Call: ERASMUS-EDU-2023-PI-ALL-INNO
Type of Action: ERASMUS Lump Sum Grants
Project Name: GREENPORT Alliances
Acronym: GREENPORT
Project Number: 101139879

GREENPORT Alliances
Work Package 4, Deliverable 4.3
TTT Modules and comprehension questions

September 2025

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Responsible Organisation:	AMA, NVNA
Version-Status:	V3
Submission date:	08/09/2025
Dissemination level:	Sensitive

GREENPORT Alliances

Co-funded by the European Union

Deliverable factsheet

Project number:	101139879
Project acronym:	GREENPORT
Project title:	GREENPORT Alliances

Title of deliverable:	Deliverable 4.3
Work package:	4
Due date according to contract:	31 August 2025

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Statement of originality:

This deliverable contains original unpublished work except where clearly indicated otherwise. Acknowledgement of previously published material and of the work of others has been made through appropriate citation, quotation or both.

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GREENPORT Alliances

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Train the Trainer: Delivering the GREENPORT Curriculum for Maritime Sustainability

TTT Modules

September 2025

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Contents

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INTRODUCTION

Welcome to **"Train the Trainer: Delivering the GREENPORT Curriculum for Maritime Sustainability."** This course is a flexible guide for educators, designed to support you in adapting the GREENPORT curriculum for both Higher Education (HEI) and Vocational Education and Training (VET) contexts. Whether you teach university students, apprentices, or maritime professionals, the course provides tools to shape existing courseware and adapt your teaching approach to your specific audience. To help you achieve this, the program offers practical methods and insights for creating impactful learning experiences that foster maritime sustainability—while giving you the freedom to tailor the content to the unique needs and contexts of your learners.

As the maritime industry stands at the crossroads of technological innovation and environmental responsibility, trainers carry a critical responsibility in guiding the energy transition. Beyond transferring knowledge, educators shape the mindsets, skills, and attitudes of the next generation of maritime professionals, ensuring they are not only aware of sustainability challenges but also capable of acting on them. This course recognizes that sustainability in shipping is being reshaped by emerging technologies, new international regulations, and evolving best practices. By equipping trainers with adaptable strategies and up-to-date resources, it bridges the gap between theory and practice and empowers you to take an active role in steering behavioral change and preparing learners to contribute meaningfully to a more sustainable maritime sector.

At the heart of the GREENPORT Train the Trainer course lies the COM-B model—Capability, Opportunity, Motivation, Behavior—a proven framework for enabling behavior change. This course will introduce and explain the model in detail. By applying COM-B at two levels—first to pinpoint where learners face barriers in turning knowledge into behavior, and second to re-think and adapt your own course design—you can greatly increase the effectiveness of your training. In this way, COM-B transforms sustainability education from a purely theoretical exercise into a practical driver of change, equipping learners to embed sustainable practices into their daily maritime operations.

1. Diagnosing Learner Barriers: As a trainer, you can use the COM-B model to pinpoint exactly where learners may struggle to translate knowledge into

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behavior. This diagnostic use of COM-B helps you analyze the specific obstacles that block behavioral change:

- Capability – Do learners have the technical knowledge of alternative fuels or the practical skills to operate energy-efficient equipment?
- Opportunity – Do they have access to updated regulations, digital tools, or professional networks that enable them to apply what they learn?
- Motivation – Are they encouraged by industry trends, peer recognition, or personal values to act sustainably even when it requires extra effort?

2. Adapting Your Own Course Design: The COM-B model also serves as the organizing principle of this Train the Trainer course. By reflecting on your own teaching through the COM-B lens, you are invited—and challenged—to adapt your methods in ways that maximize your impact on learners. This approach moves beyond simple knowledge transfer, ensuring that your course design actively fosters the behavioral shifts the maritime sector urgently needs to succeed in the energy transition and achieve long-term sustainability. Ask yourself:

- Does my course strengthen learners' capabilities with hands-on tasks and case studies?
- Does it create opportunities by linking them to real-world tools, industry practices, and regulatory frameworks?
- Does it foster long-term motivation by making sustainability meaningful, both personally and professionally?

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TTT Learning Content (Course Catalog)

<table>
<tr><td colspan="4">Course Name:
Sustainable Maritime Operations and Green Ports</td><td colspan="3">Degree: Train the Trainer</td></tr>
<tr><td rowspan="2">Code</td><td rowspan="2">Year/Semester</td><td rowspan="2">Local Credits</td><td rowspan="2">ECTS Credits</td><td colspan="3">Course Implementation, Hours</td></tr>
<tr><td>Course</td><td>Tutorial</td><td>Simulator Laboratory</td></tr>
<tr><td>GRNPRT-TTT-01</td><td>Continuous (Staff Training Program)</td><td></td><td></td><td>16</td><td></td><td></td></tr>
<tr><td colspan="2">Department</td><td colspan="5">Train the Trainer – Sustainable Maritime Operations and Green Port</td></tr>
<tr><td colspan="2">Instructors</td><td colspan="5">Computer based on-line training (self-paced)</td></tr>
<tr><td colspan="2">Contact Information</td><td colspan="5">……</td></tr>
<tr><td colspan="2">Office Hours</td><td colspan="5">…….</td></tr>
<tr><td colspan="2">Web page</td><td colspan="5">https://greenportalliance.eu</td></tr>
<tr><td colspan="2">Course Type</td><td colspan="2">Online – self study</td><td>Course Language</td><td colspan="2">English</td></tr>
<tr><td colspan="2">Course Prerequisites</td><td colspan="5">N/A</td></tr>
<tr><td colspan="2" rowspan="2">Course Category by Content (%)</td><td>Basic Sciences</td><td>Engineering Science</td><td>Engineering Design</td><td colspan="2">Humanities Social Sciences</td></tr>
<tr><td>10</td><td>10</td><td>20</td><td colspan="2">60</td></tr>
<tr><td colspan="2">Course Description</td><td colspan="5">The Train the Trainer – Sustainable Maritime Operations and Green Ports course is a two-day, self-paced online learning program designed to equip individual trainers and maritime educators with the competencies required to deliver the GREENPORT outcome course effectively and independently.

1. Setting the Context
The Train the Trainer (TTT) course begins by framing the broader context in which the GREENPORT courses will be delivered. It emphasizes the pivotal role of educators in supporting the energy transition within the shipping sector. This includes exploring the impact of technological innovations and the importance of behavioral change in achieving sustainable maritime operations.
2. Introduction to GREENPORT Courses
Participants will receive a comprehensive overview of the GREENPORT course structure. This includes the course goals, learning trajectories, and how these fit into the broader mission of preparing maritime professionals for the challenges and opportunities of sustainable shipping.
3. Instructional Strategies and Adult Learning
The TTT course equips trainers with practical methods for delivering content effectively, using principles of adult learning and instructional design specifically tailored for maritime education. It supports trainers in developing</td></tr>
</table>

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	confidence to facilitate online, asynchronous, and blended learning environments. 4. **Ensuring Standardization and Quality** A key aim of the TTT course is to promote consistent quality across institutions implementing the GREENPORT curriculum. Trainers will gain tools and best practices to align their instruction with agreed standards, ensuring a coherent learning experience across different educational contexts. 5. **Assessment and Simulator-Based Evaluation** Finally, the TTT explores assessment strategies, including the use of simulators as tools for evaluating learner performance. Practical examples will show how simulation can be integrated into assessment to ensure learners demonstrate the required competencies in realistic scenarios.
Course Objectives	**General Objective:** The primary objective of this Train the Trainer (TTT) course is to empower lecturers, maritime professionals, and academic staff to become catalysts for the energy transition in the shipping sector — with a specific focus on enhancing the operational efficiency of tugboats. Recognizing that existing educational practices may not fully support this ambition, the course addresses potential knowledge gaps and equips participants with the tools, insights, and confidence to drive behavioral change. Alongside deepening subject-matter expertise, the program enhances pedagogical skills for both online and blended learning environments. By the end of the course, trainers will be prepared to deliver outcome-oriented, practice-driven, and engaging sessions aligned with GREENPORT's mission of advancing sustainability in maritime operations.
Course Learning Outcomes	1. **Navigate and interpret** the GREENPORT curriculum, including modules, resources, and weekly learning objectives. 2. **Apply adult learning principles** to design engaging and inclusive maritime training sessions. 3. **Use official GREENPORT training materials** (PPTs, case studies, simulation tools) effectively in their own instructional contexts. 4. **Design and deliver a short lesson segment**, incorporating sustainability themes and active learning strategies. 5. **Employ digital tools** for virtual teaching, including screen-sharing, breakout room facilitation, and simulator walkthroughs. 6. **Assess learner understanding** and provide constructive feedback aligned with course objectives. 7. **Critically reflect** on their own teaching practice using structured feedback frameworks. 8. **Demonstrate a readiness** to teach the GREENPORT outcome course in a consistent and quality-assured manner.
Instructional Methods and Techniques	Individual study - Computer based training
Tutorial Place (classroom, simulator)	online
Learning Resources (Textbook, PPT, video)	Computer based training, PPT presentation

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Other References	1. **IMO Train the Trainer (TTT) Course on Energy Efficient Ship Operation** – IMO, 2016 IMO TTT Course on Energy Efficient Ship operations. 2. **IMO Model Course 6.09: Training Course for Instructors** – International Maritime Organization Covers adult learning, lesson planning, delivery techniques, and assessment. 3. **"The Adult Learner: The Definitive Classic in Adult Education and Human Resource Development"** – Malcolm Knowles, Elwood Holton, Richard Swanson (8th ed., 2015) ISBN: 978-0415739023 4. **UNESCO ICT Competency Framework for Teachers** – 2018 Edition A global guide to integrating digital tools in education. https://unesdoc.unesco.org/ark:/48223/pf0000265721 5. **"How Learning Works: 7 Research-Based Principles for Smart Teaching"** – Susan A. Ambrose et al., (2010) ISBN: 978-0470484104
Homework & Projects	Getting familiar with the Greenport course content before following the TTT.
Laboratory Work	
Other Activities (Group Discussions, Guest speakers..)	

	Activities	**Quantity**	**Effects on Grading, %**
Assessment Criteria	Attendance	**16**	**20**
	Midterm		
	Quiz	-	
	Homework	-	
	Term Project	-	-
	Laboratory Work	-	-
	Practices	-	-
	Tutorial	-	-
	Seminar	-	-
	Presentation	-	-
	Field Study	-	-
	Final Exam – Knowledge check quiz (MCQ)	**1**	**80**
	TOTAL		
	Effects of Midterm and Activities on Grading, %		
	Effects of Final on Grading, %		
	TOTAL		**100**

Module	**TOPICS**	**Learning Outcomes**
1	**Module 1: Introduction to the GREENPORT Course** **Topics Covered:**	1, 8

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	• Overview of GREENPORT project vision and objectives • Summary of the GREENPORT outcome course structure and target groups • Presentation of the "best practices" handled during the courses. • Key focus areas: sustainability, emissions, digital ports **Activities:** • Interactive course guide video • Downloadable curriculum map • Knowledge check quiz	
2	**Module 2: Principles of Adult Learning** **Topics Covered:** • Andragogy and learner-centered education • Learning styles and engagement strategies • Techniques for motivating adult learners • Inclusive teaching approaches in maritime education **Activities:** • Short reading: Knowles' Theory of Adult Learning • Reflection task: Matching strategies to learner types	2,6
3	**Module 3: GREENPORT Teaching Tools & Materials** **Topics Covered:** • How to use the provided PPTs, simulators, and case studies • Using the SEEMP and emissions monitoring materials • Teaching in relation to IMO-based regulations (MARPOL, SOLAS) • Adapting content to institutional or regional contexts **Activities:** • Video walkthrough of materials • Resource mapping exercise • Short self-test: Match content with learning outcomes	3,4,8
4	**Module 4: Online and Blended Teaching Methods** **Topics Covered:** • Online delivery models: synchronous vs. asynchronous • Digital tools: Zoom, MS Teams, LMS, screen sharing, whiteboards • Strategies for virtual engagement (polls, breakout rooms) • Simulator walkthroughs and screen-sharing tips **Activities:** • Model online class video • Task: Create a 10-minute activity using a simulator screenshot • Short self-test: Challenges of teaching online	5,7
5	**Module 5: Microteaching & Reflective Practice** **Topics Covered:** • Guidelines for planning and recording a microteaching session • Self-assessment checklists • Constructive feedback methods • Integrating case studies and simulations into lessons	4,6,7

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	Activities: • Prepare and record a 5–10 min session • Complete self-assessment rubric • Optional: submit for peer or institutional feedback	
6	**Module 6: Assessment, Feedback & Certification** **Topics Covered:** • Designing formative and summative assessments • Feedback techniques for adult learners • Using rubrics and checklists • Final review and declaration of readiness **Activities:** • Multiple choice post-course quiz • Submit: microteaching video and reflection form • Download personalized certificate	6,8
	Learning Outcome Summary Matrix	

Module	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5	CLO 6
Module 1: GREENPORT Intro	☑					
Module 2: Adult Learning		☑				☑
Module 3: Tools & Materials			☑	☑		
Module 4: Online Teaching					☑	
Module 5: Microteaching				☑		☑
Module 6: Assessment & Cert.						☑

ECTS / WORKLOAD TABLE

Activity	Count	Hours	Total Workload
Course	0	0	0
Preparation for the lecture	0	0	0
Homework	0	0	0
Quiz	0	0	0
Presentations/ Seminars Preparation	0	0	0
Midterm(s) (Exam +Preparation)	0	0	0
Group Project	0	0	0
Lab.	0	0	0
Field Work	0	0	0
Final Exam (Exam +Preparation)	0	0	0
Total Workload			**0**
Course ECTS Credits	**(Total Workload/ 25)**		**0**

Prepared by	***Date***	***Signature***
Olivier Schalm Joris Lemmens Anna Maria Darmanin	29.05.2025	

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Chapter I: Introduction and Objectives

Chapter I introduces the overarching aim of the course and sets the stage for a deeper exploration of behavioural change within the maritime industry. At its heart, the programme recognises that sustainability cannot be achieved solely through technological advancements or external mandates; rather, it depends upon the deliberate and ongoing adaptation of individual and collective practices. The guide navigates the interplay between motivation, capability, and opportunity—factors that underpin successful transformation in port environments.

Participants are invited to reflect on their own roles within this dynamic ecosystem. Whether as teachers, pilots, tugboat crews, or port operators, each stakeholder possesses unique motivations and faces distinct challenges in pursuing sustainable change. By examining these drivers in context, the course enables trainers to better understand how to foster durable, positive shifts in behaviour. The narrative then expands to consider how simulator-based learning can translate insights into practical improvements, ultimately paving the way for a new generation of maritime professionals committed to reducing environmental impact. The transition from theory to practice is both iterative and responsive: it demands that trainers equip learners not only with technical know-how but also with the confidence and flexibility to adapt habits as conditions evolve. In this way, the programme becomes a catalyst for real-world change, empowering maritime communities to take ownership of their sustainability journey.

As the maritime sector faces mounting environmental challenges and rapid regulatory shifts, the need for behavioural change has never been more urgent. The following chapters explore not only the motivations and strategies driving sustainable transformation in port operations, but also the essential role of education in shaping a new generation of industry leaders. By bridging technical innovation with human adaptability, this guide invites trainers and practitioners alike to embark on a journey towards a greener, more responsible future. With these objectives in mind, we turn to the introduction and foundational aims of the programme.

1. What Do We Want to Realise with This Course?

GREENPORT posits that a change in human behaviour, through training, can reduce the environmental impact of in-port services in the short- to medium-term. Modifications can be made to day-to-day operations, with better use of existing digital technologies, that would contribute to a significant drop in emissions

Shipping accounts for approximately 3% of worldwide greenhouse gas emissions, a figure expected to rise significantly if proactive measures are not taken. The global maritime industry is undergoing significant transformation, driven by urgent environmental imperatives and regulatory pressure. From the International

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Maritime Organization's decarbonization targets to the European Green Deal, shipping is expected to drastically reduce its carbon emissions and environmental footprint. In this rapidly changing environment, trainers and educators must serve not only as subject-matter experts but also as facilitators of change.

As the industry seeks pathways to decarbonization, it grapples with both technological innovation and the intricacies of systemic change. The challenge lies not only in adopting alternative fuels and improving vessel efficiency but also in navigating a shifting landscape of international regulations and market expectations. For maritime professionals, staying ahead means understanding the interplay between policy, technology, and operational realities.

Amidst this transformation, the educator becomes a bridge between evolving industry standards and the next generation of maritime leaders. By decoding complex frameworks and catalysing discussions about sustainable practices, educators are pivotal in nurturing a workforce prepared to meet ambitious global targets. Their influence extends beyond the classroom—shaping industry culture and setting new benchmarks for responsible maritime operations.

Education is the key lever for this transformation. On the navigation bridge, behaviour determines how efficiently a vessel is operated. Through targeted training, crews can learn how seemingly minor choices—adjusting speed, optimising manoeuvres, coordinating equipment use—directly influence fuel consumption and emissions. Each adjustment may appear small, but the results are measurable in real time through fuel data. Step by step, these microscopic improvements accumulate. When aggregated across operations, ships, and fleets, they generate substantial collective impact: marginal fuel savings at the individual level translate into significant emission reductions for the sector as a whole.

The course is therefore designed to empower trainers to go beyond knowledge transfer. It equips them to create a learning environment where learners experiment with operational practices, monitor outcomes, and refine their behaviour through trial and error. In this way, sustainability is no longer an abstract ideal but a concrete, measurable process embedded in daily operations. Ultimately, the course shows how trainers, by nurturing countless small changes, can help shift the trajectory of the entire maritime industry toward a more sustainable future. To achieve this, however, trainers also need a structured way of understanding and steering behavioural change—this is where the COM-B model becomes indispensable.

The Train the Trainer programme is designed to empower any trainer, regardless of background or teaching style, and both this guide and the GREENPORT courseware can be adapted to fit local needs. The materials are not meant as a rigid script but as a collection of ingredients from which each trainer can compose their own recipe. Course content may be delivered as presented, reworked to match institutional practices, or expanded with local case studies. Simulator experiments can be used as short demonstrations to illustrate key principles, or they can form the central component of a course where learners spend most of their time in

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realistic operational scenarios. This flexibility ensures that trainers remain in full control of delivery and emphasis, while still benefiting from a structured foundation that guarantees consistency in objectives: reducing fuel use, cutting emissions, and fostering sustainable habits across the maritime sector. At the same time, every course must operate within certain boundary conditions: defined starting competences of participants and agreed learning outcomes at the end. These ensure coherence, comparability, and accreditation of training, and they provide a framework within which trainers can exercise creativity without altering the essential competences the course is meant to deliver. Ultimately, the Train the Trainer should be seen less as a fixed recipe and more as a source of inspiration—a toolkit that helps trainers prepare their own courses in ways that best fit their learners and institutional context.

In summary, achieving sustainability in shipping hinges upon the combined efforts of regulatory compliance, technological innovation, and cultural adaptation. Educators play a pivotal role in driving this change, equipping learners with the tools, values, and vision to create a more sustainable future for the global maritime industry.

2. Why Do We Need the COM-B Model to Change Human Behaviour?

Changing human behaviour is more complex than changing technology, and facts alone are rarely enough to inspire action. This is why the Train the Trainer course uses the COM-B model (Capability, Opportunity, Motivation → Behaviour) as its foundation. Developed by Michie et al. (2011), the model highlights that behaviour only changes when three conditions are simultaneously present: individuals must have the capability to act, the opportunity to apply what they know, and the motivation to sustain the new behaviour. If even one of these dimensions is missing, behaviour change falters. Knowledge about fuel consumption and emissions is necessary, but not sufficient. Trainers themselves must undergo behavioural change so that they can embody sustainable practices, integrate behavioural approaches into their lessons, and persuade learners to act differently on board. COM-B provides a simple but powerful framework that ensures change is approached holistically, not just as knowledge transfer. For trainers, the Train the Trainer course is not only a fast access to the proper knowledge but also stimulates self-reflection on how to teach, while making them aware of their role as multipliers of change. For learners, it means that sustainability is not taught as abstract theory but embedded in practice, reinforced by supportive environments and motivational drivers. In this way, COM-B enables a “double loop” of behavioural change: first among trainers, then cascading through learners, and ultimately influencing the wider maritime sector.

3. How Does the Course Build Capability, Opportunity, and Motivation

“The only way that we can live is if we grow. The only way that we can grow is if we change. The only way that we can change is if we learn. The only way we can learn is if we are exposed.”

Albert Einstein

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The Train the Trainer course is structured around the COM-B model to prepare educators not only to teach sustainability, but to actively inspire and enable behavioural change. By developing capability, opportunity, and motivation in parallel, the course ensures that trainers are fully equipped, supported, and driven to embed sustainability into maritime education.

Capability refers to the internal factors—knowledge, skills, and competences—that enable an individual or organisation to perform a certain behaviour. In this course, capability is strengthened by deepening trainers' expertise in two ways: first, by enhancing their understanding of sustainability principles; and second, by equipping them with pedagogical tools such as adult learning theory, blended learning strategies, and simulator-based assessment. These internal resources allow trainers to move beyond theoretical explanation and design lessons, case studies, and exercises that link sustainability directly to operational practice.

Opportunity refers to the external factors—the environment, infrastructure, and social context—that make a behaviour possible or easier to perform. In this course, opportunity is created by giving trainers access to concrete resources, digital tools, and supportive networks. The course provides ready-to-use materials and online modules, while the train-the-trainer format fosters peer learning and institutional backing. This external environment encourages trainers to test behavioural change approaches, adapt them to their own teaching context, and refine their methods over time. Simulator experiments, in particular, act as a shared laboratory—producing both new knowledge and improved learning content.

- Motivation is anchored in the philosophy of continuous improvement, where small, step-by-step reductions in fuel consumption and emissions accumulate into substantial impact. Aligned with the ALARA principle (As Low As Reasonably Achievable), this approach shows trainers how ecological responsibility and economic benefits reinforce one another. By seeing how behavioural change directly reduces both fuel costs and emissions, trainers are motivated to act as catalysts of change within their institutions and the wider maritime sector.

"Within the COM-B framework, behaviour change for sustainability is shaped by capability, opportunity, and motivation. Greenport demonstrates that what appears as failure often reflects external limits, not lack of effort or interest. True impact arises when motivation persists, enabling continuous behavioural adaptation and long-term transformation in maritime operations."

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Chapter 2: Capability

Changing behaviour is not equally difficult for every learner. Young professionals entering the maritime sector can more easily be modelled to adopt a sustainability-oriented attitude, since their habits and routines are not yet fully established. For experienced crew, however, ingrained practices and long-standing routines make behavioural change more challenging. Trainers therefore need more than subject knowledge: they need the capacity to adapt their teaching to different audiences, to use the right pedagogical tools, and to translate sustainability principles into practical, operational decisions on board.

Chapter 2 of the course provides all the tools trainers need to strengthen their own capability. It enhances both their technical understanding of sustainability and their pedagogical skills for guiding learners toward behavioural change. Trainers will learn how to connect knowledge with practice, design effective learning environments, and apply methods that work equally well for younger learners and seasoned professionals.

4. How Behavioural Change Drives Maritime Sustainability?

Achieving sustainability is as much about changing habits and culture as it is about deploying new technologies. Tugboats, pilot vessels, and port operators play a critical role in port operations and therefore offer significant potential for reducing fuel consumption and emissions. GREENPORT emphasises that behavioural change in day-to-day operations—such as better communication, improved planning, and smarter use of digital tools—can already deliver substantial benefits in the short to medium term.

Behavioural change is therefore a cornerstone of maritime sustainability. Many small, microscopic adjustments—anticipating manoeuvres earlier, avoiding unnecessary idling, or coordinating tasks more precisely—aggregate into a macroscopic impact. Embedding this mindset of continuous improvement not only produces immediate efficiency gains but also strengthens the industry's ability to adopt new technologies and renewable fuels as they emerge. Trainers play a decisive role in this process. By modelling sustainable behaviours, emphasising the interplay of technology, human action, and ethical responsibility, and by using collaborative learning and case studies drawn from tugboat, pilot, and port operations, they help learners translate knowledge into lasting impact. In this way, trainers ensure that environmental responsibility becomes embedded in maritime culture, preparing today's crews for the transition toward zero-emission operations.

Crucially, reductions in fuel consumption achieved through behavioural change not only align with current sustainability goals but also position maritime operations to capitalise on future advancements in green fuel technology. The savings made today will compound when combined with hybrid systems,

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renewable fuels, and other innovations, offering both environmental and financial benefits. By proactively adopting efficiency-focused practices now, the industry lays a strong foundation for integrating alternative fuels, reducing costs, and further lowering its ecological footprint over time.

In the end, fuel reduction through behavioural change is not the responsibility of a single group but a shared effort across the maritime sector. Crew members can contribute by improving communication and refining daily manoeuvres; trainers by equipping learners with the skills and mindset to embed sustainability in their practice; shipowners by providing feedback tools, clear performance goals, and the organisational conditions for efficiency; and port operators by making smarter choices in berthing, planning, and resource management. When each stakeholder makes even small adjustments within their sphere of influence, the cumulative effect is transformative. Together, these behavioural changes create immediate reductions in fuel use and emissions while preparing the entire sector for the seamless adoption of new technologies and cleaner fuels in the future.

By sustainable adaption of the behaviour of the operators, the environmental benefits will not only have a short-term influence but will compound when combined with new technology and renewable fuels.

4.1. Capability of the Crew

A key example of how crew influences fuel consumption is the quality of communication between pilots and tugboat operators. Effective communication between pilots and tugboat operators is critical for safe, efficient, and sustainable port manoeuvres. Clear coordination reduces unnecessary manoeuvres, idle time, and misaligned thrust applications, which not only improves safety but also lowers fuel consumption and emissions. Because tugboats often operate at high power in constrained environments, even small improvements in communication can yield significant efficiency gains. Seamless operations require a shared vocabulary, standardized protocols, and reliable communication tools such as radios on designated frequencies. Pilots must provide timely, precise instructions, while tugboat operators must remain responsive and adaptable to dynamic conditions like ship movement, currents, or weather. Training programmes should reinforce this collaboration through situational awareness, respect for chain-of-command, and pre-operational briefings. Simulations and scenarios can further prepare crews for high-pressure conditions, fostering teamwork that enhances both safety and environmental performance. In the COM-B framework, this highlights the capability of the crew: when they have the skills, shared vocabulary, and situational awareness to communicate effectively, they are able to make better operational choices that reduce fuel use. Seamless operations require standardized protocols and reliable communication tools such as radios on designated frequencies. Pilots must provide timely, precise instructions, while tugboat operators must remain responsive and adaptable to dynamic conditions like ship movement, currents, or weather.

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4.2. Capability of Shipowners

A key example of how crew influences fuel consumption is the quality of communication between pilots and tugboat operators. Effective communication is critical for safe, efficient, and sustainable port manoeuvres. Clear coordination reduces unnecessary manoeuvres, idle time, and misaligned thrust applications, which not only improves safety but also lowers fuel consumption and emissions. Because tugboats often operate at high power in constrained environments, even small improvements in communication can yield significant efficiency gains Seamless operations require a shared vocabulary, standardized protocols, and reliable communication tools such as radios on designated frequencies. Pilots must provide timely, precise instructions, while tugboat operators must remain responsive and adaptable to dynamic conditions like ship movement, currents, or weather. Training programmes should reinforce this collaboration through situational awareness, respect for chain-of-command, and pre-operational briefings. Simulations and scenarios can further prepare crews for high-pressure conditions, fostering teamwork that enhances both safety and environmental performance.

In the COM-B framework, this highlights the capability of the crew: when they have the skills, shared vocabulary, and situational awareness to communicate effectively, they are able to make better operational choices that reduce fuel use. For example, practices such as optimising fuel consumption, reducing idle times, and ensuring precise coordination during port manoeuvres directly lower the sector's carbon footprint. Moreover, crews trained to prioritise environmental stewardship from the outset are far more likely to embrace and effectively implement emerging energy-efficient technologies, such as hybrid engines, wind-assisted propulsion, or solar panels on next-generation vessels.

4.3. Capability of Port Operators

Port operators represent a pivotal link in the maritime chain, and their capability—that is, their knowledge, skills, and decision-making competences—directly shapes the environmental footprint of port activities. Their choices about ship berthing, cargo handling, and resource management determine how efficiently energy is used and how much fuel is wasted. Building capability therefore means more than mastering technical procedures: it requires operators to develop the awareness, judgement, and skills needed to integrate sustainability into every operational decision. Training programmes tailored to port operators should therefore go beyond routine technical training to cultivate a mindset attuned to sustainability. By equipping operators with competences in energy optimisation, emissions tracking, and sustainable resource allocation, their internal capability to act responsibly is strengthened. When operators are able to translate sustainability principles into daily practice, they can set measurable benchmarks for greener port operations and become active agents of change in reducing the sector's environmental footprint.

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4.4. Capability of Trainers

Trainers, whether working in maritime schools or within companies, are pivotal in shaping the behaviours and mindsets of the workforce. Their capability lies not only in their technical knowledge but also in their ability to translate sustainability principles into teaching strategies that change attitudes and habits. In regular education, trainers prepare young professionals who can be more easily modelled to adopt sustainability-oriented practices from the start of their careers. In company-based training, instructors work with experienced crews, helping them to challenge ingrained routines and discover more efficient ways of operating. In both contexts, the trainer's capability to design effective learning environments—using systems thinking, participatory methods, and case-based reflection—ensures that sustainability is embedded into practice, not left as theory. By fostering collaborative training, encouraging clear communication protocols, and promoting operational discipline, trainers enable maritime professionals to achieve efficiency gains without the need for capital-intensive upgrades. Pilots and tugboat operators, for instance, can refine their coordination to minimise idle time and fuel waste, while port operators can implement straightforward but effective measures such as optimised berth planning. These cost-effective practices demonstrate that trainers are not only facilitators of knowledge but essential agents of change. Through their capability to inspire, guide, and model sustainable behaviour, they help learners align daily practices with broader sustainability goals, creating a ripple effect of positive change across the entire industry. Ultimately, in all contexts, trainers act as role models whose example carries as much weight as the content they teach.

Why Is There a Gap Between Education and Industry Needs?

An education gap analysis highlights the difference between what learners currently acquire through education (knowledge, skills, attitudes) and what industry and society expect them to be capable of in practice. The process involves three steps: first, assessing the current state of learning; second, defining the desired state or learning objectives; and third, analysing the gap to develop targeted interventions. The needs analysis carried out before the development of the GREENPORT courseware shows that, while awareness of decarbonisation and sustainability is increasing, the maritime sector—particularly in towage and pilotage—still struggles to embed this awareness in everyday practice. Current education rightly prioritises safety, but sustainability is often integrated only superficially. Economic and social aspects of sustainability remain underrepresented, and professionals frequently lack the expertise and resources to challenge entrenched routines. This creates a clear capability gap: graduates may leave training with theoretical knowledge yet lack the applied skills and attitudes needed to drive behavioural change on board.

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GREENPORT addresses this challenge by designing curricula that deliberately strengthen the capability dimension of the COM-B model. Through scenario-based training, behavioural assessments, and methods that combine psychological capability (knowledge and understanding) with physical capability (skills in practice), learners are not only prepared for current standards but also trained to adapt as industry expectations evolve. In this way, GREENPORT curricula for Higher Education Institutions (HEIs) and Vocational Education and Training (VET) go beyond filling today's gaps: they cultivate the adaptability required for tomorrow's challenges, ensuring maritime professionals can embed sustainability in their daily operations**.**

It must be acknowledged, however, that such a gap will always exist. Education evolves more slowly than society and industry, as curricula require careful design, accreditation, and implementation processes, whereas technological and societal demands often change rapidly. This inevitable time lag means graduates will always risk being a step behind the latest industry practices—unless education is deliberately structured to foster adaptability, continuous learning, and behavioural flexibility. GREENPORT explicitly incorporates this forward-looking approach, reducing the gap and preparing learners to thrive in a sector where change is constant.

5. What Is the Learner's Starting Point Before the Course?

Learners begin this course with very different starting points, shaped by their stage of life, prior knowledge, and experience. Recognising these differences is crucial for trainers, because it determines how new insights can be connected to what learners already know, and how effectively they can move toward the learning goals of maritime sustainability. Children are at the very beginning of their educational journey. Their starting point is limited knowledge and little to no practical experience. They require structured guidance and clear explanations of fundamental concepts. The learning goal for this group is to build a solid foundation of awareness and curiosity that can be developed further in later stages of education. However, this Train the Trainer course is not primarily intended for children, but for students and adult professionals already preparing for or active in the maritime sector. Young adults (students), typically in higher or vocational education, arrive with growing subject knowledge and ambition but limited professional practice. Their starting point is often theoretical competence, gained through school or early training. Their learning goals focus on applying this knowledge in realistic contexts, developing problem-solving skills, and learning how to connect technical expertise with real-world maritime operations. Adult professionals bring extensive operational experience and first-hand knowledge of maritime routines. Their starting point is strong in practice but sometimes limited in up-to-date theory. A key challenge in this group is that long-standing routines may also mean entrenched or wrong habits that no longer align with sustainability principles. Their learning goals therefore include not only acquiring new knowledge and tools but also unlearning outdated practices, correcting unsafe or inefficient routines, and adopting new behaviours that support both safety and

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sustainability. By distinguishing these groups and adapting the course accordingly, trainers can build on what learners already know, set meaningful objectives, and guide them toward new competencies. A crucial step in this process is for trainers to correctly assess the learner's capability at the outset—identifying barriers such as limited prior experience, gaps in technical knowledge, or entrenched habits that conflict with sustainable practice. Addressing these barriers directly ensures that every learner begins from their own reality but is supported in moving toward the shared goal of embedding sustainability into maritime operations.

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Self-Reflection Exercise for Trainers

Take a few minutes to reflect on your learners' starting points. Ask yourself:

1. Experience gaps

- Do my learners lack hands-on experience with real equipment, systems, or decision-making?
- How can I design activities that give them safe opportunities to practise what they don't yet know?

2. Knowledge gaps

- Do they struggle with outdated theory or missing conceptual understanding?
- Which core principles must I revisit or reinforce before introducing advanced sustainability content?

3. Habit barriers

- Are there routines, shortcuts, or ingrained practices in my learners' daily work that could hinder sustainable behaviour?
- How can I create scenarios or discussions that make learners aware of these habits and encourage them to unlearn or adapt them?

4. Motivational challenges

- Are my learners genuinely interested in the objectives I set, or do they see them as externally imposed?

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- What strategies could I use (case studies, role models, peer exchange) to make sustainability goals feel personally meaningful?

Write down one barrier you anticipate for each group you teach (students, apprentices, or adult professionals). Next to it, note a possible way to address it in your course.

6. What Learning Objectives Must the Trainer Realise?

Promoting behavioural change in maritime training requires more than transferring information—it demands aligning the trainer's teaching method with the learner's needs and context. In competency-based education, learning is not complete until the learner has integrated knowledge (what to know), skills (how to do), and attitude (how to be) in a way that supports sound decision-making and effective performance. This triad of competencies defines what it means to be truly capable in professional practice. Yet two distinct levels need to be recognised when setting learning objectives:

Learners faced with imposed objectives: Learners do not always share the same goals as the trainer. For example, students may be more interested in passing exams than in mastering sustainable practices, and adult professionals may resist objectives that require unlearning long-standing habits. Here the trainer sets objectives such as "the learner must be able to operate hybrid propulsion systems safely"—but learners may see these goals as externally imposed rather than personally meaningful. Recognising this tension is essential, since motivation can quickly become a barrier if objectives feel irrelevant or burdensome. Trainers designing objectives through COM-B: This is where the COM-B model becomes a design tool. By structuring objectives around Capability, Opportunity, and Motivation, trainers can create conditions that make objectives attainable and meaningful:

Capability: Ensure learners have both the knowledge and the practical skills to act. For students this may mean guided instruction; for professionals it may mean correcting inefficient or unsafe routines.

Opportunity: Consider the external enablers or constraints. If learners cannot access certain equipment or systems in their workplace, objectives should also include strategies to identify and create enabling conditions.

Motivation: Connect objectives to learners' values, responsibilities, and professional identity. For professionals, this often means reshaping entrenched attitudes; for students, it may mean inspiring curiosity and a sense of responsibility.

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Self-Reflection Exercise: Designing Learning Objectives

As a trainer, you are not only setting learning objectives—you are shaping whether learners will see them as meaningful and achievable. Use the prompts below to reflect on how you design and communicate objectives in your own teaching:

1. Imposed vs. meaningful objectives

- Have I ever set learning objectives that my learners did not value (e.g., they only wanted to pass the exam, not master the practice)?
- How did this affect their engagement?
- What could I change to make those objectives feel more relevant to them?

2. Applying COM-B to my objectives

- Capability: Am I clear about what knowledge and skills my learners are missing? Do I provide the right mix of theory and practice to close those gaps?
- Opportunity: Do my objectives consider whether learners actually have the tools, access, and workplace conditions to act on what I teach?
- Motivation: Do I connect objectives to what learners personally value—such as safety, professional pride, or responsibility for the environment?

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3. Reframing objectives

- Look at one of your current objectives. Does it read like “the learner knows…”?
- How could you reframe it into:

“The learner is able to…”

“The learner is confident in…”

“The learner values and prioritises…”

Write down one example of an objective you currently use and practice reframing it with COM-B in mind. Reflect on how this small change could increase both learner motivation and the likelihood of real behavioural change.

7. How Do Different Learning Styles Affect Maritime Training?

Learners do not all absorb knowledge in the same way. While some prefer structured, theoretical instruction, others thrive in hands-on, experiential environments. Recognizing and responding to this diversity in learning styles is essential in maritime education—where technical concepts must ultimately be applied in complex, real-world conditions. Learning styles can be visualized along a spectrum:

- Theoretical learners benefit from lectures, conceptual models, reading, and structured discussions. They often want to understand the “why” before they engage with the “how.” Without clear frameworks, they may feel uncertain or disengaged.
- Practical learners learn best by doing. They prefer simulations, fieldwork, troubleshooting tasks, and collaborative exercises. They can become frustrated if training remains too abstract and does not allow them to test knowledge in action.

Most learners fall somewhere in between, and effective training should blend both approaches. In practice, this means starting with clear explanations and structured frameworks to anchor understanding, then moving into applied exercises such as

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shipboard tasks, simulator runs, or case studies. This transition is critical: without it, theoretical learners risk remaining passive, while practical learners may fail to grasp the underlying principles.

Barriers can also emerge when trainers rely too heavily on one approach. For example, a classroom-heavy course may demotivate experienced professionals who value application, while a purely practical course might leave students without the conceptual depth to adapt knowledge in new situations. Moreover, learning styles evolve over time: a student who begins as theory-driven may, through experience, grow into a more practice-oriented learner—and vice versa. Trainers must therefore remain flexible, using varied methods (visuals, stories, demonstrations, hands-on tasks, peer feedback) to engage learners and move them along the theory-practice continuum. In the context of behavioural change and sustainability, matching teaching approaches to learning preferences becomes even more critical. While a theoretical explanation of emission regulations might convince some learners, others may only be persuaded when they see real fuel savings in a simulator, discuss outcomes with peers, or directly observe the environmental benefits in practice. To maximise impact, the trainer must identify potential barriers to learning—such as mismatched teaching methods, lack of relevance, or difficulty moving from knowledge to behaviour—and actively adapt their approach. This alignment ensures that training not only informs but also motivates and enables learners to embed sustainable practices into their work.

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Self-Reflection Exercise

Think about the group of learners you currently train (students, apprentices, or professionals):

1. Which learners in my group are more theory-driven? Which are more practice-driven?
2. Have I noticed disengagement or resistance that might reflect a mismatch between my teaching style and their learning preferences?
3. What is one practical step I can take in my next session to balance knowledge explanation with hands-on application?
4. How can I gradually guide learners along the spectrum—from understanding why something matters to knowing how to put it into action?

Write down one barrier you anticipate in your current group and one strategy you can use to overcome it.

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8. Which Teaching Methods Are Most Effective for Changing Behaviour?

Changing behaviour is not equally difficult for every learner. Young professionals entering the maritime sector can more easily be guided toward a sustainability-oriented attitude, since their habits and routines are not yet fully established. For experienced crew, however, ingrained practices and long-standing routines make behavioural change more challenging. Trainers therefore need more than subject knowledge: they must have the capability to select and combine the right teaching styles for each learner in order to maximise their impact. Traditional frontal teaching—where the trainer speaks and learners passively listen—can serve as a benchmark, since it is still the most widely used method. However, it does not align with the COM-B model. COM-B stresses that Capability, Opportunity, and Motivation must all be in place for behaviour change to occur. While frontal teaching may help learners acquire theoretical knowledge, it does little to build practical capability, create opportunities to apply knowledge, or stimulate intrinsic motivation. It remains useful for delivering information, but insufficient for shaping sustainable behaviours. As a trainer, this means actively exploring new teaching methods, testing them against this traditional benchmark, and evaluating whether they lead to stronger behavioural outcomes. Learners often encounter capability barriers. They may understand what needs to be done but lack the hands-on practice to know how to do it. Without opportunities to apply theoretical knowledge in realistic scenarios, their learning remains abstract and disconnected from daily operations. They also face opportunity barriers. When instruction is limited to passive listening, learners are not given the chance to practise, problem-solve, or reflect in contexts that mirror their professional environment. This restricts their ability to transfer knowledge into meaningful behaviour. Finally, learners may struggle with motivational barriers. If learning objectives feel imposed, irrelevant, or too abstract, they risk disengaging. In such cases, sustainability is perceived not as a personal responsibility or professional value but as an external demand, reducing the likelihood of real behavioural change.

Behavioural change is also difficult for trainers themselves. Even when interactive approaches are proven effective, many resist moving away from familiar teaching methods. One challenge lies in capability barriers. Trainers may feel they lack the pedagogical expertise or digital skills to implement new methods such as simulations, case studies, or collaborative exercises. This lack of confidence can discourage experimentation and innovation in the classroom. In addition, opportunity barriers are common. Institutional constraints—tight schedules, rigid curricula, or limited access to equipment—make it easier for trainers to default to traditional frontal teaching rather than redesign courses around learner-centred methods. Lastly, motivational barriers play a strong role. Trainers may be comfortable with long-established routines, sceptical of new teaching approaches, or reluctant to risk losing authority by shifting from a lecturer role to that of a facilitator. Without motivation to adapt, even capable and well-resourced trainers may stick to methods that do not support behavioural change.

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Self-Reflection Exercise

1. How often do I rely on frontal teaching in my current practice?
2. Which COM-B elements (Capability, Opportunity, Motivation) might be underdeveloped in my learners because of my current methods?
3. Which COM-B barriers might apply to me as a trainer (lack of skills, limited institutional support, reluctance to change)?
4. What is one concrete adjustment I can make in my next course to move from information delivery toward behavioural engagement?

Write down one barrier you recognise in your learners and one in yourself. Next to each, note one strategy you could try to overcome it.

This section of the course provides trainers several tools to implement the COM-B model in practice and to strengthen their own capability. It enhances both technical understanding of sustainability and pedagogical skills for guiding learners with different backgrounds and levels of experience. Trainers will learn how to design effective learning environments, stimulate participation, and adapt their methods to both younger learners and seasoned professionals. The educator's role is not just to teach facts or enforce rules, but to create conditions where learners think critically, act responsibly, and collaborate toward a more sustainable maritime sector. Educators can achieve this by leveraging case studies, simulations, and real-world scenarios that mirror the complexity of daily operations. For instance, a lesson on retrofitting older vessels with renewable technologies can combine financial, technical, and ethical perspectives, prompting both critical thinking and problem-solving. Similarly, interdisciplinary exercises that connect maritime operations with energy, logistics, or manufacturing help learners understand how sustainability challenges span across networks and demand adaptive skills. Key approaches include:

- Adult Learning Theory: Training that acknowledges learners' prior experience and emphasises practical, problem-solving activities. (Capability)

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- Sustainability Education: Interdisciplinary, future-focused teaching that encourages systems thinking and behavioural change.

- Blended and Digital Learning: Flexible delivery through digital platforms, including asynchronous and hybrid formats, allowing personalised learning pathways.

- Competency-Based Training: Evaluation based on applied knowledge and demonstrated ability through simulations, performance tasks, and collaborative exercises.

This blended and modular approach ensures that training is active, participatory, and practice-oriented, giving learners the opportunity to test new behaviours in realistic scenarios. By moving decisively beyond frontal teaching and adopting methods that foster interaction and engagement, trainers can maximise their influence and ensure that sustainable practices are not only understood but also consistently applied in daily maritime operations.

To further amplify the effectiveness of these learner-centred strategies, it becomes essential to integrate techniques that not only encourage active engagement but also provide continuous support and reinforcement throughout the learning journey. Building on the foundational approaches discussed, trainers can deepen behavioural change by embedding structures and practices that sustain growth beyond the classroom. This means complementing interactive, practice-based methods with ongoing assessment, mentorship, and organisational support—approaches that nurture lasting transformation and resilience. In this way, the transition from knowledge to habitual practice is bridged, ensuring sustainable behaviours are both cultivated and maintained in real-world maritime settings.

Additional Methods and Their Implementation in Behavioural Change Training

- Continuous Assessment and Feedback Loops: Throughout maritime training, incorporate regular reflective journals, peer assessments, and self-checklists. For example, after simulation exercises or shipboard tasks, have learners document their experiences and insights, followed by structured peer and instructor feedback. This ensures that behavioural change is tracked and internalised over time.

- Mentorship and Coaching: Pair new recruits with experienced crew members in a formal mentorship programme. Arrange scheduled check-ins where mentors model sustainable practices, guide troubleshooting tasks, and share real-life experiences. This ongoing support helps learners apply classroom knowledge to complex operational challenges.

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- Social and Organisational Support Structures: Integrate discussion forums, buddy systems, and collaborative group projects into courses. Encourage participants to share case studies, discuss obstacles encountered during fieldwork, and collectively develop solutions. These communal activities foster a culture of shared responsibility, helping reinforce positive behaviours beyond individual performance.

- Emotional Intelligence and Motivation: Embed activities that encourage learners to explore their motivations and values, such as storytelling sessions or value-mapping workshops. For instance, before a lesson on emission reduction, prompt participants to reflect on the wider environmental impact and their personal connection to sustainability, fostering deeper emotional engagement.

- Use of Real-Time Data and Technology: Utilise digital platforms that display real-time operational data—such as fuel usage or emissions dashboards—during simulator runs or onboard tasks. This immediate feedback bridges the gap between theory and practice, allowing learners to see the tangible effects of their actions.

- Change Management Principles: Introduce foundational change management concepts, such as recognising stages of change and overcoming resistance, through role-playing exercises and group discussions. Encourage trainers to celebrate incremental successes, like improvements in safety or efficiency, to build momentum for ongoing change.

- Inclusion and Diversity Considerations: Design learning activities that account for diverse backgrounds and abilities. Use multilingual resources and ensure that collaborative tasks mix learners from varied cultures and experience levels, enriching the learning environment and making behavioural change accessible to all.

- Evaluation of Long-Term Impact: Schedule follow-up surveys and workplace observations months after training sessions to assess whether new behaviours are being maintained. Use this feedback to adjust training content and methods, ensuring continuous improvement and sustained transformation.

By embedding these strategies within maritime behavioural training, educators not only facilitate knowledge transfer but also create a supportive, adaptive environment where real-world change is possible and lasting.

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"While these strategies provide tangible guidance for cultivating lasting behavioural change in maritime settings, it is equally important to ground such practices in well-established educational theory. Understanding how adults learn not only informs the design of effective training but also ensures that interventions are responsive to learners' needs and motivations. The following section introduces Adult Learning Theory as a crucial framework to ensures sessions are responsive to learners' unique needs and motivations, making professional development impactful, enduring, and suited to the dynamic realities faced at sea.

8.1. Competency-Based Training

Higher education programmes today are increasingly structured as competency-based training (CBT). This means that, as a trainer, you must not only transfer knowledge but also understand the principles of competency-based teaching. At its core, this approach requires learners to demonstrate that they have integrated knowledge (what to know), skills (how to do), and attitudes (how to be) into their practice. For you as a trainer, it is therefore essential to design learning experiences and assessments that go beyond theory, ensuring that learners can apply what they learn in real-world situations.

Traditional frontal teaching (the benchmark mentioned earlier) often emphasise theoretical knowledge over practical skills. This focus may result in employees being less prepared for real-world tasks, which can affect organisational efficiency. As industries evolve, there is an increased interest in training methods that are tailored to specific outcomes. Competency-based training (CBT) is one such method, where competency is a synonym for capability. CBT is designed to develop particular skills and competencies relevant to job roles. It provides definitions, examines potential benefits, and includes real-world examples. The train the trainer course also addresses recommended practices for implementing CBT within learning and development programs, as well as common challenges that may arise. The aim is to provide information on how CBT can support employee development and improve job-related skills.

Competency-based training (CBT) is an education and training approach centred on acquiring and demonstrating specific skills needed for effective job performance. In contrast to traditional methods, which typically prioritise theoretical knowledge, CBT emphasises practical, measurable results. This structure creates the Opportunity for learners to apply new skills directly in their roles, which may contribute to increased proficiency, Motivation and confidence.

CBT is structured around well-defined competencies that correspond to both organisational and role-specific requirements. The Greenport curriculum focuses on the sustainability and human behaviour of tug crews, pilots, and port operators.

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8.2. How Do Learning Approaches Evolve Across Different Levels?

One important aspect for you as a trainer to consider is the type of learner you are teaching—whether they are young children, young adults, or professional adults. Each group comes with different levels of prior knowledge, experience, and learning needs. Since the primary aim of this course is to foster behavioural change among tugboat crews, the main target group is professional adults. This means the focus is on learners who already bring significant operational experience but may also have long-standing habits that need to be questioned, adjusted, or replaced to support more sustainable practices.

Before delving into the theoretical underpinnings of adult learning, it is important to recognise that the practical methods described above are most effective when rooted in sound educational principles. Each strategy—whether it involves reflective feedback, mentorship, the use of real-time data, or fostering diversity—draws on core concepts from adult learning theory. To fully harness the power of these practical approaches, it is vital to recognise their grounding in robust educational theory. The effectiveness of strategies like collaborative forums, value-driven activities, real-time feedback, and inclusive design is amplified when they are intentionally linked to a deeper understanding of how adults learn. This theoretical foundation ensures training is not only practical but also meaningful, adaptive, and genuinely transformative. With this in mind, the next section turns to Adult Learning Theory—a cornerstone in educational practice—which illuminates why these methods resonate with adult learners and how they can be leveraged to produce lasting professional growth. Adult Learning Theory, often called andragogy, has guided educators for years. It is based on the idea that adults learn differently from children: they respond best to teaching that connects with their real-life experiences, acknowledges their prior knowledge, and encourages hands-on problem-solving. For trainers, this makes andragogy a valuable tool to organise training around the learner's needs rather than around the trainer's knowledge.

The benefits of this approach are clear: it increases engagement, ensures that learning is directly applicable to the workplace, and empowers learners to take ownership of their progress. It also aligns closely with the COM-B model, since it develops capability (building on prior skills), leverages opportunity (by applying knowledge in realistic contexts), and strengthens motivation (through relevance and immediate benefits). However, there are also limitations. Adult Learning Theory assumes that learners are self-directed and motivated, which is not always the case in practice. Experienced professionals may resist change if new approaches challenge established habits, and less confident learners may struggle without sufficient structure. For trainers, the challenge is therefore to balance autonomy with guidance: providing enough direction to ensure learning outcomes are met, while still creating space for learners to connect the training to their own experiences.

The theory itself is straightforward—built around five key principles—but applying it thoughtfully makes the difference between a generic training session and one that changes behaviour. Within these five steps of andragogy, the core logic of the COM-B model reappears, reminding us that successful learning depends on strengthening internal capability, creating opportunities to apply knowledge, and maintaining motivation to sustain change.

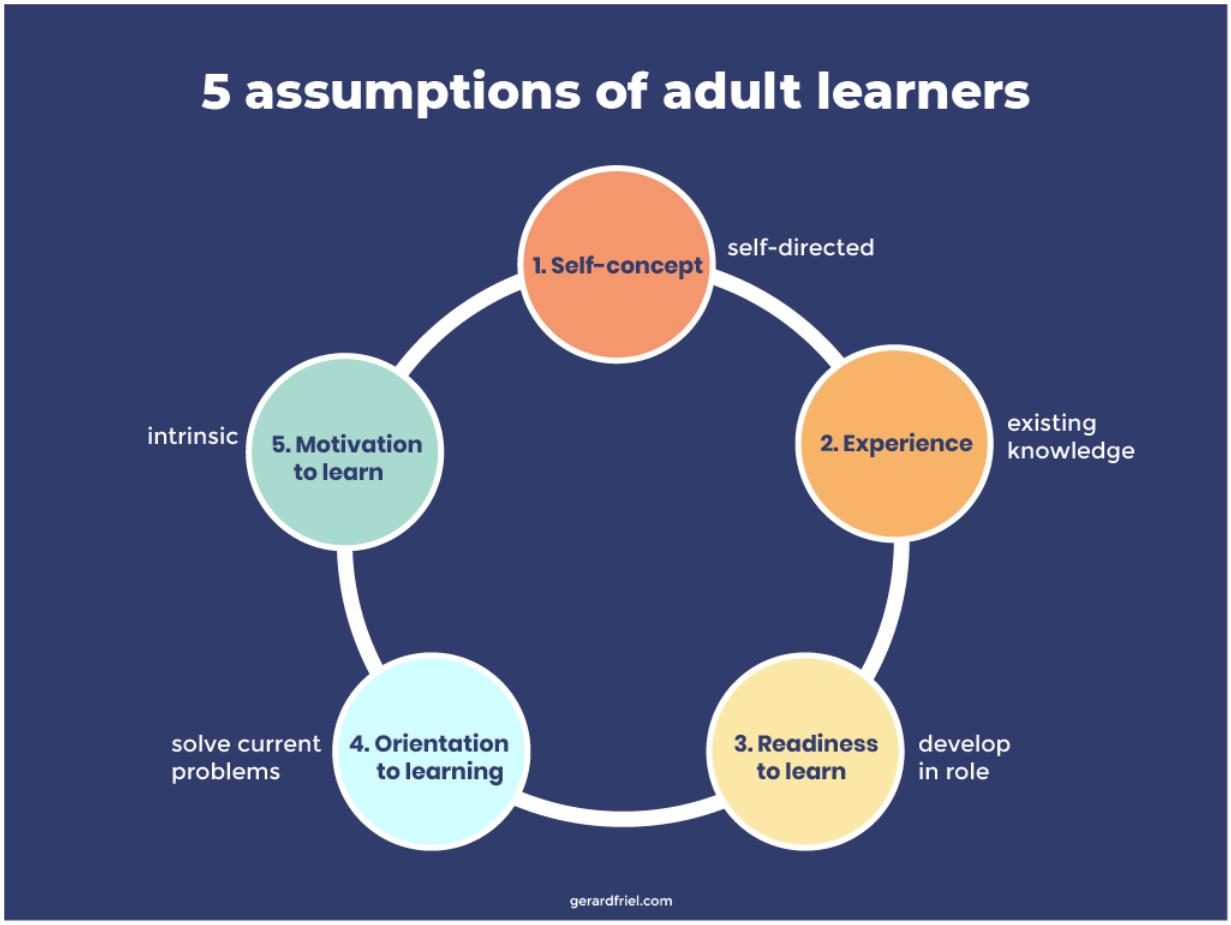

Figure 1: the principles of adult learning, source Gerardfield

Pedagogy, broadly understood as both the general framework of teaching methods and the teacher-centred approach traditionally used with younger learners, provides the foundation for exploring how educational strategies are shaped across different contexts. Pedagogy can be understood in two main ways within education. Firstly, it refers broadly to the art and science of teaching—the methods, strategies, and philosophies educators use to help students learn. This includes everything from how lessons are structured and delivered, to the relationships teachers build with their learners, and the ways they adapt their approach to meet the needs of diverse groups.

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In this sense, pedagogy is flexible, encompassing collaborative activities, hands-on projects, lectures, and anything else that facilitates learning, guided by educational research and responsive to changing contexts.

The second interpretation sees pedagogy in a more specific, traditional light: Historically, the term "pedagogy" derives from the Greek word “paidagogos”, meaning "to lead the child." In its original context, pedagogy was rooted in a teacher-centred model, with the instructor as the primary authority and learners positioned as dependent recipients of knowledge. This foundational view has shaped many traditional educational practices, emphasizing structured guidance and clear authority within the classroom setting. Here, the teacher stands at the centre of the learning process, deciding what will be taught, how, and when. Knowledge is largely transmitted from teacher to younger students, often through lectures, structured presentations, and standardised assessments. The expectation is that students absorb information, reproduce it in exams, and meet clearly defined outcomes. This approach is especially common in settings where consistency and regulatory standards are essential, such as primary education or technical courses in fields like maritime studies.

These two interpretations are not mutually exclusive but rather reflect a spectrum of teaching practices. While the broader view promotes adaptability and learner engagement, the instructor-centred approach provides structure and ensures all students reach a consistent baseline of knowledge. Thoughtful educators often blend both, using structure when needed but also encouraging participation and critical thinking where possible. This interplay between different educational philosophies highlights a fundamental shift in focus as one move from traditional, teacher-led models to more learner-centred approaches. Pedagogy, especially in its classical form, positions the educator as the anchor of the learning process—designing, directing, and delivering knowledge in a structured manner. Yet, as educational needs evolve and adults or professionals become the primary learners, andragogy enters the conversation, advocating a participatory and experience-driven approach.

Understanding where each model excels, and how they can be integrated, allows trainers and institutions to better match their methods to the context of their learners—whether that means maintaining structure for regulatory subjects or empowering adults to take charge of their growth and development. For workplace training, embracing andragogical principles means designing sessions that tap into learners’ existing skills and CAPABILITIES, encourage discussion and collaboration, and allow for self-direction.

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Adults respond well to problem-based tasks, practical scenarios, and OPPORTUNITY to reflect on how new concepts integrate with what they already know. When trainers facilitate rather than dictate, learning becomes a partnership—MOTIVATING and empowering participants to take ownership of their professional development and fostering an environment where learning is adaptive, dynamic, and responsive to real-world challenges.

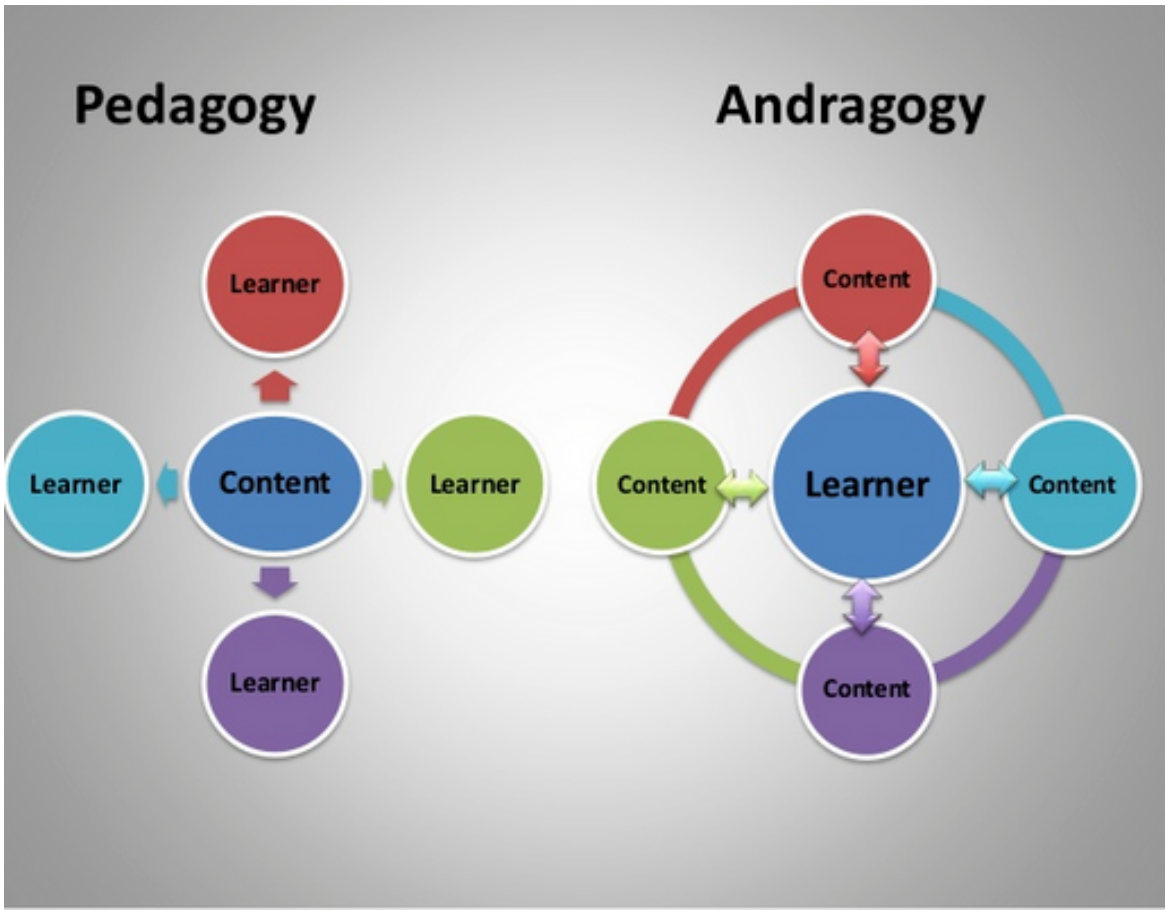

Figure 2: difference between Pedagogy, where the knowledge flows from the instructor to the learned, and Andragogy where the learners contribute experience and insight, and the instructor facilitates learning.

Within instructor-centred learning, the teacher acts as the authority figure and is responsible for transferring knowledge to students. Lectures, structured presentations, and standardized assessments are the primary teaching formats. Students are expected to absorb material, reproduce it in exams, and demonstrate understanding of concepts according to predefined criteria. In higher education institutions (HEIs), instructor-centred methods are common.

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This approach positions the educator at the core of the learning process, deciding on content, pace, and instructional methods. Despite broader adoption of active learning models, many HEI courses—especially in fields like maritime studies—continue to use instructor-centred delivery. For Greenport-related courses, topics such as sustainability regulations, energy efficiency, port operations, and environmental compliance are often presented through formal lectures. Students are introduced to international frameworks (including IMO conventions and EU directives), technical guidelines, and operational procedures via instructor-led sessions. This approach establishes a consistent baseline of knowledge, which is necessary in areas governed by safety, regulation, and compliance requirements. When is the reliance on instructor-centred approaches most evident within Greenport-focused higher education institutions, and what factors contribute to its persistence?

- Standardization of Knowledge: Maritime and port sustainability subjects are tied to strict international standards. Delivering this content uniformly helps ensure all students gain consistent grounding. Efficiency: Large student groups can be taught simultaneously, enabling coverage of complex regulatory or technical topics within limited time frames.

- Authority of Expertise: Instructors typically possess significant experience in maritime or regulatory contexts, so their instruction is viewed as reliable and structured.

- Assessment Requirements: Courses frequently conclude with standardized examinations or reports. Instructor-centred methods align with these measurable learning outcomes.

Advantages of Instructor-Centred Approaches in the Greenport Context

- Ensures all students receive consistent instruction on sustainability standards and protocols.

- Prepares large groups efficiently for compliance with relevant requirements.

- Reduces misinterpretation in high-risk topics through clear, accurate explanations.

Limitations and Challenges

- May limit critical thinking and problem-solving skill development.
- Student experience and innovation are less likely to be integrated.
- Less interactive, which may hinder learning in interdisciplinary areas like green port operations.

Finding the right mix between structured instruction and learner-centred engagement is key to effective teaching. By adopting a balanced approach, trainers can draw from the strengths of both pedagogical and andragogical methods—delivering essential content efficiently while encouraging learners to apply real-world experience, think critically, and stay motivated. This harmony ensures that teaching remains adaptable and relevant, equipping learners not only with knowledge but also with the skills and initiative they need for lasting success.

The Greenport project identifies the need for a combination of approaches. While lectures and structured instruction provide foundational maritime and regulatory knowledge, they are increasingly supplemented with andragogical methods such as case studies, simulations, and collaborative projects.

Typically, HEI students first receive instructor-centred instruction to establish a foundation. Subsequently, they participate in workshops, simulator training, and group activities, allowing them to apply concepts and incorporate their perspectives into sustainable maritime operations.

In tandem with the higher education pathway, the VET (Vocational Education and Training) stream in the Greenport context is designed to provide hands-on, skills-focused learning tailored to the operational realities of the maritime sector. Learners in the VET stream typically begin with structured, instructor-led modules that cover core regulatory, safety, and environmental protocols essential for compliance and job readiness.

Building on this foundation, the VET curriculum transitions into immersive experiences such as practical workshops, workplace simulations, and collaborative tasks that mirror real port operations. This approach ensures participants not only understand theoretical standards but can also confidently apply them in day-to-day scenarios. Supported by trainers with industry expertise, VET learners are encouraged to reflect on their experiences, adapt to evolving sustainability practices, and develop the problem-solving abilities critical for modern green port roles.

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By integrating structured content delivery with experiential, learner-centred activities, the VET stream equips trainees with both the technical proficiency and adaptive mindset necessary for immediate employment and long-term growth within the green maritime industry.

Before reviewing the table below, a brief introduction to the three teaching approaches being compared is useful. The table summarizes pedagogy as originally an instructor-based method for younger learners, as well as instructor-centred methods and andragogy. Each approach has its own origins, principles, and areas of application, shaping how learning is organised and experienced by students. This comparison aims to clarify the unique features and strengths of each method in the context of sustainable maritime and port training.

TABLE I: Comparison of 3 mentioned teaching methods.

Aspect	Pedagogy	Instructor-Centred	Andragogy
Origin/Meaning	**To lead the child"**	**Teaching style where instructor directs learning**	**"To lead the adult"**
Focus	**Teacher-centred**	**Instructor controls content and process**	**Learner-centred**
Role of Instructor	**Authority, main source of knowledge**	**Controller of what, when, and how learning happens**	**Facilitator, guide, co-learner**
Role of Learner	**Dependent, follows instructions**	**Passive, receives knowledge**	**Active, self-directed, brings in experience**
Use of Learner's Experience	**Minimal, seen as unimportant**	**Usually limited or ignored**	**Central — learners' knowledge enriches learning**

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Learning Approach	**Content-focused, structured, directive**	**Content delivery, repetition, assessment**	**Problem-solving, collaborative, experience-based**
Motivation	**External (grades, approval)**	**External (certification, requirement)**	**Internal (relevance, practical application)**
Advantages	**- Clear structure - Efficient for beginners - Good for foundational knowledge**	**- Fast delivery of standardized content - Instructor has full control - Easier to manage large groups**	**- Builds on real-world experience - Increases motivation & engagement - Encourages critical thinking & problem-solving**
Disadvantages	**- Learners are passive - Little room for creativity or experience - May not meet individual needs**	**- Learners remain passive - Risk of low engagement - Can ignore learners' insights**	**- Less efficient if learners lack experience - Requires skilled facilitator - Can be harder to standardize & control**
Example	**A child learning math step by step from the teacher A child learning math step by step from the teacher**	**A safety trainer lecturing without interaction**	**Mariners sharing real cases of emissions handling, applied to**

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8.3. What Is the Difference Between Sustainable Education and Education for Sustainability

For trainers, it is important to distinguish clearly between sustainable education and education for sustainability, because the two concepts focus on different but complementary goals. If this distinction is overlooked, trainers may design courses that miss their intended impact—either by focusing only on environmental content without considering the long-term quality of teaching itself, or by improving teaching methods without embedding sustainability values. Understanding the difference helps trainers align their teaching objectives with both the immediate needs of learners and the broader responsibility of preparing them for future challenges. Sustainability is a broader concept that goes beyond protecting the environment alone. It refers to the ability to meet the needs of the present without compromising the ability of future generations to meet their own needs (Brundtland Commission, 1987) One of the first upsides about sustainability and sustainable development- Education is that it encourages people to think long-term and not just short-term effects of their actions, technologies and businesses. Sustainable Education can be interpreted in various ways. Some view it as supporting educators in their professional development, which can enhance the quality of education. Others define Sustainable Teaching as methods that consider and protect natural resources, and sometimes the term is used interchangeably with Teaching Sustainability. All definitions consistently describe Sustainable Teaching as a long-term approach aimed at improving both educational provision and broader environmental outcomes. Sustainable Teaching is all about helping students pick up skills and capabilities that really matter on the long-term scale—like thinking critically, doing solid research, working well with others, and presenting ideas clearly—instead of just memorising facts. With so much information out there changing all the time, it's important for learners to be able to adapt by sharpening their ability to analyse and communicate. Textbooks and other academic resources can become outdated fast, but Sustainable Teaching gives people the tools to keep learning and making smart choices long after school ends, getting them ready for whatever life throws their way. Sustainability education isn't just about textbooks or lectures—it's about preparing people for the real world, giving them the confidence and adaptability to face whatever comes their way. Instead of focusing on memorisation, it emphasises practical skills like critical thinking, collaboration, good research habits, and clear communication. In the workplace, this means encouraging learners to think on their own, solve real problems, and keep building on what they know, even as things change around them. Trainers help participants develop the judgment to make good decisions and the initiative to keep improving themselves and their organisations. By connecting learning with everyday challenges and ongoing professional growth, sustainability education ensures people are ready to succeed now and well into the future. Ultimately, the goal is to inspire a sense of responsibility and pride, so that graduates leave not just with facts, but with the mindset and tools to keep learning, adapting, and contributing—wherever their careers may take them. In short, sustainable education is about how we teach — ensuring our teaching methods are adaptable, high-quality, and long-lasting.

Education for sustainability is about what we teach — embedding environmental and social responsibility into the curriculum. Both must go hand in hand: trainers in Greenport need to deliver sustainability content (education for sustainability) using methods that are themselves future-proof and engaging (sustainable education).

8.4. Blended and Digital Learning

For you as a trainer, it is important to understand the difference between blended learning and fully digital learning, because each demands a different role and set of skills. In blended learning, your task is to integrate classroom interaction with digital tools in a way that complements one another—you remain a facilitator who connects theory, practice, and online resources. In fully digital learning, however, the trainer must adapt to a more guiding and moderating role, ensuring that learners remain engaged, supported, and motivated without the structure of physical classroom contact. Recognising this distinction helps you choose the right approach and prepare strategies that align with your learners' needs and the course objectives. Blended and digital learning is a modern approach to education that combines the best of traditional classroom teaching with the advantages of digital technology. In this setup, students spend some time learning face-to-face with teachers and classmates, and some time exploring content, activities, or discussions online. This blend offers flexibility and makes it easier to meet the needs of all kinds of learners. Blended learning gives students access to all sorts of digital materials—think interactive lessons, videos, and activities they can do at their own pace. If someone learns best by watching, there are videos and diagrams; if hands-on experience works better, there are simulations and practice exercises. The beauty of digital tools is that students can revisit lessons as often as needed, giving them more control over how and when they learn. For trainers, blended learning opens up a window into how students are doing. Online quizzes and progress-tracking tools make it simple to see who's thriving and who might need a little extra help. This data lets teachers adjust their approach to better support every learner. Plus, working with digital tools helps teachers boost their own tech skills and find new ways to engage their classes.

The Train the Trainer course is structured for comprehensive digital learning. Both the HEI and VET tracks are delivered using a blended approach and may be conducted either in-person or online, depending on participant needs.

Blended and digital formats also differ in timing: some are self-paced, others are live. Trainers need to balance asynchronous (flexible) and synchronous (interactive) methods. The following section explains how

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8.5. Asynchronous and Synchronous Learning

As a trainer, it is essential to understand the distinction between asynchronous and synchronous learning, because each format requires a different teaching approach and set of strategies. In asynchronous learning, your role shifts toward designing clear, self-guided materials and providing structured opportunities for reflection and delayed interaction. In synchronous learning, by contrast, you take on a more immediate role as facilitator, guiding real-time discussions, responding to questions on the spot, and fostering group dynamics. Recognising these differences allow you to choose the right balance between flexibility and interaction, depending on your learners' needs and the goals of the course.

There are two main approaches to delivering digital learning: asynchronous and synchronous. Asynchronous learning gives students the flexibility to work through materials at their own pace, accessing resources and discussion boards whenever it suits them. This approach is excellent for fostering autonomy and enables learners to balance their studies with other commitments.

Synchronous learning, on the other hand, happens in real time—via face-to-face meetings or live video sessions—where everyone participates together according to a set schedule. This format is ideal for interactive activities and immediate feedback, helping to build a sense of community among participants.

When designing a learning experience, it's important to choose the format that best matches the learning objectives and the needs of the students. Asynchronous activities are great for self-directed study, while synchronous sessions encourage collaboration and real-time engagement. Using the right digital tools—such as forums for asynchronous interaction or video conferencing for synchronous meetings—ensures that everyone can participate fully, regardless of their preferred learning style.

In the Train the Trainer course, asynchronous elements allow teachers to log in whenever they wish and proceed at their own pace, while HEI modules provide materials accessible throughout an extended period. The VET course, by contrast, is designed for synchronous participation, with all learners encouraged to join live discussions and share their experiences with the group. Whichever mix of asynchronous and synchronous learning is chosen, trainers need tools to deliver, monitor, and support these activities. This is where a Learning Management System (LMS) becomes essential, providing a digital environment that organises both independent study and live interaction LMS Platforms.

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8.6. LMS Platforms

For many trainers, working with a Learning Management System (LMS) can feel like a significant shift in their usual teaching practice. Instead of relying only on classroom interaction or printed materials, course content, activities, and assessments must be adapted to fit the digital environment of the LMS. This requires structuring lessons into smaller modules, creating interactive elements such as quizzes or discussion boards, and providing clear guidance that learners can follow independently. The LMS is not just a delivery tool but a learning environment in itself, and as a trainer you need to adapt both your teaching methods and your courseware so that they make full use of the platform's possibilities. An LMS is a software application designed for the administration, documentation, tracking, reporting, automation, and delivery of educational courses or training programmes. Originally developed for e-learning, LMS platforms have grown into a major part of today's learning system market. They are used to identify training and learning gaps through analytical data and reports, primarily supporting online learning but also offering a platform for a variety of approaches, including both asynchronous and synchronous formats. In higher education, an LMS may be used to support classroom management for instructor-led training or to facilitate a flipped classroom model. Through an LMS, educators can create and integrate course materials, set learning goals, align content with assessments, monitor progress, and design customised tests for students. The system communicates learning objectives, organises timelines, and delivers content and tools directly to learners. It also automates assessments and incorporates features to reach diverse groups of learners. Instructors benefit from customisable assessment and tracking options that allow them to view learner progress in real time and measure the effectiveness of their teaching. At the same time, LMS platforms strengthen communication by providing spaces for dialogue between learners and instructors, offering tools that support interaction, knowledge exchange, and feedback. These platforms also make it possible to build structured courses by integrating text, images, videos, PDFs, interactive tests, slideshows, and links. They allow the creation of different user types—teachers, students, parents, visitors, editors—and provide role hierarchies to manage access and responsibilities. This functionality helps trainers maintain control over content, enrol students or allow self-enrolment, and guide learning more effectively. Assessment is another core function. LMS platforms enable instructors to design automated tests and assignments that can be submitted online in various formats, such as multiple choice, matching, free text, essay, ordering, or true/false questions. This flexibility allows trainers to measure learning outcomes in ways that go beyond traditional examinations, giving a more comprehensive picture of learner performance.

Feedback also plays an important role. Discussion forums and group activities built into the LMS create opportunities for learners to exchange ideas with peers and provide feedback to instructors. This helps trainers refine courses, address gaps,

and ensure that students feel included and supported throughout their learning journey.

An LMS can further support both asynchronous and synchronous learning. Learners can access pre-recorded videos, documents, and discussion forums at their own pace, while also participating in live video sessions, discussions, and group work scheduled in real time. This combination provides flexibility without losing the benefits of interaction and immediacy.

Finally, most platforms offer learning analytics, with dashboards that track metrics such as completion rates, attendance, and likelihood of success. These insights allow trainers to identify where learners are struggling and to make timely interventions. For trainers, the use of an LMS therefore not only reshapes teaching methods but also provides powerful tools to support learner engagement, personalise instruction, and enhance overall effectiveness. An LMS does more than deliver content—it also provides opportunities for assessment. Since assessment shapes how learners approach their training, it becomes a powerful driver of behaviour. The next section examines how assessment can be designed not just to measure learning, but to actively encourage sustainable practice.

8.7. Assessment as a Driver of Behavioural Change

Assessment is more than a tool to check whether learners have reached a minimum standard; it is a powerful mechanism that steers how learners approach their training. In maritime education, where the ultimate aim is safe and sustainable behaviour on board, assessment must therefore go beyond testing theoretical knowledge. The way assessment is designed not only measures learning but actively signals to learners what really matters.

Because learners often prepare with the exam in mind, the chosen assessment format has a direct short-term influence on their behaviour. If, for example, learners know in advance that the final assessment will consist of multiple-choice questions, they may focus on memorising details rather than practising real-world application. By contrast, if they know the exam includes simulator exercises, reflective tasks, or group problem-solving, they will engage with the courseware differently - practising decisions, questioning routines, and exploring their own attitudes. In this sense, assessment does not just evaluate outcomes; it drives how learners process the material from the beginning of the course.

In competency-based education, assessments must therefore capture all three pillars of competence: knowledge, skills, and attitude. When viewed through the COM-B model, the alignment becomes even clearer:

- Capability is assessed through problem-solving, applied knowledge, and skill demonstrations.

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- Opportunity is tested by evaluating whether learners can perform under realistic conditions with the tools and constraints they will face in practice.

- Motivation is encouraged by assessments that reward sustainable, safe, and proactive attitudes.

By covering all three dimensions, trainers ensure that assessment does not remain a one-off measurement but becomes an integrated driver of behavioural change. It signals what behaviours are valued, guides how learners prepare, and increases the likelihood that sustainable practices will be internalised and carried forward into daily maritime operations.

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Chapter 3: Opportunity

Within the Greenport curriculum, Opportunity is recognised as a key driver for fostering meaningful and lasting changes in workplace behaviour. As described in the COM-B model, Opportunity is not limited to the chance to act but includes the **external**, physical and social conditions that enable individuals and organisations to adopt more sustainable and effective work practices.

In a port environment, Opportunity is shaped by access to resources, clear operational policies, technological tools, prevailing cultural attitudes, and the design of physical workspaces. These factors collectively determine whether new behaviours can be implemented and maintained over time.

Applying the COM-B perspective, trainers and leaders are encouraged to identify both barriers and enablers within their operational context. Effective change requires more than just individual capability or motivation; it depends on whether the workplace structures and supports new behaviours. Opportunity may involve reliable access to equipment such as simulators, teaching curriculum, new technologies and alternative fuels.

Understanding the importance of Opportunity highlights that sustainable change is achieved when the environment encourages and reinforces desirable behaviours. As ports and maritime operations continue to transition towards more sustainable practices, deliberately creating these opportunities—through targeted **investment**, **policy** alignment, and organisational support—becomes essential to real and enduring transformation.

Greenport's emphasis on port operations, tugboats, and pilots is rooted in the understanding that meaningful, lasting behavioural change depends on deliberately creating and sustaining these enabling opportunities. Ultimately, Greenport's focus on these sectors is a deliberate strategy to maximise the systemic opportunities for change and transformation in maritime sustainability.

9. How Do External Conditions, Culture, and Regulation Drive Behavioural Transformation in the Maritime Sector?

As a trainer, you cannot directly influence the external conditions that shape maritime operations—such as fuel infrastructure, digital systems, or regulatory frameworks. Yet, if you aim to achieve lasting behavioural change in your learners, you must ensure they understand these external opportunities and constraints.

Behaviour does not occur in isolation; it depends on whether the environment provides the space, tools, and incentives for new practices to take root.

In the case of tugboats, a particular challenge is that IMO emission regulations do not apply to this sector. Unlike larger vessels, tug operators are not bound by strict international thresholds for emissions. This absence of regulation can be seen as a barrier—there is no legal pressure to change—but it also highlights the importance of self-regulation and continuous improvement. Even without imposed thresholds, it is always possible to perform better than yesterday, setting internal benchmarks and striving for higher standards of efficiency and sustainability.

Sustainable transformation in the maritime industry therefore hinges not only on intent or knowledge but critically on opportunity—the external circumstances and structures that allow new behaviours to flourish. Port operators, tug crews, and pilots are at the core of this shift. Their ability to adopt low-emission fuels, integrate digital technologies, or implement energy-efficient procedures relies on the opportunities their environments present. For example, transitioning to alternative fuels such as methanol, ammonia, hydrogen, or biofuels requires more than willingness; it demands infrastructure adaptations, specialised equipment, and comprehensive safety protocols. Opportunity is realised through targeted investment in refuelling stations, compliant engine technologies, and training that covers both technical and regulatory requirements.

Similarly, digitisation in tugboat and port operations introduces opportunities for optimising efficiency and reducing emissions, but only if crews and operators are given access to predictive analytics tools, smart navigation systems, and real-time monitoring devices. Effective opportunity means these resources are not only available but also embedded into operational workflows, supported by leadership, and reinforced by policy.

Cultural and social opportunity is equally vital. Prevailing attitudes within the port community, clear communication of sustainability goals, and recognition of achievement create an environment where desired behaviours are encouraged and normalised. When organisational structures reward innovation and provide ongoing support, individuals are empowered to act confidently and consistently in line with new sustainability practices.

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At the same time, barriers such as high upfront investment costs—especially for retrofitting vessels or port facilities—can limit opportunity. Addressing these concerns through strategic funding, phased implementation plans, and collaborative industry partnerships widens the window of opportunity, making sustainable choices not only viable but attractive.

9.1. How Rules and Regulations Create Opportunities in the Maritime Sector?

Driven by a sense of environmental responsibility and the tangible benefits of early action, port operators, tugboat crews, and pilots are forging ahead with sustainable practices even when not compelled by international mandates. This proactive approach positions them as pioneers within the maritime sector, embracing cleaner technologies and operational changes that set new benchmarks for others to follow.

Their efforts are not only reshaping daily routines but are also cultivating a culture of innovation, where the adoption of green technologies, investment in staff training, and a commitment to continual improvement become the norm. The transition to low-carbon operations is thus achieved through a combination of regulatory frameworks, local initiatives, and the desire to future-proof business models in a rapidly evolving industry.

By harnessing both regulatory momentum and voluntary engagement, these maritime professionals are laying the groundwork for a new era—one where sustainability is not just an obligation, but an opportunity to lead, differentiate, and inspire systemic change throughout the sector.

Greenport's particular emphasis on port operations, tugboats, and pilots is driven not only by the belief that enabling environments are essential for change, but also because these groups are mostly **outside the scope** of IMO and EU regulations. By targeting sectors that fall beyond the reach of global and regional frameworks, Greenport addresses crucial gaps where local action can have outsized impact.

Within the COM-B model, "opportunity" includes not just permission or chance to act, but the physical, social, and organisational context that makes new behaviours possible. This is where international, regional, and local regulations come into play, providing scaffolding for change and driving investment in new technologies, infrastructure upgrades, and workforce training.

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9.2. Key Maritime Sustainability Regulations and Their Scope

Rules and regulations play a pivotal role in driving sustainability across the maritime sector. This section highlights how international, regional, and local frameworks—such as those introduced by the IMO and EU—are shaping opportunities for cleaner operations, investment in new technologies, and workforce development.

- IMO GHG Reduction Strategy: A comprehensive global framework from the International Maritime Organization, targeting the phase-out of greenhouse gas emissions from shipping, with overarching measures for all ships and specific technical requirements for larger vessels.
- FuelEU Maritime Regulation: An EU directive designed to accelerate the adoption of sustainable fuels in maritime transport, applicable to ships ≥ 5,000 GT calling at EU ports, covering a wide range of vessel types like cargo ships, tankers, Ro-Ro, and cruise ships.
- Energy Efficiency Existing Ship Index (EEXI): A mandatory standard for sea-going ships ≥ 400 GT engaged in international trade, including cargo ships, tankers, bulk carriers, container vessels, and more. Excludes most tugs, pilot boats, and smaller craft.
- Carbon Intensity Indicator (CII): An assessment tool for cargo, Ro-Pax, and cruise ships ≥ 5,000 GT, measuring carbon emissions per transport work, excluding smaller vessels like tugboats and service craft.

How are various types of Vessels Covered?

- Large ocean-going vessels (≥ 400–5,000 GT): Main focus of IMO & EU measures (EEXI, CII, FuelEU). Includes cargo ships, tankers, container ships, bulk carriers, cruise ships.
- Smaller vessels (tugs, pilot boats, port craft): Generally outside global/EU regulations but included in local port rules such as shore power requirements, Emission Control Areas (ECAs), and differentiated port fees. Greenport's strategy is to focus particularly on these sectors, recognising that international measures do not sufficiently cover their emissions or operations.

Besides large-scale measures, local and port-level rules—like shore power mandates —help extend sustainability standards to smaller craft when infrastructure allows.

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9.3. How Is Technological Innovation Transforming Maritime Sustainability?

Where Greenport aims to reduce emissions on a short-term trough a change in behaviour, the benefits of technological innovation are typically long-term based, requiring sustained development and investment to create significant and lasting carbon reductions. A change in operational behaviour will be, as seen from the ship-owners position, not only beneficial for the environment but will also immediately reduce the operational cost, produce additional recourses what can be invested in the long term.

Changin the vessel to alternative fuels involves a very big initial investment (CapEx) where the benefits will be paid back only after a longer period.

New fuels like methanol, ammonia, hydrogen, and biofuels present promising opportunities for tugboats and port operations but come with logistical, regulatory, and safety challenges. For instance, while hydrogen offers significant potential for near-zero emissions, its storage and handling require specialized materials and infrastructure due to its flammability and low volumetric density. Methanol and ammonia, though more stable, demand considerations around their environmental and health impacts, as well as the development of compliant engine technologies. Training for tugboat crews and port operators must focus on understanding these fuels' benefits and constraints to ensure safe and efficient adoption.

Similarly, advancements in digitalization are reshaping tugboat operations and port activities. Predictive analytics, powered by AI and machine learning, can help forecast maintenance needs, optimize tugboat dispatching schedules, and anticipate weather patterns, greatly enhancing operational efficiency. Smart navigation systems and real-time monitoring tools are increasingly essential for reducing fuel consumption during tug manoeuvres and optimizing port logistics. These technologies require new competencies, such as data interpretation and cyber-security awareness, which should be prioritized in training programs for these sectors.

Renewable energy integration, such as wind-assisted propulsion or solar panels, also offers significant potential for tugboats and port facilities to reduce emissions. However, retrofitting older tugboats or integrating renewable technologies into port infrastructure involves technical and financial challenges. These adaptations often require substantial investment, precise engineering modifications, and regulatory compliance. Tugboat crews and port managers must be equipped to evaluate these complexities, balancing short-term costs with long-term sustainability benefits. Educators and trainers play a crucial role in preparing these

professionals to handle such transitions, blending ethical considerations with practical problem-solving.

Environmental stewardship should be a foundational element in the training of tugboat operators and port personnel. This includes instilling awareness of how operational choices, such as minimizing idle time or optimizing thrust applications during manoeuvres, directly impact emissions and resource efficiency. Similarly, port operators must be attuned to the environmental consequences of their decisions regarding ship berthing, cargo handling, and energy use. By prioritizing sustainability, these professionals can contribute significantly to reducing the maritime industry's overall carbon footprint.

Through a combination of technical expertise, systems thinking, and ethical leadership, education for tugboat crews and port operators can empower them to adopt sustainable practices. By embracing innovation, collaboration, and a commitment to environmental responsibility, they will be well-prepared to meet the challenges of modern maritime operations and contribute meaningfully to global sustainability goals.

10. What Tools and Recourses are Available to Support Trainers?

One of the tools available to educators and trainers is the structured curriculum provided through Higher Education Institutions (HEI) and Vocational Education and Training (VET) pathways. Both serve as dynamic platforms, not just for the transmission of technical knowledge, but for cultivating a deep-rooted commitment to sustainable transformation within maritime industries. These curricula are more than just educational frameworks—they are opportunities: invitations for learners and practitioners to engage directly with the complex challenges and ethical questions posed by maritime sustainability.

Through thoughtful integration of emerging technologies, regulatory updates, and behavioural change strategies, HEI and VET programmes become catalysts for lasting impact. They foster environments where participants can experiment, reflect, and collaborate, transforming abstract principles into concrete action. By aligning academic rigor with industry relevance, these pathways ensure that each graduate is equipped to act as both a skilled technician and a conscientious steward of the environment.

Whether through case studies, hands-on exercises, or collaborative projects, the curriculum encourages learners to bridge the gap between what is possible and what is necessary. In this way, HEI and VET training do not simply prepare individuals for jobs—they empower maritime professionals to lead their

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organisations toward greener horizons, positioning education itself as both a tool and an opportunity for sustainable progress.

Both the HEI and VET pathways are designed to connect what learners' study with what they'll face on the job. These courses focus not just on building technical skills, but also on nurturing adaptability and teamwork—qualities that are essential for meeting the real-world challenges of maritime sustainability. By the end of the programme, participants are better prepared to lead meaningful change, bringing fresh ideas, creative problem-solving, and a genuine commitment to greener, more resilient practices within the maritime sector.

11. How Can Trainers Use the Higher Education Learning Path?

Greenport has developed a structured learning path for Higher Education Institutions (HEIs), designed to guide students through both foundational knowledge and the critical thinking skills needed to address maritime sustainability. This path offers a ready-made framework, but as a trainer you are free to adapt, select, or supplement the materials in ways that best fit your learners, your teaching style, and your institutional context.

The learning path spans a fourteen-week programme and places the human dimension of maritime sustainability at its core. While technical advances and regulatory frameworks are covered, the modules consistently highlight the decisive role of people—both as the agents and the beneficiaries of sustainable change. The message is clear: lasting transformation depends not only on technological innovation, but on behavioural and organisational shifts within the maritime sector.

Within this framework, technical topics such as hybrid propulsion systems or real-time emissions monitoring are introduced as supportive tools, never as substitutes for human capability and commitment. The modules encourage learners to engage with the practical and emotional realities of change: overcoming resistance, fostering teamwork, and inspiring responsibility. Through case studies and hands-on exercises, students are prompted to confront the challenges of upskilling, effective communication, and leadership in diverse maritime environments.

By the end of the programme, learners are expected to have gained not just technical and regulatory insight, but also the confidence, empathy, and creativity to champion sustainability from within their organisations. Assessment is integrated throughout: formative tasks such as mapping exercises and quizzes reinforce understanding, while summative assignments require learners to apply their knowledge to complex, real-world situations.

For trainers, this learning path serves as a toolbox: it provides a clear structure, rich content, and tested activities, yet leaves space for adaptation and personalisation to ensure the training resonates with your specific group of learners.

11.1. HEI 1: An Introduction to Maritime Sustainability and Environmental Regulations

Importance of Behavioural Change for Sustainable Operations

Sustainability in maritime operations goes beyond environmental protection, encompassing social and economic dimensions. Changing individual and organizational behaviour is vital for reducing emissions in port services, particularly as technology alone cannot solve environmental challenges. The COM-B model highlights capability, opportunity, and motivation as key factors for enabling sustainable behaviours.

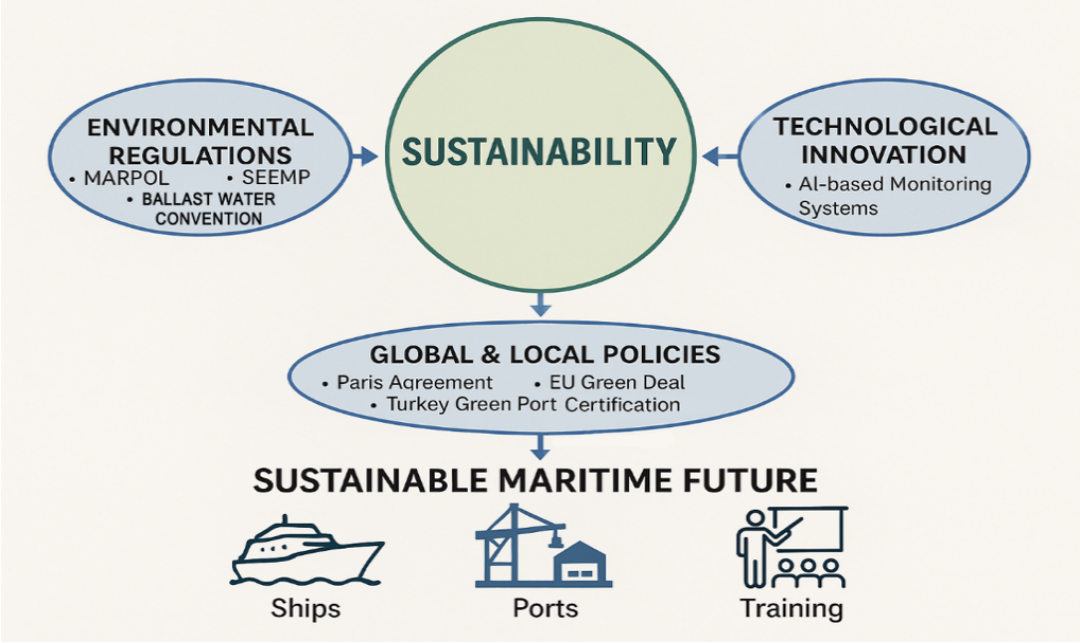

Figure 3:Relationship Between Sustainability Goals and Environmental Policies in the Maritime Sector (Produced by Artificial Intelligence)

Basic Concepts of Sustainability in Maritime Operations

Raising awareness and training crews in energy-saving techniques and emission reduction is essential. Tugboats and pilotage operations can benefit from hybrid propulsion systems, real-time monitoring, and optimized routing to reduce fuel

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consumption, demonstrating how technology and behavioural change work together.

Overview of EU and IMO Regulations and Their Indirect Impact on Port Services

Major regulations like MARPOL, the European Green Deal, Fit for 55, FuelEU Maritime, and EU ETS set decarbonization targets primarily for vessels over 5,000 GT, indirectly influencing port services. Compliance drives infrastructure upgrades and encourages voluntary green initiatives in smaller port activities, though technical and financial barriers remain.

Navigation Safety versus Emission Reduction

Balancing operational safety and emission reduction is critical in pilotage and towing. While safety often requires high engine power and responsiveness, emission reduction relies on cleaner technologies and smarter operations.

TABLE II Hybrid tugboats, smart navigation systems, and specialized training help reconcile safety with sustainability goals.

Aspect	Navigation Safety	Emission Reduction Priority
Engine Power	High, responsiveness	Lower, fuel efficiency
Manoeuvring Speed	Fast, precise movements	Slower, optimized movements
Equipment Redundancy	Essential for safety	May increase energy use
Real-Time Decisions	Based on safety needs	May conflict with fuel-saving plans

The role of sustainability in the operational excellence and competitiveness of ports

Sustainability is central to operational efficiency, regulatory compliance, and competitive advantage. Adoption of digitalization, resource efficiency, and clean technologies not only lowers emissions but boosts service reliability and market appeal, attracting eco-conscious clients and stakeholders.

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Importance of aligning with client expectations and future-proofing operations

Client expectations are shifting toward sustainability, innovation, and transparency. Ports must invest in clean tech and digital systems, engage stakeholders, and adapt services to remain competitive and resilient while supporting decarbonization.

Education and training for behavioural change are key in optimizing human interaction with technology, ensuring safety and sustainability coexist in daily operations.

Conclusion

Environmental policies and sustainability are interconnected, requiring a holistic approach for long-term resilience in maritime operations. By integrating sustainable practices into port services, ports can enhance safety, efficiency, and competitiveness, thus evolving into smart, green hubs for global maritime logistics.

11.2. HEI 2: Industry Ecosystem and Technological Landscape

Port requirements

Ports play a central role in global trade, depending on coordinated piloting, towing, and mooring services. Success relies on effective collaboration among stakeholders, workforce expertise, robust insurance, and updated infrastructure. Regulatory compliance, especially with IMO and EU standards, drives innovation: examples include hybrid-electric tugboats, smart fender technology, and advanced navigation systems using AI and IoT. Digital integration improves operations but raises cybersecurity concerns. Sustainability initiatives, such as shore power and hybrid vessels, support decarbonization goals. The GREENPORT training program equips operators with real-world skills and knowledge.

Trends in shipping: Alternative fuel vessels

Ports are shifting to cleaner fuels for tugboats and service vessels to meet stricter emission standards. LNG is most common, delivering substantial emission reductions, but methanol and ammonia are emerging as alternatives, each with unique benefits and challenges. Infrastructure and training still lag behind fuel technology, and safety protocols are evolving alongside new fuels. Ports must upgrade facilities and standardize training to support this transition.

Use of ShaPoli systems on client vessels and implications for port services

Shaft Power Limitation (ShaPoLi) systems help vessels comply with IMO emission rules by restricting engine power. While this reduces emissions, it can make ships harder to manoeuvre, requiring more tug assistance and closer coordination with port services. Ports must train staff and adjust resource allocation. Sharing propulsion data digitally boosts efficiency but introduces cybersecurity challenges.

Emission monitoring tools and their usability for crews

IMO's Ship and Port Emissions Toolkits guide operators in tracking and reducing emissions, with practical tools for assessment and strategy. Key technologies include Continuous Emission Monitoring Systems (CEMS), Fuel Flow Monitoring Systems, and Smart Buoy Networks. These systems provide real-time data and support compliance but require integrated dashboards and crew training. Future developments may include smart helmets and digital twins for ports.

Best practices: Different types of tug and pilot boats using cleaner fuels, including HVO

Tug and pilot boats are adopting cleaner fuels like Hydrotreated Vegetable Oil (HVO), LNG, methanol, ammonia, and biofuels to cut emissions and boost efficiency. HVO stands out for its high emission reduction and compatibility with existing engines. Cleaner fuels can improve performance and reliability, especially when paired with hybrid propulsion systems. Success requires updated training, regulatory adherence, and reliable supply chains.

Challenges for their uptake: Limited availability and high cost of alternative fuels

Despite clear benefits, alternative fuels face hurdles: high costs, limited supply, and infrastructure gaps. Managers must balance environmental goals with financial realities. Collaboration among ports, pilot projects, and policy incentives can help address these barriers and support adoption.

Available funding and the cost of going green

Transitioning to greener operations means significant upfront investment (CAPEX) and additional operating, compliance, and financing costs. Still, long-term savings—fuel, maintenance, emissions credits—can offset expenses within several years. Grants, green financing, and public-private partnerships are available to share costs. Early adoption positions ports for future competitiveness and regulatory compliance. The lack of clarity about future fuels remains a challenge, affecting planning and technology adoption in the sector.

11.3. HEI 3: Operational Strategies for Energy Saving and Emission Reduction

Techniques using existing resources.

Making the most of current equipment and day-to-day operations can lead to significant energy and emissions reductions in ports. This might mean smarter scheduling of cranes, trucks, and yard equipment to keep idle time to a minimum, relying on automated systems to monitor energy use, encouraging ships to plug into onshore power, installing smart meters for real-time tracking, or adding solar panels where possible. When it comes to pilot operations, optimizing routes and fleet schedules can help cut down on fuel, while moving to hybrid or electric pilot boats can boost efficiency even more. Collaboration among tugs, using AI for dispatching, and taking advantage of predictive maintenance all help get the best use out of existing resources.

Eco Speed Steaming: Benefits and Implementation

Eco-speed steaming—sometimes called slow steaming—simply means reducing ship speeds to save fuel and cut emissions. The benefits go beyond the environment: less pollution, better air quality around ports, less congestion, cost savings for operations, and more predictable docking schedules. To make this work, ports need to coordinate closely with shipping lines, use digital tools to manage arrivals, offer incentives for compliance, and keep everyone engaged. Regularly monitoring ship speeds and emissions is key to making ongoing improvements.

Key Behavioural Strategies

Driving change in eco-speed steaming isn't just about technology—it's also about people. Techniques like using social norms, making public pledges, providing regular feedback, setting eco-speed as the default, rewarding positive behavior, having leaders set the example, and presenting eco-speed as a strategic opportunity all help encourage lasting change.

Scheduling with tidal windows to optimize fuel use.

Planning vessel movements to take advantage of favourable tides can lower engine strain and reduce fuel use, especially during pilotage and tug operations. Integrating real-time tidal data into daily planning, dynamically dispatching pilots, and making sure the largest vessels get tidal assistance when needed all help maximize these benefits. Tools like AIS, VTS, tidal forecasting software, and decision support systems provide real-time guidance to support smarter scheduling.

Real-time fuel consumption visualization for port service craft

With the help of advanced monitoring tools, port service craft can see their fuel use in real time, thanks to data from onboard sensors and GPS. This gives crews the information they need to stay compliant, track performance, and spot further opportunities to save energy. Effective training—using things like gamification, recognition, and peer learning—can help crews use these systems to their full potential and build a strong culture of efficiency.

Tug energy saving, before and after a job

Saving energy during tug operations starts before the job even begins warming up engines efficiently, planning the route, checking tides, and matching tug power to the job. During the job, steady speeds and smart use of environmental factors like tides improve efficiency. Afterward, it's important to shut down engines promptly, review fuel usage, and address any maintenance needs. Regular feedback and recognition go a long way in reinforcing a culture of fuel saving and sustainability.

11.4. HEI 4: Collection And Analysis of Emissions and Sustainability Data

Introduction

The maritime industry is a major source of global CO_2 emissions and faces increasing pressure to reduce its environmental footprint. With new regulations and rising expectations, ports and shipping companies must adopt smarter, data-driven strategies.

GREENPORT and emission reduction strategies in ports and maritime operations

Ports are embracing cleaner energy, smarter operations, and community engagement to cut emissions. Solutions include switching to alternative fuels, optimizing schedules, and electrifying port equipment. Hybrid tugboats, shore power, and AI-driven planning tools are being used to save energy and reduce pollutants. Regular monitoring and collaboration across all stakeholders are essential for success.

Key sustainability/progress indicators and their monitoring

Measuring progress is vital. Ports track metrics like carbon intensity, air quality, waste recycling, and fuel use to gauge their environmental performance. Tools such as IoT sensors, satellite surveillance, and blockchain enable detailed, real-time

reporting. For pilot and tug operations, specific indicators cover emissions, efficiency, equipment use, and compliance.

Data collection and processing techniques

Modern ports rely on sensors, GPS, and crew input to gather data on emissions and efficiency. This information is carefully validated, standardized, and stored in secure cloud platforms, ensuring it meets both industry standards and privacy regulations.

Analytics and reporting for environmental responsibility

Advanced analytics help ports predict maintenance needs, forecast emissions, and identify risks. Real-time dashboards provide clear updates for regulators and stakeholders, while third-party certifications add credibility to reporting.

Conclusion

Sustainable maritime operations require both new technology and a shift in mindset. By democratizing data, anticipating environmental challenges, and tracking holistic progress, the industry can achieve a balance between economic growth, social responsibility, and environmental protection.

11.5. HEI 5: Interpretation and Use of Data in Operational Decision-Making

Introduction

The maritime industry is at a turning point, driven by the urgent need for environmental responsibility and operational efficiency. With digital transformation underway, ports and shipping companies are using data analysis more than ever to inform and improve decisions, helping them reduce emissions and meet increasingly strict regulations.

Data analysis and visualization for decision support

With more data available, maritime operations are becoming smarter. Ships and ports generate vast amounts of information—everything from cargo flows to engine conditions. By analyzing and visualizing this data, operators can spot trends, optimize routes, and make better decisions for both business and the environment. Research shows that using data to weigh environmental and operational priorities helps companies find the right balance between compliance and efficiency.

Application of Data in Daily Operations

Day-to-day, real-time data is helping the industry become more efficient and sustainable. Ships can adjust routes and speeds based on weather and engine performance, reducing fuel use and emissions. Ports use analytics to manage berths and monitor environmental compliance. These tools lead to real savings and help crews work more safely and sustainably.

Data-driven Risk Management

Modern risk management in shipping is all about being proactive. Thanks to real-time monitoring and prediction tools, companies can address issues like mechanical failures or bad weather before they cause trouble. Data also helps manage environmental risks and cybersecurity threats, making operations safer and more reliable.

Conclusion

Harnessing data is now essential for the maritime industry to thrive. Digital tools and analytics aren't just about numbers—they're about empowering people to make smarter decisions every day. By integrating these tools into daily operations and rewarding sustainable behavior, the industry can move closer to its environmental goals while supporting economic growth and social good. Data, at its best, isn't just information—it's a catalyst for real change.

As we sail toward IMO's 2050 net-zero goal, remember: the toughest currents to navigate are human habits. But with transparency, smart incentives, and technology GREENPORT is not just tracking metrics but charting a new course for maritime tradition.

11.6. HEI 6: Use of Simulation for Eco Navigation 1

Using simulation tools to estimate savings

Tugboats are central to safe ship movements in ports, but their powerful engines can lead to high fuel consumption and emissions. Modern bridge simulators now let operators test new tug deployment strategies under realistic port conditions. By experimenting with the number of tugs, timing, and maneuvers, crews can find the most energy-efficient ways to work—without sacrificing safety. Simulator-based training encourages better throttle control and smarter use of engine power, which studies suggest can save 10–20% of fuel per operation. These sessions also help crews reduce idle times and unnecessary repositioning, leading to less wear on engines and lower emissions. By linking simulator insights with port

planning systems and weather forecasts, ports can further streamline tug operations and energy use.

Utilizing simulation to train on energy efficient manoeuvring techniques

Organizations like the European Tugowners Association (ETA) and European Maritime Pilots Association (EMPA) are driving a new focus on teamwork, planning, and communication to make towage operations safer and greener. Today's crews use digital tools—IoT sensors, analytics, and simulators—to track movements, analyze fuel use, and learn best practices. Simulators give pilots and tug captains the space to practice energy-saving habits: keeping speeds low, reducing unnecessary movements, and making quick, informed decisions in tough scenarios. They get instant feedback on their performance, helping them refine their approach and see the real-world impact on fuel use and emissions. Scenario-based training also prepares crews for tough conditions—like congestion or bad weather—without raising operational risks.

Encouraging behavioural change through data-driven feedback

Beyond technology, real progress hinges on people. Simulator-based training is proving to be a powerful tool for shaping new, more sustainable habits in maritime crews. With realistic port scenarios and live feedback, operators can safely test out low-emission techniques and benchmark their skills against industry standards. Emerging research shows that crews trained on simulators are more likely to stick to emissions protocols and make smarter choices on the job. Notably, some ports have seen a 17% drop in harbor-side particulate matter thanks to these practices. In the bigger picture, reaching the IMO's 2050 targets means investing not just in cleaner equipment, but also in well-trained, data-savvy crews who can turn insights from simulation into lasting change.

This isn't about telling seasoned mariners how to do their jobs—it's about giving them new tools and perspectives to help them operate even more safely and sustainably, all while maintaining the high standards the industry expects.

11.7. HEI 7: Use of Simulation for Eco Navigation 2

Introduction

Ports today are busier and more complex than ever, so smart simulation tools have become essential for efficient planning and operations. By using digital models and real-time data, ports can improve safety, cut down costs, and boost sustainability.

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Port-specific digital modelling

Terminal simulation software and ship traffic simulators help identify bottlenecks, plan infrastructure, and manage daily operations more smoothly. Digital twins—virtual replicas of real ports updated with live data—have become especially valuable for instant monitoring and flexible problem-solving.

Using vessel momentum strategically

Understanding and managing a vessel's momentum can save fuel and reduce emissions. By planning maneuvers to use a ship's natural motion, crews can rely less on engines and tugboats, leading to more sustainable navigation.

Prioritizing safety in manoeuvring

Safety depends on careful risk assessment, clear communication, and ongoing crew training. Using modern navigation systems and staying alert to changing weather ensures safer operations without sacrificing efficiency.

Using elements to advantage

Simulator experiments, like those at Antwerp Maritime Academy, show how human behavior affects fuel use. By analyzing data from training sessions, ports can tailor education to encourage energy-saving habits, cutting costs and emissions.

Monitoring for overuse of tugs and ship's engine by pilot

Setting clear guidelines and using data tracking helps prevent unnecessary use of tugboats and engines. Regular reviews and feedback encourage crews to make smarter, more efficient choices.

Elements which a tug master can do better to save energy.

Tug masters can save energy by maintaining steady speeds, picking the right tug for the job, planning efficient routes, and keeping equipment well-maintained. Training and open communication further boost fuel-saving efforts.

Post-Operation pilot and tug master/s debrief.

After each operation, debriefing is key. Crew members discuss what went well, what could improve, and how to adapt best practices next time. This process strengthens teamwork and helps ports operate even more safely and sustainably.

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11.8. HEI 8: Security Procedures and Crisis Management in a Digitalized Environment

Introduction

The maritime world is changing rapidly, thanks to digital technology and the urgent need for cleaner, more efficient operations. Green ports and digital systems have become the backbone of progress, offering real-time tracking, smarter routes, and reduced fuel use. But with all these advances, cyber risks have increased. Ports and ships rely heavily on digital connections, which can be a double-edged sword when it comes to security and safety.

Security procedures for digitalized systems

New digital tools make monitoring ship operations easier and more efficient, but they also open the door to cyber threats. Older ship systems weren't built for cybersecurity, which leaves them exposed to attacks like ransomware and malware. The industry has responded by adopting international standards and guidelines, like those from the IMO and BIMCO, which stress the need for proper crew training, network protection, and step-by-step plans for detecting and responding to threats. The “defence in depth” approach—layering physical and digital protections—is key, and recent regulations now require ships and ports to have strong cybersecurity plans in place.

GNSS Spoofing, Jamming, and Cyber Threats in Navigation

Navigation systems are especially vulnerable in busy, interconnected port environments. Attacks that target vessel positioning, pilot communications, or tugboat controls can cause serious disruptions, from delays and groundings to environmental disasters. Because digital systems in ports are so closely linked, trouble in one area can quickly spread. The best defense is a mix of strong cyber protocols, backup communication systems, and well-trained crews who are ready to act if something goes wrong.

Crisis management and emergency response

Being ready for cyber incidents is crucial. Plans that cover detection, containment, and recovery help keep business running even when under attack. International guidelines recommend regular drills and clear procedures for reporting and responding to incidents. Technology like emergency response services can provide expert help remotely, but these systems themselves need to be protected against threats. Having manual backups and the ability to switch to offline operations can make all the difference during a major disruption.

Human factors and crew management

People remain at the heart of safety at sea, even as automation and digital systems grow. Crews need a mix of traditional maritime skills and new digital know-how. Training programs are evolving, teaching not just technical skills but also teamwork, adaptability, and leadership. As ships become more automated, the role of human operators is shifting, requiring constant learning and a focus on collaboration between people and machines.

Conclusion

Digitalization offers huge benefits to the maritime industry but also brings new risks that can't be ignored. The path forward is to build a culture where cybersecurity is as important as any other aspect of safety. This means ongoing investment in secure systems, strong crisis management, comprehensive training, and international cooperation. Only by working together and staying vigilant can the industry enjoy the rewards of digital transformation while keeping people, ships, and ports safe.

11.9. HEI 9: Intermediate Examination

11.10. HEI 10: Application of Biofuels and Alternative Propulsion Technologies

Introduction

The maritime sector faces growing pressure to reduce greenhouse gas emissions and meet new environmental standards like the IMO's net-zero goal for 2050 and the EU's Fit for 55 target. This has encouraged exploration of alternative fuels and propulsion systems—such as biofuels, hydrogen, ammonia, and hybrid-electric engines. Tugboats, thanks to their typical short-range operations, are especially suited for adopting these new technologies early.

Fuel Conversion Technologies and Biofuel Systems

Biofuels, made from renewable biological resources, include biodiesel, bio-LNG, and straight vegetable oil. Converting to these fuels is possible for many marine engines and can cut back on emissions like particulate matter and carbon monoxide. Hybrid propulsion, which pairs diesel engines with electric motors or batteries, can deliver substantial fuel savings—as seen in tugboats in Istanbul, where hybrid batteries reduced fuel use by over 70%. Methanol is also gaining popularity, since it's easy to store and works with existing systems.

FAME: Widely used biodiesel, often blended with marine diesel.

BTL: Synthetic fuel made from biomass using advanced processes.

HVO/HDRD: Renewable diesel compatible with regular engines, requiring no modifications.

Biofuels are important for meeting regulations like the CII and the EU's MRV. Certified biofuels with high emissions savings count toward lower emission scores, while uncertified fuels are judged like fossil fuels.

Adaptation of Operating Procedures for Alternative Fuels

Switching to alternative fuels means updating many operating practices—like bunkering, ventilation, and crew training—to keep things safe and efficient. International safety codes and training programs are being adjusted to help crews handle new fuels like methanol and hydrogen safely. Challenges include preventing microbial growth, managing lower temperature flow, and ensuring seals and hoses don't degrade with new fuel types.

Collaboration with Engine Manufacturers and Suppliers

Partnerships are key: ship operators, engine makers, and fuel suppliers are teaming up to create engines that run on both traditional and alternative fuels. New hybrid and electric tugboats are already reducing emissions and improving efficiency worldwide. Examples include the Carolyn Dorothy (USA), NYK Line's Sakigake (Japan), Hydrotug 1 (Belgium), and Svitzer's Methanol Hybrid Fuel Cell Tug (Sweden). Methanol-powered vessels, like the Methatug in Antwerp, show that these changes are practical and scalable.

Implementation of Eco-Friendly Propulsion Systems

Pioneering fleets, like GİSAŞ's electric tugboats, are setting new standards for zero-emission port operations. These battery-powered tugs are quiet, efficient, and can handle tough daily tasks without environmental harm. Smart energy management systems, like STEMS, optimize their power use and make fleet operations more efficient. Onshore power supplies (OPS) are also being considered to further cut emissions from tugs and pilot boats, helping ports stay ahead of stricter regulations and public expectations for sustainability.

11.11. HEI 11: Advanced Methods of Maintenance of Ship Systems and Equipment

Introduction

The maritime industry is embracing technology and innovation to make ship maintenance safer, smarter, and more sustainable. Traditional, reactive methods

are giving way to proactive strategies that boost reliability and efficiency while supporting environmental goals.

Maintenance and Calibration of Ship Engines and Systems

Routine and precise care of ship engines is essential for safety and smooth operations. Regular inspections, timely repairs, and advanced diagnostics help reduce unexpected failures and costly delays. Embracing digital tools for monitoring has become vital, as well-maintained engines directly impact emissions and overall efficiency.

Performance Monitoring and Use of Predictive Algorithms

Continuous monitoring of engine performance using sensors and data-driven insights allows ship operators to catch issues early, optimize maintenance, and comply with regulations. Tracking key indicators like fuel use, engine load, and emissions helps improve efficiency and avoid downtime.

Maintenance Documentation Management

Keeping organized and accurate maintenance records is crucial for compliance, safety, and effective decision-making. Digital management systems and standardized processes ensure that all maintenance, inspections, and repairs are logged, making it easier to track equipment health and meet regulatory requirements.

Predictive and Preventive Maintenance Techniques

The shift from fixing problems after they occur to predicting and preventing them marks a new era in ship maintenance. Predictive techniques use real-time data and analytics to foresee issues, while preventive strategies schedule regular check-ups, both reducing downtime and extending equipment life.

Use of Digital Tools for Maintenance Management

Modern tools like Computerized Maintenance Management Systems (CMMS), IoT sensors, and digital twins are revolutionizing ship upkeep. These technologies help plan, monitor, and document maintenance—streamlining operations, enhance decision-making, and ensure compliance with industry standards.

Life Cycle Management of Ship Equipment

Managing ship equipment responsibly throughout its lifespan—from purchase to disposal—ensures sustainability, regulatory compliance, and cost control. Best practices include thorough record-keeping, regular reviews, and using analytics to support smart procurement and maintenance decisions.

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Conclusion

Advanced maintenance methods, supported by digital innovation and a life cycle mindset, are essential for the future of maritime operations. These strategies help protect the environment, increase safety, and keep the industry competitive in a world of rising expectations and tighter regulations.

11.12. HEI 12: Reporting and Document Management According to ESG and Regulatory Requirements

Introduction

Today, companies face increasing pressure to meet ESG (Environmental, Social and Governance) compliance and regulatory reporting standards. The way organizations handle sustainability data has evolved quickly, with digital tools like automated reporting platforms and document management systems now essential for accurate and timely sustainability reports.

ESG (Environmental, Social, and Governance) standards and reporting requirements

Applying ESG principles has transformed corporate reporting. Now, companies must closely monitor, measure, and share their sustainability performance. Digital solutions help collect data and analyze results, making it possible to keep up with changing international and national regulations. Reliable documentation is key for transparency and meeting stakeholder expectations.

Management and archiving of compliance documentation.

Managing compliance documents well is crucial, and digital archiving systems make storage, retrieval, and audit preparation much easier. AI and blockchain technologies boost efficiency and reliability, while data retention policies and security protocols safeguard sensitive information. Having a well-organized digital archive helps with audits, regulatory checks, and maintaining an accurate record of sustainability efforts.

Preparation of reports for regulatory bodies

Preparing reports for regulators demands careful data management and strict quality controls. Successful organizations rely on automated workflows, digital formats, and detailed archiving to produce accurate and timely regulatory submissions. Teams must stay updated on reporting requirements and use technology to keep their reports consistent and compliant.

Conclusion

Moving towards digital, strategic ESG reporting brings many benefits, better compliance, stronger stakeholder trust, and smarter business decisions. Solid documentation and reporting systems are now essential for sustainable growth and maintaining transparency in operations.

11.13. HEI 13: Communication and Stakeholder Engagement

Introduction

Maritime transport and port operations play a central role in world trade. Today, these sectors are being transformed by the growing need for sustainability and digitalization, which means integrating green technologies and fostering collaboration between stakeholders—everyone from port authorities to local communities and technology partners. Digital platforms like Port Community Systems and blockchain are helping ports manage their operations more efficiently and with less environmental impact. However, success isn't just about technology—clear communication and effective organizational change are equally important.

Roles of various stakeholders in sustainable port operations

Port authorities are at the centre of port activities, guiding development, enforcing rules, and often financing projects, especially those focused on sustainability like shore power. Pilots, tug operators, shipowners, customs agencies, technology providers, and local communities all have key parts to play. For example, pilots and tugs make sure operations run safely and efficiently, while technology providers give ports the tools they need to modernize. Stakeholders can be grouped by their influence, proximity (from internal staff to outside NGOs), and type of interest—commercial, regulatory, or social. This approach helps everyone understand their role in building greener ports.

Behavioural change: The role of training, leadership, and peer influence

Modern ports must not only invest in new technologies but also inspire stakeholders to change how they work. Training programs, strong leadership, and positive peer influence are all essential for creating a culture of sustainability. Building trust, raising awareness, and improving skills are at the heart of this effort. Training can take many forms—higher education modules, vocational courses, workshops, or online learning. Leadership styles such as transformational or servant leadership are particularly effective for motivating stakeholders and

ensuring accountability. Peer mentorship and collaborative projects also help reinforce positive behaviours and keep everyone engaged in reaching sustainability goals.

Good planning of effective communication with all players involved

Clear, well-planned communication is the glue that holds complex port operations together. With so many variables, it's critical to coordinate towing, piloting, and berthing using reliable channels and real-time data. Change management is also about involving all stakeholders early, tailoring business cases for each group, and using feedback to improve. Regular analysis of performance and sharing best practices helps everyone stay on track. Digital tools like Port Community Systems, Just-In-Time platforms, and navigation aids (such as PortCDM and digital twins) are making coordination smoother, but human factors like transparency and collaboration remain vital.

Eliciting the required information for smooth operations

To keep ports running smoothly, it's crucial to gather the right information from all stakeholders. Structured interviews, surveys, focus groups, workshops, observational studies, and data analysis are all useful methods. Regular meetings and dedicated technology platforms make it easier to share updates and address concerns. These approaches help port authorities get the insights they need to optimize operations, solve problems, and strengthen relationships within the port community.

Clarifying the role of digital aids (e.g. PPU, VR)

Digital aids like Portable Pilot Units (PPUs) and Virtual Reality (VR) are changing the game in port operations. PPUs give maritime pilots real-time data for safer navigation, integrating weather, traffic, and other essential information. VR is being used for training, allowing personnel to practice scenarios in a safe, immersive way—everything from vessel arrivals to emergency responses. These tools help ports operate more safely and efficiently, and they're quickly becoming standard in the industry.

Conclusion

Effective communication, smart change management, and the integration of new digital tools are all key to achieving sustainability in ports. Digital platforms for data sharing and planning (like PortCDM and arrival systems) help cut emissions, reduce delays, and boost efficiency. Success depends on involving all relevant stakeholders, adapting to new technologies, and fostering a culture of continuous improvement. Case studies like the Long Beach and Port of Los Angeles show how

strategic use of digital tools can deliver real-world sustainability gains—and highlight the importance of planning ahead for future regulations.

11.14. HEI 14: Development and Implementation of Sustainable Port and Shipping Strategies

Introduction

Within the European Union, the Green Deal pushes for a dramatic cut in transport emissions—by 55% by 2030 and net-zero by 2050. For ports, this means not just adopting new technologies, but also embracing comprehensive strategies that involve planning, boosting efficiency, measuring impact, and investing in innovation. These changes don't happen overnight—they require teamwork across industry, academia, and government, and a fresh approach to education and human behavior.

Planning and implementation of sustainability strategies

Sustainability planning starts with understanding environmental, social, and economic impacts. It's vital to bring together port authorities, shipping companies, local communities, and regulators so everyone's goals are aligned. Setting up a framework—using international standards like ISO 14001 or the UN SDGs—and creating a clear roadmap helps. This means defining practical targets, such as lowering carbon emissions or improving waste management, and weaving these goals into everyday operations. Regulatory analysis is key, ensuring compliance with international and EU rules, and often unlocking funding or incentives for innovation. The process follows phases: first, set a vision and master plan, then move onto detailed technical and financial planning, implement actual projects, and finally, review and adjust based on results and changing technologies.

Operational efficiency in ports and optimizing port logistics

Ports can become more efficient by digitizing and automating their core activities—vessel tracking, scheduling, inventory management, and logistics. Smart systems that monitor real-time data reduce delays and help cut emissions. Even services like tugboats and pilot boats, which aren't always included in official emission targets, play a big role in local air quality. Strategies like slow steaming (optimizing speed and routes) and standardized procedures help save fuel. Collaborating closely with technology providers and using funding opportunities makes these improvements feasible and worthwhile.

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Measuring impact and continuous improvement

Tracking progress in sustainability requires using key performance indicators (KPIs) across economic, environmental, social, and governance dimensions. Environmental KPIs measure things like emissions and fuel consumption, while social ones might track safety incidents and air quality for local communities. Digital platforms now allow teams to monitor and report on these metrics in real time, speeding up decision-making. Regular audits and benchmarking against leading ports help identify areas for improvement, making sure strategies stay effective as circumstances evolve.

The role of innovation and new technologies in port development

Innovation is at the heart of port transformation. Technologies like shore power, electric vehicles, alternative fuels, IoT, automation, and digital twins are making operations cleaner and more efficient. Digital twins, for example, let ports simulate scenarios and predict maintenance needs, reducing downtime and costs. IoT and AI optimize truck movements to cut waiting times and lower emissions. Cleaner energy sources, such as hydrogen and renewables, are being piloted in major ports, showing promising results. Adopting these new solutions requires both investment and a willingness to change how people work.

Conclusion

Making ports more sustainable means more than just new tech—it requires a shift in culture, mindset, and daily habits. Effective change management is essential: anticipate resistance, communicate clearly, engage stakeholders, and provide training. When employees understand and support these changes, ports are better positioned to meet future regulations and industry demands. The real engine of sustainable transformation isn't just technology—it's people, working together towards a cleaner, more resilient future.

12. How Can Trainers Use the Vocational Education Learning Path?

Greenport has developed a dedicated learning path for Vocational Education and Training (VET), designed to translate sustainability concepts directly into the daily routines of maritime professionals. As a trainer, you can use this structured path as it is, or adapt it to the specific needs of your learners, workplace contexts, and local regulations. It serves as a flexible tool, giving you both a ready-made framework and the freedom to tailor the content.

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The VET learning path builds on practical insights from pilots, tugboat crews, harbourmasters, and other port professionals, ensuring that the material is grounded in authentic maritime practice. It equips participants with the most up-to-date knowledge of environmental regulations, technological innovations, and operational standards—without losing sight of safety as the industry's core priority.

The modules emphasise hands-on learning closely linked to routine tasks. Practical examples and case-based exercises help learners immediately connect sustainability principles to their day-to-day responsibilities. This approach strengthens not only their technical competence but also their confidence in applying sustainable practices under real operational conditions.

The course is designed as a living tool, evolving in close collaboration with industry partners to keep pace with shifting regulations and emerging challenges. Learners are encouraged to share experiences, reflect on best practices, and build a collective understanding that combines theory with practice. Trainers will find that the course provides:

- Clear overviews of regulatory requirements and their practical implications.
- Activities that encourage reflection and peer-to-peer exchange.
- Practical case studies that bridge knowledge and action.
- A framework to promote continuous professional development.

Ultimately, this VET learning path is not just about compliance or certification. It is a proactive resource that empowers trainers to guide maritime professionals toward excellence, safety, and leadership in a sector where sustainability and adaptability are becoming indispensable.

12.1. VET 1: Introduction to Sustainable Maritime Operations

Scope of the training program

The Sustainable Maritime Operations and Green Port Technologies program is designed for pilots, tug masters, and port service operators. Its goal is to give participants the knowledge, tools, and strategies to reduce emissions and improve efficiency, while keeping the highest standards of navigational safety. Delivered under the GREENPORT Project, it combines classroom theory, real case studies, and simulator practice to show how small operational changes can lead to big environmental and cost benefits.

Safety of navigation and ship handling is paramount.

Sustainability must never come at the expense of safety. Safe navigation remains the primary responsibility of pilots, tug masters, and port service teams. Environmental measures should support—not conflict with—safety. For example, reducing engine RPM saves fuel but only when full control is assured; planning with tides reduces fuel use but must be coordinated with traffic; efficient tug deployment lowers idling but safety margins must always be preserved. A sustainable operation is, above all, a safe operation.

Why sustainability matters in port services.

Ports and shipping face increasing pressure to cut emissions. Even though most service vessels are not yet directly regulated by IMO or EU rules, their operations affect the overall environmental footprint of port calls. Small decision-like approach speeds or idle time—can significantly reduce fuel use and emissions. Shipowners and clients prefer eco-efficient partners, meaning sustainable practices also create a competitive advantage in a low-carbon market.

Behavioural change for sustainability – The COM-B Framework

Lasting change requires more than new technology; it requires new behaviour. The COM-B model shows that behaviour changes when three elements come together:

Capability – skills and knowledge to act efficiently.

Opportunity – access to tools, systems, and data.

Motivation – awareness of environmental impact and client expectations.

When these align, small daily actions can deliver meaningful emission reductions.

Looking ahead

This introduction sets the stage for why sustainable maritime operations matter and how behavioural change complements technology and regulation. Next, the programme will explore energy-saving principles and the regulatory frameworks that are already shaping client demands and future standards.

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12.2. VET 2: Fostering understanding of emission reduction theory and regulations

Energy Saving and Emission Reduction in Port Service Operations: A Practical Overview

As the global maritime industry faces increasing scrutiny over its environmental impact, the need for ports and service providers to reduce emissions has never been more pressing. Maritime transport accounts for an estimated 2–3% of worldwide greenhouse gas emissions, contributing not only to climate change but also to local air and water pollution that affects the health and well-being of communities living near busy ports. With the world moving steadily toward stricter regulations and with clients raising the bar for environmental accountability, the ability of a port or service provider to demonstrate low-emission operations is quickly becoming essential for business survival.

Key Theories and Practical Approaches

Operators in this sector are now expected to make informed decisions that not only improve fuel efficiency but also minimize environmental impacts while maintaining the highest standards of safety and reliability. Achieving this balance requires an integrated approach—one that combines technical solutions, operational changes, and a deep awareness of evolving client demands.

Operational Behaviour: Small Changes, Big Impact

One of the most effective ways to reduce emissions in port operations lies in daily operational behaviour. The cumulative effect of small, consistent adjustments can be substantial. For instance, reducing tug engines idling between assignments not only saves fuel but also cuts down on unnecessary emissions. Optimizing vessel speed during approaches to the port, planning manoeuvres with the help of tides and currents, and maintaining tight coordination with the bridge team to avoid unnecessary repositioning are all examples of how small tweaks can lead to significant improvements in overall environmental performance.

Life Cycle Thinking: Sustainable Choices at Every Stage

Another cornerstone of sustainable port operations is life cycle thinking. Rather than focusing solely on the immediate performance of equipment and processes, operators are encouraged to consider the total environmental impact from acquisition to disposal. This means opting for hybrid or electric propulsion systems when commissioning new tugs, sourcing equipment that is both energy-efficient and low-maintenance and using recyclable or renewable materials whenever possible. Proactive maintenance not only extends the lifespan of equipment but

also reduces waste and the need for resource-intensive replacements. By making sustainability a priority at every stage of the asset's life, ports can achieve meaningful reductions in their overall environmental footprint.

Adapting to Client Expectations and Future-Proofing the Business

Client expectations in the maritime world are evolving at a pace that matches, and occasionally even outpaces, regulatory change. Shipping companies, charterers, and cargo owners are now placing greater emphasis on selecting partners who can demonstrate a genuine commitment to low-emission operations, operational efficiency, and the adoption of alternative fuel technologies. This shift means that port service providers must not only comply with existing requirements—but also anticipate what will be expected in the future in order to remain relevant and competitive.

Future-proofing operations involve being prepared for the challenges and opportunities that lie ahead. For pilots, tug masters, and port operators, this translates into adopting eco-handling techniques, supporting just-in-time vessel arrivals to minimize unnecessary waiting and idling, upgrading fleets to hybrid or electric craft, and maintaining up-to-date knowledge of protocols for handling alternative fuels. Those who embrace these changes early will be better positioned to secure long-term partnerships, meet or exceed client expectations, and lead the way in sustainable port operations.

Building Partnerships and Investing in People

To truly excel in this new landscape, port service providers must also focus on building strong relationships with clients, suppliers, and local communities. Securing business is no longer just about price or speed; environmental performance is now a key differentiator. Investing in the training and development of personnel ensures that teams have the skills and awareness needed to implement best practices and adapt to emerging technologies and regulatory requirements.

Addressing Emerging Environmental Challenges

While much progress is being made, new challenges continue to emerge. For example, the use of exhaust gas cleaning systems—commonly known as scrubbers—has raised concerns due to the discharge of wash water containing toxic substances into port waters. Such discharges can harm marine life and degrade water quality, offsetting the benefits of reduced air emissions. Similarly, the deployment of ShaPoli systems in pilotage operations has created operational complexities and potential environmental issues that require careful attention and

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management. Tackling these challenges head-on, through transparent reporting and the adoption of best available technologies, will be essential for maintaining the trust of stakeholders and delivering on environmental commitments.

Conclusion

In summary, the journey toward lower emissions and sustainable port operations is both necessary and achievable. By making thoughtful choices at every level, operational, technical, and strategic—ports and service providers can reduce their environmental impact, meet the rising expectations of clients, and secure their place in the future of the maritime industry. The path forward will require ongoing commitment, collaboration, and innovation, but the rewards—in business resilience, community well-being, and a healthier planet—are well worth the effort.

12.3. VET 3: Industry ecosystem and technological landscape

The port industry is going through one of the most significant transitions in its history. Decarbonization targets, the introduction of alternative fuels, and the rise of digital technologies are reshaping how ships are moved, assisted, and made safe within ports. For pilots and tug masters, these changes are not abstract policies; they are daily operational realities. The way you maneuver vessels, interact with shore teams, and respond to risks is already evolving—and will continue to do so in the years ahead.

Port requirements – Onshore Power Supply (OPS)

One of the clearest examples is the growing use of **Onshore Power Supply (OPS)**. Connecting a vessel to shore power requires it to berth with much higher precision than before. A small deviation in position can make the connection process more time-consuming or even impossible. For pilots, this means planning approaches and departures with new levels of accuracy and coordination with tugs. For tug masters, it requires steady hold techniques and constant communication to keep the vessel exactly where it needs to be. From 2030, OPS will be mandatory for many ships in European ports, meaning that “connection-ready” arrivals will soon become the norm.

Trends in shipping – alternative fuel vessels (LNG, methanol, ammonia)

Another major shift is the **entry of alternative fuels** such as LNG, methanol, and ammonia. Each of these fuels behaves differently, not only in terms of energy efficiency but also in safety risks and operational restrictions. For example, LNG introduces cryogenic hazards, methanol has toxic and flammable properties, and

ammonia poses strong health and environmental risks. As a pilot, you must understand how these fuels may change a ship's handling or limit maneuvering zones within a port. As a tug master, you must adjust your positioning strategies to minimize crew exposure and ensure safe assistance during berthing or unberthing. Knowing the implications of each fuel type is essential for reducing risks and maintaining smooth operations.

Use of ShaPoli systems on client vessels

Alongside new fuels, **digitalization** is becoming a standard part of the maritime workplace. Shaft Power Limitation (ShaPoli) systems restrict propulsion power to reduce emissions, and emissions monitoring tools now track performance in real time. These tools will directly affect how you plan and execute maneuvers. Instead of relying only on experience, you may need to work with data-driven indicators, adjusting tug allocations, approach speeds, or berth scheduling based on information shared across the port community. This shift towards transparency and data-based decision-making requires an open attitude and stronger collaboration with terminal operators, authorities, and other stakeholders.

Operational implications

Meanwhile, the **service craft operating is also evolving**. Some tugboats and pilot vessels are transitioning from traditional fuels to greener alternatives such as HVO, hybrid propulsion, hydrogen dual-fuel, or even full-electric systems. These vessels bring environmental benefits but also operational challenges. Charging and bunkering infrastructure may be limited, fuel costs remain higher, and crew members must learn new safety and handling procedures. For tug masters and pilots alike, understanding these technical differences is key to ensuring efficiency while also maintaining safety and reliability in port operations.

Behavioural change aspect

All these changes underline a simple but important point: adapting to the future of port operations requires more than new technical knowledge. It also calls for **behavioral change**. As a professional, you will need to strengthen communication with colleagues and shore teams, remain flexible in adopting new maneuvering practices, and stay open to using digital tools as part of your everyday decision-making. By doing so, you not only comply with new regulations but also contribute to safer, more efficient, and more environmentally responsible ports.

In short, the future of pilotage and towage is already here. OPS, alternative fuels, digitalization, and greener service craft are shaping the way you work today—and will continue to do so tomorrow. By understanding these trends, adapting your

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practices, and embracing new ways of working, you can ensure that port operations remain both safe and sustainable in the years to come.

12.4. VET 4: Operational Strategies for Energy Saving and Emission Reduction

Operational efficiency and emissions reduction are now essential in maritime operations due to regulatory, environmental, and commercial pressures. Pilots, tug masters, terminal planners, and port authorities must rethink standard practices to achieve these goals without sacrificing safety or reliability. While alternative fuels and vessel designs play a role, operational strategies often provide the fastest results using existing resources and effective collaboration.

Techniques Using Existing Resources

Efficiency can be improved by optimizing vessel speeds, adjusting tug deployment, scheduling movements with favourable tides, and using real-time fuel and emissions data. Examples from major ports show that small operational adjustments—like avoiding “rush and wait” or aligning arrival times—reduce fuel waste and emissions. Behavioural changes, including better communication and post-job debriefs, further reinforce efficient habits.

Eco-Speed Steaming: Benefits and Implementation

Eco-speed steaming means operating at the lowest safe speed, especially during port approaches. Reducing speed by even 10% can significantly cut fuel use and emissions, as seen in real-world programs in Los Angeles, Rotterdam, and Gothenburg. Key steps include pre-arrival planning, coordinated tug and pilot vessel movements, and real-time speed and ETA monitoring. All stakeholders—from pilots to VTS—benefit through improved safety, lower costs, and reduced congestion.

Scheduling with Tidal Windows

Scheduling ship movements to align with favourable tides minimizes engine load and tug assistance needs, saving fuel and emissions. Ports like London and Gothenburg have documented significant savings by timing operations with tidal currents. Implementation requires analyzing tide data, incorporating it into planning, and collaborating across all stakeholders.

Real-Time Fuel Consumption Visualisation

Displaying live fuel use data to operators enables proactive decision-making and immediate adjustments, improving efficiency. Trials in Los Angeles and

Gothenburg show fuel consumption drops after crews receive real-time feedback. Success depends on installing proper monitoring equipment, training crews, and integrating data into performance reviews.

Encouraging Behavioural Change Through Data-Driven Feedback

Behavioral change is critical—technology and data only lead to savings if operators use them to adapt habits. Providing timely, relevant feedback (like post-job reports or efficiency dashboards) motivates continued improvement. Recognizing and sharing high performers further supports a culture of efficiency.

Tug Energy Saving, Before and After a Job

Most tug fuel use occurs during active assistance but optimizing pre- and post-job actions also matters. Synchronizing departures, minimizing idle time, and using eco-modes when possible, can yield additional savings. Case studies from Rotterdam and Antwerp-Bruges highlight benefits such as reduced idle time and lower overall fuel consumption.

In summary, implementing operational measures, fostering behavioural change, and leveraging real-time data are practical ways to achieve substantial energy savings and emission reductions in port operations—delivering environmental and economic benefits while maintaining safety and reliability.

12.5. VET 5: Communication and Stakeholder Engagement

Effective Communication in Port Operations

Strong, timely communication among all port stakeholders—like pilots, tugs, VTS, terminal staff, and ship crews—is vital for smooth, fuel-efficient, and environmentally responsible operations. Using the right channels, sharing updates at key moments, and confirming understanding all help avoid costly mistakes and wasted resources.

Stakeholder Roles and Responsibilities

Each group has its unique set of duties, but true efficiency and sustainability come from everyone working together. Clear division of responsibilities (who does what, who needs to know) ensures nothing slips through the cracks.

Behavioural Change for Sustainability

Changing operating habits is just as important as new technology. Training, good leadership, and learning from peers all help build a culture where fuel-saving and

eco-friendly decisions become the norm. Real-world practice, from simulators to on-the-job mentoring, makes sustainable behaviours stick.

Smart Communication Planning

It's not just about talking—it's about making sure the right people get the right information at the right time. Careful planning, closed-loop communication, and choosing the best channel for the message all keep operations running smoothly.

Getting the Information You Really Need

Finding out exactly what's required—like berth readiness, tug timing, and weather—at just the right moment helps avoid delays, excess fuel burn, and safety risks. Using checklists, confirming details, and having regular update checkpoints keeps everyone on the same page.

Practicing Communication with Simulations

Simulated exercises, whether on a screen or in real time, help teams practice clear communication, quick thinking, and efficient coordination. These drills reinforce good habits and highlight areas for improvement, all without real-world consequences.

Digital Tools: Benefits and Risks

Digital aids like Portable Pilot Units, VR training, and real-time data platforms make operations safer and more efficient—when used wisely. They bring clearer situational awareness and faster coordination, but must be supported by manual skills, backup systems, and strong cybersecurity. Over-reliance or technical failures can pose risks, so cross-checking and ongoing training are vital.

Safe Use of Digital Aids

To get the best from digital tools, always compare data from multiple sources, keep manual navigation skills sharp, have backup procedures ready, and follow robust cybersecurity practices. Operators need to regularly review and update their use of technology as conditions and threats evolve.

12.6. VET 6: Recap and Reflections

Introduction

This recap pulls together the most important points from the first five modules, highlighting how rules, technology, teamwork, and behavior all connect to support safer, greener port operations**.**

Emission reduction theory & regulations

Big changes in maritime sustainability are driven by international laws and industry trends—even if port service vessels aren't always directly regulated. Knowing about emission-cutting measures and new technologies helps port teams keep up with decarbonization efforts**.**

Industry ecosystem & technology landscape

The maritime world is changing fast, thanks to new fuels, smart systems, and urgent climate goals. While innovation like electric tugs or onshore power supply brings new options, real progress also depends on shifting daily habits and tackling challenges like cost and infrastructure.

Operational strategies for energy saving

Smarter operations can save fuel and cut emissions without expensive upgrades. Simple tactics—like adjusting speed, timing maneuvers with the tides, tracking fuel use, and better scheduling—make a difference in everyday work.

Stakeholder engagement & communication

Sustainability is a team effort. Pilots, tug crews, terminal staff, and shipowners all need to work together, using digital tools wisely but also relying on strong leadership and clear communication. Tech helps, but good judgement and cooperation matter most.

Reflection & Discussion questions

Which strategies could be applied in your port?

What challenges might you face, and how could you overcome them?

How do you balance safety with efficiency and sustainability?

How can individual leadership accelerate change?

Which practices from other ports might work locally?

12.7. VET 7: Eco Navigation

This module introduces pilots and tug master's to eco-navigation, emphasizing how operational choices affect safety, fuel efficiency, and emissions during port approaches and berthing.

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Navigation scenario

The simulation aims to identify energy-efficient ship-handling behaviours using real-life conditions like wind, tide, and tug assistance. Trainees compare inefficient and best-practice manoeuvring to see how small changes can reduce fuel use and emissions without compromising safety.

Navigation scenario objectives:

- Identify environmental best practices during port approach
- Evaluate fuel and emission impacts of different manoeuvring styles
- Apply sustainable navigation principles
- Reflect on real-world decision impacts

Best-practice focuses on steady RPM, advance planning, early tug coordination, and smart use of environmental forces. Data on engine use, fuel, emissions, and docking time are collected for comparison.

Instructors' guidelines

Trainees complete two scenarios: one without best practices and one applying them. They plan, execute, and monitor all stages, keeping thorough records and referencing sustainability throughout.

Bridge Procedures Guide

Trainees follow four stages for safe passage:

- Appraisal
- Planning
- Execution
- Monitoring

They gather route, port, environmental, and ship details to support safe and efficient navigation.

Exercise procedure

Trainees use scenario data to prepare their pilotage plans and monitor fuel use, emissions, and docking time. Assessment focuses on planning quality, practical execution, teamwork, record keeping, and reflection.

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Focus areas during simulation

Key areas include effective use of technology, momentum management, safety, optimized tug use, and clear communication.

Case study

A case study explains how engine RPM affects fuel efficiency and emissions. Operating within the optimal RPM range (1000–1200 RPM) maximizes efficiency and reduces emissions. Data tables show how different engine loads impact fuel and CO_2 output, highlighting the value of eco-navigation in achieving sustainability goals.

12.8. VET 8: Final Reflections and Course Wrap-Up

The purpose of this final session is to consolidate the knowledge gained throughout the course, encouraging participants to reflect on the insights drawn from the simulation exercises. It aims to connect the theoretical foundations of sustainable maritime operations with their practical application in real-world port environments. Finally, the session provides an opportunity to define concrete next steps for implementing eco-navigation, ship handling principles, and sustainability practices in daily operations.

1. Group discussion on simulation insights

- The simulation session prompts participants to reflect on using natural elements, effective communication, and sustainable ship handling for operational efficiency and safety.
- Group activities encourage sharing lessons learned and connecting practical insights with theoretical foundations from earlier sessions.

2. Consolidation of learning outcomes

The course demonstrates that sustainable port operations are achieved through a blend of technology, behaviour, and collaboration. Key points covered include the importance of safety, evolving regulations, innovative technologies, practical operational strategies, stakeholder cooperation, and the positive results of simulation exercises. Small operational changes, when widely adopted, can collectively drive significant improvements in fuel efficiency, emissions reduction, and teamwork.

3. Feedback and next steps

Participants are encouraged to reflect on how course concepts apply to their own operations, identify which sustainable practices to adopt, and consider barriers such as infrastructure and culture. The importance of leadership, teamwork, and communication among port stakeholders is highlighted, alongside the complementary roles of technology and human judgement. Small individual actions can collectively drive significant progress toward decarbonization targets, emphasizing that sustainable maritime operations require both informed decisions and collaborative effort.

13. Using Simulators to Trigger Behavioural Change?

Simulators offer a safe and controlled environment to explore how human decisions impact fuel use (how much is used) and efficient fuel use (how much is done with that fuel). In a typical exercise, participants are asked to navigate and perform manoeuvres—such as mooring a tugboat in a port area—not simply to complete the task, but to expose how variations in behaviour (e.g., speed, rudder use, engine control) result in measurable differences in energy consumption.

By designing scenarios in which behavioural choices directly influence outcomes, trainers can prompt participants to reflect on more energy-efficient alternatives. These simulations are particularly valuable because they make the impact of operational decisions tangible. Thanks to the immersive nature of the environment, participants not only see the consequences of their actions—they also feel how different decisions might have improved performance.

Simulators allow trainers to directly observe participant behaviour in the wheelhouse—how controls are used, how decisions are made, and how communication is managed. When the simulator records ship parameters over time, these logs provide a rich dataset for post-exercise analysis. Trainers can use this data to compare energy consumption across participants, identify inefficient actions, and highlight best practices.

In the following sections, we describe how to set up simulator experiments using a concrete example and offer guidance on assessing outcomes, both quantitatively and qualitatively. Trainers may choose to replicate the example in their own simulator or use it as inspiration to create a similar scenario tailored to their available equipment and learning objectives. They can choose to use the simulator as a demonstration in a more theoretical course or use it as their main instrument to train crew.

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In the sections that follow, we explain how to set up such simulator experiments through the help of an example and explore different ways to assess outcomes, both quantitatively and qualitatively. The trainer can use the example in his simulator or use the example as inspiration to build his own exercise.

13.1. What Model Scenarios Can We Use with Simulators?

The goal of this exercise is to deliver a short, high-impact simulator experience—lasting around 20 minutes—so that multiple participants can complete it within a single training day. Trainers are free to adapt the ship type or port environment to match their available simulator setup, as long as the operational scenario remains identical for all participants. This ensures that observed differences in performance are due to human behaviour rather than variations in scenario difficulty.

To obtain authentic behaviour, it is advisable not to inform participants beforehand that the focus of the exercise is on fuel consumption. This encourages them to act naturally, relying on their established routines and habits—making the exercise more revealing in terms of behavioural variation. However, in practice, this can be difficult to achieve, especially when the simulator session takes place within a course that is clearly focused on energy efficiency. In such cases, participants may already anticipate that their performance is being evaluated from a sustainability perspective. While this awareness may influence behaviour, it also creates an opportunity: trainers can contrast how participants perform under normal assumptions versus how they adapt when they know efficiency matters. Both perspectives offer valuable insights into mindset, habits, and readiness for change.

In the provided example, participants are tasked with navigating a tugboat from an offshore starting point to the ferry terminal in the Port of Bodø, Norway, and mooring portside against the quay. The vessel begins the exercise already underway, with engines operating at half power and a moderate forward speed. During the passage, participants encounter crossing traffic and must independently decide how to manage interactions—adjusting timing, speed, and safe distances. Bodø was selected because it is available in the Kongsberg simulator used during course preparation and was unfamiliar to all test participants. This lack of prior knowledge ensures a level playing field and avoids bias from local familiarity. If Bodø is not available, trainers are encouraged to choose a port with comparable navigational complexity and traffic conditions to maintain the integrity of the scenario.

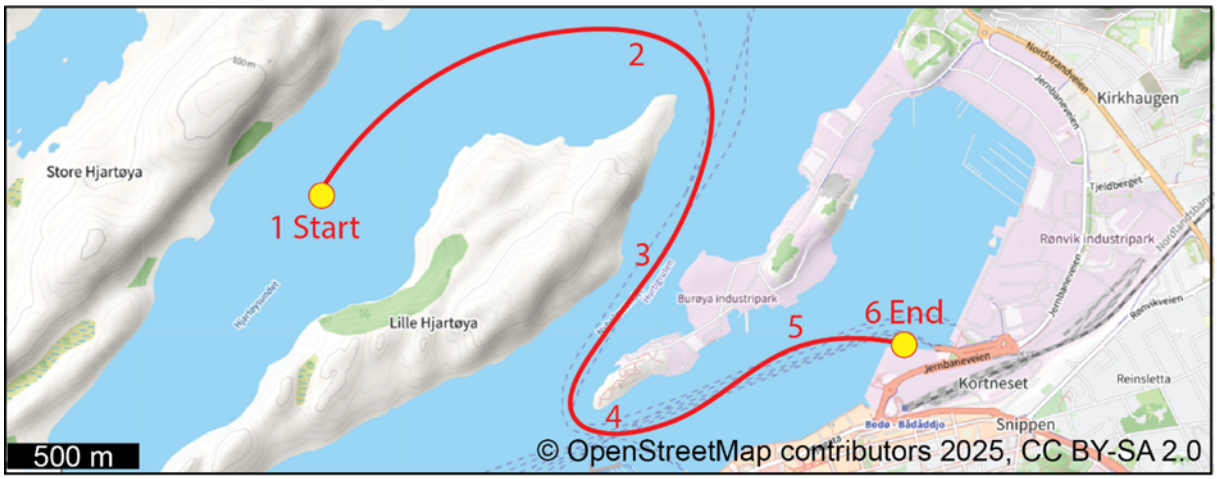

Figure 4: Schematic overview of the voyage to be performed

The selected vessel is the “Smit Panama,” listed in the Kongsberg simulator used during the preparation of this course as “TUG12.” This compact and responsive tugboat is particularly well-suited for exercises requiring precise manoeuvring. Equipped with two propellers and two rudders with standard rotation, it can be operated by all maritime personnel without requiring specialised handling skills. If the “Smit Panama” is not available, trainers may substitute a comparable tugboat—provided the same vessel is used across all sessions to ensure consistent conditions and enable meaningful comparisons between participants.

A key educational feature of the simulator exercise is the structured division of roles: one participant assumes the role of the commander (captain), while the other acts as the helmsman. This setup allows the trainer to observe not just the outcomes of decisions, but also the underlying reasoning and communication processes that shape operational behaviour.

The commander holds full responsibility for navigation and must guide the vessel using both visual cues and available instruments. Crucially, the commander is not allowed to operate the controls directly but must issue clear and concise verbal orders regarding engine and rudder actions. This dependency creates a situation where effective communication becomes essential. The trainer can thus assess how clearly the commander articulates instructions and how logically decisions are made under pressure.

The helmsman is tasked exclusively with executing the commands given. All orders must be repeated back to the commander to confirm understanding, but the helmsman is not permitted to offer input on navigation or manoeuvring decisions. The focus is entirely on precise, disciplined execution.

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This structured interaction highlights the critical role of teamwork in fuel efficiency. Well-coordinated crews typically avoid oversteering, excessive corrections, and reactive adjustments—factors that contribute to unnecessary energy use. By simulating real-world command dynamics in a controlled setting, this exercise reveals how communication quality and task delegation directly influence sustainable operations.

13.2. How to Assess Progress ?

After the simulator exercise, a meaningful assessment can be conducted to analyse how human behaviour influences fuel consumption and operational efficiency. Two primary indicators can be used to quantify energy performance: (1) the total amount of energy consumed during the task, and (2) the degree to which fuel was used efficiently to achieve the operational goal. This includes examining whether participants took unnecessarily long routes, made excessive course corrections, or misused engine power—all of which impact fuel efficiency.

The first evaluation method is a threshold-based evaluation, which compares actual performance against predefined standards—such as fuel consumption per hour in different ship states (e.g., idle, towing, or free sailing). These thresholds serve as clear benchmarks, categorising outcomes into "acceptable" and "unacceptable" zones. To encourage continuous improvement, the thresholds can be progressively tightened as crew skills develop or as environmental standards evolve. The distance between a participant's measured performance and the established threshold provides a quantitative indication of how much improvement is still needed. This method gives both trainers and learners a concrete reference point to evaluate progress, while also reinforcing the importance of meeting objective environmental targets. It clearly shows whether the crew's current behaviour aligns with good practices—or how far they still are from that goal.

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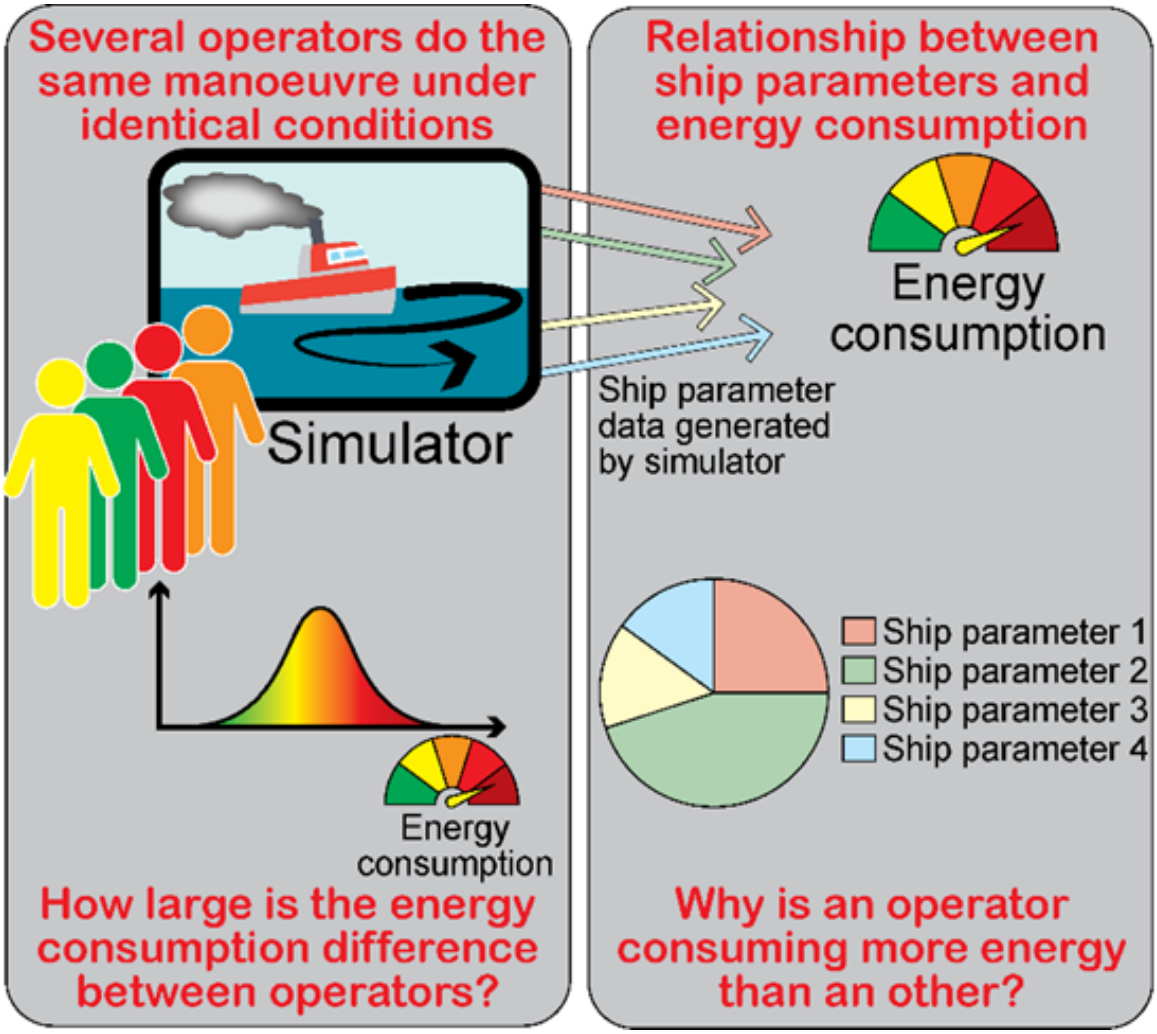

Figure 5: Overview of experiment and processing of simulator data.

While the first method focuses on reducing absolute emissions and meeting predefined thresholds, the second approach emphasises the efficiency with which fuel is used—in other words, achieving more with the same amount of energy. Unlike threshold-based assessment, this method does not rely on a fixed benchmark for what constitutes “acceptable” fuel use. Instead, it is rooted in the principle of continuous improvement, using "betterness" as a relative measure of progress. Participants are evaluated on their ability to improve over time—whether by reducing energy consumption or enhancing manoeuvring precision across repeated simulation exercises. Key indicators may include the absence of fuel consumption peaks, fuel usage per nautical mile, or maintaining smoother navigation paths that avoid unnecessary corrections or wasteful engine commands. This approach is especially relevant in training environments that aim to foster behavioural change, rather than enforce compliance. By valuing

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incremental progress, this method aligns with the ALARA principle ("As Low As Reasonably Achievable"), recognising that even small improvements reflect a growing awareness and commitment to energy-efficient operations. It encourages learners to adopt a mindset of ongoing optimisation—developing skills that are critical for sustainable ship handling.

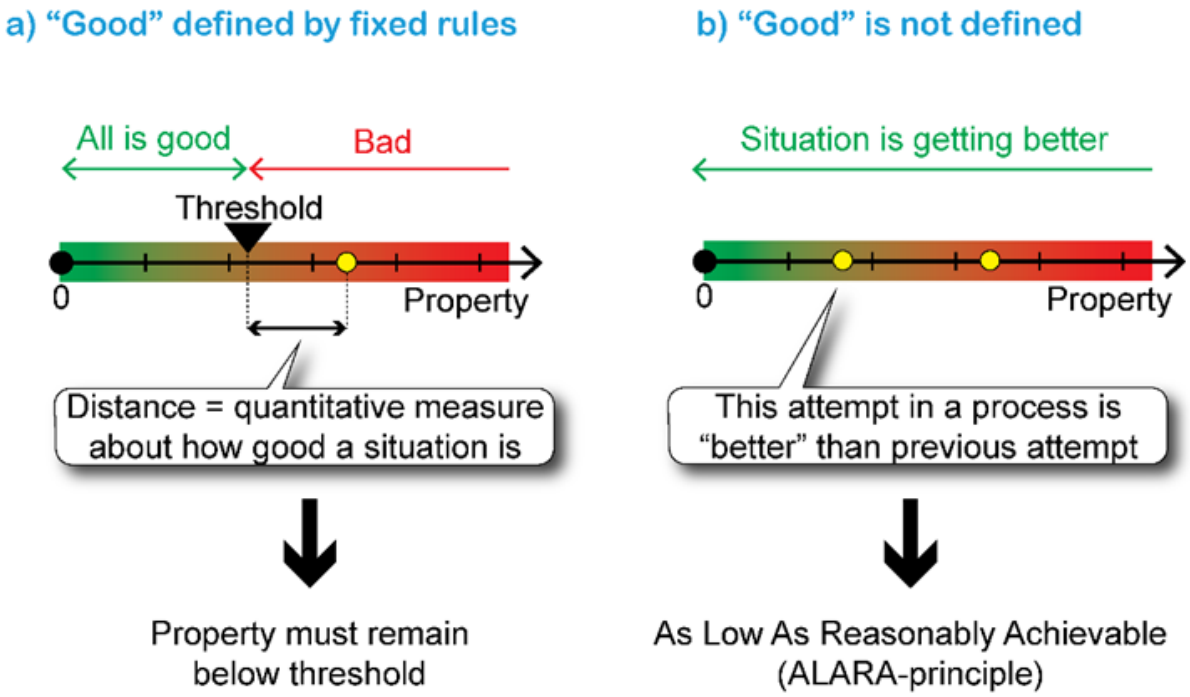

Figure 6: Two approaches to defining "good" in ecological footprint assessment. (a) A compliance-based approach, where fixed thresholds set by legislation distinguish acceptable from unacceptable performance. (b) A process-based approach, where no absolute thresholds apply.

13.3. Efficient Use on Board Tugboats

The GREENPORT methodology is built around the continuous optimisation of a ship's input–output energy balance during real operations, such as towing, navigating, or manoeuvring. Rather than requiring radical change, this approach focuses on small, systematic adjustments in behaviour and routine decision-making to gradually improve fuel efficiency.

The goal is to minimise avoidable inputs—like excessive fuel consumption, inefficient commands, or suboptimal maintenance—while maximising useful outputs, such as delivered propulsion, precise navigation, and the effective completion of operational tasks. Crucially, this optimisation happens while the

vessel is actively performing its duties, ensuring that energy savings are achieved without compromising the task.

In practice, this means tugboat operators refine how they steer, manage throttle settings, and coordinate actions during realistic scenarios like harbour towing or docking. These subtle refinements—such as avoiding sudden accelerations, reducing oversteering, or timing commands more precisely—lead to incremental energy gains that accumulate over time.

Maintenance practices and intelligent upgrades to onboard systems also contribute to overall efficiency, but human decisions at sea remain central. While weather and sea conditions can't be controlled, optimising the aspects that are within human and technical influence ensures continuous progress. Step-by-step, these changes help vessels reduce their environmental impact and fuel costs—not by working less, but by working smarter.

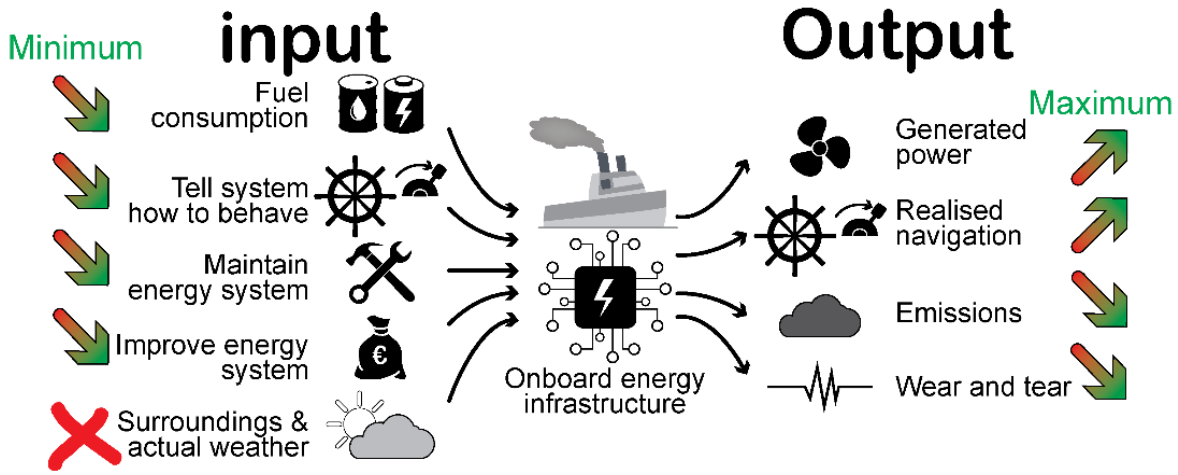

Figure 7: Input–output model of a ship's onboard energy infrastructure. The diagram illustrates how various inputs—fuel consumption, crew control, system maintenance, and energy system improvements—affect operational outputs such as generated power, navigation

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Chapter 4: Motivation

Motivation is the engine that sustains behavioural change. Without it, even the most capable trainer with the best resources will struggle to inspire learners to adopt and maintain new practices. In the maritime sector, motivation must be approached from two sides: trainers need to feel committed to integrating sustainability into their teaching, and learners must see why adopting new operational habits is both worthwhile and achievable.

Applying the COM-B perspective, trainers and leaders are encouraged to nurture both intrinsic and extrinsic motivational factors within their teams. For trainers, motivation is strengthened by recognising their role as catalysts of change. They are not simply passing on technical knowledge but shaping the professional attitude of the next generation and influencing the behaviour of experienced crews. This responsibility comes with a tangible impact: every small fuel-saving practice they teach has the potential to spread across vessels and fleets, contributing to measurable reductions in emissions. Knowing that their teaching directly translates into environmental and economic gains builds a strong sense of purpose.

For learners, motivation comes from experiencing first-hand the benefits of behavioural change. Through simulator sessions and feedback on fuel use, they can immediately see the results of different manoeuvres and choices. This trial-and-error process shows that even modest adjustments lead to visible savings. Over time, these small wins build confidence and form new habits. The philosophy of continuous improvement—reducing emissions step by step, aligned with the ALARA principle (As Low As Reasonably Achievable)—provides a clear and achievable pathway rather than an overwhelming, abstract goal.

Motivation is further reinforced when economic, professional, and personal incentives align reduced fuel costs benefit the company, compliance with regulations secures the future of operations, and contributing to sustainability fosters pride and responsibility among crews. Importantly, simulator experiments do more than support learners—they also generate new insights and evidence that trainers can integrate into future teaching. Each simulation produces concrete results on fuel use, emissions, and operational choices, which can be fed back into courseware, ensuring it remains relevant, practical, and continuously improving. For trainers, this feedback loop is a key motivational driver: it shows that their teaching evolves with real-world practice and reinforces their role as innovators in maritime education.

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14. What Drives Sustainable Change in Ports: How Do Teachers, Pilots, and Tugboat Crews Find Their Motivation?

Against this backdrop, it becomes clear that motivation is not a uniform force, but one that is experienced and expressed differently by each group within the port and maritime ecosystem. While the principles of the Greenport approach lay a foundation for positive change, the true engine of transformation lies in understanding the unique perspectives and incentives that drive the various actors—whether on the deck, in the engine room, or at the organisational helm.

To truly foster sustainable behaviour, it is essential to explore how motivation manifests for distinct roles: the crew, who bring a spirit of teamwork and lived experience to the fore; the shipowners, whose priorities encompass long-term value and operational success; and the port operators, who balance efficiency with environmental stewardship on a grand scale. By examining these perspectives in turn, we can appreciate how targeted strategies can ignite and sustain motivation across all levels, ensuring the momentum for meaningful change endures.

As each link in the maritime chain—crew, shipowner, port, and educator—takes ownership of fostering sustainable habits, the cumulative impact becomes transformative. Every invested stakeholder, from those operating vessels to those guiding learning and innovation, contributes to a cultural shift where sustainability is not just an objective, but a shared identity. This collective momentum seamlessly leads into the crucial role of teachers, whose commitment to inspiring lasting change shapes not only individual careers but the future of the entire maritime sector.

14.1. Motivation of the Crew

Motivation for crew members is at the heart of real change in the maritime world. Yet, motivation alone does not guarantee smooth adoption of new practices—acceptance and resistance to behavioural change are intertwined forces at play in any transformation. Within the maritime context, acceptance of change often flourishes when individuals see direct benefits, feel their voices are heard, and understand the rationale behind new procedures. Open communication, hands-on demonstrations, and opportunities for feedback create an environment where crews and staff are more likely to embrace innovation, perceiving it as a path to shared success rather than an imposition. Conversely, resistance can surface when change is perceived as a threat to established routines, professional identity, or autonomy. Longstanding traditions at sea, scepticism about unproven methods, or concerns over increased workload can foster hesitation and pushback. Resistance may manifest subtly, such as in reluctance to engage with training, or more overtly, through open criticism or adherence to old habits despite new guidelines.

Addressing resistance constructively is essential—not by dismissing concerns, but by acknowledging and engaging with them. Supportive leadership, peer learning, and transparent sharing of positive outcomes help to gradually shift attitudes. When individuals witness colleagues succeeding or experiencing tangible improvements, initial reluctance often gives way to curiosity and, eventually, acceptance. In this way, motivation, acceptance, and resistance form a dynamic interplay that ultimately shapes the pace and depth of sustainable behavioural change.

Choosing to follow the Greenport course and learn new habits isn't just about rules or personal gain—it's about working together and taking pride in the job. For many crew members, motivation grows from teamwork. When everyone supports each other and their efforts matter, people feel encouraged to do their best. It's not only about meeting requirements, but also about caring for the group and the success of the operation.

Crew members also find motivation in their everyday experience at sea. Seeing how their actions affect the environment and safety makes sustainability goals feel real, not just something abstract. They want to do things the right way—not only because someone says so, but because they know it matters for their own future and for the world around them.

Good leaders help keep people motivated. They set a positive example, listen to ideas, and celebrate progress, even when it's small. When leaders show that every step forward is noticed and appreciated, crew members feel more motivated to keep improving.

Taking part in the Greenport course can be rewarding too. When crews see real results—like safer working conditions, smoother teamwork, or savings in fuel—they feel proud of their efforts and are encouraged to keep learning.

In the end, motivation comes from feeling connected to something bigger, knowing your work matters, and sharing successes together. With this kind of spirit, adopting new, sustainable habits becomes much more natural, and crews can help build a stronger, greener maritime industry.

14.2. Motivation of the Shipowner

For shipowners, the motivation to embrace more sustainable practices and invest in greener shipping extends well beyond compliance or short-term profitability. Increasingly, shipowners recognise that their choices have far-reaching consequences—not only for their vessels' operational efficiency and cost control, but also for their reputation and long-term resilience in an evolving industry. Sustainability-driven decisions can open doors to new markets, unlock financial incentives, and foster stronger partnerships with clients and charterers who value

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environmental responsibility. Moreover, as international regulations become stricter and public scrutiny intensifies, proactive investment in sustainable solutions helps shipowners stay ahead of the curve. By modernising fleets, adopting cleaner technologies, and supporting crew training on sustainable procedures, shipowners reduce future risks and avoid costly penalties. These investments also contribute to the operational safety and reliability of their ships, enhancing competitiveness in a market where efficiency, transparency, and environmental stewardship are ever more prized. Sometimes, it only takes a modest investment in technology to spark meaningful progress. For example, equipping a vessel with a simple fuel meter may seem like a minor upgrade, but the impact can be profound. With access to real-time consumption data, crew members and shipowners alike become more aware of their practices, allowing them to identify inefficiencies, adjust routines, and measure the results of new habits almost instantly. Such transparency not only empowers crews to take ownership of their performance but also demonstrates to shipowners how even incremental changes yield measurable returns, both financially and environmentally.

There is also a personal dimension: for many shipowners, taking steps toward sustainability is about safeguarding their legacy. By acting as stewards of both their businesses and the marine environment, they ensure that shipping remains a viable and respected profession for generations to come. Ultimately, the motivation to change is fuelled by the recognition that sustainable choices are not sacrifices, but strategic moves that secure lasting value—commercially, environmentally, and socially.

14.3. Motivation of the Port Operator

For port operators, the drive to support behavioural change is rooted in their unique position at the intersection of maritime logistics, regulation, and community expectations. Ports are bustling gateways where the actions of many different stakeholders converge and where the impact of sustainable operations can be felt most immediately—whether in reduced emissions, improved air quality, or more efficient cargo flows. Port operators understand that their success depends not only on the infrastructure and technology they deploy, but on the collective behaviour of everyone working within the port's ecosystem.

Fostering positive behavioural change among terminal staff, visiting crews, and service providers enables port operators to achieve smoother coordination, streamline processes, and meet increasingly ambitious environmental targets. They are motivated by the tangible benefits of such change: quicker vessel turnaround times, lower operational costs, and compliance with stringent international and local environmental standards. Furthermore, as public scrutiny of port activities intensifies, operators recognise the reputational value of being seen as forward-thinking stewards who prioritise both economic vitality and environmental responsibility. Behavioural change also empowers port communities to adapt more readily to new technologies and evolving regulations. By investing in training, awareness campaigns, and incentive systems, port

operators help embed a culture of safety, energy efficiency, and environmental care. The result is not just better performance metrics, but a shared sense of purpose and pride among all who work in and around the port. This collaborative spirit lays the foundation for long-term competitiveness and resilience in an industry that is being transformed by global sustainability imperatives.

In addition, port operators often serve as catalysts for change not only within their own operations but across the broader maritime network. By collaborating with shipping companies, local authorities, and environmental organisations, they help raise standards industry-wide and encourage the sharing of best practices. This cooperative approach ensures that sustainable behaviour is reinforced at every stage of the supply chain, multiplying its positive effects from ship to shore.

Furthermore, the motivation of port operators is constantly renewed by the visible, real-world improvements resulting from their efforts—clearer skies above port cities, healthier communities, and a strengthened reputation for their facilities on the global stage. These outcomes validate the belief that embracing behavioural change is both a strategic advantage and a social responsibility.

14.4. Motivation of the Teachers

At the heart of sustainable maritime operations lies a deeper motivation: the desire to inspire lasting behavioural change. Teachers—whether in the classroom or in the training simulator—are driven to guide human behaviour not simply to ensure compliance with regulations or efficiency targets, but to foster a mindset that endures beyond the immediate task. This drive is rooted in recognising that genuine progress in environmental stewardship and operational effectiveness only occurs when individuals internalise principles of responsibility, curiosity, and adaptability. For example, rather than expecting trainees to overhaul their routines overnight, educators encourage incremental improvement. A trainee might begin by making small adjustments to engine settings during a voyage—perhaps fine-tuning speed or monitoring fuel consumption more closely. Over time, these modest changes can become ingrained habits, accumulating to produce significant fuel savings and a smaller ecological footprint. To help learners develop the ability to assess their own actions and adjust them in response to shifting standards, technological advances, or environmental demands, teachers place a strong emphasis on self-reflection and critical thinking. Building on this foundation of self-awareness, educators also highlight the importance of teamwork and communication, ensuring that sustainable practices are adopted collectively. For instance, an instructor may facilitate group exercises where crews collaborate to identify inefficiencies and propose solutions, reinforcing the shared responsibility for operational excellence. Moreover, teachers understand that nurturing intrinsic motivation is central to meaningful and lasting behavioural change. When individuals take ownership of their skills and recognise their role in collective outcomes, they are more likely to innovate, collaborate, and drive progress. One maritime instructor described the process: “When we give trainees the opportunity

to set their own improvement targets and celebrate even small successes, I see them become much more engaged. It's not just about doing what's required—it's about wanting to make a difference."

In maritime contexts, this means cultivating habits of energy awareness, precision, and care that ripple outward to benefit the vessel, the crew, and the environment. Ultimately, educators are motivated by the belief that empowering people to make informed, responsible choices ensures that sustainable practices become the norm, not the exception, and that genuine transformation is possible through education and collaboration.

15. Sustaining Motivation for Change

"Education is what survives when what has been learned has been forgotten."

B.F.Skinner

Motivation is not a one-time spark but a force that must be continuously renewed if behavioural change is to last. In the maritime context, the most powerful driver of sustained motivation is the alignment between economic benefits and sustainability goals. Every tonne of fuel saved directly lowers operational costs while simultaneously cutting emissions. This dual gain creates a strong business case that resonates with both individuals and organisations: crews see the immediate impact of their actions in reduced fuel use, while companies benefit from lower expenses and improved compliance with tightening environmental regulations. Over time, these short-term economic rewards reinforce long-term cultural change, embedding sustainability into daily decision-making. By linking financial efficiency with environmental responsibility, the course ensures that motivation is not based on abstract ideals alone but grounded in tangible results that encourage crews and trainers alike to keep striving for better performance.

16. Turning Simulator Insights Into New Courseware

Since the ultimate goal of the Train the Trainer course is to change the knowledge, skills, and attitudes of both future and experienced crew, simulator experiments play a vital role in generating new insights that can be fed back into course design. Unlike classroom teaching, simulators allow trainers to observe learners in realistic operational settings, where technical skills and behavioural patterns are revealed side by side.

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The outcomes of simulator sessions provide trainers with valuable information about skills—what participants actually do when operating a tugboat—and attitudes—how they think, make decisions, and approach problems. For example, a trainer may notice whether participants reduce speed proactively to save fuel, or whether they default to high-power manoeuvres even when unnecessary. They may also observe how well crew members communicate and cooperate during joint tasks, such as docking or towing, where coordination has a direct impact on efficiency and emissions.

From these observations, trainers can identify atomic habits: the small, routine actions that either support or undermine sustainability goals. Some habits may be less sustainable (e.g., overuse of thrusters, late course corrections, unnecessary idling), while others demonstrate more sustainable practices (e.g., anticipating manoeuvres early, smooth power adjustments, effective teamwork). By capturing and analysing these habits, trainers can adapt their courseware to reinforce positive behaviours and address negative ones.

In this way, simulator experiments not only provide a safe learning environment for participants but also act as a continuous feedback loop for educators. Each exercise becomes a source of evidence that can enrich teaching materials, generate new case studies, and refine training methods. This ensures that courses evolve in step with practice, remain grounded in real-world behaviour, and continuously drive both skill development and attitude change toward more sustainable operations.

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Chapter 5: Conclusions: Behavioral change

When capability, opportunity, and motivation are developed together, meaningful behavioural change becomes possible. Trainers equipped with knowledge, resources, and institutional support—and who feel motivated—are better able to influence learners toward sustainable practices.

Behaviour is central to the COM-B model and evolves gradually through training, operational experience, and feedback. As new behaviours yield positive results like efficiency and lower emissions, they become routine rather than deliberate actions. Sustainable change is most durable when integrated into daily habits, coming from authentic experiences rather than mandates. In this way, the maritime sector can drive innovation and responsibility for a future that is both economically and environmentally resilient.

Ultimately, the effectiveness of any training initiative depends on its ability to cultivate not just technical proficiency but genuine behavioural transformation. This transformation is most robust when it is supported by ongoing assessment and the deliberate reinforcement of desired actions. Regular feedback—both from simulators and from real-world operations—enables trainers to highlight progress, correct missteps, and celebrate achievements. Over time, such reinforcement turns one-off changes into consistent patterns, making sustainability less a matter of external enforcement and more a feature of organisational identity.

Moreover, fostering open dialogue among crew and trainers creates a learning culture where experimentation is encouraged, and setbacks are viewed as opportunities for growth. When individuals feel empowered to share their experiences and insights, best practices spread organically across teams and vessels. This collaborative atmosphere not only sustains motivation but also sparks innovation, as crews collectively refine approaches to operational challenges in pursuit of ever-higher standards of efficiency and environmental stewardship.

For crew members, this results in everyday improvements: informed operational choices practiced safely, reinforced by both personal and collective incentives. Over time, these decisions become habits, building skills and attitudes that favour sustainability. The COM-B model thus shifts from theory to action, enabling measurable reductions in fuel use, lower emissions, and lasting cultural change throughout the maritime industry.

In closing, the Train the Trainer course stands as both a catalyst and a compass for those shaping the future of maritime operations. By weaving together practical experience, reflective practice, and evidence-based teaching, we have journeyed beyond technical instruction to nurture a culture of sustainable excellence. The tools, insights, and strategies explored here will continue to serve as beacons—guiding trainers and crew alike toward smarter, safer, and more sustainable ways of working.

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As you return to your vessels, classrooms, and teams, remember that the true legacy of this course lies not within these sessions, but in the daily choices you make and the habits you help instil. Every conversation, every simulation, and every debrief is an opportunity to nudge the industry closer to its collective goals: operational mastery, environmental stewardship, and enduring professional growth.

Let us remain committed to curiosity, collaboration, and continuous improvement. Through your leadership and dedication, the transformation we have begun together will ripple outward—empowering others, shaping practices, and ultimately anchoring sustainability at the heart of maritime culture. Safe journeys and fair winds as you chart the next course.

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Final remarks

The GREENPORT Train the Trainer course offers a comprehensive and adaptable framework designed to empower maritime educators to drive meaningful behavioral change towards sustainability in port operations. By integrating the COM-B model—Capability, Opportunity, Motivation—and embedding it throughout the curriculum, trainers are equipped not only with technical knowledge but also with pedagogical skills and motivational strategies necessary to transform learners' attitudes and habits. This course recognizes that sustainable maritime operations rely as much on human behavior as on technology and regulation, emphasizing that incremental improvements in daily practices can collectively yield substantial reductions in fuel consumption and emissions.

Furthermore, the course places great importance on creating enabling environments through access to resources, supportive policies, and strong communication and collaboration among all port stakeholders. Using innovative teaching tools, including simulation-based training, digital platforms, and competency-based assessment, trainers can bridge the gap between theory and practice. This ensures that learners gain practical experience and develop confidence to apply sustainable techniques in real-world maritime settings. By fostering a culture of continuous improvement and reflection, the program promotes long-term behavioral transformation that extends beyond the classroom and into everyday maritime operations.

Ultimately, the true success of this training initiative lies in its capacity to nurture motivated, knowledgeable, and adaptable maritime professionals who embrace responsibility for environmental stewardship while maintaining operational safety and efficiency. The course exemplifies how education can serve as a catalyst for the maritime industry's energy transition, positioning trainers as multipliers of change and contributors to a sustainable future. As this knowledge spreads through crews, shipowners, and port operators alike, it will help harmonize innovation, regulation, and culture—charting a course toward greener, smarter, and more resilient maritime operations worldwide.

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Self-comprehension questions

1. According to the COM-B model, behavioural change in maritime training is most effective when which three factors are developed together?

A. Capability, Opportunity, Motivation

B. Training, Discipline, Regulation

C. Knowledge, Experience, Efficiency

D. Technology, Communication, Safety

2. What is a key outcome when new sustainable behaviours yield positive results in operational settings?

A. They are quickly abandoned

B. They become routine habits

C. They require constant reminders

D. They cause confusion among crew

3. Which element is described as central to the COM-B model in driving behavioural change?

A. Technology

B. Feedback

C. Behaviour

D. Leadership

4. How does regular feedback contribute to behavioural transformation in training initiatives?

A. By discouraging new practices

B. By reinforcing and celebrating progress

C. By eliminating all errors

D. By increasing external enforcement

5. What is the effect of fostering open dialogue among crew and trainers?

A. It creates competition

B. It limits innovation

C. It encourages experimentation and growth

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D. It discourages sharing of best practices

6. Which of the following best describes the lasting impact of consistent reinforcement of desired actions?

A. Temporary improvement

B. One-off changes

C. Consistent patterns and organisational identity

D. Increased regulatory oversight

7. When individuals feel empowered to share their insights, what is the expected outcome according to the course text?

A. Isolation among teams

B. Organic spread of best practices

C. Reduced motivation

D. Increased resistance to change

8. The Train the Trainer course aims to nurture a culture of excellence that is.

A. Technically focused only

B. Driven by mandates

C. Sustainable and reflective

D. Resistant to change

9. What is identified as the true legacy of the Train the Trainer course?

A. The course sessions themselves

B. Daily choices and habits instilled in maritime professionals

C. External regulations

D. Written examinations

10. What ongoing attitude should trainers and crew adopt for continuous improvement according to the closing statement?

A. Curiosity, collaboration, and commitment

B. Complacency and routine

C. Strict adherence to old methods

D. Passive observation

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