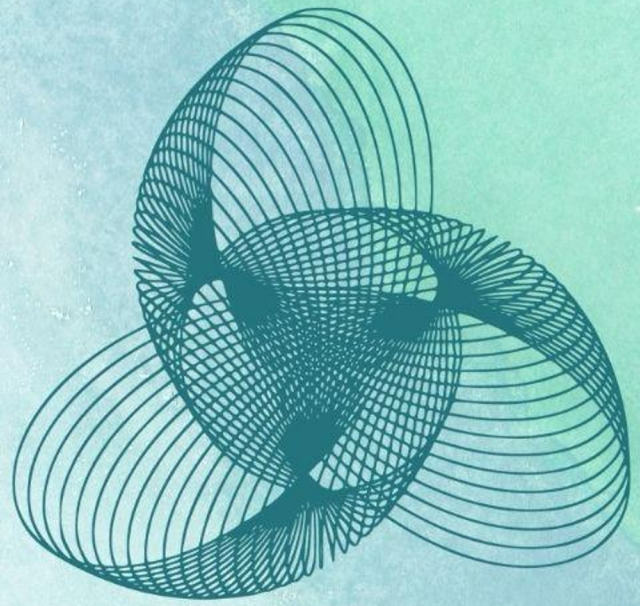

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the Sustainability EducationAl programme for greeNER fuels and enerGY on ports

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Module #8: Evaluating the energy and environmental performance of ports PART 2

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Terminologies

- **ESG:** Environment, Social and Governance
- **KPI:** Key Performance Index
- **LCA:** Life Cycle Assesment

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Introduction

Course contents:

PART 1
- Key concepts about ESG
- ESG in ports: application in port of ESG concept and goals
- ESG KPIs and Energy performance evaluation

PART 2
- E=Environment - the Life Cycle Assessment (LCA)
- LCA applied in ports
- Transparency and Traceability

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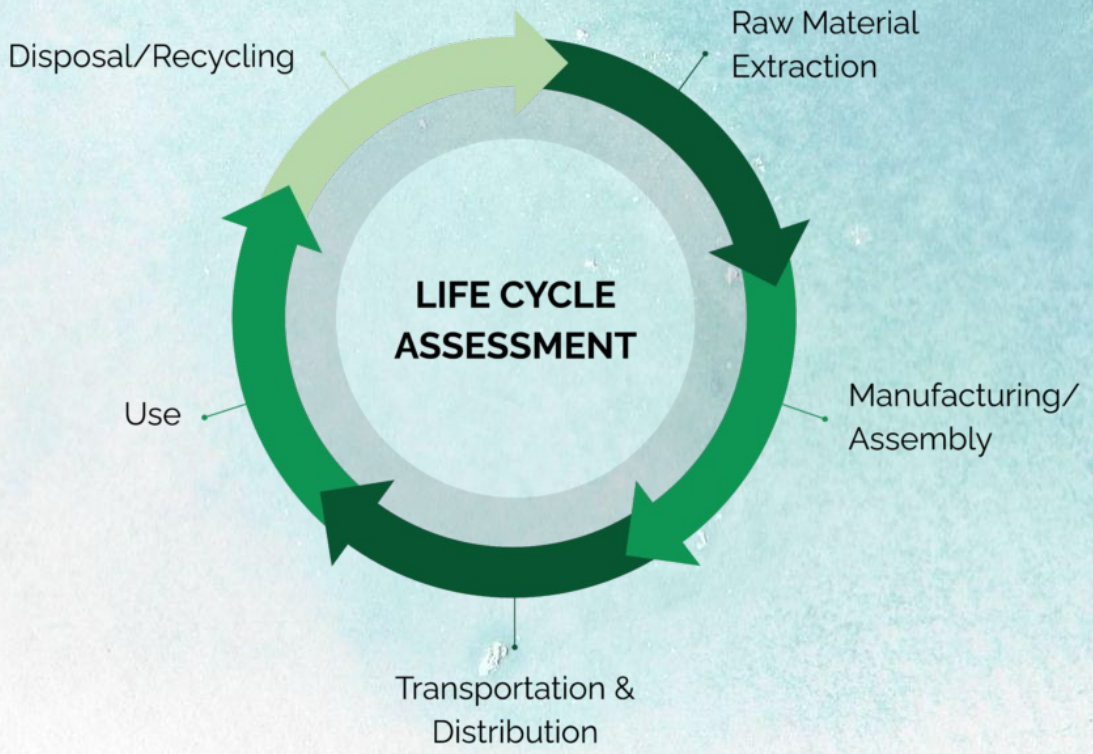
What is LCA?



Life Cycle Assessment is a systematic process used to **evaluate the environmental impacts** of a product, process, or service throughout its entire life cycle. The life cycle includes all stages from raw material extraction (cradle) through manufacturing, distribution, use, and disposal or recycling (grave).

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Advantages of performing an LCA

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Life Cycle Assessment (LCA) offers numerous benefits by providing scientifically-based environmental information that helps in:

Identifying opportunities to improve environmental performance: LCA insights can drive enhancements in product development and environmental communication.

Informing decision-making in policy and business: It supports evidence-based policymaking and strategic planning.

Supporting communication and marketing strategies: Marketing teams can use factual data for sustainability communications.

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Advantages of performing an LCA

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Examples of LCA applications include:

- **Product Designers:** They can explore how design choices affect product sustainability.
- **Policy-Makers:** They can compare environmental impacts to make informed decisions.
- **Sustainability Managers:** They can assess their portfolio to achieve carbon footprint goals.
- **Marketing Teams:** They can utilize factual data for sustainability communications.
- **Purchasing Departments:** They can identify suppliers with the most sustainable products and methods.

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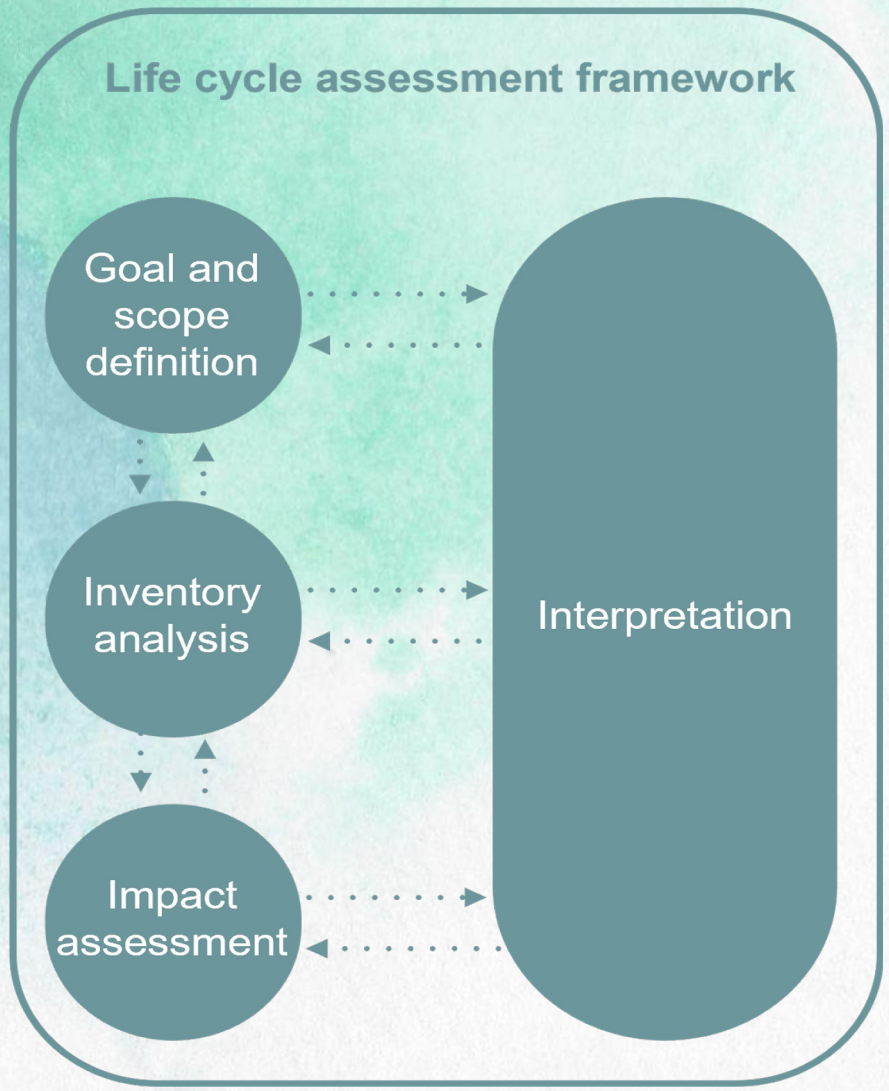
LCA Methodology

LCA is a standardized methodology, ensuring its reliability and transparency. The International Organization for **Standardization (ISO)** provides guidelines for LCA through **ISO 14040** and **14044**. These standards outline the four main phases of an LCA:



https://pre-sustainability.com/articles/life-cycle-assessment-lca-basics/

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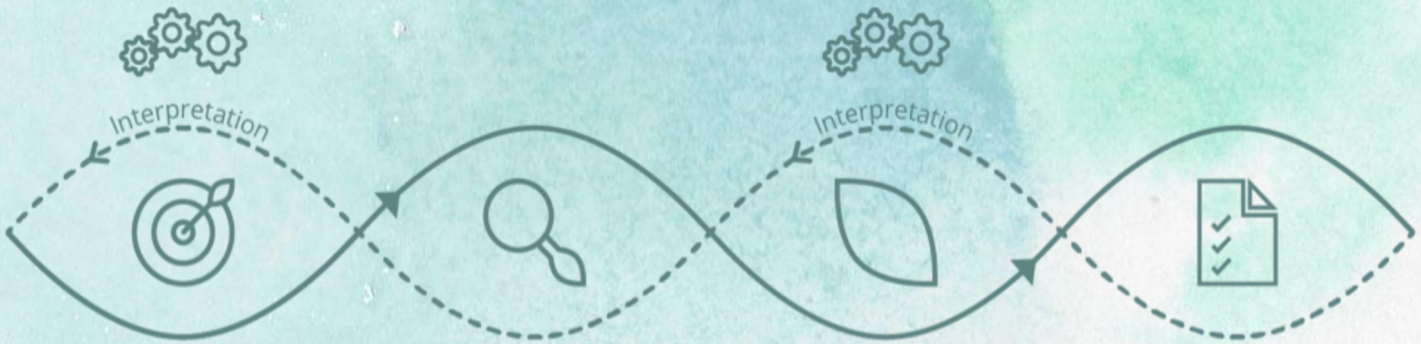
LCA Methodology

LCA is an iterative methodology, where you refine your analysis as you progress. Additionally, the results of the assessment or your interpretation might prompt you to revise your goal and scope. In this way, each LCA provides valuable business insights and guides future assessments, enhancing learning and decision-making.



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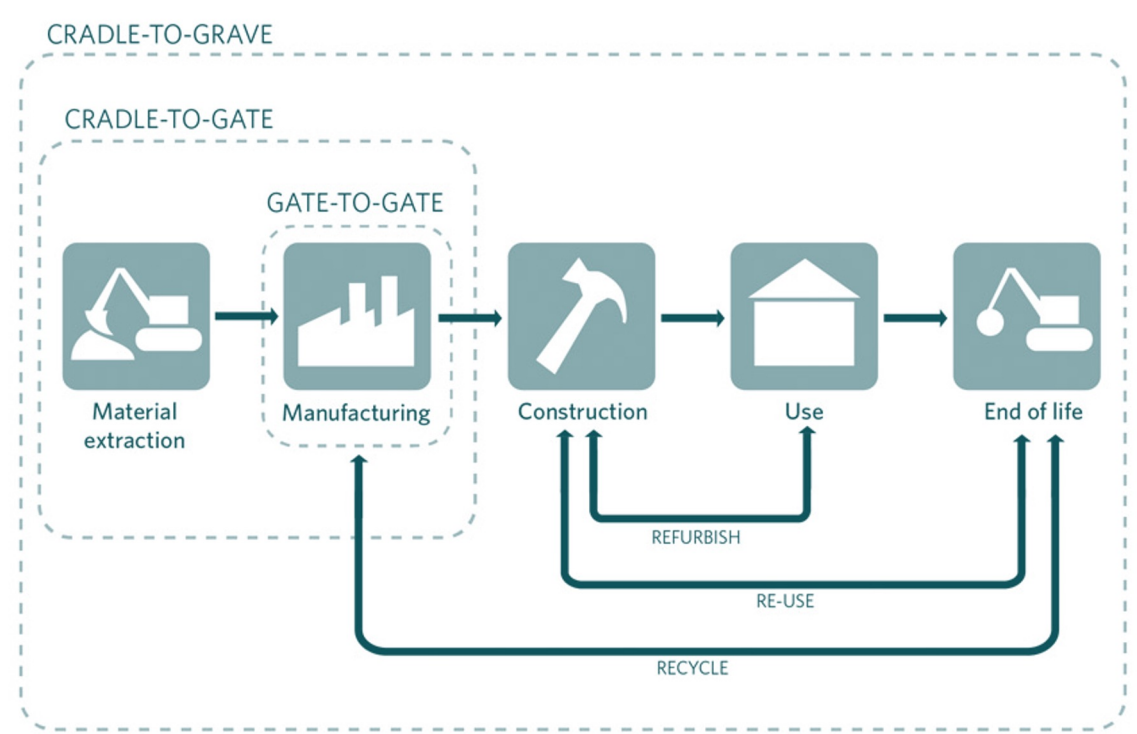
LCA Methodology

With LCA, you can assess your product or service's environmental effects at any stage, from beginning to end. There are different scopes for LCA:

- **Cradle to Gate:** From raw materials to the factory gate.
- **Gate to Gate:** Focusing solely on the manufacturing processes.
- **Cradle to Grave:** From raw materials to disposal.



Adapted from K. Simonen, Life Cycle Assessment

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LCA Methodology

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Goal and scope

The goal and scope definition is the first and foundational step in LCA, outlining the study's purpose and boundaries to ensure consistency. An LCA models a product, service, or system life cycle, simplifying complex realities, which can introduce distortions. To minimise these, it's crucial to carefully define the goal and scope, which includes subjective choices like the reason for the LCA, precise product definitions, and system boundaries. These boundaries determine what is included or excluded from the assessment, such as omitting minor ingredients with minimal impact.

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LCA Methodology

Inventory

In the second step, inventory analysis of extractions and emissions, you examine all environmental inputs (like raw materials and energy) and outputs (such as pollutants and waste) associated with a product or service. This process provides a comprehensive **life cycle inventory (LCI)**, focusing on collecting and accurately modelling relevant data through these **inputs and outputs.**

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LCA Methodology

Impact assessment

In the life cycle impact assessment (LCIA), you evaluate the potential environmental impacts identified in the inventory analysis. This step helps you understand sustainability challenges and make informed business decisions. **You classify and translate environmental impacts into themes such as global warming and human health.** A key decision is whether to present results as a single sustainability score or in detailed categories (e.g., CO2 emissions and land use) based on your audience's needs and ability to understand the results.

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LCA Methodology

Interpretation

The interpretation phase concludes the assessment by reviewing and substantiating the conclusions. ISO 14044 outlines several checks to ensure the data and procedures used to support your conclusions. This thorough review allows you to confidently share your results and improvement decisions with the world, minimising the risk of any surprises.

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LCA applied in ports

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Applying Life Cycle Assessment (LCA) in ports involves evaluating the environmental impacts of various activities and processes associated with port operations. This comprehensive analysis helps port authorities and stakeholders identify opportunities for improving environmental performance and sustainability.

Goal and Scope Definition

- **Purpose:** Determine the LCA's primary objective, such as reducing emissions, improving energy efficiency, or assessing overall environmental performance.
- **Boundaries:** Define the system boundaries to include activities like cargo handling, transportation, energy use, waste management, and infrastructure maintenance.

Inventory Analysis

- **Inputs:** Collect data on inputs such as fuel, electricity, water, and raw materials used in port operations
- **Outputs:** Gather information on outputs including emissions (CO2, NOx, SOx), wastewater, solid waste, and other pollutants.

Impact Assessment

- **Classification:** Classify environmental impacts based on categories like global warming potential, air and water pollution, resource depletion, and ecosystem impacts.
- **Characterization:** Quantify the potential impacts using standardized metrics and models

Interpretation

- **Analysis:** Review and interpret the results to identify significant environmental impacts and areas for improvement.
- **Recommendations:** Develop actionable strategies for reducing negative environmental impacts, enhancing energy efficiency, and promoting sustainable practices.

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Benefits of LCA in Ports

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Environmental Performance: Helps identify and mitigate significant environmental impacts, leading to improved sustainability.

Stakeholder Communication: Provides transparent and credible information for stakeholders, including regulatory bodies, customers, and the community.

Regulatory Compliance: Assists in meeting environmental regulations and standards.

Strategic Planning: Supports informed decision-making for long-term sustainability initiatives and investments.

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Examples of LCA Application in Ports

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Energy Use: Assessing the environmental impacts of energy consumption in port operations and identifying opportunities for renewable energy integration.

Emissions Reduction: Evaluating emissions from port machinery, ships, and vehicles to develop strategies for reducing air pollution.

Waste Management: Analysing waste generation and disposal processes to improve recycling and waste reduction efforts.

Infrastructure Development: Assessing the life cycle impacts of constructing and maintaining port infrastructure to ensure sustainable development practices.

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Example Syros and Valencia Port's LCI

Life Cycle Inventory Template

Port:	
Location	
Country :	
City:	
Area km2	

Responsible to fill out the template:	
Email:	

This section is refered to the energy and fuel consumption for the logistic and maintenance in the ship-port interface. Taking into account, boats, security
For these section, the template must fill out with the docks equipment and consumption.
It will be divided by Fuel and Energy

Fuel

Please for the next sectors fill the suppliers and their specific product, inversion and life time use
In consumption section please fill out per 1 unit

	SOURCE	QUANTITY	TYPE OF FUEL	January	unit	February	unit
Example	Tugboats	5	Diesel, low-sulfur	200	l	250	l
	Patrol boats	2	Diesel, from coal	150	l	200	l
	Boiler	3	Natural gas	20	m3	25	m3

Energy consumption

*this could be a section of general lightning

	SOURCE	QUANTITY	ENAERGY SOURCE	January	unit	February	unit
Examples	street lamps *	80	photovoltaic	200	Wh	220	Wh
	Motors	6	Electricity from biomass	150	kWh	200	kWh
	Cranes	8	electricity from country	400	kWh	500	kWh
	Security		electricity from country	252	kWh	300	kWh

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Example Syros and Valencia Port's LCI

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Inputs

- Ferries
- Cruise ships
- Commercial and private vessels
- Commercial, private and small vessels for fishing
- Lightning
- Building and Facilities
- Touristic boat pillars
- Auxiliary systems
- Vehicles and heating in buildings

Marine Diesel

Electricity

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Example Syros and Valencia Port's LCA

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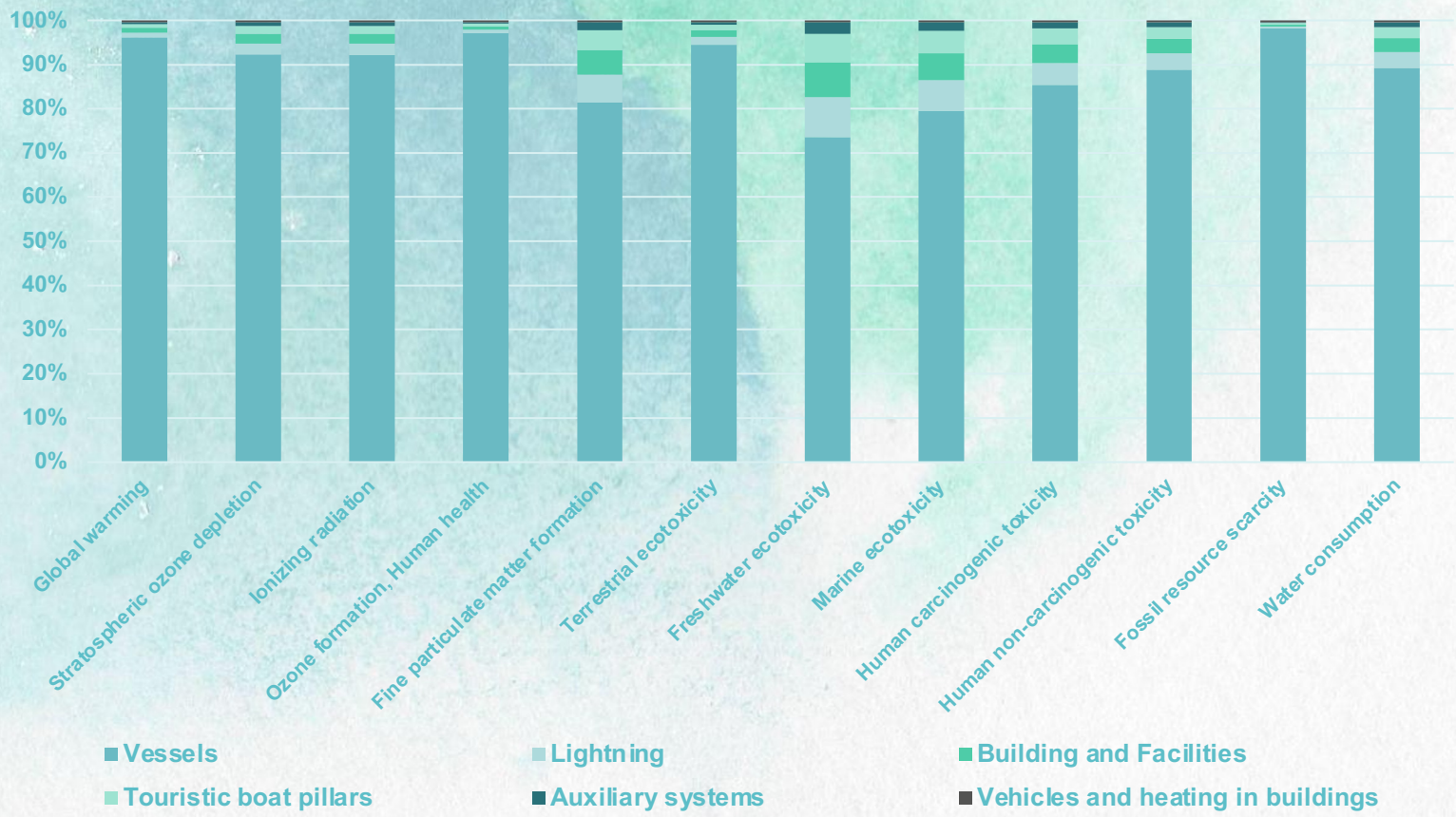
Impact Assessment SimaPro Software



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Example Syros and Valencia Port's LCA

Demo port/LCA´s variables	Port of Valencia	Port of Syros
Functional Unit	1 TEU	1 SHIP
Main operational equipment responsible for CO2 emissions	Tugboats, Commercial Vessels, Trucks	Commercial Vessels (Cargo & Passengers)
Type of fuel	Marine Gas Oil (MGO) and Diesel	Marine Gas Oil (MGO)
CI (CO2 emissions)	15,740.3 Ton CO2	3,000 Ton CO2
LCIA (CO2 emissions)	Global Warming (7.94 kg CO2) SimaPro	Global Warming (678.4 kg CO2) SimaPro
Total CO2 emissions	50,367 Ton CO2	9,618 Ton CO2
CO2 emissions reduction strategy	Replace the use of MGO with LNG	Replace the use of MGO with LNG
Total CO2 emissions reduction	40,939 Ton CO2	7,248 Ton CO2
Total CO2 emission reduction (%)	19%	25%

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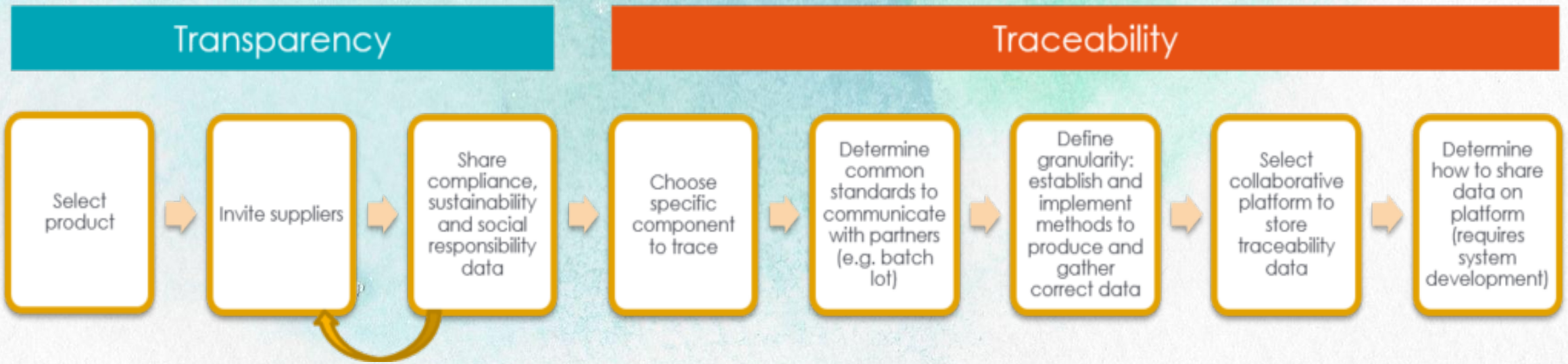
Transparency and Traceability

Transparency and traceability are essential for ensuring that products are ethically sourced, sustainably produced, and safely delivered to consumers. These concepts are critical for supporting sustainable business development in supply chains worldwide.



Source: https://www.transparency-one.com/es/transparency-vs-traceability-whats-the-difference/

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Transparency and Traceability

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Transparency: Mapping the supply chain

Transparency **captures high-level information** regarding a supply chain: a product's components, names of suppliers, locations of facilities, associated certifications, etc. Through transparency, businesses can identify all suppliers for all the components in a product, down to the source, and capture specific information related to these suppliers—such as a facility's certifications, certifying body, expiration date, and even a copy of the certification itself. Implementing the tools necessary to achieve transparency can be done with a relatively low impact on existing processes and systems. Once the right solution is found, it can be used for all product types and easily scaled up to meet the needs of global supply chains. ***To sum up: Transparency = Show***

Traceability: Capturing granular data

Traceability in supply chain management is about **capturing granular data**, such as batch-lot data (catch/harvest date, field data, etc.), purchase order (PO) data, and other operational information. The focus is less on mapping the entire end-to-end supply chain but on following certain batches of components or purchase orders as they move through the supply chain. This approach is particularly useful when a recall is necessary. The ability to identify a specific impacted batch of components can greatly reduce the overall scale of the recall, demonstrating the practical value of traceability. ***To sum up: Traceability = Know***

Source: https://www.transparency-one.com/es/transparency-vs-traceability-whats-the-difference/

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Transparency and Traceability

Transparency:

Key elements	Benefits
Visibility: Clear, real-time visibility into every stage of the supply chain	**Trust Building:** Enhances consumer trust and brand loyalty by demonstrating ethical and sustainable practices.
Disclosure: Open sharing of information about sourcing, production practices, environmental impacts, and labor conditions.	**Risk Management:** Helps identify and mitigate risks related to unethical practices, regulatory non-compliance, and supply chain disruptions.
Communication: Regular updates and reporting on supply chain activities and performance metrics.	**Competitive Advantage:** Differentiates companies in the market by showcasing commitment to transparency and sustainability.
Accountability: Establishing mechanisms for stakeholders to hold companies accountable for their supply chain practices.	

Traceability:

Key elements	Benefits
Data Capture: Involves collecting detailed information at each step of the supply chain, including raw material extraction, processing, manufacturing, distribution, and retail.	**Quality Control:** Enables precise tracking of product quality and origin, allowing quick response to quality issues.
Unique Identification: This involves assigning unique identifiers to products and components using barcodes, RFID tags, QR codes, or blockchain technology.	**Regulatory Compliance:** Ensures compliance with regulations and standards related to product safety, environmental impact, and labor practices.
Data Integration: Ensuring seamless integration and data sharing across all supply chain partners.	**Sustainability:** Promotes sustainable practices by tracking and verifying products' environmental and social impacts.
Verification and Validation: Regularly auditing and validating data to ensure accuracy and authenticity.	

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Transparency and Traceability

Implementation:

Advanced technologies: - Blockchain - IoT devices - AI	**Collaborative platforms** Platforms that enable seamless information sharing and collaboration among supply chain partners.	**Standardisation** (e.g. ISO 9001, ISO 14001)	**Policy development** Establishing clear policies and guidelines for data transparency and traceability within the organization	**Stakeholder engagement** Engaging with stakeholders to understand their expectations and concerns regarding supply chain transparency and traceability.

Challenges And solutions:

Data Silos: Disparate systems and lack of integration can create data silos, hindering visibility and traceability.	**Cost**: Implementing advanced tracking technologies and systems can be costly.	**Complexity**: Managing and analyzing large volumes of data from diverse sources can be complex.	**Data Privacy**: Ensuring data privacy and security while maintaining transparency is challenging.
Integration Platforms: Use integration platforms that connect disparate systems and enable seamless data sharing.	**Scalable Solutions**: Implement scalable solutions that can grow with the organization and adapt to changing needs.	**Data Analytics**: Leverage data analytics tools to manage and analyze large datasets effectively.	**Robust Security Measures**: Implement robust security measures to protect data privacy and integrity.

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Example Syros and Valencia Port's LCA

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Implementing Life Cycle Assessment (LCA) in the demo ports of Syros and Fundación Valencia allowed us to identify major sources of environmental impact, particularly related to energy and fuel use. By adhering to ISO 14040-44 guidelines and using ReCiPe 2016 Midpoint methods, we found that diesel-powered sources at the Port of Valencia account for about 70% of CO2-eq emissions per TEU, while marine diesel is the primary emitter at Syros Port.

The LCA analysis highlighted the need for strategies to reduce carbon footprint and greenhouse gas emissions. For Valencia, this may involve **improving operational efficiency and adopting renewable energy.** For Syros, potential measures include **route efficiency, engine maintenance, upgrades, or using renewable energy sources like hydrogen or natural gas.**

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Conclusions LCA in ports

Learning objectives n° 4 & n° 5: learn how to apply and understand the principles, methodologies, and tools of LCA in port operations, analysing the Seanergy project case study to understand the LCA methodology application.

> Identification of Major Emission Sources

Life Cycle Assessment (LCA) effectively identifies the primary sources of environmental impact in port operations. In the case of the Port of Valencia, diesel-powered sources such as commercial vessels, RTG cranes, terminal tractors, and trucks constitute around 70% of CO2-eq emissions per TEU. Similarly, at Syros Port, marine diesel used by vessels is the major contributor to CO2-eq emissions per ship. This identification helps in targeting specific areas for emission reduction efforts.

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Conclusions LCA in ports

Learning objectives n° 4 & n° 5: learn how to apply and understand the principles, methodologies, and tools of LCA in port operations, analysing the Seanergy project case study to understand the LCA methodology application.

> Opportunities for Emission Reduction:

The LCA process reveals significant opportunities to reduce carbon footprint and greenhouse gas emissions. For instance, the Port of Valencia can achieve reductions through increased operational efficiency and adopting renewable energy sources. At Syros Port, strategies such as improving route efficiency, maintaining engines, upgrading vessels, or transitioning to renewable energy sources like hydrogen or natural gas can be effective. These insights provide actionable steps to enhance the sustainability of port operations.

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Conclusions LCA in ports

Learning objectives n° 4 & n° 5: learn how to apply and understand the principles, methodologies, and tools of LCA in port operations, analysing the Seanergy project case study to understand the LCA methodology application.

Guidance for Strategic Decision-Making:

LCA provides a comprehensive framework for port authorities and stakeholders to make informed decisions. By adhering to ISO 14040-44 guidelines and utilising established LCIA methods like ReCiPe 2016 Midpoint, ports can ensure the relevance and accuracy of their environmental impact assessments. This robust analysis supports the development of strategic initiatives aimed at mitigating environmental impacts, promoting sustainability, and complying with regulatory requirements. It also aids in effectively communicating environmental performance and improvement measures to stakeholders.

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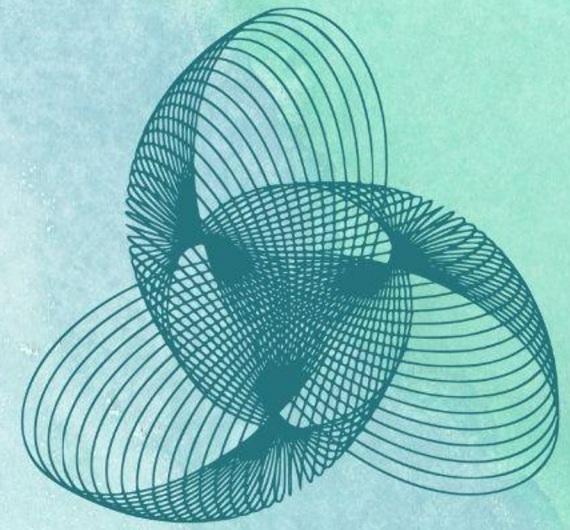

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