SEANERGY

the Sustainability EducationAl programme
for greeNER fuels and enerGY on ports

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Module 9: Continuous Improvement of Port Performance

Course coordinator(s):

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Learning objectives of the course

On completion of this course, the participants will be able to:

- **Examine** the importance of continuous improvement in enhancing port performance
- **Evaluate** monitoring mechanisms and frameworks for ensuring accountability in port operations
- **Understand** feedback loops and conduct critical analysis of operational outcomes.

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Learning objectives of the course

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- **Explain** strategies for identifying and addressing 'low-hanging fruits' and planning ambitious interventions
- **Describe** the actions based on measurable outcomes and continuously assess performance for further enhancement
- **Discuss** the different environmental and social performance improvement programmes in EU ports

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Agenda

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- Introduction to Continuous Improvement for Port Energy Transition
  - Overview of continuous improvement principles and energy transition
  - Overview of port environmental and energy management plan
- Monitoring and Responsibility Mechanisms for Sustainable Success

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Agenda

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- Understand the key concept energy management as well as the implementation of ISO certifications
  - Overview of the PDCA cycle
  - Plan mechanisms for successful transition
  - Do mechanisms for successful transition
  - Check mechanisms for successful transition
  - Act mechanisms for successful transition

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Agenda

- Case studies on successful continuous improvement initiatives in EU ports:
  - energy transition performance
  - environmental performance
  - social performance
- Port Environmental Review System (PERS)

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Introduction to Continuous Improvement for Port Energy Transition

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Continuous Improvement for Port Energy Transition

- The transition to sustainable and energy-efficient ports is a critical aspect of the global effort towards decarbonization and environmental sustainability.

- Optimizing energy management, reducing carbon emissions, and integrating renewable energy sources are vital strategies in achieving these objectives.

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Innovative Strategies for Sustainable Port Development (1)

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Promoting Low-Carbon Transitions in Ports

- Yang et al. (2022) highlight the effectiveness of clean energy in facilitating low-carbon transitions in ports, which is essential in reducing their environmental footprint.

Port Efficiency and Continuous Improvement

- According to Osundiran (2020), port efficiency modeling and the development of continuous improvement frameworks are crucial in enhancing port productivity while aligning with sustainability goals.

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Innovative Strategies for Sustainable Port Development (2)

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Energy Recovery and Industrial Symbiosis

- Haezendonck & Berghe (2020) point out the significant role of energy recovery initiatives, particularly industrial symbiosis, in the early stages of the transition process for seaports.

Renewable Energy and Emission Reduction

- Yao et al. (2022) and Amaral (2023) emphasize the importance of utilizing renewable energy sources and adopting new solutions to reduce carbon emissions from port infrastructure.

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Innovative Strategies for Sustainable Port Development (3)

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Integration of Marine Renewable Energy

- Cabrero (2024) and Tawfik (2024) underscore the role of marine renewable energy and the integration of renewable energy systems in achieving sustainable and environmentally friendly port operations.

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WRAPUP

- The synthesis of these studies underscores the critical need for ports to prioritize energy efficiency, reduce carbon emissions, and transition towards sustainable practices through the integration of renewable energy sources and continuous improvement frameworks.

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Environmental Issues in Ports

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- Ports are significant contributors to greenhouse gas emissions.
- The necessity of reducing greenhouse gases and transitioning to sustainable energy (Anwar, 2024).
- Importance of adapting port operations for energy efficiency and environmental sustainability (Alamoush et al., 2020).

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Strategies for Energy Transition

- **Renewable Energy Sources:**
  - Introduction of renewable energy technologies in port infrastructure (Anwar, 2024).
  - Examples: Solar, wind, and marine renewable energy sources.
- **Energy-Efficient Technologies:**
  - Implementation of energy-efficient technologies in port operations (Cabrero, 2024).
  - Examples: Energy-efficient lighting, HVAC systems, and automated controls.

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Onshore Power Supply Systems

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- The role of onshore power supply (OPS) in port electrification and decarbonization.
- Benefits of shifting docked ships from fossil fuels to electric power (Amaral, 2023; Yao et al., 2022).
- Impact on the reduction of emissions in both onshore facilities and port-wide operations.

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Diversifying the Energy Mix

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- **Ocean Energy:**
  - Potential of marine renewable energy sources (Cabrero, 2024).
  - Benefits of diversifying energy sources for port operations.
- **Low-Carbon Fuels:**
  - Adoption of low- or zero-carbon fuels for ships at sea and at berth (Amaral, 2023).

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Roadmap for Decarbonizing Seaports

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- Development of time-phased control mechanisms for port decarbonization (Song, 2024).
- Sequenced measures to achieve 'net-zero' emissions.
- Importance of roadmap-based approaches to structure the transition.

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Integration of Renewable Energy Technologies

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- Implementation of renewable energy technologies to improve energy efficiency in ports (Sadiq et al., 2021; Parhamfar, 2023).

- **Distributed Energy Management Systems:**
  - Role in promoting green development and reducing emissions (Shan et al., 2022).

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Challenges and Future Directions

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- Challenges of transitioning from high carbon-intensive to low-carbon energy models.
- Continued efforts towards greener and more efficient port operations.
- The alignment of port sustainability with global climate change objectives.

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Importance of Environmental and Energy Management in Ports

- Overview of the significance of energy and environmental management in port operations.
- Key aspects: sustainability, efficiency, and regulatory compliance.

Source: Mikael Lindt et al.

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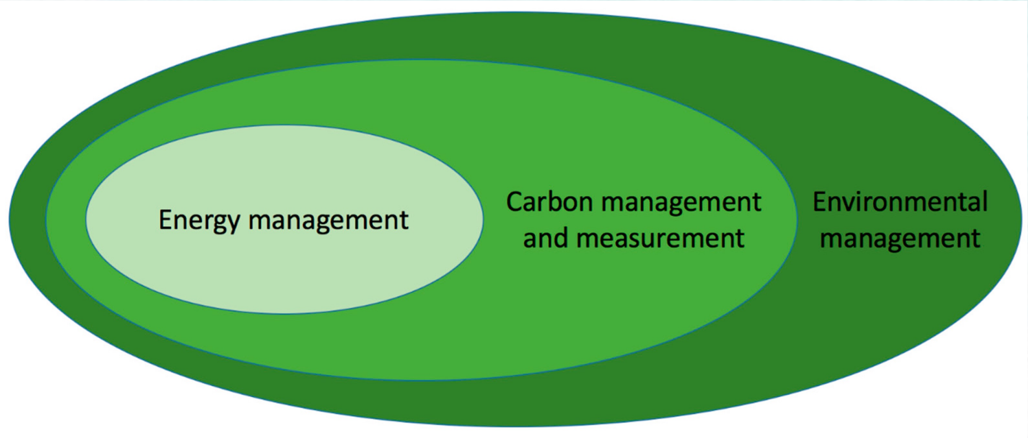
Energy Management in Sustainable Port Planning

- Energy management as part of sustainable port planning (Argyriou, 2023).
- Integration with environmental management systems.

Framework of environmental management



Source: Sdoukopoulos et al., 2019

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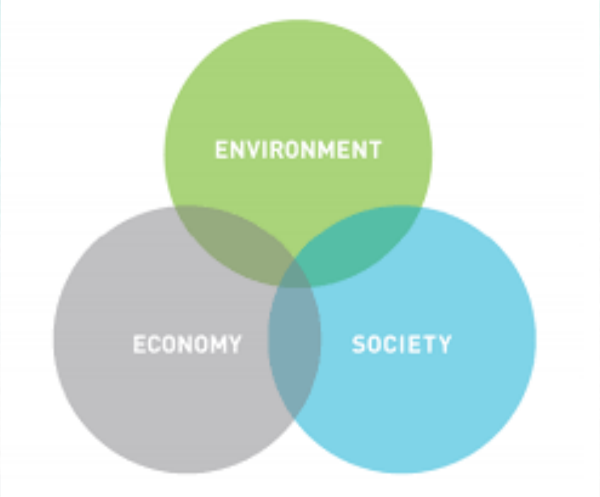
Eco-Port Policies for Balanced Sustainability

- Eco-port policies integrate social, economic, and environmental dimensions (Andriyanto, 2024).
- Promotion of environmentally friendly port management practices.

The three dimensions of sustainability



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Smart Green Ports and Machine Learning

Enhancing energy management through machine learning and optimization (Tawfik, 2024).

Benefits: cost-effective and eco-friendly operations.

Source: Fundacion Valencia Port

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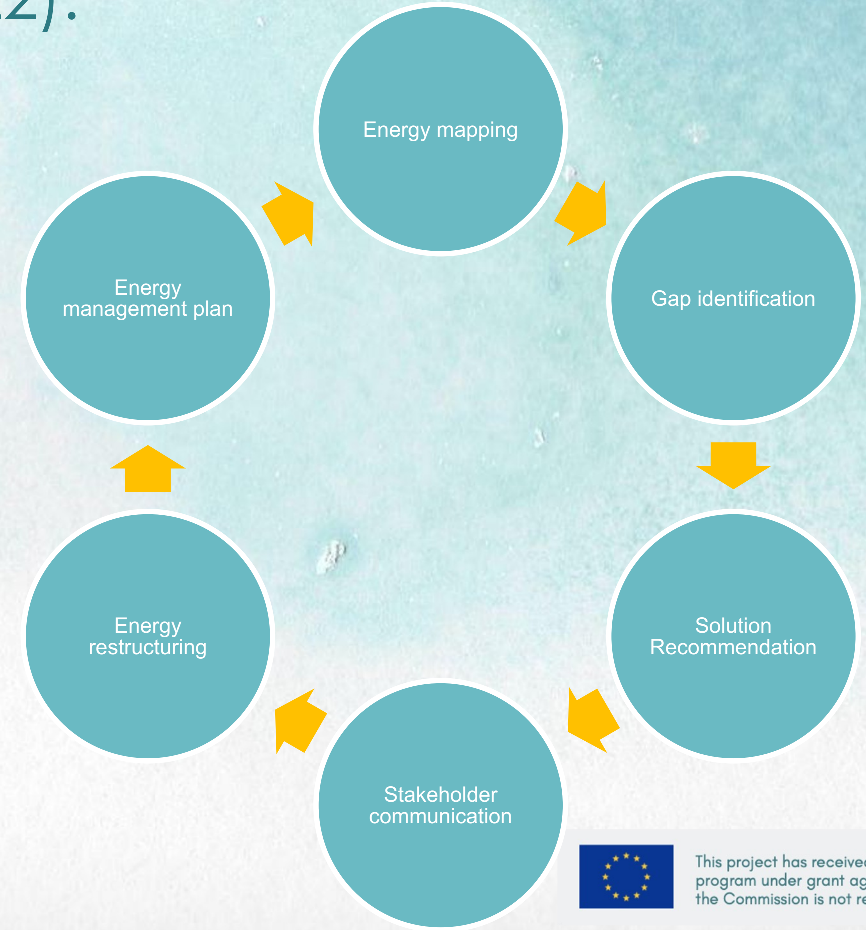
Technical-Environmental Assessment Approach

6-step process for energy management systems (Nguyen et al., 2022).



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Sustainability in Port Supply Chains

- Integrating sustainability into port operations (Beyene, 2024).
- Port sustainability involves internal (port side) transport) and external actions (ships and land) (Alamoush et al., 2021).

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Key Factors in Port Sustainability

Factors include:

- ✓ Location
- ✓ Infrastructure
- ✓ Planning
- ✓ Governance
- ✓ Models

(Caldeirinha, 2024).

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Role of Environmental Mainstreaming & Sustainability Frameworks in Ports

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- Integration into corporate strategies and port planning (Chlomoudıs et al., 2022).
- Implementing sustainability balanced scorecards (Suárez-Gargallo & Zaragoza-Sáez, 2023).
- Eco-centric views of sustainability in planning (Wu, 2020).

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Ensuring Sustainable Success Monitoring and responsibility mechanisms

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- Monitoring and responsibility mechanisms are crucial for sustainable port operations.
- Effective monitoring enhances planning, assesses externalities, and incorporates green practices.
- Strategic management, including leadership and reporting, is essential for long-term sustainability.
- Continuous improvement through technology, policy, and environmental focus is key.

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Monitoring and responsibility mechanisms

SEANERGY

- Ports are critical hubs for global trade and economic activities.
- Sustainable success of ports hinges on robust monitoring systems and responsibility mechanisms.
- Key areas of focus: Environmental sustainability, operational efficiency, and strategic management.

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Role of Monitoring Systems in Ports (1)

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- **Enhanced Planning and Investment Decisions**
  - **Lee et al. (Abramowicz-Gerigk, 2024):** Monitoring systems are vital for improving planning and making informed investment decisions in ports. They help in identifying areas requiring immediate attention and long-term development strategies, ensuring that resources are allocated efficiently.
  - **Practical Example:** Ports utilizing advanced monitoring systems can better anticipate future needs, such as upgrading infrastructure or investing in new technologies, leading to more strategic and sustainable growth.

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Role of Monitoring Systems in Ports (2)

- **Environmental Monitoring and Sustainability**
  - **Stylıadıs et al. (2022):** The application of environmental indicators is crucial for assessing the externalities associated with port activities, such as emissions, waste, and water pollution. These indicators enable ports to track their environmental footprint and make necessary adjustments to minimize negative impacts.
  - **Practical Example:** Ports that systematically monitor air and water quality can take proactive measures to reduce pollution, complying with international environmental regulations and improving local community health.

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Role of Monitoring Systems in Ports (3)

- **Leveraging Emerging Technologies**
  - **Resende (2023):** Emerging technologies, including IoT and AI, enhance the efficiency, safety, and sustainability of port operations. These technologies facilitate real-time monitoring, predictive maintenance, and automation, reducing human error and operational costs.
  - **Practical Example:** Implementing AI-driven predictive maintenance in ports can prevent equipment failures, reduce downtime, and lower maintenance costs, contributing to more sustainable and reliable operations.

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Environmental Indicators and Policy Development (1)

- **Energy and Water Consumption Monitoring**
  - **Nguyen et al. (2022):** Ports must develop policies and establish comprehensive monitoring systems to track energy and water consumption. This allows for identifying inefficiencies and implementing conservation measures, essential for reducing the overall environmental impact of port operations.
  - **Practical Example:** By monitoring water usage, ports can identify opportunities for recycling and reusing water, reducing their dependence on freshwater resources and contributing to water conservation efforts.

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Environmental Indicators and Policy Development (2)

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- **Smart Green Port Concepts**
  - **Elhussieny (2023):** Smart green port concepts involve integrating advanced technologies to minimize environmental impact while improving operational performance. This includes implementing renewable energy sources, automating processes to reduce waste, and optimizing logistics to lower emissions.
  - **Practical Example:** Ports adopting smart green technologies, such as solar panels and electric vehicles, can significantly reduce their carbon footprint and achieve higher energy efficiency, setting an example for the global maritime industry.

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Environmental Indicators and Policy Development (3)

- **Incorporation of Renewable Energy and Efficient Technologies**
  - **Anwar (2024):** Ports need to incorporate renewable energy solutions and energy-efficient technologies into their operations. This includes using solar, wind, or tidal energy to power port facilities and adopting energy-saving technologies in fleet management to reduce emissions and improve efficiency.
  - **Practical Example:** A port that integrates wind turbines and solar panels to power its operations can significantly cut down on fossil fuel consumption, reducing greenhouse gas emissions and operational costs.

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Sustainability Reporting and Leadership (1)

- **Sustainability Reporting as a Management Tool**
  - **Geerts & Dooms (2020):** Sustainability reporting is an essential management tool for understanding an organization's current position along the sustainability pathway. It provides transparency, holds the port accountable to stakeholders, and guides continuous improvement efforts.
  - **Practical Example:** Ports that regularly publish sustainability reports can track progress on environmental goals, communicate achievements to stakeholders, and identify areas for further improvement, leading to better management and stronger stakeholder trust.

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Sustainability Reporting and Leadership (2)

- **Comprehensive Sustainability Initiatives**
  - **Cunha (2023):** Effective sustainability initiatives in ports include the development of robust environmental policies, active stakeholder engagement, and continuous research and development to address emerging challenges. These initiatives ensure that ports remain adaptable and resilient in the face of changing environmental and regulatory landscapes.
  - **Practical Example:** Engaging with local communities, environmental groups, and industry stakeholders helps ports to better align their sustainability goals with broader societal and environmental expectations, leading to more successful outcomes.

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Sustainability Reporting and Leadership (3)

- **Role of Transformational Leadership and Strategic Responses**
  - **Tsai & Lu (2021):** Transformational leadership, strategic responses to environmental challenges, and fostering a sustainability-focused culture among employees are key factors in the successful implementation of sustainability efforts in ports. Leaders must inspire and drive change, while employees play a crucial role in executing sustainability strategies on the ground.

  - **Practical Example:** Ports led by transformational leaders who prioritize sustainability can more effectively implement green initiatives, motivate employees to embrace sustainable practices, and achieve long-term sustainability goals.

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ENERGY MANAGEMENT SYSTEM: OVERVIEW

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PDCA (plan–do–check–act or plan–do–check–adjust) is an **iterative** four-step **management** method used in business for the control and continual improvement of processes and products. It is also known as the **eming** circle/cycle/wheel, the **Shewhart** cycle, the control circle/cycle, or plan–do–study–act (PDSA). Another version of this PDCA cycle is OPDCA] The added "O" stands for observation or as some versions say: "Observe the current condition."

The PDCA Cycle

Source: ASQ Quality Press, 2004

Plan: The planning phase involves assessing a current process, or a new process, and figuring out how it can be improved upon

Do: Implementation and Operation element of any management system

Check/Study: Check the health of your management systems/make corrections

Act: Act to improve the identified weakness and decide other improvement steps needed

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THE PDCA CYCLE OVERVIEW

Source: EERE

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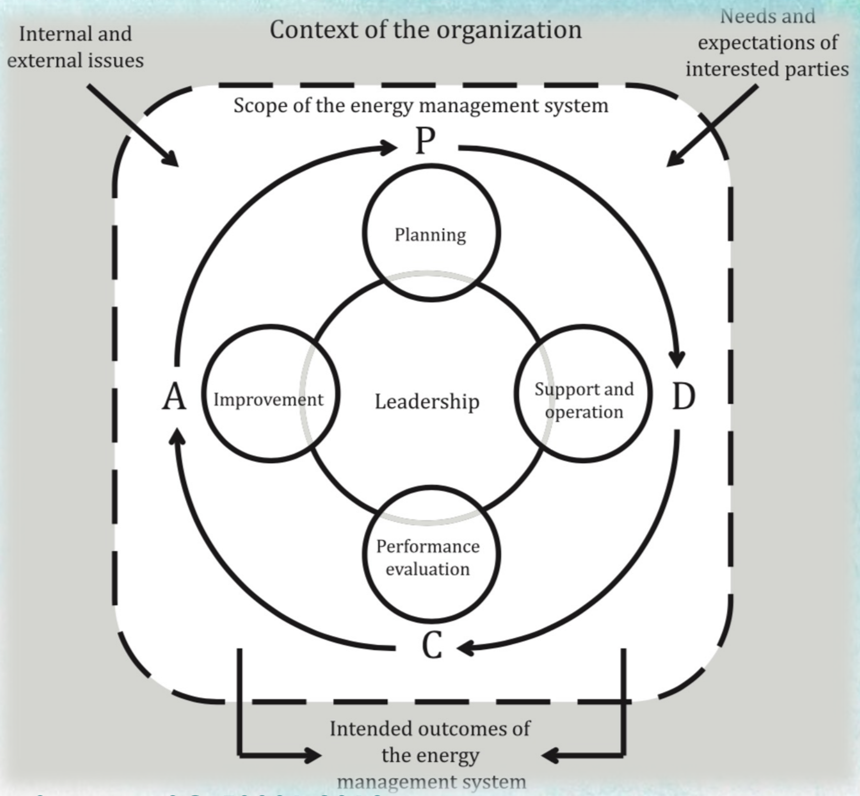
ENERGY MANAGEMENT SYSTEM: OVERVIEW



Source: ISO 50001:2018.

Plan: understand the context of the organization, establish an energy policy and an energy management team, consider actions to address risks and opportunities, conduct an energy review, identify significant energy uses (SEUs) and establish energy performance indicators (EnPIs), energy baseline(s) (EnBs), objectives and energy targets, and action plans necessary to deliver results that will improve energy performance in accordance with the organization's energy policy.

Do: implement the action plans, operational and maintenance controls, and communication, ensure competence and consider energy performance in design and procurement.

Check: monitor, measure, analyse, evaluate, audit and conduct management review(s) of energy performance and the EnMS.

Act: take actions

WORLD MARITIME UNIVERSITY

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THE PDCA CYCLE OVERVIEW

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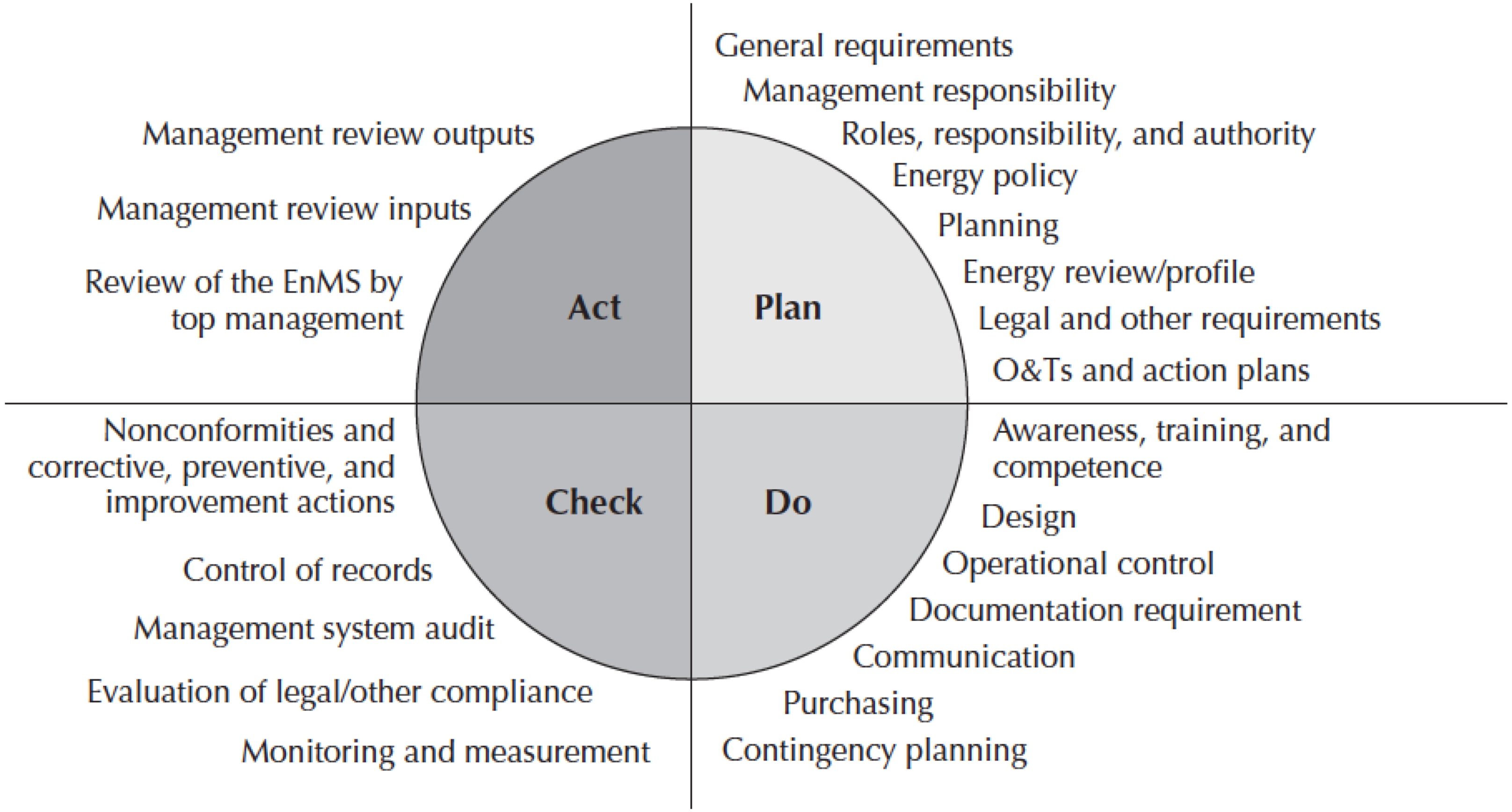
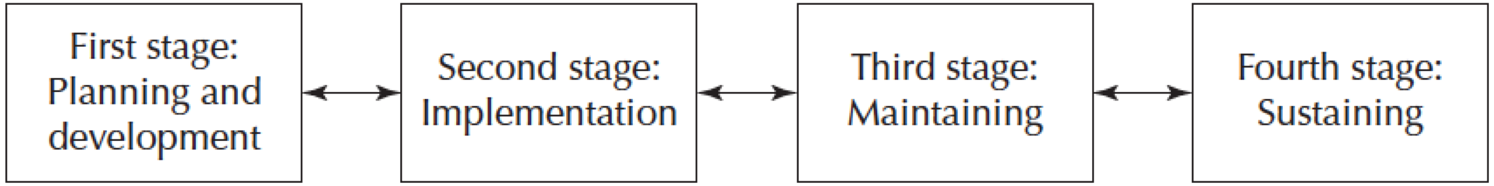
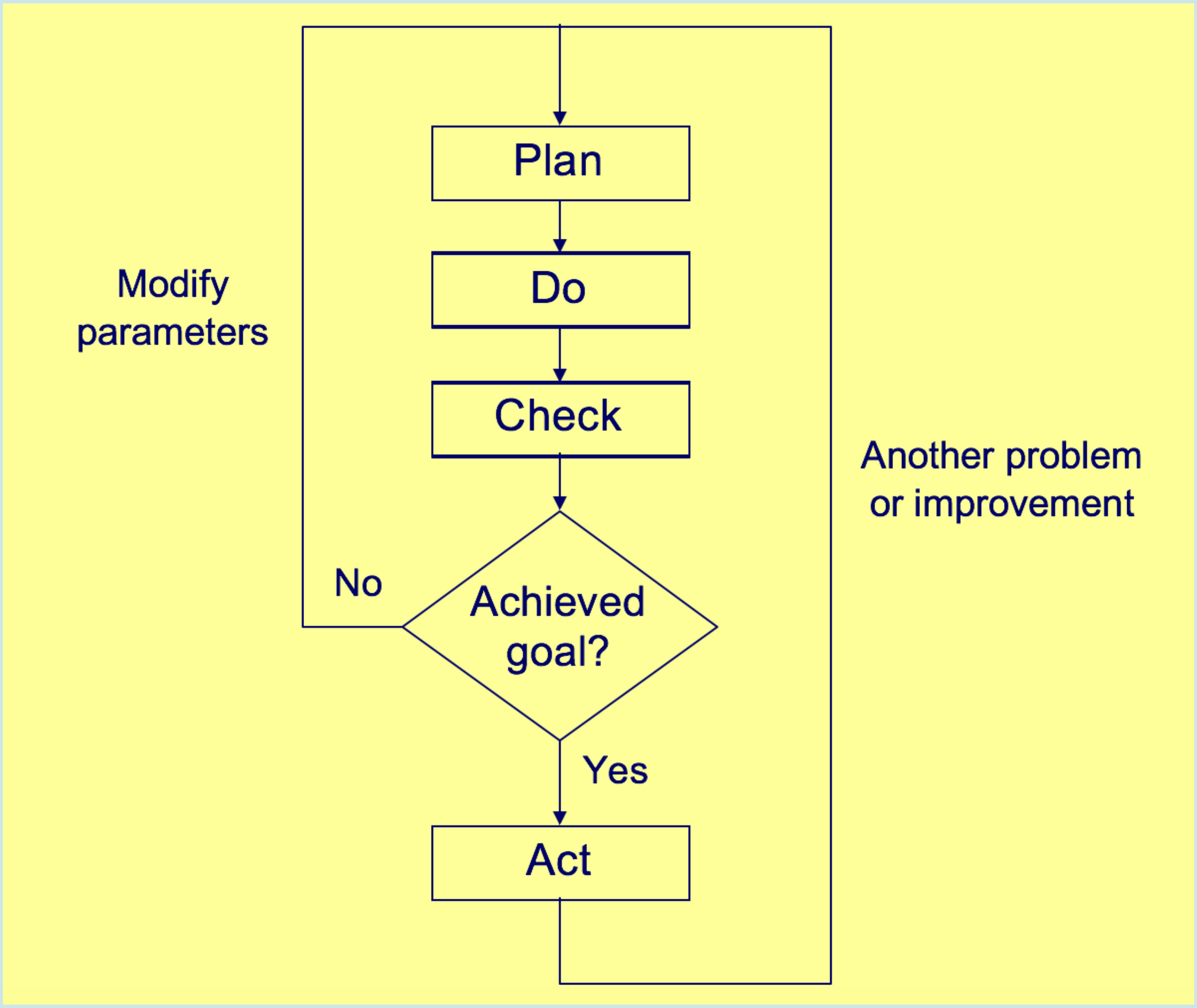




PDCA: OVERVIEW



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PDCA CONCLUSION

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The PDCA cycle can be an effective and rapid method for implementing continuous improvement.

Each step: Plan, Do, Check, and Act are critical for consistent implementation of successful process improvements.

Avoid the common disconnects as seen by one professional in industry, such as over/under-planning and not validating the hypothesis, even on successful results.

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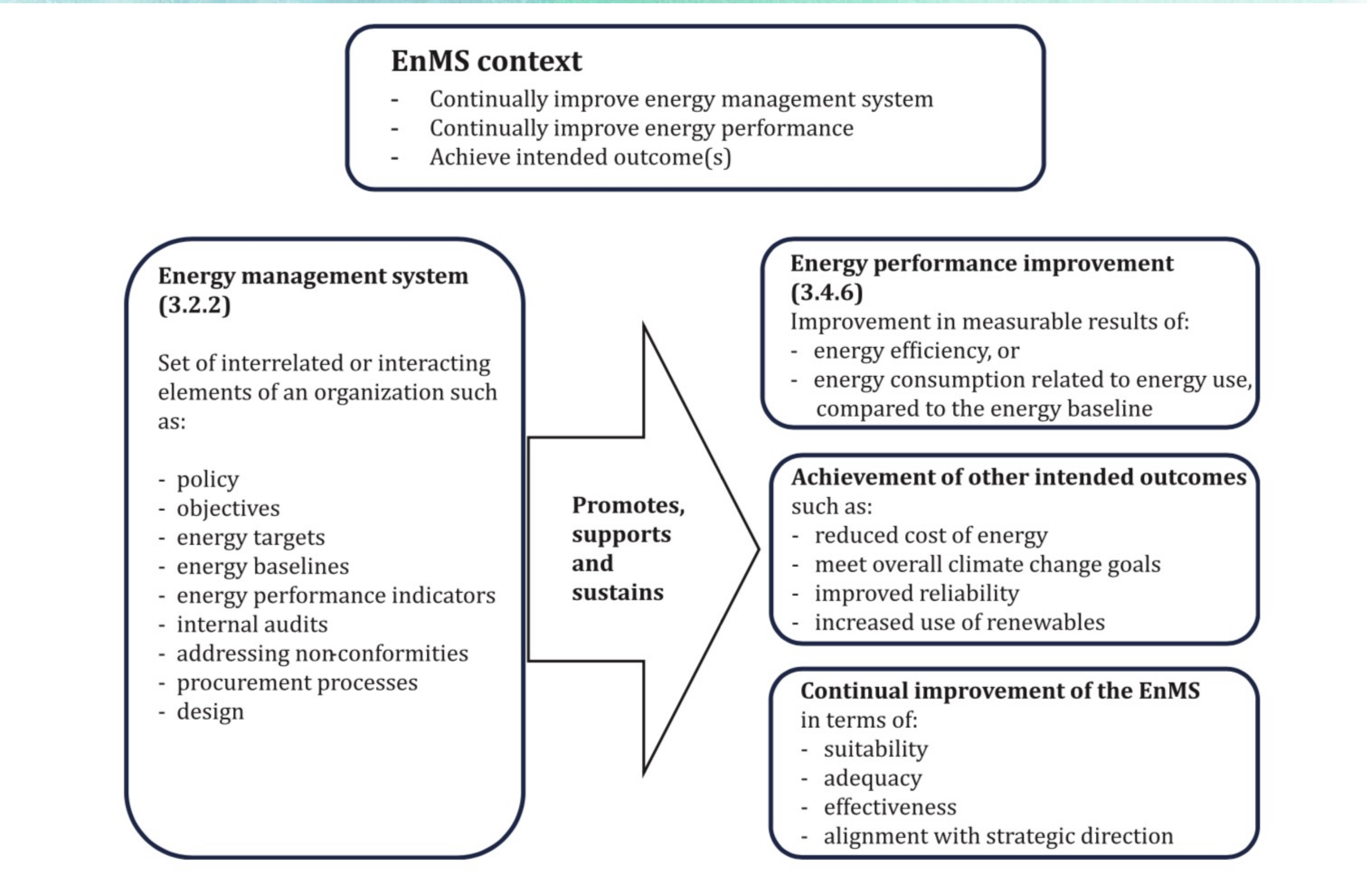
RELATIONSHIP BETWEEN ENERGY PERFORMANCE AND EnMS STANDARD



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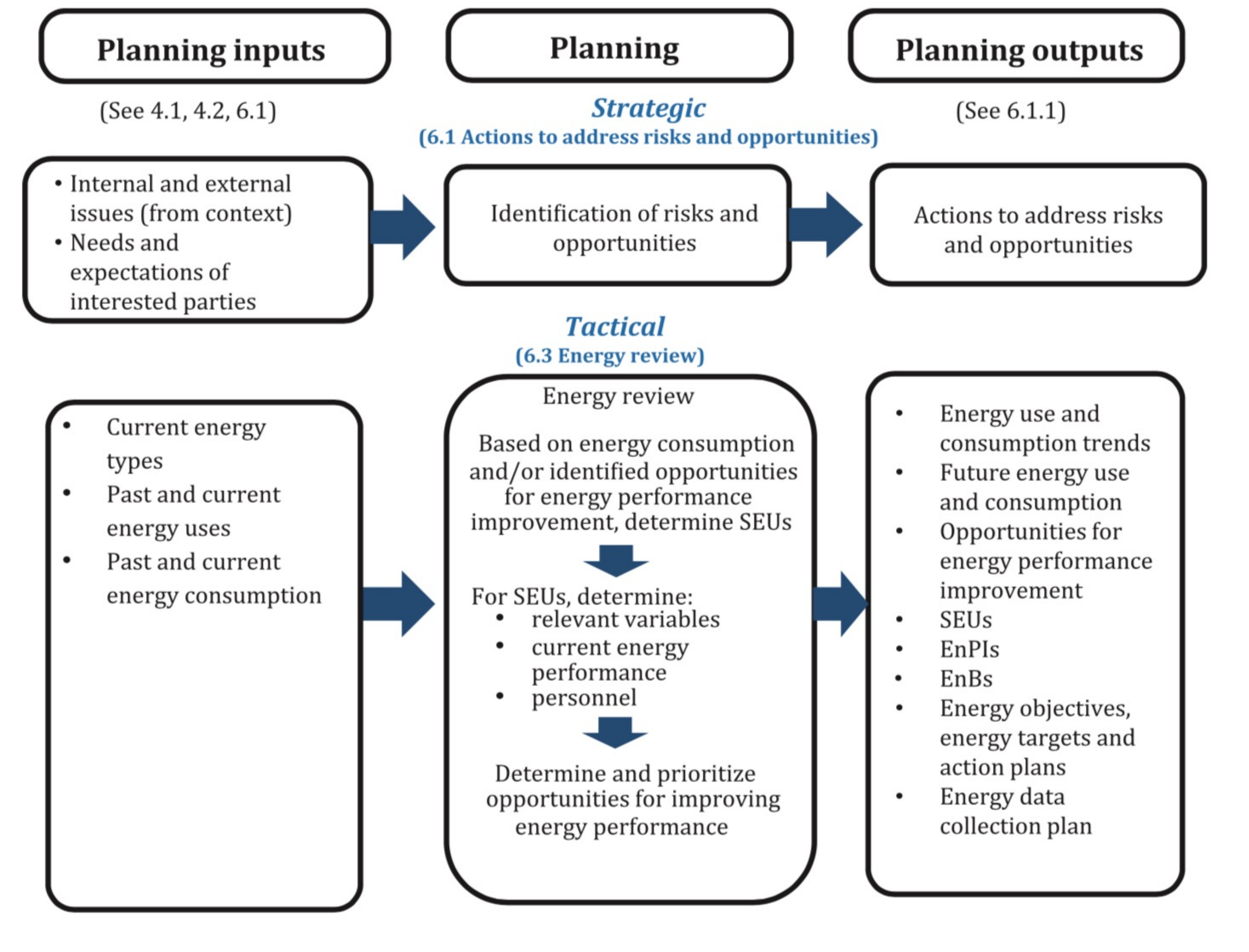
Source:ISO 50001

ENERGY PLANNING PROCESS



EnMS Standard

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What are the benefit for using ISO 50001 standard?

Identify the opportunity for reducing energy use

Assists you in putting appropriate operational control in place

Help you to be better compliance with legal and other requirement

Force you to understand you current energy usage and its related cost. And more important, reduce your energy cost and consumption

Improve your energy performance

Help you to gain management support and will help you explain to all the staff their role and responsibility

It will enable you to put into practice procedures and process to improve your design and procurements efforts in relationships to energy managment

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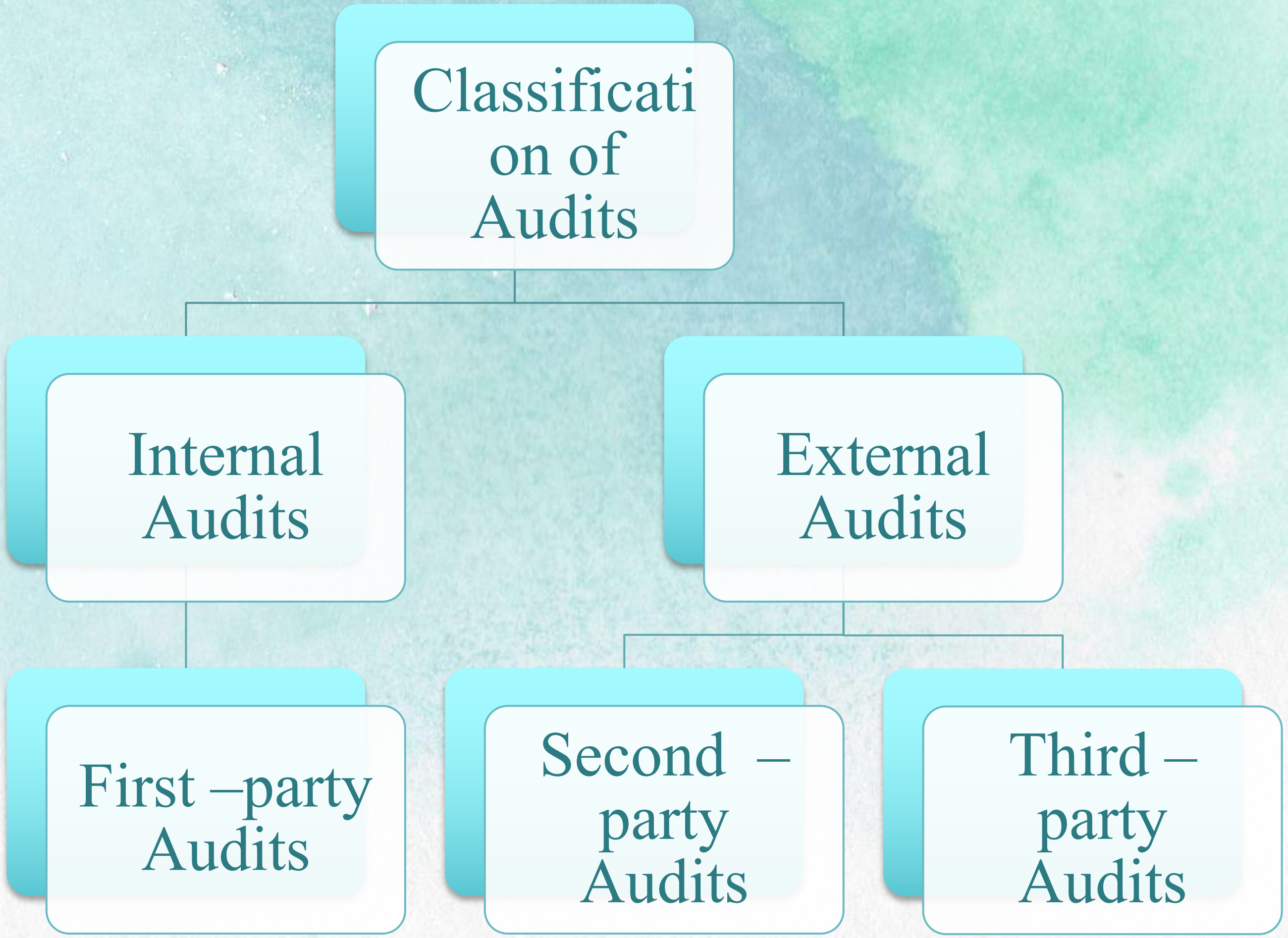
FOCUS AUDITS

Classifications of Audit



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FOCUS AUDITS

Product audit

Product audit is an examination of a particular product or service to evaluate whether it conforms to requirements

Process audit

Process audit is performed to very that processes are working within established limits. Th a audit method od following process steps is a process audit technique.

System audit

System audit is an examination of a management system

Desk audit or Document review. Focuses on documents review.

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FOCUS AUDITS: What is the difference between certification, registration, and accreditation?

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Certification & Registration:

•Used interchangeably to verify an organization's management systems against standards or requirements.

•Certification also involves validating and verifying individual credentials, such as auditors.

Accreditation:

•Refers to the process of validating that a Certification Body meets national and/or international criteria.

Certification Body (Registrar):

•A third-party company that evaluates an organization's conformance to standards and issues a certificate of conformance when appropriate.

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PORT ENVIRONMENTAL REVIEW SYSTEM (PERS)

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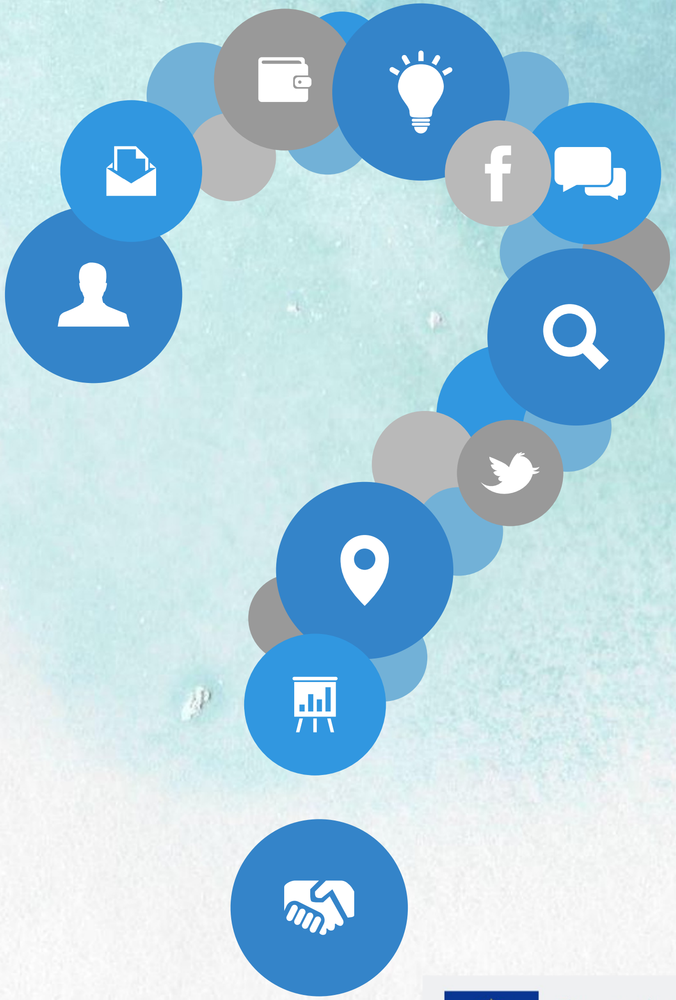
What is PERS?



- Port sector specific environmental management standard
- Developed by ports, for ports
- Incorporates the ISO 14001 concept

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PORT ENVIRONMENTAL REVIEW SYSTEM (PERS)

THE STRUCTURE

✓Port Profile
✓Environmental policy statement
✓Register of environmental aspects, legal requirements and performance indicators
✓Documented responsibilities and resources related to environmental aspects
✓Conformity review on legal requirements
✓Environmental Report
✓Selected examples of best practice

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PORT ENVIRONMENTAL REVIEW SYSTEM (PERS)

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This is the basic ECOPORTS environmental management system.

I. To implement this system it is required , amongst others, to formulate an environmental port policy, to make a description of how environmental management is implemented in the port organisation and to make an overview of environmental aspects that are seen in the whole port area.

II. Certification is possible after the validation of your results by an independent auditor, Lloyd's Register.

III. Once PERS is implemented, the port can apply for ECOPORTS PERS certification.

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PORT ENVIRONMENTAL REVIEW SYSTEM (PERS) BENEFITS

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PERS is designed to help with:

- Cost saving and improved management control
- Compliance with legislation
- Fair competition
- Meeting customer expectations
- Improved environmental performance
- Raising awareness and motivating personnel
- Integrating the elements of EMS
- Monitoring the quality of management and environmental performance

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PORT ENVIRONMENTAL REVIEW SYSTEM (PERS)

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✓Based on internationally recognized, best practice – but has been developed by ports – for ports

✓The PERS approach defines a European port sector standard of best practice for reviewing and reporting on significant aspects of port environmental management

✓It provides recognized building blocks for ports wishing to progress toward more comprehensive systems such as ISO 14000 or EMAS

✓Includes the option of voluntary application for a Certificate of Verification based on external, independent review

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Initiatives in EU Ports

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Case studies on successful continuous improvement initiatives in EU ports

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- European ports are not just adapting to global challenges but are leading the way in sustainable and socially responsible port management.
- By integrating cutting-edge innovation, environmental consciousness, and community engagement, these ports are setting benchmarks for others to follow.
- Their efforts underscore the importance of continuous improvement and the role ports can play in advancing both economic recovery and environmental sustainability.

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Port of Rotterdam

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- Energy Transition: Rotterdam is actively working towards becoming a carbon-neutral port by 2050.

- Its initiatives include the installation of shore power systems to reduce emissions from docked ships and the development of a Green Hydrogen Hub powered by renewable energy.

- These efforts not only aim to reduce the port's carbon footprint but also attract new green energy companies to the region.

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Port of Rotterdam PERS

Port of Rotterdam

Port Environmental Review System (PERS)

PERS reapplication for the port of Rotterdam, July 2015

ECOPORTS FOUNDATION

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Port of Rotterdam – (PERS)

1.1 Port of Rotterdam Authority & Corporate Social Responsibility

The Port of Rotterdam Authority ('PoR') regards Corporate Social Responsibility (CSR) as the key to a successful future. The port is following a course of balanced development. We are convinced that CSR is a crucial precondition for a healthy development of the port in harmony with the surrounding area. Investing in sustainability, commitment and transparency is necessary and will lead to a world class port and prosperous future for the region and its hinterland.

Since 2009, we integrated the report of the executive board and the CSR report in one integrated annual report. We chose to do so because CSR is an integral part of our business operations (where possible we integrate the corporate governance code as well).
The Port Environmental Review System (PERS) fits nicely into our ambition to be transparent regarding our environmental ambitions and results we achieve and to inspire other port to do the same.

1.2 Aim of PERS

The Port Environmental Review System (PERS) is primarily designed to assist ports to implement an environmental management programme in line with the recommendations of ESPO. The ESPO Environmental Code of Practice (2004) recommends that ports should:

- contribute to the development of a sustainable logistics chain;
- encourage wide consultation, dialogue and cooperation with relevant stakeholders at local level (port users, public, NGOs);
- generate new knowledge and technology and develop sustainable techniques which combine environmental effectiveness and cost efficiency;
- enhance cooperation between port administrations in the field of environment, facilitate the exchange of experiences and implementation of best practices on environmental issues;
- prepare a publicly available environmental policy to increase awareness of environmental concerns and integration of sustainable development;
- conduct appropriate environmental impact assessments for both port projects and port development plans;
- stimulate continual improvement in the port environment and its environmental management;
- promote monitoring, based on environmental performance indicators, in order to measure objectively identifiable progress in environmental port practices;
- promote environmental reporting as a means of communicating environmentally good behavior to stakeholders;
- intensify the communication about environmental improvements achieved by ports.

Port of Antwerp

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- Environmental Performance: Antwerp's environmental strategy is characterized by incremental projects like EcoCombis, which reduces CO_2 emissions by increasing freight transport efficiency, and ‘Antwerp Removes Waste,’ a comprehensive waste management program.

- The port has also created green spaces to improve air quality and support local wildlife, highlighting its commitment to environmental sustainability.

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Port of Lisbon

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- **Social Performance and Community Engagement:** Lisbon's port focuses on social inclusion and workforce development through its 'Blue Growth' strategy, which includes initiatives like the Port Academy for training in new technologies and sustainable practices.

- The port also engages with the local community and authorities to ensure its activities align with broader societal goals, enhancing social cohesion and worker satisfaction.

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