New construction and renovation

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HI-SMART

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MŰEGYETEM 1782

STU SLOVAK UNIVERSITY OF TECHNOLOGY IN BRATISLAVA

TECHNISCHE UNIVERSITÄT KAISERSLAUTERN

ENERGIAKLUB CLIMATE POLICY INSTITUTE APPLIED COMMUNICATIONS

Contents

Introduction

- Represents numerous fundamental principles.
- Incorporation of green strategies at early design stage.
- **Green building**
  - More efficient in the utilization of ecologically valuable resources (energy, water, material, land)
  - More efficient in providing of healthier, more comfortable, and more productive indoor space for occupants

MORE SYMPATHETIC TO THE ENVIRONMENT

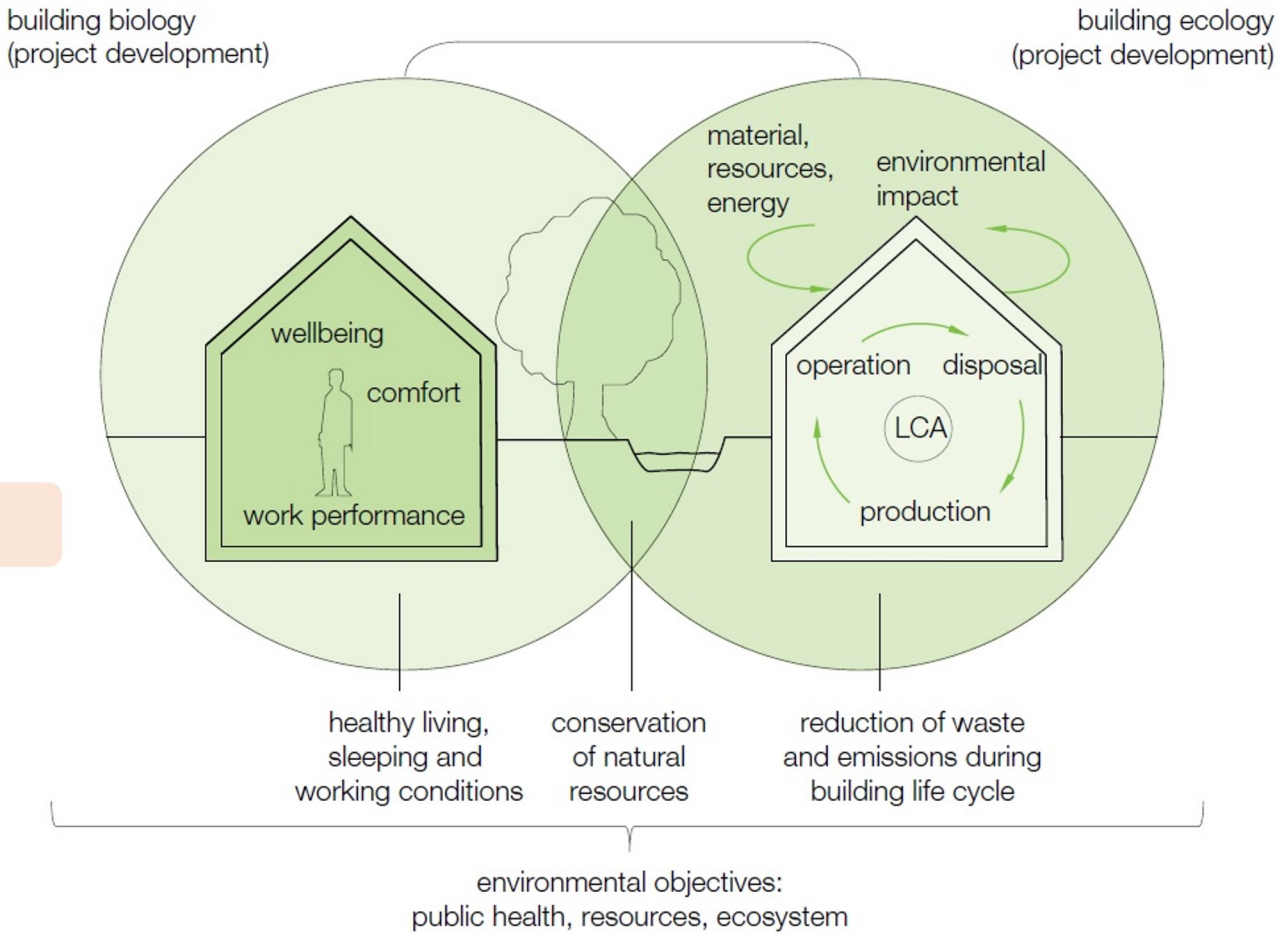
Introduction

- Aspects of a resource-saving building design with regard to different scales.

Dimension	Consistency *nature and heath-compatible design*	Sufficiency *demand analysis*	Efficiency *increase of functional performance*	Life cycle optimization *building life cycle*	 *material life cycle*
Building	reduce environmental impact during life cycle	create awareness for changes of use	increase space efficiency	reduce production through re-use	provide measures for deconstruction
Unit	use materials that are non-hazardous to health	reduce space requirements and envelope surface area (compact design)	improve design for optimised operation (reduction of operating energy; simple upkeep and maintenance systems)	neutral utilisation of space	improve durability
Room		reduce quality of fit-out		reduce repairs by introducing maintenance plan	
Component	increase proportion of renewable resources	reduce amount of technology	increase efficiency of construction	use standard dimensions	make use of prefabrication or modular systems
Material	use alternative resources	reduce detailing	increase technical performance of materials	improve project documentation	minimise material flow by choosing materials carefully

Sustainable constructions

- **Leaving buildings with sufficient value for future generations which can have similar quality for life like ours.**
- The three environmental objectives of green building :
  - **protection of public health**
  - **protection of ecosystems**
  - **protection of resources**



- Traditional and sustainability criteria for building constructions:

Traditional criteria	Sustainability criteria
• Performance • Quality • Cost	• Resource depletion • Environmental degradation • Healthy environment

Sustainable constructions

The issues of sustainable construction:

Resources	• Energy consuption • Water use • Land use • Materials selection
Healthy environment	• Indoor environmental quality • Exterior environmental quality
Design	• Building design • Community design
Environmental effects	• Construction operations • Life cycle operation • Deconstruction

Technical criteria for materials selection:

- **Embodied energy content**
- **Greenhouse warming gases**
- **Toxics generated/content**

Sustainable constructions

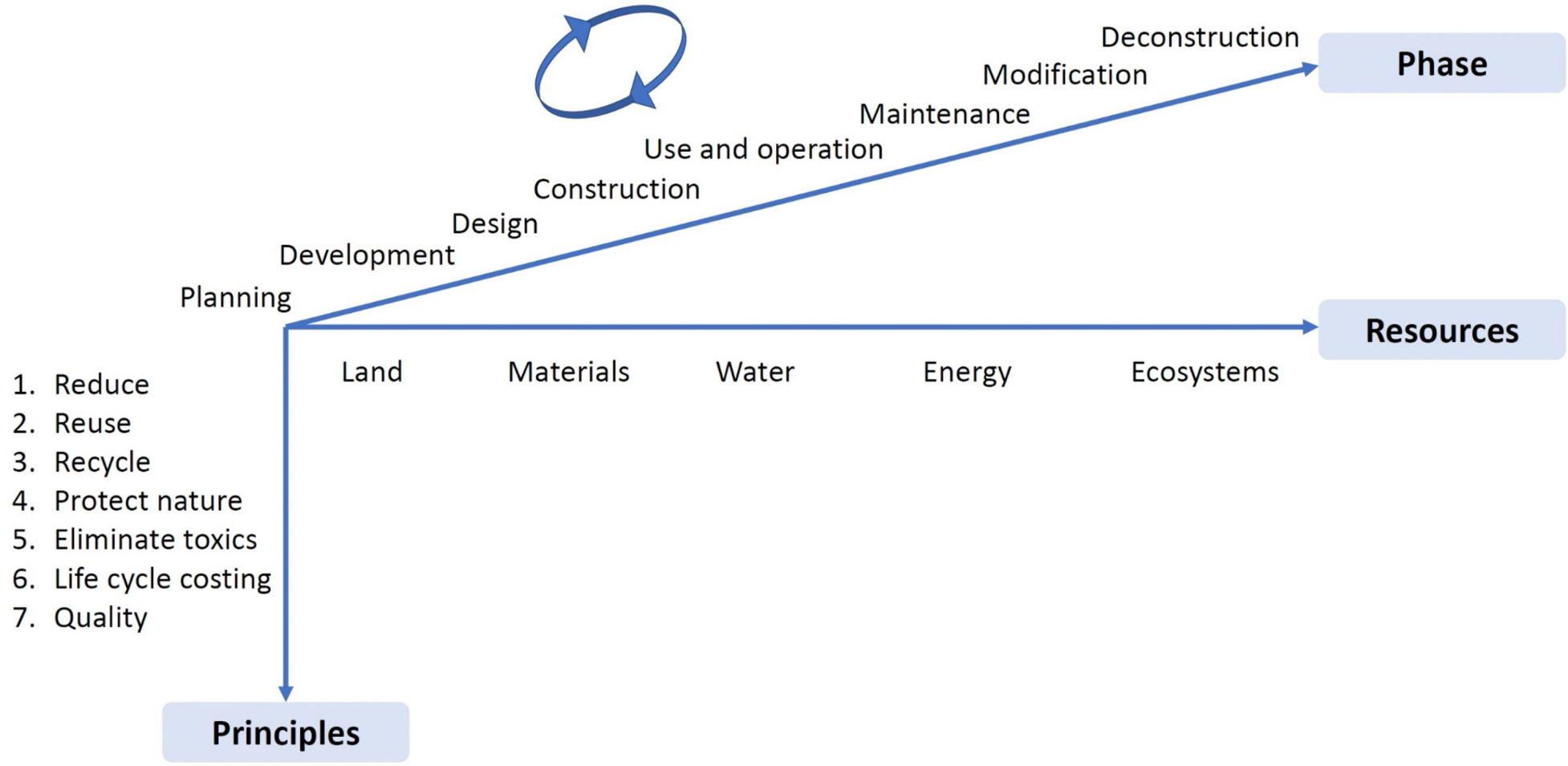
Sustainable construction provides an ethical and practical response to issues of environmental impact and resource consumption. Sustainability assumptions encompass the entire life cycle of the building and its constituent components, from resource extraction through disposal at the end of the useful life of the materials.

Principles of Sustainable Construction:

- Reduce resource consumption (reduce).
- Maximize reuse resources (reuse).
- Use recyclable resources (recycle).
- Protect nature (nature).
- Eliminate toxics (toxics).
- Apply life-cycle costing (economics).
- Focus on quality (quality).

Sustainable constructions

The framework for sustainable construction developed in 1994 by the CIB Task Group 16



Sustainable materials

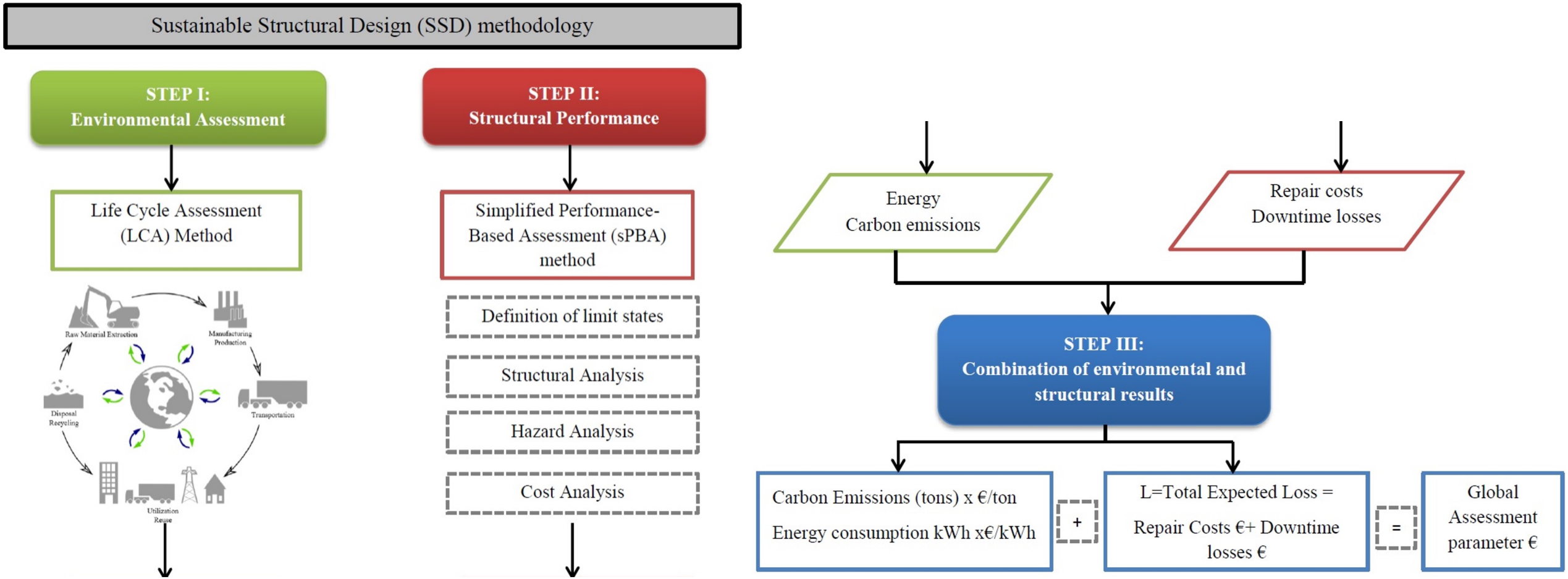
Appropriate material selection should consider numbers of factors, including the material's impact throughout its life cycle (from raw material extraction to use and then to reuse, recycling, or disposal). The areas of impact to consider at each stage in the life cycle of a material include:

- Energy required for extraction, manufacturing, and transport.
- Natural resource depletion; air and water pollution; hazardous and solid waste disposal.
- Energy performance in useful life and durability.
- Impact on indoor air quality; exposure of occupant, manufacturer, or installer to harmful/toxic substances; moisture and mold resistance; cleaning and maintenance methods.

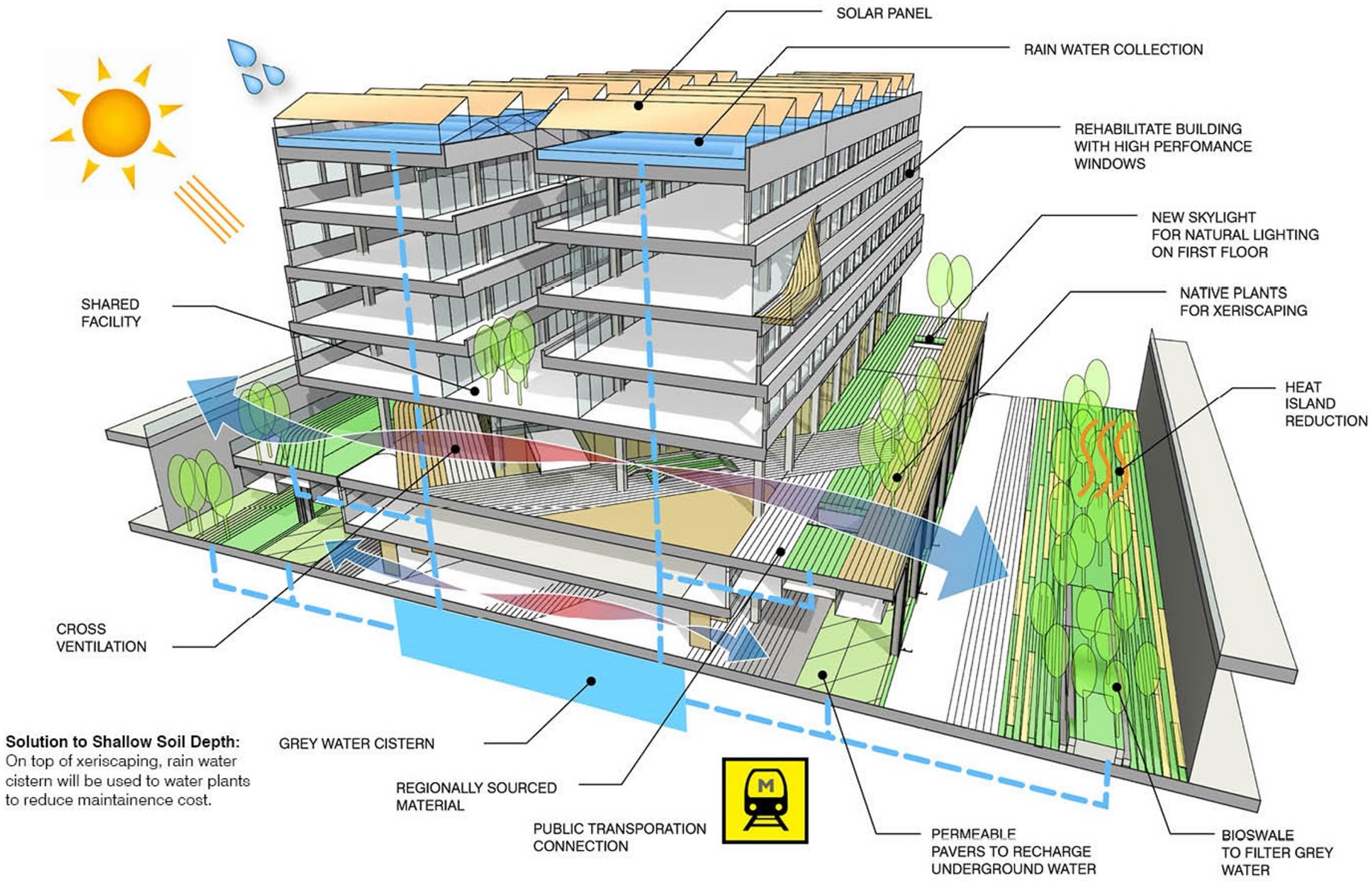
Design principles of sustainable constructions

In the design process of novel high-performance building constructions specific 10 steps have to be involved:

- Use building energy simulation tools throughout the design process.
- Optimize the passive solar design of the building.
- Maximize the thermal performance of the building envelope.
- Minimize internal building loads.
- Maximize daylighting and integrate with a high-efficiency lighting system.
- Design a hyper efficient heating, ventilation, and air conditioning (HVAC) system that minimizes energy use.
- Select high-efficiency appliances and motors.
- Maximize the use of renewable energy systems.
- Harvest and use waste energy.
- Incorporate innovative emerging strategies, such as ground coupling and radiant cooling.



Source: K. Tsimplokoukou, M. Lamperti, P. Negro: Building Design for Safety and Sustainability. European Union, 2014, doi:10.2788/338223, ISBN 978-92-79-45682-4.



Sustainable strategy in building. www.constructiontuts.com/sustainable-construction

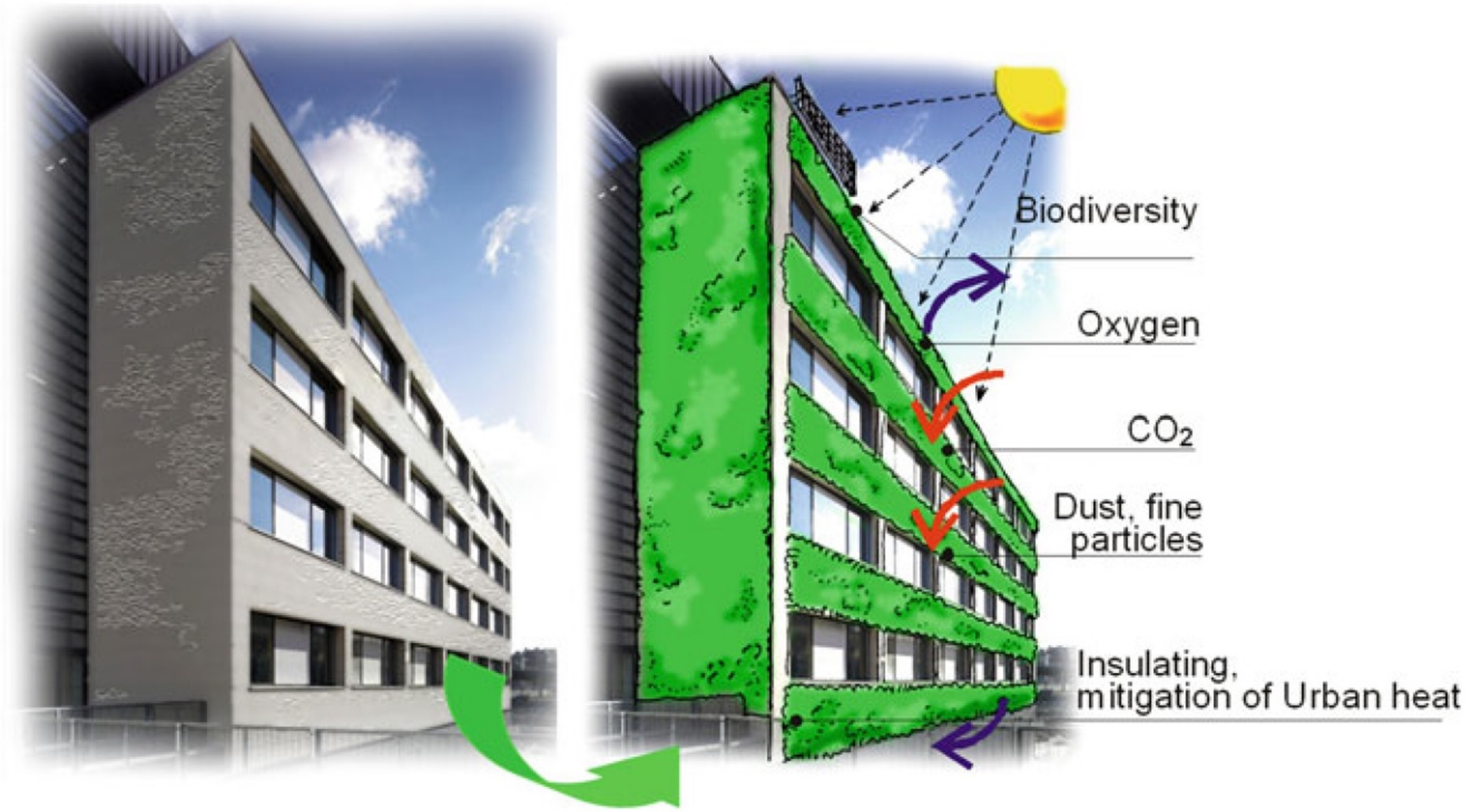
Design principles of green buildings

Direct integration of plants in a building envelope can induce the transformation of the solar energy into biomass, oxygen, and air humidity. Plants regulate the urban microclimate, while conventional surfaces lead to microclimatic extremes and reduce the thermal comfort within cities.

The vertical greened surfaces can increase insulation value by different mechanisms:

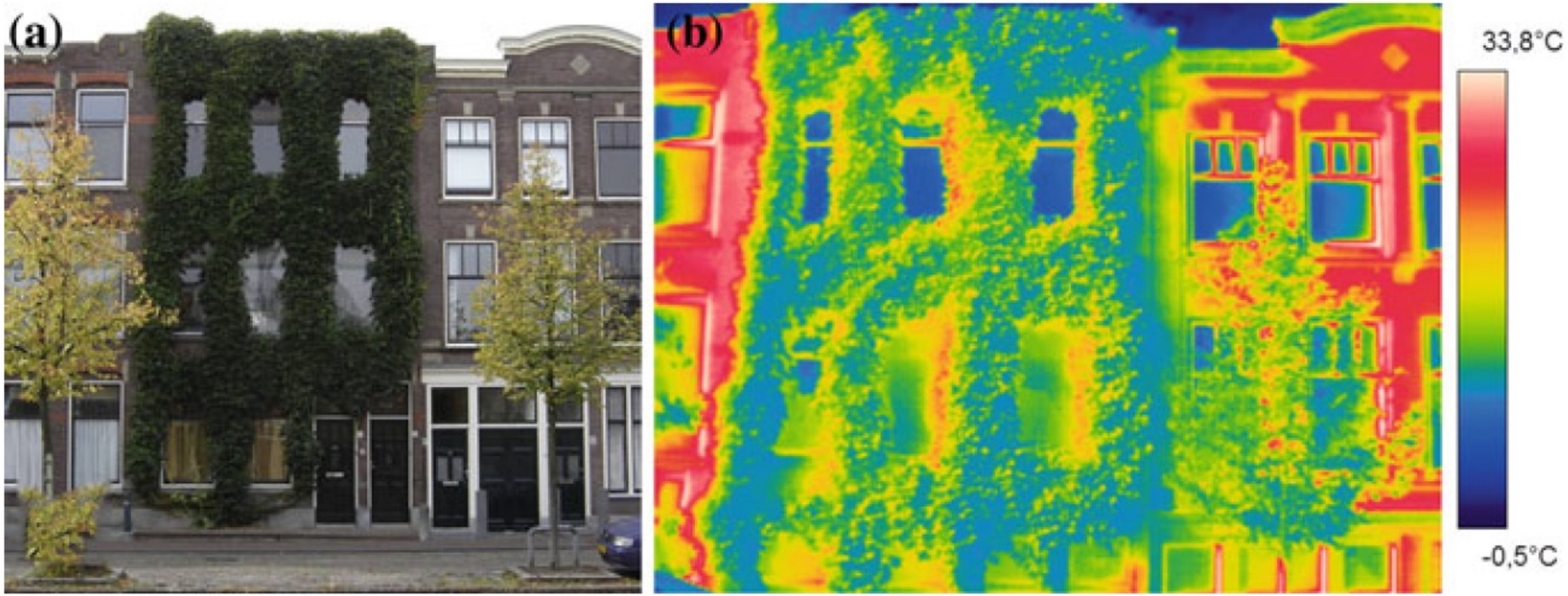
- Covering the building with vegetation, the summer heat is prevented from reaching the building skin (shadow), and in the winter, the internal heat is prevented from escaping, reflected, or absorbed.
- Thermal insulation provided by vegetation, substrates, and configuration.
- Trapping an air layer within the plant foliage, since wind decreases the energy efficiency of a building by 50 %, a plant layer will act as a buffer that keeps wind from moving along a building surface.
- Cooling of air due to evapotranspiration of plants and substrates.

Design principles of green buildings



A green building envelope strategy. Source: Marc Ottelé, A Green Building Envelope: A Crucial Contribution

Design principles of green buildings



a) Green façade in Delft summer 2009. b) Infrared photo of the façade.
Source: Marc Ottelé, A Green Building Envelope: A Crucial Contribution

Design principles of green buildings

Additionally, the advantages for the built environment by using vegetation on roofs are:

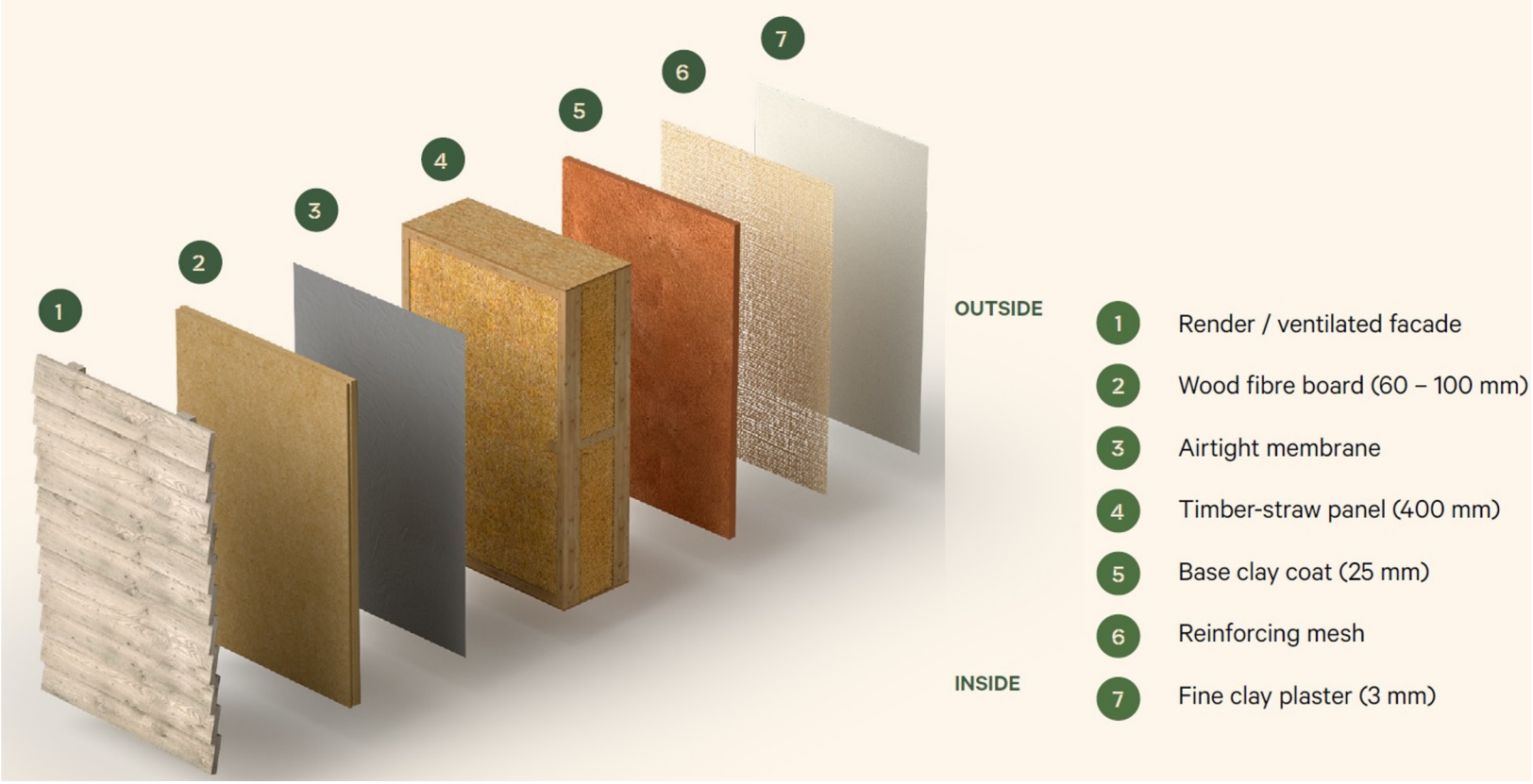
- Increase of water buffering capacity instead off peak runoff to sewage system due to delayed runoff, transpiration, and evaporation.
- Improvement of air quality (deposition of particulate matter on leaves for example).
- Reduction of the heat island effect in urban areas. Energy savings (increase of insulation capacity—keep building cool in summer and keep cold out in winter).
- Noise level reduction up to 10 dB(A).
- Increase of lifetime of roofing material.
- Increase of aesthetic values.
- Increase of ecological value and biodiversity.

Design principles of green buildings

Green roof at the British Horse Society headquarters. Source: wikipedia.org

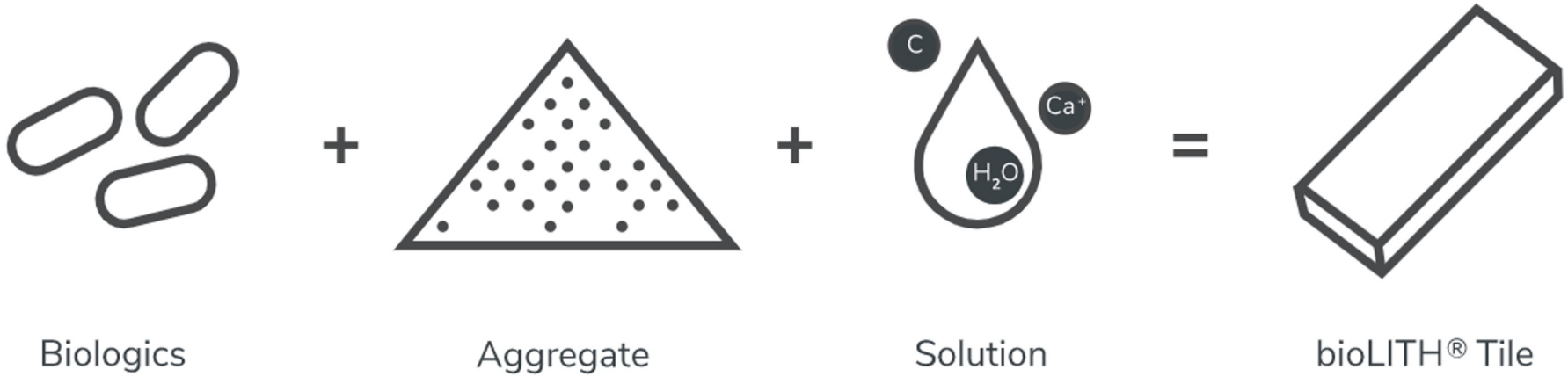
Design principles of green buildings

The main building blocks can be composed as structural timber-straw wall elements - The EcoCocon wall system with both Passivhaus and Cradle to Cradle certifications. An integral part of the system is the use of an airtight, yet diffusion-open membrane on the outside of the panels. A layer of insulating wood fibre board is fixed over the membrane.



Design principles of green buildings

The biocement with natural microorganisms was released by Biomason company. Its process of the cement production captures carbon and uses it the same way nature does. The combination of carbon and calcium provides biologically formed limestone materials. The biocement materials consist of approximately 85% granite from recycled sources, and 15% biologically grown limestone. The bioLITH tiles offer the lowest carbon footprint cement tile on the market.



Sustainable renovation

One logical solution to reduce the environmental impact of the existing buildings is through green retrofitting. The ratio of existing buildings to new green buildings is large.

The main results expected from public buildings refurbishment are:

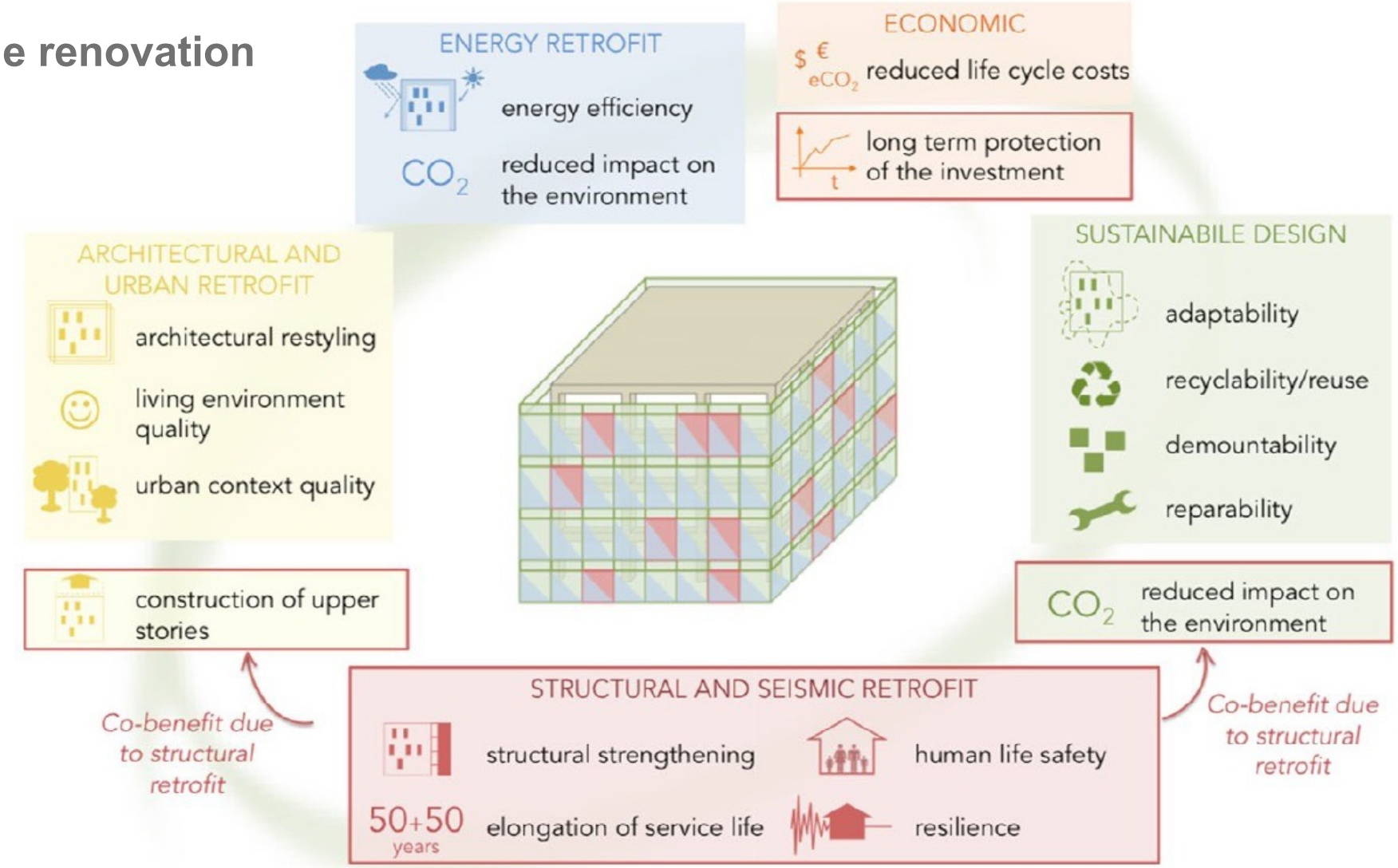
- Energy savings;
- Increase of comfort;
- Healthy working environment assurance;
- Extension of building life cycle;
- Economized exploitation;
- Environmental protection.

Sustainable renovation

Sustainable refurbishment must reconcile further dimensions:

- social (collaboration, public awareness and education, social safety, etc.);
- ecological (ecological construction materials, energy, waste, noise, land use, heath, air quality, etc.);
- economic (cost-efficient price, fair price and good service, energy saving reliability, etc.);
- cultural (cultural heritage, behavioural norms, etc.);
- architectural (comfort, aesthetics, decoration, environment, buildings purposes matching exterior, etc.);
- technical (innovative HVAC technologies, energy saving technologies, etc.).

Sustainable renovation



Source: Marini et. al (2017): Combining seismicretrofit with energy refurbishment for the sustainable renovation of RC buildings: a proof of concept, European Journal of Environmental and Civil Engineering, DOI: 10.1080/19648189.2017.1363665

THANK YOU FOR YOUR ATTENTION

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