with a spinning reserve of at least 15%; a power management system stabilises the grid of diesel-electric tugs at peak loads	• Energy-efficient manoeuvring and passage planning; • Route optimisation on ECDIS; • Generator loading and power management; • Reading power, fuel and emissions data
Human behaviour and educators [22], [23]	86 maritime educators are motivated to teach behavioural change but lack capability (training, resources) and opportunity (real cases, interactive methods); IoT monitoring of stress-related deck crew behaviour, validated with captains	• Bridge and watch team communication; • Human factors and stress; • Decisions under operational constraints; • Initiative and opportunity spotting (EntreComp); • Behavioural change approaches

Two of these results directly shaped the training. The COM-B survey showed that the main obstacles for educators are capability and opportunity rather than motivation [22], which supports the emphasis of GREENPORT on a train-the-trainer programme and on ready-to-use, simulator-based case material. The study of diesel generators on DP vessels [24] provided the method used to convert simulator power records into fuel consumption and emissions, by means of brake specific fuel consumption curves and emission factors, which was later applied in the CMU pilot (Section 4.5). The reviews also explain the operational focus of the course:

Creative Commons Attribution BY 4.0 International Licence (CC BY-4.0)

Journal of Marine
Technology and Environment
DOI:10.53464/JMTE.03.2026.01
ISSN (Print): 1844-6116
ISSN (Online): 2501-8795
https://www. jmte.eu

technical solutions such as electric tugs or shore power require time, investment and infrastructure [19]-[21], whereas a change in manoeuvring practice can be trained immediately.

These topics fit into the existing structure of the bachelor programme in navigation, which already covers ship manoeuvring, voyage planning, electronic navigation and ECDIS, meteorology, pollution prevention and marine ecology, international and EU maritime regulation, port systems, watch team management and entrepreneurship in maritime transport. They can therefore be integrated into teaching as updated content, case studies and simulator exercises, without waiting for new study programmes, and the same material supports the vocational course for port services personnel.

4.2 The eco-navigation simulator session

Within the vocational course *Sustainable Maritime Operations and Green Port Technologies*, Session 7, Eco Navigation, is a four-hour instructor-led simulator exercise for pilots, tug masters, deck officers and port operations professionals [13]. A large commercial vessel approaches an enclosed dock basin with the wind from astern, swings to head into the wind and berths with the assistance of two harbour tugs. Trainees perform the same manoeuvre twice under identical initial and environmental conditions. In Run 1 they apply their usual professional practice; in Run 2 they apply an optimised plan, agreed jointly by the pilot and the tug masters during a structured debrief (Figure 1). Simulator-based exercises of this kind allow learners to observe the consequences of their own decisions in a safe environment and to repeat a task under identical conditions, which is rarely possible on board [11].

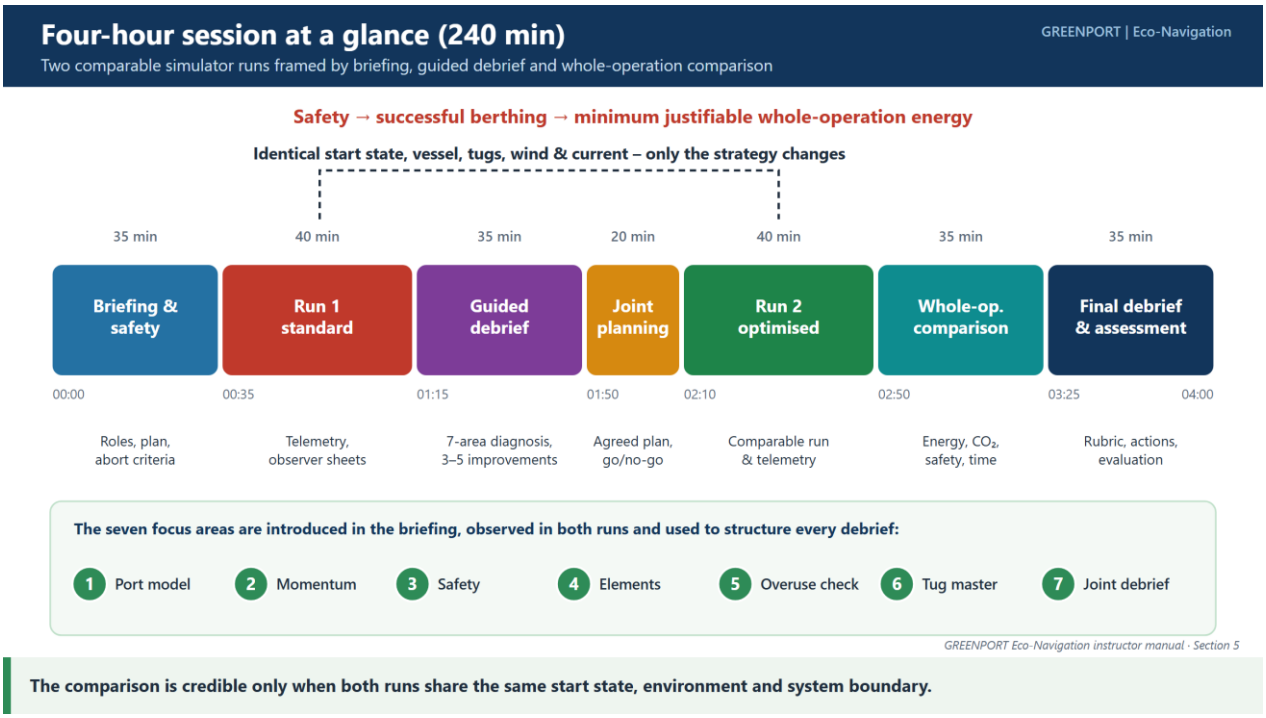


Figure 1 Structure of the four-hour eco-navigation session (illustrative) [13]

The session is designed to be replicable at different training centres and on different simulator platforms, such as Wärtsilä-Transas Navi-Trainer Pro 5000 or Kongsberg. At CMU, the session was implemented on the Kongsberg K-Sim Dynamic Positioning simulator (Section 4.5), which illustrates this transferability. A centre configuration sheet records the local port model, the vessel and tug models and the validated wind conditions. Where available, the instructor exports time-stamped engine and tug demand data; when tug engine-load data are not available, the requested bollard pull and its duration are used as an indicator [13].

The guiding principle is safety first, then a successful berthing, then the lowest justified energy use and emissions. Completion is based on participation and demonstrated reasoning, not on achieving a predetermined percentage of emission reduction, and a lower-energy run is not considered successful if safety limits are violated [13].

Creative Commons Attribution BY 4.0 International Licence (CC BY-4.0)

Journal of Marine
Technology and Environment
DOI:10.53464/JMTE.03.2026.01
ISSN (Print): 1844-6116
ISSN (Online): 2501-8795
https://www. jmte.eu

4.3 Seven focus areas and the whole-operation comparison

The briefing introduces seven focus areas in which energy can be saved during the approach, swing and berthing (Figure 2): (1) port-specific digital modelling and planning of the swing; (2) strategic use of the vessel's momentum, by reducing main-engine power early and in stages; (3) prioritising safety in manoeuvring; (4) using wind and current to advantage instead of counteracting them; (5) monitoring for overuse of tugs and ship's engine, including propulsion demands that cancel each other out; (6) delivering tug assistance efficiently: the tug master's contribution; and (7) a joint post-operation debrief of pilots and tug masters [13].

A key element is that the two runs are compared for the whole operation, the assisted vessel and each tug, and not for the ship alone. Learners examine the manoeuvring time, the periods of high main-engine and tug load and the tug force-time demand, and ask whether total emissions fell or simply moved from the ship to the tugs [13]. This whole-operation view makes visible the shared responsibility of pilots and tug masters: every engine and tug order has an energy and emissions consequence.

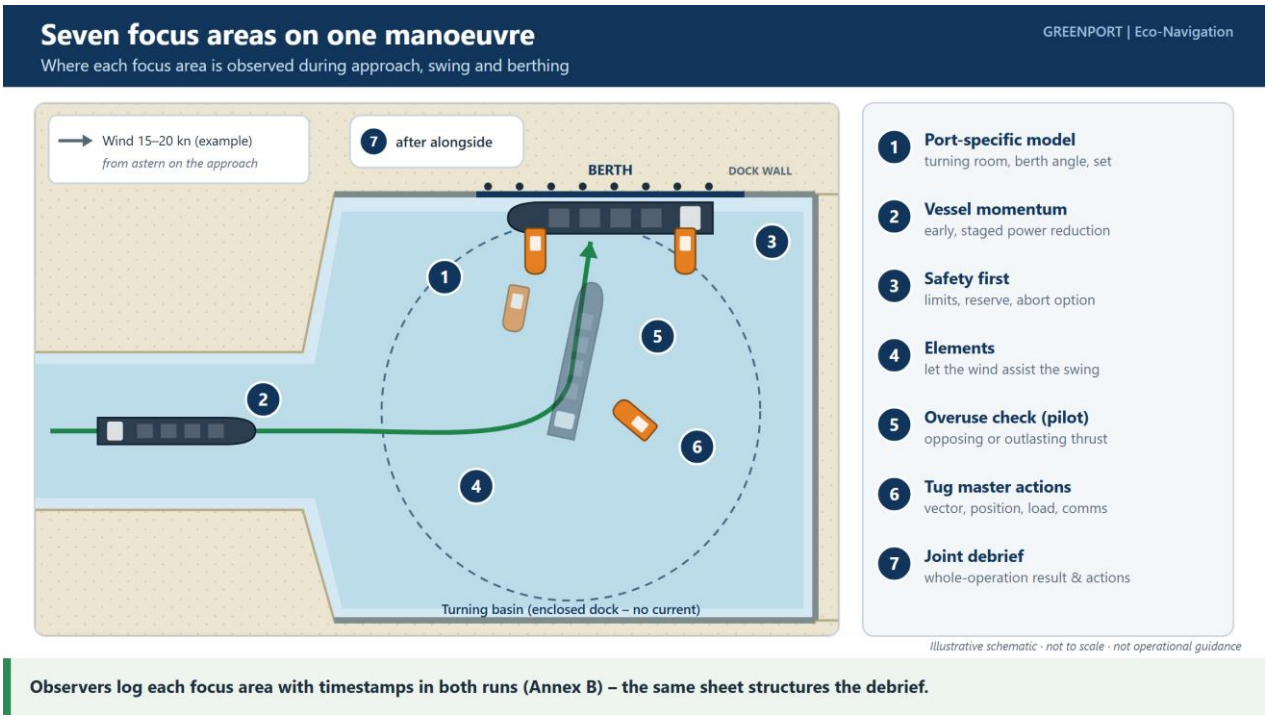


Figure 2 Seven focus areas for energy saving during a tug-assisted swing and berthing manoeuvre [13]

4.4 Evaluation framework

The effectiveness of the session is evaluated with the four-level model of Kirkpatrick [12], as summarised in Table 2. Learning is assessed through observation sheets, run data and a competence-based rubric, while behaviour and results are followed up after the course.

Table 2. Evaluation of the eco-navigation session with the Kirkpatrick model [12], [13]

Level	*Evidence collected*
1. Reaction	Participants' rating of the relevance and usefulness of the session
2. Learning	Competence-based assessment of decisions, coordination and whole-operation reasoning
3. Behaviour	Three practical actions committed by each participant for their own work, followed up after the course
4. Results	Operational evidence in port, such as fewer high-load periods and lower tug and engine demand

Levels 3 and 4 require cooperation with pilotage and towage operators beyond the classroom, which strengthens the links between the university and the port community. The model is complemented by the EQAVET quality assurance cycle of planning, implementation, evaluation and review [27], used to document how the evidence of each delivery informs the next one.

4.5 Pilot implementation at CMU

Creative Commons Attribution BY 4.0 International Licence (CC BY-4.0)

Journal of Marine
Technology and Environment
DOI:10.53464/JMTE.03.2026.01
ISSN (Print): 1844-6116
ISSN (Online): 2501-8795
https://www. jmte.eu

CMU piloted the vocational course in four sessions between November 2025 and May 2026 with 20 participants: captains and deck officers, a chief engineer, experienced maritime pilots and the management and operational staff of a towage company, with a pilot from the Port of Aveiro, a project partner, as guest observer [26]. The sessions were conceived as successive validation stages, each refining the next: the first reviewed the methodology, the second tested the full sequence with initial and final knowledge assessments, the third refined the simulator exercise with experienced pilots and the fourth examined the applicability of the course to real tug operations. The course combines 8.5 contact hours, delivered online on the CMU Moodle platform or face-to-face and on the Kongsberg K-Sim Dynamic Positioning simulator, with about 6 hours of individual work, and was delivered by instructors trained in the GREENPORT train-the-trainer programme. The eco-navigation exercise confirmed that a planned manoeuvre, with steady thrust and use of wind and tide, needs less energy than a reactive one while remaining within safety limits; the scenario and the energy analysis are reported separately [24].

Evidence was collected at the first three Kirkpatrick levels: a post-course questionnaire on satisfaction, knowledge tests, which all formally assessed participants passed, complemented for experienced professionals by simulator observation and debriefing, and a follow-up questionnaire one month after the course on the application of learning. The debriefings converged on the same lessons: better planning reduces unnecessary power demand, small operational adjustments produce measurable reductions, communication between pilots and tug masters is essential for both safety and sustainability, and digital decision-support tools complement but do not replace professional judgement [26]. Level 4 evidence requires operational data from towage operators and remains to be collected.

4.6 Institutional integration and dissemination

Following the pilot, the course was formally integrated into the continuing professional development portfolio of the CMU Training Centre by decision of the University Senate, which secures its delivery beyond the lifetime of the project [26]. This step turns a project output into a permanent part of the educational offer of the university.

The results were also discussed with the wider maritime community. In September 2025, a stakeholders' roundtable gathered more than 25 representatives of port authorities, training centres, regulatory bodies, recruitment agencies and companies around the implementation of the EU MRV Regulation [26]. The international conference MariLog, organised by CMU, hosted in 2025 the round table Green Ports for Sustainable Maritime Future [28]. In 2026, the conference included a keynote address of the project coordinator on cooperation for sustainable development, a session on maritime transport trends with GREENPORT research, and an expert panel with DNV and the Romanian Naval Authority on the impact of ESG, CSRD, MRV, EU ETS and FuelEU Maritime requirements on workforce development and sustainability training [29].

5. DISCUSSION: A COM-B READING AND THE WAY FORWARD

The aim of GREENPORT is a change in the behaviour of port services personnel, not only an increase in knowledge. The COM-B model, which explains behaviour as the result of capability, opportunity and motivation [30], was used by the project team to study how maritime educators integrate sustainability into their teaching [22]. The same structure offers a useful reading of the CMU experience as a whole (Table 3).

Table 3. The CMU GREENPORT experience read through the COM-B model [22], [30]

COM-B component	How the CMU experience addresses it
Capability	Up-to-date content from the research of the CMU team (Table 1); knowledge of regulations and technologies; planning, timing and power-use skills practised on the simulator; instructors prepared through the train-the-trainer programme
Opportunity	Repeatable simulator scenarios and Moodle resources; course integrated into the CMU Training Centre portfolio; joint sessions of pilots, tug masters, engineers and managers; dialogue at MariLog and stakeholder events
Motivation	Learners see the effect of their own decisions in their own data; safety-first principle consistent with professional identity; structured debrief and personal commitments for their own work
Target behaviour	Planned and coordinated manoeuvres with fewer power peaks and less counteracting thrust, followed up at Kirkpatrick levels 3 and 4

Capability was built from two directions. The research of the CMU team supplied up-to-date content on technologies, regulations and energy management, and the train-the-trainer programme addressed the gap found among educators, who are motivated but report insufficient training and resources [22]. For learners, the comparison of two runs turns an abstract objective into concrete skills of planning, timing and power use, and the debrief, grounded in experiential learning [14], lets them build their own optimisation plan instead of receiving a prescribed solution.

Creative Commons Attribution BY 4.0 International Licence (CC BY-4.0)

Journal of Marine
Technology and Environment
DOI:10.53464/JMTE.03.2026.01
ISSN (Print): 1844-6116
ISSN (Online): 2501-8795
https://www. jmte.eu

Opportunity is both physical and social. The simulator allows a manoeuvre to be repeated under identical conditions, and the integration of the course into the Training Centre portfolio keeps it available after the project. The joint participation of pilots, tug masters, engineers and managers, and the dialogue opened by MariLog and the stakeholder events, make energy use a shared concern of the port community rather than an individual one. Assessment opportunities must also fit the learners: written tests suit officers, while experienced professionals are better assessed through observation and professional discussion, and the two forms of evidence should be reported separately [26].

Motivation is strongest when learners see the effect of their own decisions in their own data. The finding that a slower, planned manoeuvre can be the greener one is more convincing when it emerges from a participant's run than when it is stated in a lecture. Placing safety explicitly before energy saving keeps the message consistent with the professional culture of pilots and tug masters and prevents savings at the expense of safe margins, while the personal commitments made at the end of the session connect reflection with practice. Read in this way, the experience suggests that the three components reinforce each other: knowledge without opportunity to practise, or practice without a convincing reason to change, is unlikely to change behaviour in port.

The approach has also started to travel beyond the consortium. GREENPORT Alliances has received a Letter of Intent from Race for the Baltic (RFTB), an initiative of the Baltic Sea region, to explore long-term cooperation in maritime research, innovation, sustainability and capacity building [31]. Within this cooperation, RFTB will pilot and evaluate the GREENPORT behavioural-change methodology in its own operational context, and the two initiatives will work towards a broader sustainability framework for ports, shipping and maritime communities. This transfer is also a test of the COM-B reading above: if capability, opportunity and motivation are developed together, a training approach designed for the Black Sea should be adaptable to the operational realities of another sea basin.

For CMU, the way forward includes integrating the GREENPORT outputs into bachelor and master curricula and into continuing professional development courses; extending simulator exercises to engine-room energy management and alternative fuels, and to hybrid and electric tugs [25]; developing data literacy for emissions monitoring and reporting; training the trainers, building on the capability gaps identified among educators [22]; measuring the capability, opportunity and motivation of course participants before and after training, with an instrument adapted from [22]; introducing a common observation rubric for simulator exercises across partner institutions; and cooperating with the Port of Constanta and port service providers to measure the effects of training in real operations. The approach also has limitations: simulator results depend on the fidelity of the ship and tug models, the pilot results rely on a small number of participants and runs, and the transfer of training to real operations has to be confirmed through follow-up at Kirkpatrick levels 3 and 4.

6. CONCLUSIONS

Over more than five decades, Constanta Maritime University has adapted its educational offer to successive technological changes in shipping. The sustainability transition requires a similar but faster adaptation, driven by the IMO GHG Strategy, the operational carbon intensity requirements and the European climate legislation for maritime transport.

This paper argued that integrating sustainability topics into teaching, supported by applied research, simulator-based learning and international cooperation, is an effective way to make every graduate and practitioner aware of their role in reducing emissions.

The GREENPORT Alliances project illustrates this approach: in a safe and repeatable setting, the eco-navigation session shows pilots and tug masters that their everyday manoeuvring decisions determine the energy use and emissions of the whole operation.

The pilot with 20 port professionals confirmed this in practice: the simulator exercise showed the lower energy demand of a planned manoeuvre, all formally assessed participants passed the final test, and the course has become a permanent part of the CMU Training Centre offer.

Read through the COM-B model, the experience shows that a lasting change of operational behaviour requires capability, opportunity and motivation to be developed together: research and trainer training build capability; the simulator, the institutional integration of the course and the dialogue with the port community create opportunity; and the experience of one's own data, within safety limits, sustains motivation.

Building on this experience, CMU can continue to contribute to a safer and greener maritime industry in the decades to come.

7. ACKNOWLEDGMENTS

The authors thank the partners of the GREENPORT Alliances consortium for their cooperation in developing and reviewing the eco-navigation session, the CMU instructors and researchers involved in the project, and the participants in the pilot sessions.

8. FUNDING

This study was developed within the GREENPORT Alliances project, co-funded by the European Union

Creative Commons Attribution BY 4.0 International Licence (CC BY-4.0)

ISSN (Print): 1844-6116
ISSN (Online): 2501-8795
https://www. jmte.eu

under the Erasmus+ Programme. Views and opinions expressed are however those of the authors only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor the granting authority can be held responsible for them. Project Number: 101139879.

9. DECLARATION

The authors declare the responsible use of Claude AI during the refinement of this manuscript. Assistance was limited to language polishing and structural alignment. All data analysis, interpretation, methodological decisions, and final writing were carried out under the full intellectual responsibility of the authors.

10. CREDIT AUTHORS STATEMENT

Conceptualization: N.A., T.A.; Investigation: N.A., T.A.; Methodology: N.A., T.A.; Project administration: T.A., N.A.; Visualization: N.A.; Writing - original draft: N.A.; Writing - review & editing: T.A., N.A.

11. REFERENCES

[1] Constanta Maritime University, *Codul calitatii UMC* [Quality Code of CMU], 2026. Available: https://cmu-edu.eu/calitate/

[2] International Maritime Organization, *2023 IMO Strategy on Reduction of GHG Emissions from Ships*, Resolution MEPC.377(80), London, 2023.

[3] International Maritime Organization, *Amendments to the Annex of the Protocol of 1997 to amend the International Convention for the Prevention of Pollution from Ships (MARPOL Annex VI)*, Resolution MEPC.328(76), London, 2021.

[4] European Parliament and Council, Directive (EU) 2023/959 of 10 May 2023 amending Directive 2003/87/EC establishing a system for greenhouse gas emission allowance trading within the Union, *Official Journal of the European Union*, L 130, 2023.

[5] European Parliament and Council, Regulation (EU) 2023/1805 of 13 September 2023 on the use of renewable and low-carbon fuels in maritime transport (FuelEU Maritime), *Official Journal of the European Union*, L 234, 2023.

[6] European Parliament and Council, Regulation (EU) 2023/1804 of 13 September 2023 on the deployment of alternative fuels infrastructure (AFIR), *Official Journal of the European Union*, L 234, 2023.

[7] International Maritime Organization, *International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW), 1978, as amended*, London.

[8] Faculty of Maritime Studies, University of Rijeka, *GREENPORT Alliances - project information*, 2024. Available: https://pfri.uniri.hr/web/en/projekti/aktivni/03-2024/GREENPORT-eng.pdf

[9] AcrossLimits, *GREENPORT Alliances project at its midway point*, 2025. Available: https://www.acrosslimits.com/greenport-alliances-project-at-its-midway-point/

[10] Bacigalupo, M., Kampylis, P., Punie, Y., Van den Brande, G., *EntreComp: The Entrepreneurship Competence Framework*, Publications Office of the European Union, Luxembourg, 2016.

[11] Kim, T.-e., Sharma, A., Bustgaard, M., Gyldensten, W. C., Nymoen, O. K., Tusher, H. M., Nazir, S., The continuum of simulator-based maritime training and education, *WMU Journal of Maritime Affairs*, Vol. 20, pp. 135-150, 2021.

[12] Kirkpatrick, D. L., Kirkpatrick, J. D., *Evaluating Training Programs: The Four Levels*, 3rd ed., Berrett-Koehler, San Francisco, 2006.

[13] GREENPORT Alliances, *Session 7 - Eco Navigation: Energy-Efficient Tug-Assisted Port Manoeuvring. Instructor Manual*, version 2.0, 2026.

[14] Kolb, D. A., *Experiential Learning: Experience as the Source of Learning and Development*, Prentice Hall, Englewood Cliffs, NJ, 1984.

[15] Panaitescu, M., Panaitescu, F.-V., 18 years of stories for Journal of Marine Technology and Environment - more mature, more dedicated, Journal of Marine Technology and Environment, Vol. 1, pp. 10-11, 2026. DOI: 10.53464/JMTE.01.2026.01

[16] Deshpande, A., Greening the operation of the Arleigh Burke-class (DDG-51) vessel under climate change scenarios: a cost and emissions perspective, Journal of Marine Technology and Environment, Vol. 1, pp. 19-24, 2026. DOI: 10.53464/JMTE.01.2026.03

[17] Ribarov, L. A., Reductions in engine exhaust emissions in a hybrid Flettner rotor power-assisted vessel, Journal of Marine Technology and

Creative Commons Attribution BY 4.0 International Licence (CC BY-4.0)

ISSN (Print): 1844-6116
ISSN (Online): 2501-8795
https://www. jmte.eu

Environment, Vol. 2, 2026. DOI: 10.53464/JMTE.02.2026.08

[18] Acomi, N., Surugiu, G., Raicu, G., Stanca, C., A thematic review of port services and emission reduction strategies using ATLAS.ti, TransNav, the International Journal on Marine Navigation and Safety of Sea Transportation, Vol. 19, No. 2, pp. 447-457, 2025. DOI: 10.12716/1001.19.02.14

[19] Acomi, N., Stanca, C., Raicu, G., Surugiu, G., Popa, E. M., Advantages and disadvantages of using electric tugboats: a systematic review, Journal of ETA Maritime Science, Vol. 13, No. 1, pp. 59-70, 2025. DOI: 10.4274/jems.2025.90912

[20] Acomi, N., Voicu, I., Stan, L. C., A thematic review of onshore power supply challenges, Acta Technica Napocensis, Series: Applied Mathematics, Mechanics, and Engineering, Vol. 69, Special Issue I, pp. 93-102, 2026.

[21] Voicu, I., Acomi, N., Panaitescu, F.-V., Panaitescu, M., A simulation-based assessment of cost effectiveness of onshore power supply under the EU ETS framework, International Multidisciplinary Scientific GeoConference SGEM, Vol. 25, Issue 4.2, 2025. DOI: 10.5593/sgem2025v/4.2/s16.02

[22] Eker İşçioğlu, T., Albayrak, M. T., Gençer, H., Acomi, N., Surugiu, G., Jardas, M., Valčić, S., A COM-B perspective on integrating sustainability into maritime education, Scientific Journal of Maritime Research [Pomorstvo], Vol. 40, No. 2, pp. 294-302, 2026. DOI: 10.31217/p.40.2.10

[23] Hnatiuc, M., Acomi, N., Identifying deck crew behaviour using IoT systems and intelligent methods. Preliminary study, IOP Conference Series: Materials Science and Engineering, Vol. 1336, 012001, 2025. DOI: 10.1088/1757-899X/1336/1/012001

[24] Acomi, N., Preda, A., Operational optimization of parallel diesel generator systems for enhanced fuel efficiency and emissions reduction in DP vessels, TransNav, the International Journal on Marine Navigation and Safety of Sea Transportation, Vol. 20, No. 2, pp. 469-473, 2026. DOI: 10.12716/1001.20.02.20

[25] Preda, A., Acomi, N., High-fidelity simulation and power management optimization of parallel diesel generators for electric tugboats, IOP Conference Series: Materials Science and Engineering, Vol. 1351, 012012, 2026. DOI: 10.1088/1757-899X/1351/1/012012

[26] Constanta Maritime University, GREENPORT Evaluation Report on the Pilot Implementation of the Vocational Education and Training "Sustainable Maritime Operations and Green Port Technologies", GREENPORT Alliances project deliverable, 2026.

[27] Council of the European Union, Council Recommendation of 24 November 2020 on vocational education and training (VET) for sustainable competitiveness, social fairness and resilience (2020/C 417/01), Official Journal of the European Union, C 417, 2020.

[28] Constanta Maritime University, MariLog 2025 - International Conference on Maritime Transport and Logistics Trends, Conference Programme, 29-30 May 2025.

[29] Constanta Maritime University, MariLog Trends 2026 - International Conference on Maritime Transport and Logistics Trends, Conference Agenda, 4-5 June 2026.

[30] Michie, S., van Stralen, M. M., West, R., The behaviour change wheel: a new method for characterising and designing behaviour change interventions, Implementation Science, Vol. 6, 42, 2011. DOI: 10.1186/1748-5908-6-42

[31] Race for the Baltic (RFTB), https://www.raceforthebaltic.com/, and GREENPORT Alliances, Cooperation across sea basins: building a sustainable maritime future together, project newsletter, 2026.

Creative Commons Attribution BY 4.0 International Licence (CC BY-4.0)