SMARCO

SMARt COmmunities Skills Development in Europe

Promotion of Innovative Infrastructure Design

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Unit 1

Life Cycle Assessment

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Module - Aim and Objective

- **Evaluate** and select sustainable technologies and materials for infrastructure development projects.
- **Consider** adaptive organizational frameworks that enhance operational resilience and efficiency.
- **Analyse** the lifecycle performance of physical structures to optimize maintenance strategies.
- **Integrate** cutting-edge digital solutions to improve infrastructure functionality and monitoring.

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Module - Content

The aim of this module is to provide a **comprehensive understanding of key sustainability concepts** within the context of smart communities.

The module explores **Life Cycle Assessment (LCA), energy management**, **and waste management**, focusing on how these approaches can support informed decision-making and enable more efficient, sustainable, and resilient community systems.

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Unit 1 - Aim and Objective

In the first unit of this module, the foundational concepts of **Life Cycle Assessment (LCA)** and **Life Cycle Thinking (LCT)** will be introduced.
The unit will outline the purpose and methodology of LCA, as well as the broader perspective offered by LCT in evaluating environmental impacts across the entire life span of products, services, and systems.

The unit will examine the **goals** and **strategies** associated with key areas of LCT that contribute to the development of sustainable and efficient smart communities.

This will provide a framework for applying life cycle principles to support resource optimization, informed decision-making, and long-term sustainability.

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Unit 1 - Learning Outcomes

- Understand what Life Cycle Assessment (LCA) is.
- Understand what Life Cycle Thinking (LCT) is and how it can be applied in different areas.
- Identify the goals within these specific areas, and recognize strategies that can be used to achieve them.

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Unit - Content

- Life Cycle Assessment
- Life Cycle Thinking
- The thematic application areas of Life Cycle Thinking
  - Buildings
  - Energy
  - Food
  - Green Space and Landscape
  - Mobility
  - Waste
  - Urban Planning
  - Water

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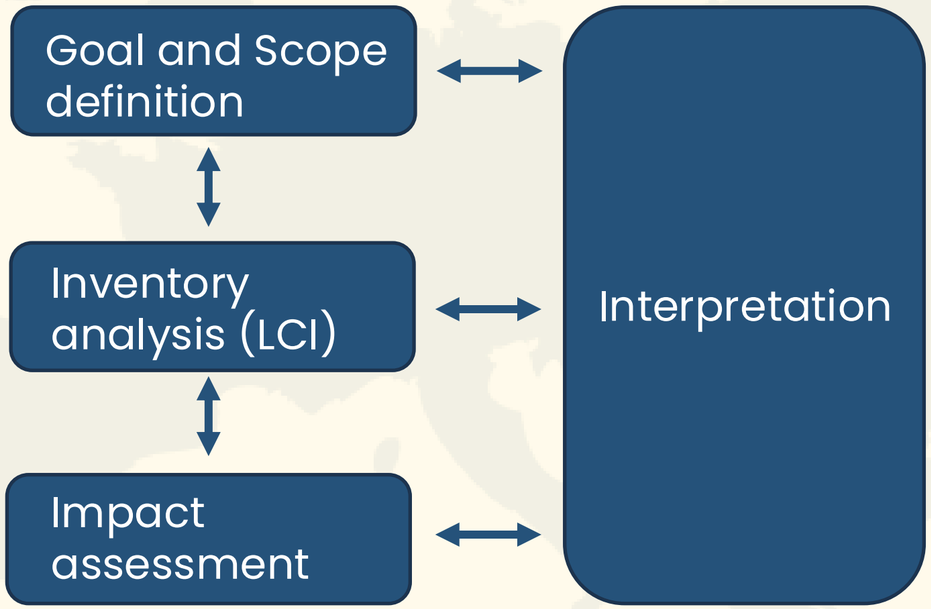
What is the Life Cycle Assessment?

Life Cycle Assessment (LCA) is a **comprehensive analytical framework** used to evaluate, quantify, and interpret the environmental implications of human activities throughout their entire life cycle.

This methodology is applicable across a wide range of sectors, including manufacturing, infrastructure, and smart city development.



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The phases of LCA

- **Goal and Scope Definition**
  Establishing the purpose of the study, its boundaries, and the intended application of the results.

- **Life Cycle Inventory (LCI) Analysis**
  Collecting and quantifying data on inputs (such as energy and materials) and outputs (such as emissions and waste) throughout the product or system's life cycle.

- **Life Cycle Impact Assessment (LCIA)**
  Evaluating the potential environmental impacts based on the inventory data, including categories such as climate change, resource depletion, and pollution.

- **Interpretation of Results**
  Analyzing and summarizing the findings to draw conclusions, identify improvement opportunities, and support informed decision-making.

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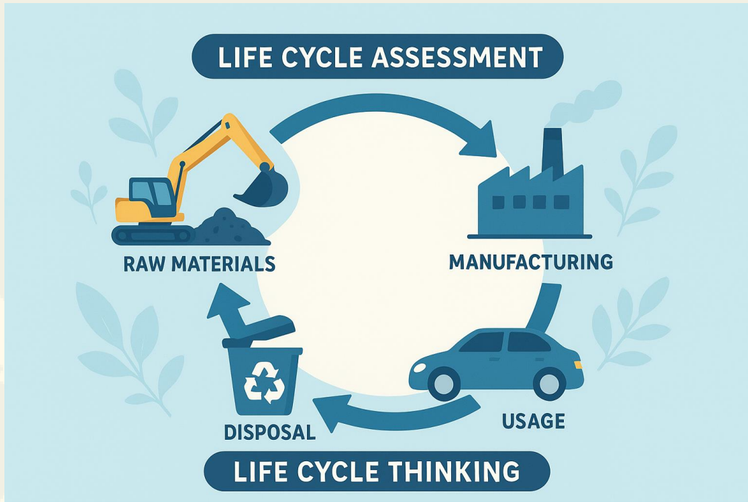
What is Life Cycle Thinking?

Life Cycle Thinking (LCT) is an approach to decision-making that builds on the principles of Life Cycle Assessment (LCA).

It involves evaluating or anticipating the environmental, economic, and social impacts of a product, process, or service throughout its entire life cycle, from resource extraction to disposal.

The **goal** of LCT is to identify opportunities for improvement and implement changes that enhance overall sustainability.



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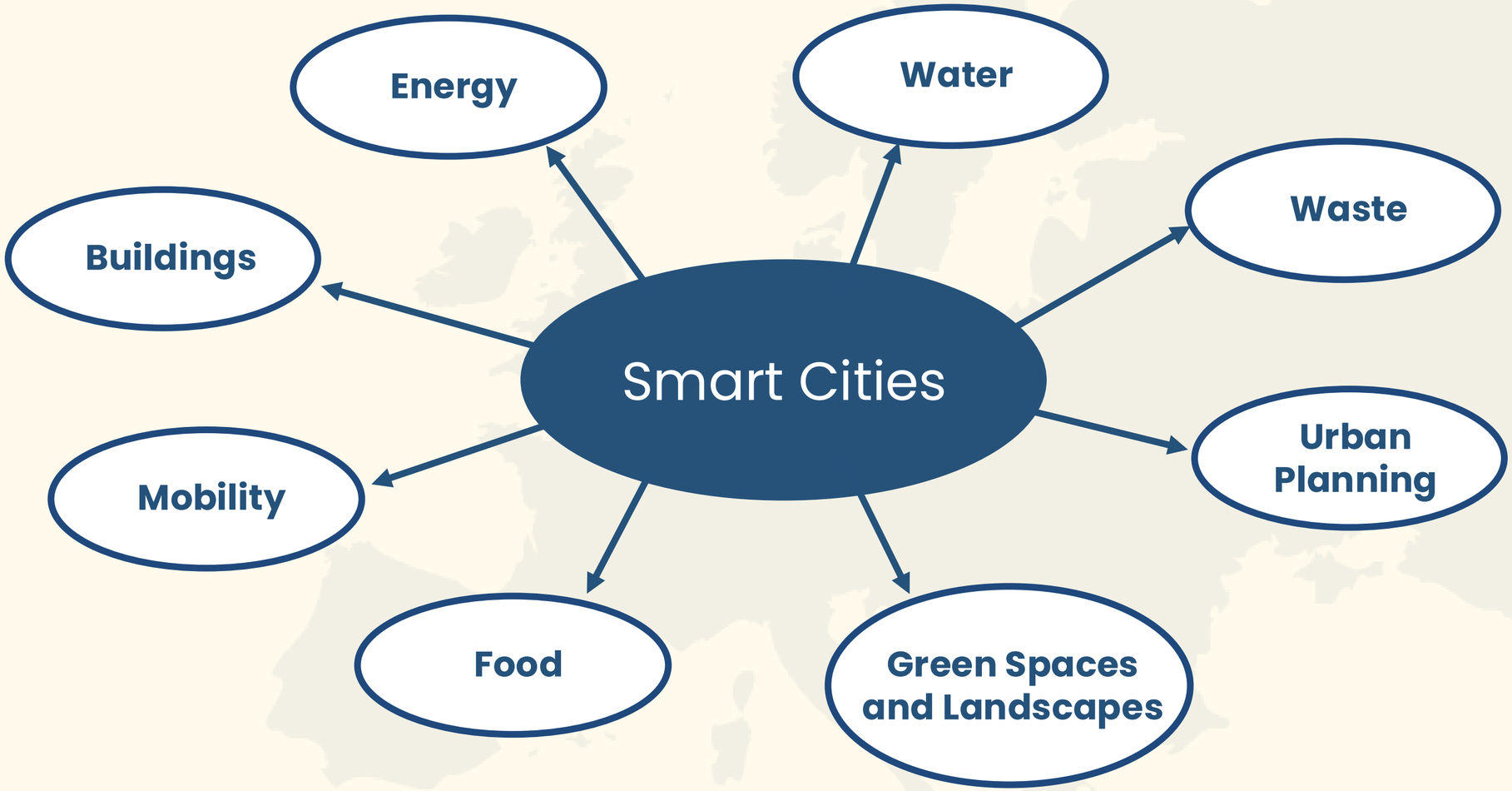
Thematic application areas LCT



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Buildings

GOAL
Improving building sectors and their contribution to urban sustainability

Strategies for Buildings

- **Efficient use of energy and other resource**
  Quantification of Energy Consumption and Environmental Impacts
  - Insulation Efficiency
  - Management of Heating and Cooling Systems
  - Selection of Building Materials
  - Impact of User Lifestyle

- **Support the Generation of Renewable Sources**
  Renewable Energy Production
  - Evaluation of the Effects of System Installation
  - Assessment of Costs and Energy Requirements for System Production

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Buildings

GOAL
Improving building sectors and their contribution to urban sustainability

Strategies for Buildings

- **Using More Sustainable Construction Materials**
  provide renewable, biodegradable, and energy-efficient alternatives
  - Kenaf Fibers
  - Cotton
  - Jute
  - Flax
  - Hemp and Cork

- **Increasing the durability of buildings**
  Refurbishing buildings
  - Improving Energy Efficiency
  - Extending Building Lifespan

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Energy

GOAL
Reduce Urban Energy Consumption and Associated Environmental Impacts

Strategies for Energy

- Transition to **Renewable Energy Sources**
- Implement **Self-Supplied Energy Systems**
- Increase **Energy Efficiency**
- Ensure Access to **Affordable Energy for All**

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Energy

Production and Consumption of Renewable Energy

- **Solar Thermal Panels and Geothermal Systems** for generating domestic hot water
- **Installation of Power Generators** such as micro wind turbines and photovoltaic (PV) panels
- **Integration of Energy Systems** to optimize efficiency and management
- **Smart Street Lighting Systems** with sensors and energy-efficient bulbs
- **Influence of User Behavior** on energy consumption
- **Interconnection with Buildings, Mobility, and Urban Planning** for holistic energy management
- **Monitoring Inflows and Outflows of People** to optimize energy demand and distribution

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Food

GOAL
Ensure Food Security and Quality for Citizens

Strategies Food

- **Building Up Urban Agriculture**
  To enhance local food production, optimize space, and foster community involvement
  - Urban Gardens for local food production
  - Rooftop Greenhouses to optimize space and extend growing seasons
  - Rooftop Community Gardens

- **Promoting Regional and Local Food Products**
  - Encourage Consumption of Regional and Local Foods
  - Reduce Reliance on Imported Products
  - Support Local Supply Chains

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Grean Space and Landscape

GOAL
Provide Access to Natural and Recreational Areas

Strategies for Green Space and Landscape

- **Increasing Urban Green Areas**
  The carbon footprint of existing green areas is quantified and assessed to determine ways to enhance carbon sequestration.
  The evaluation considers several parameters:
  - Type of Trees and Grasses used in the area
  - Density of Greenery and its spatial distribution
  - Impact of Green Management Practices, including water use, nutrient management, and maintenance
- **Foster Green Building**
  Green Roofs, Living Walls, and Green Facades
  - Function as CO_2 sequestration systems
  - Provide natural thermal insulation

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Mobility

GOAL
focus on managing horizontal growth in the city to optimize land use and urban planning

Strategies for Mobility

- **Reduce Private Car Use and Promote Alternative Transportation**
  - Implement Sharing Systems for cars and other vehicles
  - Enhance Public Transportation options and accessibility
  - Encourage Bicycles and Other Alternative Vehicles

- **Promote Efficient and Fossil Fuel-Free Vehicles**
  - Encourage the Purchase of Efficient and Green Vehicles for both public and private use
  - Apply Higher Taxes on High-Polluting Vehicles to discourage their use

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Mobility

GOAL
focus on managing horizontal growth in the city to optimize land use and urban planning

Strategies for Mobility

- **Reduce and Optimize Heavy Truck Circulation in Urban Areas**
  - Implement New Distribution Systems in the logistics sector to minimize urban traffic
  - Optimize Routes and Schedules for heavy trucks to reduce congestion and emissions

- **Increase the Use of Intelligent Transport Systems (ITS)**
  - Optimize Route Selection to improve traffic flow and reduce travel time
  - Reduce CO_2 Emissions through more efficient transportation management

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Waste

GOAL
Enhance Urban Livability and Minimize Health Impacts

Strategies for Waste

- **Improve Waste Collection and Management Systems**
  - Compare Environmental Impacts of different waste management technologies
  - Evaluate Treatment Process Impacts on the environment
  - Increase Efficiency of waste collection operations
  - Integrate Energy Recovery Processes into waste management
  - Assess Recycling Processes to maximize material recovery

- **Promote Waste Prevention**
  - Develop Plans to Reduce Waste at the source
  - Implement Food Waste Prevention Strategies
  - Evaluate Rebound Effects to ensure waste reduction measures are effective

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Urban Planning

GOAL
Optimize Urban Functionality

Strategies for Urban Planning

- **Promoting Sustainable Urban Development**
  - Encourage Conscious Land and Transportation Use in planning and decision-making
  - Implement Compact Urban Models to optimize land use and reduce sprawl
  - Support Regional Planning for coordinated and sustainable growth
  - Advance Sustainable Urbanism to create environmentally friendly, resilient, and livable cities

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Water

GOAL
Provide Safe and Reliable Water Access to Urban Populations

Strategies for Water

- **Upgrade Water and Sewer Networks**
  To enhance efficiency and reliability
- **Implement Retrofit Systems**
  For modernization and improved performance
- **Enhance Urban Water Retention**
  To reduce flooding and optimize resource use
- **Promote Alternative Water Flows**
  Such as rainwater harvesting or greywater reuse

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Water

GOAL
Provide Safe and Reliable Water Access to Urban Populations

Technologies and Approaches:

- **Real-Time Monitoring** using sensors and smart grids
- **GIS (Geographic Information Systems)** for spatial analysis and planning
- **Hydrologic Simulations** to model water behavior in urban environments
- **Scenario Prediction** to anticipate potential challenges and outcomes
- **Assessment of Environmental and Economic Impacts** of system implementations

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Unit completed! – What's next?

To consolidate your learning and reflect on the key concepts covered, please take a moment to complete this quiz.

Your feedback and results will help you track your progress and support continuous improvement of the training experience.

Click the link to begin the quiz!

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