



HELLENIC REPUBLIC  
National and Kapodistrian  
University of Athens



# Sustainable Buildings: Shaping a Greener Future

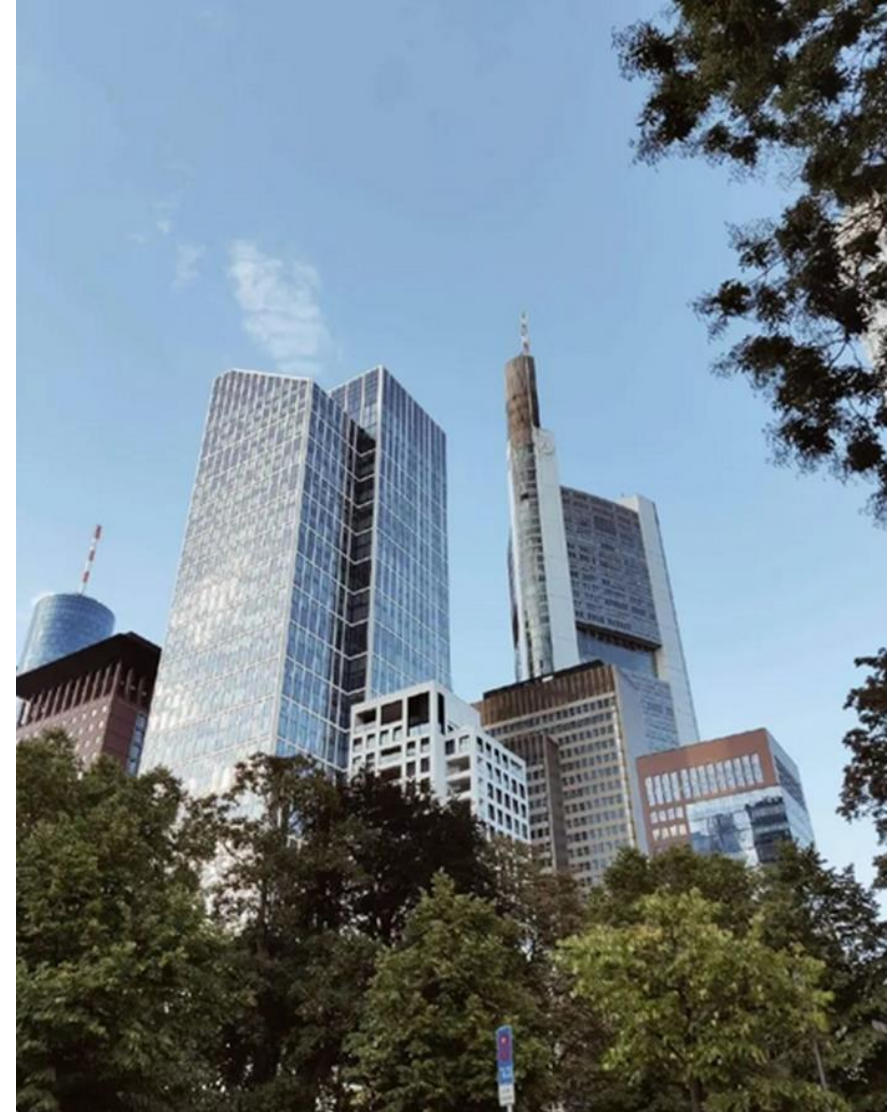
Margarita-Niki Assimakopoulos, Assoc. Professor,  
Department of Physics, National and Kapodistrian University of Athens

## Buildings

- Key component in the fabric of cities as the most important sector (alongside with construction) for interventions
- Provide opportunities to limit environmental impact and contribute to the achievement of sustainable development goals
- Provide 5 to 10% of employment (national level)
- Generate 5 to 15% of GDP
- Provide housing, mobility, water and sanitary infrastructures
- Linked to public health

However, the built environment accounts for

- approximately 40% of global energy use
- approximately 30% of the energy related greenhouse gas emissions
- waste generation and use of natural resources




# Definition of Sustainability

- **Energy Performance of Buildings Directive (EPBD):** a **sustainable building** is typically defined as a building that **meets certain criteria** related to energy efficiency and environmental performance (varies by country or region within the EU)
- Key elements:
  - **Energy Efficiency:** achieve high levels of energy efficiency (advanced insulation, energy efficient heating and cooling systems, and other technologies to minimize energy consumption)
  - **Reduced Environmental Impact:** minimize greenhouse gas emissions, reduce water consumption, use of sustainable building materials with lower environmental footprint
  - **Compliance with Building Standards:** comply with national or regional building standards and regulations related to energy performance (set minimum requirements for factors like thermal insulation, air tightness, and energy use)
  - **Renewable Energy Integration:** solar panels or wind turbines to generate clean and renewable energy onsite
  - **Indoor Environmental Quality:** air quality, thermal comfort, natural lighting ensuring occupants' healthy and comfortable living or working environment
  - **Monitoring and Reporting:** required from building owners and operators over time to ensure that sustainability standards are achieved
- The exact **definition** of a sustainable building according to the EPBD **may vary** based on the specific regulations and guidelines in place in each EU member state.



# The Importance of Sustainable Construction

- **Environmental Conservation:** sustainable construction minimizes the environmental impact of building activities (reduces resource consumption, lowers energy use, and decreases waste generation)
  - Conservation of natural resources
  - Protection of ecosystems
- **Energy Efficiency:** use less energy for heating, cooling, lighting, and appliances
  - Reduced energy bills for occupants
  - Less strain on energy resources
- **Reduced Greenhouse Gas Emissions** associated with building and operating structures
- **Improved Indoor Air Quality:** using nontoxic materials and promoting proper ventilation
  - Healthier living and working environments
  - Reducing the risk of respiratory issues and other health problems
- **Resource Efficiency:** efficient use of materials, use of recycled and locally sourced materials
  - Reduces waste
  - Minimizes environmental impact of extracting, processing, and transporting construction materials
- **Water Conservation:** essential in regions facing water scarcity or drought conditions



especially crucial in the face of climate change and decreasing fossil fuel reserves



# The Importance of Sustainable Construction

- **Long Term Cost Savings:** While sustainable construction may have higher initial costs, it often results in long term cost savings.
  - Reduced energy and water bills,
  - lower maintenance costs, can offset the initial investment. Many governments also offer incentives and rebates for sustainable construction.
- **Enhanced Property Value:** higher property values, as they are in demand among environmentally conscious buyers and tenants. These buildings often provide better comfort and quality of life,
- **Regulatory Compliance:** Many regions have adopted building codes and regulations that mandate sustainable construction practices. Compliance with these standards is essential for legal and financial reasons.



## **Innovation and Technological Advancement:**

- innovation in building materials, technologies, and construction methods
- development of new, more efficient, and cost-effective solutions



## **Corporate Social Responsibility:**

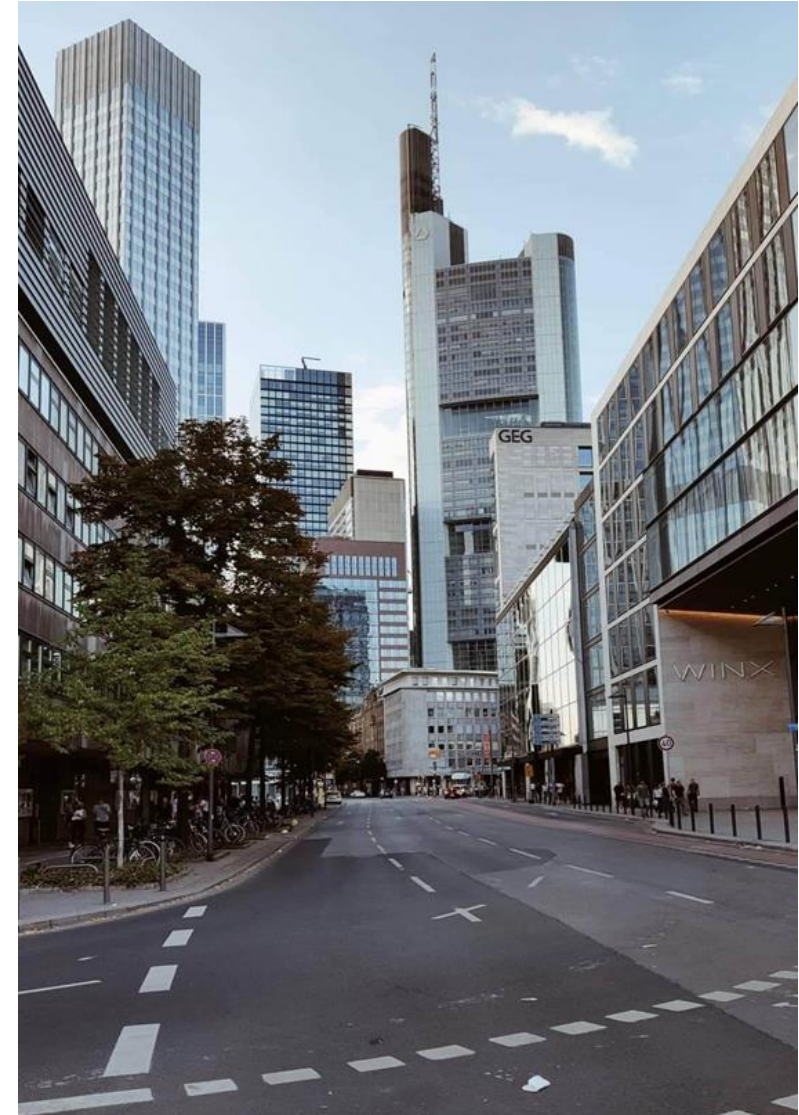
For businesses, commitment to corporate social responsibility and environmental stewardship (improve a company's image and reputation)

**In summary, sustainable construction is essential for the wellbeing of the planet, its inhabitants, and the economy aligning with the goals of mitigating climate change, conserving resources, and creating healthier, more efficient buildings for people to live and work in.**

# Why Sustainable Buildings?

Traditional construction practices can have significant negative environmental impacts

- **Resource Consumption:** extensive resource consumption, including the extraction and transportation of raw materials such as timber, concrete, steel, and other building materials.
  - habitat destruction,
  - soil erosion,
  - deforestation.
- **Substantial Energy Use:** manufacturing of materials, transportation, and onsite construction activities (burning of fossil fuels contributes to greenhouse gas emissions)
- **Waste Generation:** considerable amounts of waste, including excess materials, construction debris, and packaging waste.
  - depletion of landfill space
  - environmental pollution
- **Water Use:** Construction sites often require water for various purposes, including mixing concrete, dust control, and site cleaning (strain local water resources, especially in areas with water scarcity issues)
- **Air Pollution:** dust, particulate matter, and volatile organic compounds (VOCs) harming air quality and have adverse health effects on nearby communities
- **Habitat Disruption:** disruption of local ecosystems and wildlife habitats
  - Deforestation
  - Wetland drainage,
  - Land clearance and displacement of plant and animal species.



# Why Sustainable Buildings?

Traditional construction practices can have significant negative environmental impacts

- **Transportation Emissions of greenhouse gases and other pollutants:** Long distance transportation of materials
- **Loss of Green Space:** Possible conversion of green spaces and farmland into built environments
  - reduce biodiversity
  - availability of natural areas for recreation and wildlife.
- **Heat Island Effect:** Use of materials that absorb and radiate heat
  - higher urban temperatures,
  - increased energy consumption for cooling,
  - reduced air quality.
- **Inefficient Building Design:** Lack of energy efficient features and design principles,
  - higher energy consumption for heating, cooling, and lighting.
- **Limited Adaptability:** Buildings that are not easily adaptable or recyclable.
  - more demolition and waste when buildings are no longer suitable for their intended use.

Sustainable construction practices aim to mitigate negative environmental impacts by using ecofriendly materials, minimizing waste, reducing energy consumption, and promoting designs that consider long term sustainability. Awareness of environmental issues will lead to the adoption of more sustainable building practices to minimize environmental footprint of the construction industry.



# The Role of Buildings...

in energy consumption and emissions



Contributing to both energy usage and greenhouse gas emissions in various ways. Understanding their impact is crucial in efforts to mitigate climate change and reduce the carbon footprint of the built environment.

# The Role of Buildings...

in energy consumption and emissions

- **Energy Consumption:**
  - **Heating and Cooling:** Buildings require energy for heating (usually natural gas or electricity) and cooling (electricity) to maintain comfortable indoor temperatures. Inefficient HVAC systems and poorly insulated buildings lead to higher energy consumption
  - **Lighting:** The use of artificial lighting within buildings accounts for a significant portion of electricity consumption. Traditional incandescent bulbs and older fluorescent lights are less energy efficient than LED and CFL lighting options
  - **Appliances and Electronics:** Buildings house a wide array of appliances and electronic devices, including refrigerators, ovens, computers, and televisions (electricity)
    - **Standby Power:** Devices and appliances left in standby mode continue to draw power, adding to energy consumption
  - **Water Heating for domestic purposes :** Traditional electric water heaters and less efficient gas-powered models consume substantial amounts of energy
  - **Ventilation (Mechanical ventilation and air exchange systems):** Proper ventilation is essential for indoor air quality but can contribute to energy consumption if not managed efficiently.

# The Role of Buildings...

## in energy consumption and emissions

- Emissions:

- **Fossil Fuel Combustion (natural gas or heating oil):** release carbon dioxide (CO<sub>2</sub>) and other pollutants into the atmosphere, contributing to greenhouse gas emissions and air pollution
- **Electricity Generation:** often generated from fossil fuels, such as coal, natural gas, and oil. This results in emissions of CO<sub>2</sub> and other greenhouse gases
- **Manufacturing and Construction:** production of building materials and the construction process itself contribute to emissions. The extraction and transportation of materials, concrete production, and manufacturing of construction products generate greenhouse gases.
- **Waste and Demolition:** disposal of construction and demolition waste, often sent to landfills, can produce emissions as materials decompose
- **Transportation:** The location of a building influences the transportation emissions of its occupants. Buildings in urban areas with good access to public transportation and services tend to have lower transportation related emissions.
- **Land Use and Urban Planning:** Poor urban planning and land use can lead to urban sprawl, longer commutes, and increased energy use. Compact, mixed-use developments can reduce emissions by reducing the need for car travel.



# Sustainable Building Design Principles



Sustainable building design principles are the **foundational guidelines and strategies** used to **create ecofriendly and environmentally responsible buildings**. These principles aim to minimize the environmental impact of construction and operation while maximizing the wellbeing of occupants.

# Sustainable Building Design Principles

- **Site Selection and Planning:**

- Location: Choice of an appropriate site (minimizes the need for long commutes, encourages the use of public transportation, and avoids sensitive environmental areas)
- Orientation: Optimisation of building orientation to maximize exploitation of external weather conditions while at the same time protecting the building from them
- Open Spaces: Preservation or creation of green spaces, parks, and community areas to enhance the environment and promote outdoor activities

- **Energy Efficiency:**

- Passive Design strategies: Proper building orientation, natural ventilation, and shading, to reduce the need for mechanical heating and cooling
- Insulation: High quality insulation to minimize heat loss or gain, enhancing energy efficiency
- Efficient HVAC Systems: Installation of energy efficient heating, ventilation, and air conditioning (HVAC) systems and controls and proper sizing.
- Renewable Energy: Utilisation of solar panels, wind turbines, and geothermal systems to generate onsite power

- **Water Efficiency:**

- Water Efficient Fixtures: Installation of low flow toilets, faucets, and showerheads to reduce water consumption
- Greywater and Rainwater Harvesting: Collection and reuse of greywater (from sinks, showers, and laundry) and rainwater for irrigation and non potable uses
- Landscape Design: Use of drought tolerant plants and efficient irrigation systems in landscaping

- **Materials Selection:**

- Sustainable Materials: Choice of ecofriendly building materials that are renewable, recycled, or locally sourced to reduce the environmental impact
- Low VOCs: Use of materials with low or zero volatile organic compounds (VOCs) to improve indoor air quality
- Durability: Selection of durable materials to increase the lifespan of the building and reduce the need for replacements

# Sustainable Building Design Principles

- **Indoor Environmental Quality:**
  - Natural Ventilation: to provide fresh air and reduce the reliance on mechanical ventilation
  - Daylighting: Maximize natural daylight through well-placed windows and skylights to reduce the need for artificial lighting (orientation)
  - Thermal Comfort: Proper design of spaces to provide thermal comfort to occupants
  - Air Quality: Use of air filtration systems and ventilation controls
- **Waste Reduction:**
  - Construction Waste Management: Implementation of reduction construction waste strategies (recycling and reusing materials)
  - Deconstruction: Promotion of deconstruction over demolition when renovating or dismantling buildings to salvage materials for reuse
- **Adaptability and Flexibility:**
  - Design buildings that can be easily adapted for different uses, extending their lifespan and reducing the need for new construction
- **Real time Monitoring and Building Management:**
  - to optimise energy use, indoor conditions, and water consumption
  - to educate occupants on energy efficient and environmentally responsible practices
- **Sustainable Certifications:**
  - Achieving certifications like LEED (Leadership in Energy and Environmental Design), BREEAM (Building Research Establishment Environmental Assessment Method), or Passive House to ensure compliance with sustainable design standards
- **Community and Social Considerations:**
  - Enhance the wellbeing of the local community by designing buildings that contribute to a sense of place, inclusivity, and cultural significance

**Sustainable building design principles emphasize a holistic approach, considering the building's entire life cycle, from construction and operation to eventual demolition or renovation (cradle to grave). These principles promote responsible resource use, environmental conservation, and improved occupant wellbeing, leading to more sustainable and ecofriendly buildings.**



# Sustainable Materials



Sustainable materials, also known as ecofriendly or green materials, are materials that are produced and used in ways that have minimal negative impacts on the environment, human health, and society. These materials are essential for sustainable construction, manufacturing, and various other industries.

# Sustainable Materials

- **Renewability:** Sustainable materials are derived from renewable resources, meaning they can be replaced or regenerated within a relatively short period. Common examples:
  - Bamboo: a rapidly renewable resource used for various applications, including flooring, furniture, and construction
  - Cork: harvested from the bark of cork oak trees while the trees continue to grow and produce more cork
- **Recycled Content:** These materials are made from postconsumer or postindustrial waste, diverting materials from landfills and reducing the need for virgin resources. Examples:
  - Recycled Steel: Steel products made from recycled steel scrap
  - Recycled Glass: Glass products created from postconsumer or postindustrial glass waste
- **Locally Sourced:** Materials that are sourced and manufactured regionally to reduce the environmental impact of transportation and support local economies reduce emissions associated with long-distance transportation
- **Low Environmental Impact:** Sustainable materials are manufactured with processes that have minimal environmental impacts, including reduced energy and water use, as well as lower emissions. Examples:
  - Low VOC Paint: improves indoor air quality
  - Environmentally Friendly Concrete mixes: use less cement, reducing carbon emissions
- **Durability:** Materials that have a longer lifespan and require less maintenance and replacement reducing waste and the use of resources over time. Examples:
  - Durable Timber treated to resist decay and pests, extending its lifespan
  - High Quality Roofing Materials designed for longevity, reducing the need for frequent replacements

# Sustainable Materials

- **Sustainable Forestry and Agriculture:** Materials that come from responsibly managed forests or agricultural practices that minimize negative environmental impacts (Certified wood products ensure responsible forest management)
- **Energy Efficiency:** Materials that contribute to energy efficiency in buildings or products (cellulose or foam board etc.)
- **Non-Toxic and Healthy:** Materials that do not emit harmful substances, such as formaldehyde or lead (low VOC adhesives and sealants)
- **Waste Reduction:** Materials that are designed to produce minimal waste during manufacturing and construction (Prefabricated building components and modular construction)
- **Innovative Materials:** Advances in material science have led to the development of new sustainable materials, such as biobased plastics, mushroom based packaging, and more

**Sustainable materials are an essential part of green building practices and environmentally responsible manufacturing. They contribute to reducing resource depletion, environmental degradation, and human health concerns associated with traditional materials.**

**Incorporating sustainable materials, can help mitigate climate change, reduce waste, and promote a more sustainable and responsible approach to resource use.**

# Sustainable Certifications



Sustainable building certifications are third party verification systems that assess and recognize buildings and construction projects for their adherence to specific sustainability and environmental performance standards. These certifications help promote green building practices, reduce the environmental impact of the construction industry, and provide assurance to building owners and occupants.



# Sustainable Certifications

## some examples

- **Leadership in Energy and Environmental Design (LEED):**
  - Scope: Buildings and construction.
  - Description: LEED is one of the most widely recognized green building certification systems globally. It evaluates the design, construction, and operation of buildings based on several sustainability criteria, including energy efficiency, water conservation, indoor environmental quality, and materials selection.
- **BREEAM (Building Research Establishment Environmental Assessment Method):**
  - Scope: Buildings and construction.
  - Description: BREEAM is a sustainability assessment method commonly used in the United Kingdom and Europe. It evaluates the environmental performance of buildings based on criteria related to energy use, water efficiency, materials, and more.
- **Green Globes:**
  - Scope: Buildings and construction.
  - Description: Green Globes is a building certification system that provides a flexible and customizable approach to sustainable building assessments. It covers various aspects of building design, construction, and operation.
- **Passive House (Passivhaus):**
  - Scope: Buildings, with an emphasis on energy efficiency.
  - Description: The Passive House standard focuses on achieving extremely high levels of energy efficiency and thermal comfort in buildings. It emphasizes airtightness, insulation, and efficient ventilation systems.
- **Living Building Challenge:**
  - Scope: Buildings and communities.
  - Description: The Living Building Challenge is one of the most rigorous green building certifications. It sets ambitious performance standards, requiring buildings to be self-sufficient in terms of energy, water, and waste, while also promoting health and biophilic design.

# Sustainable Certifications

## some examples

- **WELL Building Standard:**
  - Scope: Buildings, focusing on occupant health and wellbeing.
  - Description: The WELL Building Standard assesses and certifies buildings based on criteria related to indoor air quality, lighting, water quality, nutrition, fitness, and mental wellbeing, with the aim of promoting occupant health and comfort.
- **Green Building Initiative (GBI) Green Globes for Existing Buildings:**
  - Scope: Existing buildings.
  - Description: This certification, provided by the Green Building Initiative, focuses on improving the environmental and energy performance of existing buildings, making them more sustainable.
- **ENERGY STAR for Buildings:**
  - Scope: Buildings.
  - Description: The ENERGY STAR certification, managed by the U.S. Environmental Protection Agency, focuses on energy efficiency in buildings, including commercial and industrial facilities.
- **Certified Passive House (CPH):**
  - Scope: Buildings and energy efficiency.
  - Description: Certified Passive House is an international standard for highly energy efficient buildings. It emphasizes a "fabric first" approach to energy efficiency.
- **Living Product Challenge:**
  - Scope: Products used in buildings.
  - Description: This certification, developed by the International Living Future Institute, focuses on creating sustainable, healthy, and environmentally responsible products used in building construction and operation.

**These sustainable building certifications help create more environmentally responsible, energy efficient, and healthy buildings, while also offering various levels of recognition and incentive for owners, developers, and architects to adopt green building practices. Certification requirements may vary by region and building type, so it's essential to choose the one that best aligns with your project's goals and priorities.**

# Case Studies

1. Proactive synergy of inteGrated Efficient Technologies on buildings' Envelopes  
H2020-EE-2016-PPP – Innovation Action



2. Driving decarbonization of the EU building stock by enhancing a consumer centered and locally based circular renovation process  
H2020-LC-SC3-EE-2018 - Innovation Action



3. Metrological framework for passive radiative cooling technologies  
European Partnership on Metrology - EURAMET





Where we started from...

The project idea was based on the innovative integration of technologies to achieve a **multi-benefit approach** by a closer integration between **energy and non-energy related benefits**.

Thus, the project aimed at combining in a same integrated system the highest performances (iii):

- **Energy requirements**
- **Safety**
- **Social sustainability**



# Energy Efficiency

Energy efficiency refers to the practice of using less energy to perform the same tasks or achieve the same results



in various sectors  
(residential, commercial,  
industrial, transportation)

reduce energy consumption

lower energy costs

decrease greenhouse gas emissions



mitigation the impact of climate change

# PROGETONE



















## The exoskeleton and the prefab elements' installation



## The exoskeleton and the prefab elements' installation





## The exoskeleton and the prefab elements' installation



## The exoskeleton and the prefab elements' installation



## The exoskeleton and the prefab elements' installation





## The exoskeleton and the prefab elements' installation



## The exoskeleton and the prefab elements' installation





## The exoskeleton and the prefab elements' installation



## The exoskeleton and the prefab elements' installation





## The exoskeleton and the prefab elements' installation







































# Final Remarks

No  
technological  
innovation  
without  
Legislative Changes





# Case Studies

1. Proactive synergy of inteGrated Efficient Technologies on buildings' Envelopes  
H2020-EE-2016-PPP – Innovation Action



2. Driving decarbonization of the EU building stock by enhancing a consumer centered and locally based circular renovation process  
H2020-LC-SC3-EE-2018 - Innovation Action



3. Metrological framework for passive radiative cooling technologies  
European Partnership on Metrology - EURAMET

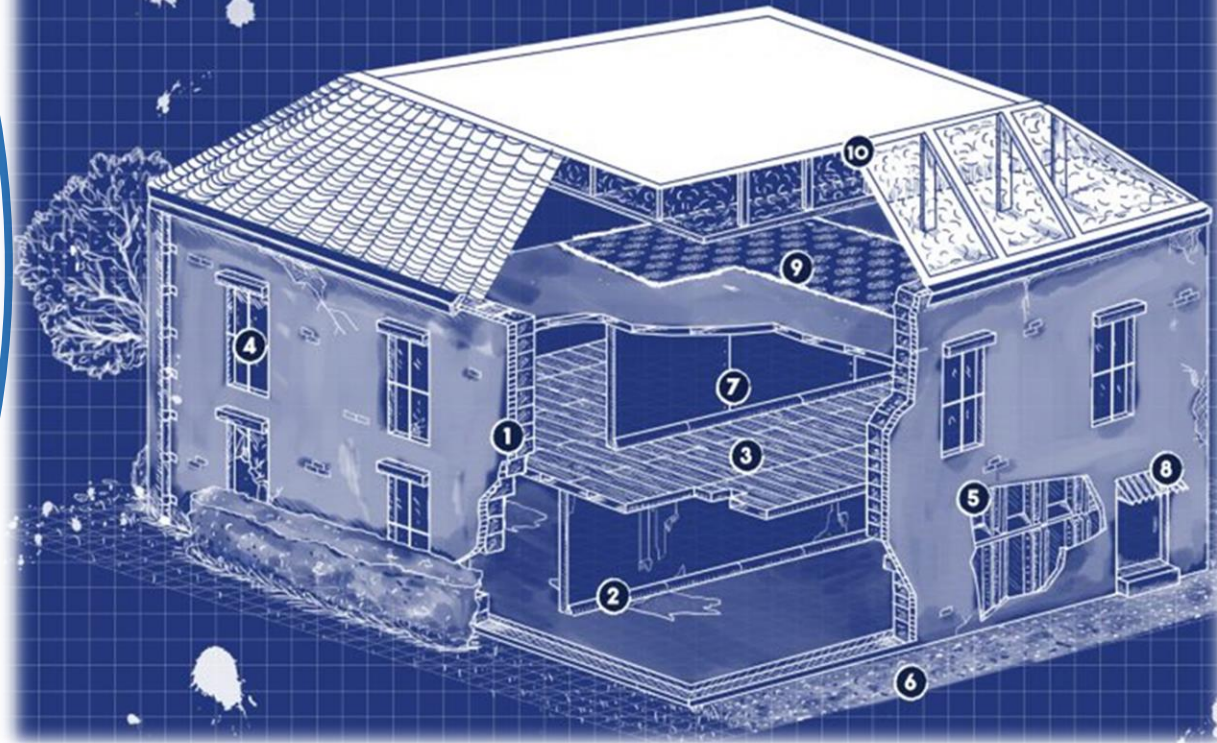


**Summary description of project:** The DRIVE 0 concept is based on developing circular deep renovation solutions and supporting consumer centered business models for 7 specific countries and demonstration cases as real environments.

We want to **accelerate** deep **renovation** processes by enhancing a consumer centered circular renovation process in order to make deep renovation **environmentally friendly,** **cost effective** and more attractive for consumers and investors.

# Recycling Buildings

1. *Concrete*
2. *Gypsum*
3. *Wood*
4. *Glass*
5. *Metals*
6. *Aggregates*
7. *Plasterboard*
8. *Plastics*
9. *Floor and wall coverings*
10. *Insulation*





# Demonstration cases

Netherlands



Ireland



Italy



Slovenia (3)



Estonia



Spain



Greece (2)



# Challenges and future recommendations for circularity

- ❑ Market readiness
- ❑ Availability of circular products in each EU country
- ❑ Seismic performance, materials durability and resistance in various conditions (fire resistance, acoustic performance, thermal performance, etc.)
- ❑ Product quality certification/ labeling of available circular

No technological  
innovation without  
Legislative Changes

# Case Studies

1. Proactive synergy of inteGrated Efficient Technologies on buildings' Envelopes  
H2020-EE-2016-PPP – Innovation Action
2. Driving decarbonization of the EU building stock by enhancing a consumer centered and locally based circular renovation process  
H2020-LC-SC3-EE-2018 - Innovation Action
3. Metrological framework for passive radiative cooling technologies  
European Partnership on Metrology - EURAMET





# the World faces a looming “cold crunch”



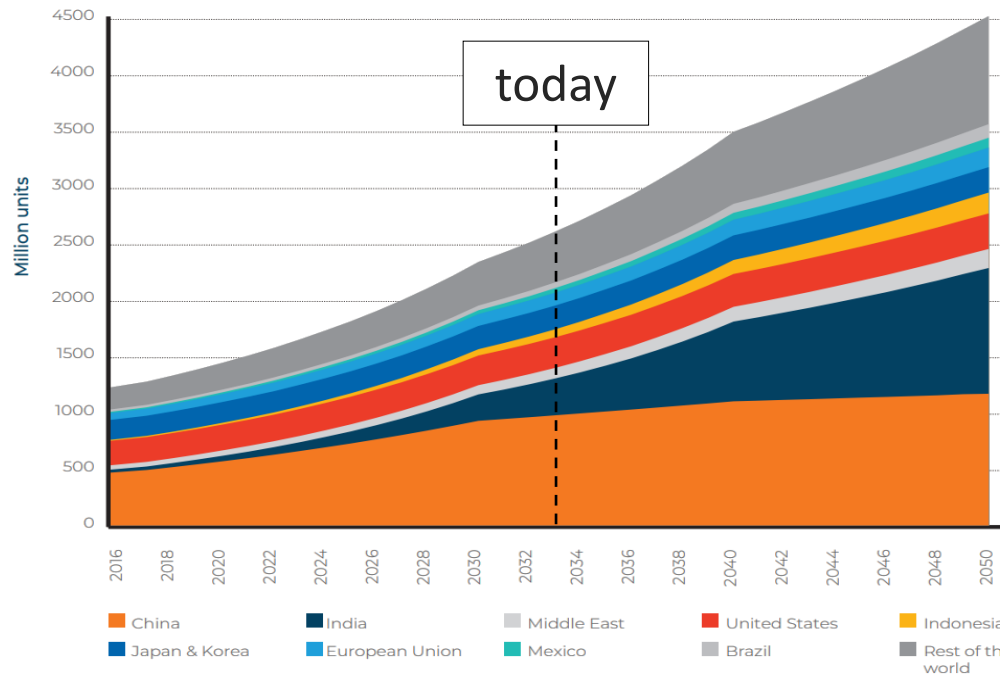
8%



10/s



3.3TW

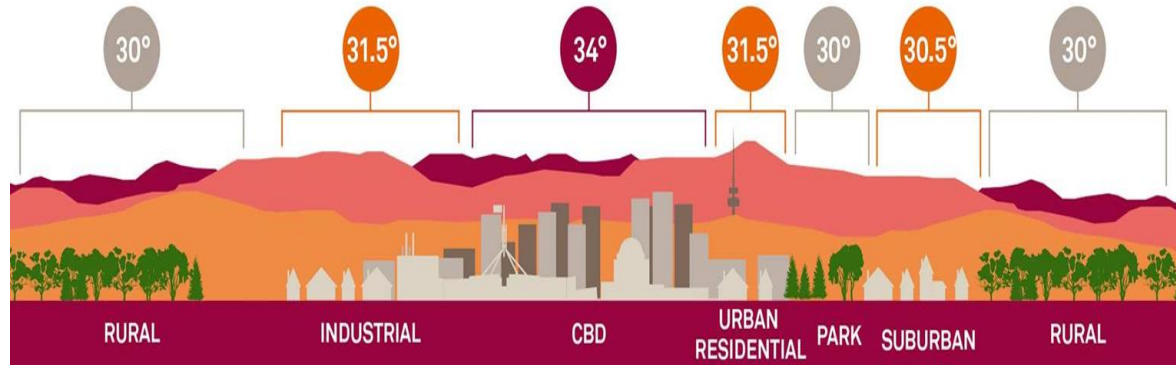


EU: 3x A/C units before 2050

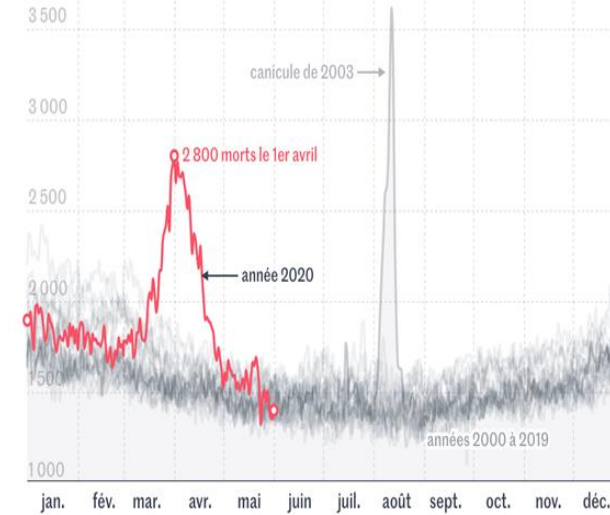
80 GW additional generation capacity needed for the residential sector alone

# Impact of industrial and civil cooling systems

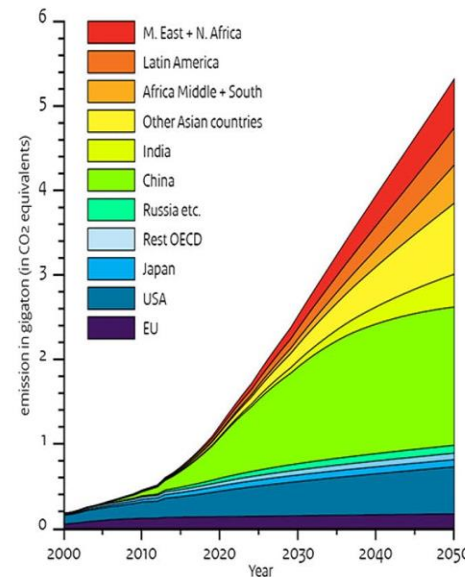
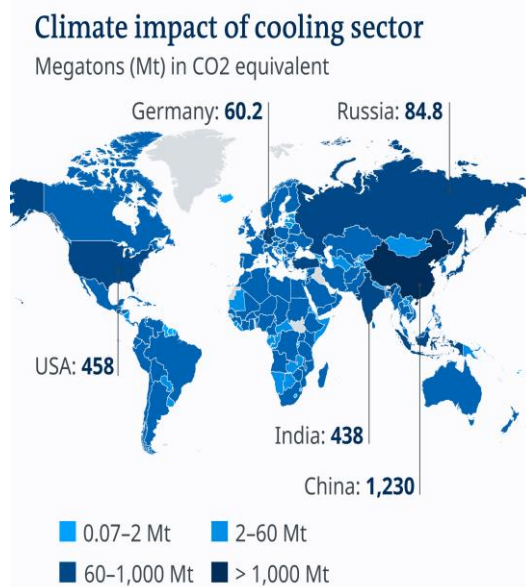
## Heat Island Effect



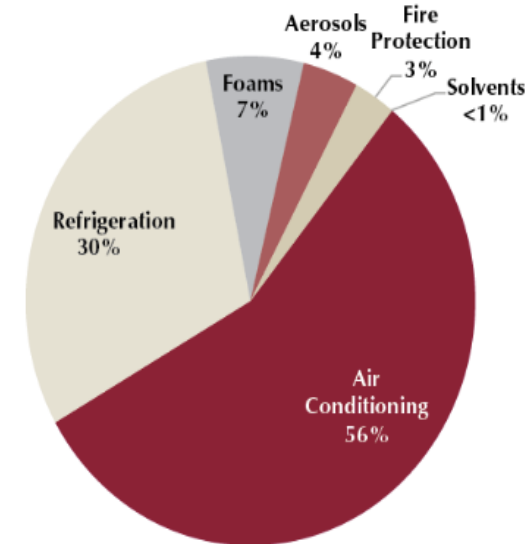
## Health risks during heat waves



## CO<sub>2</sub> emissions of cooling sector



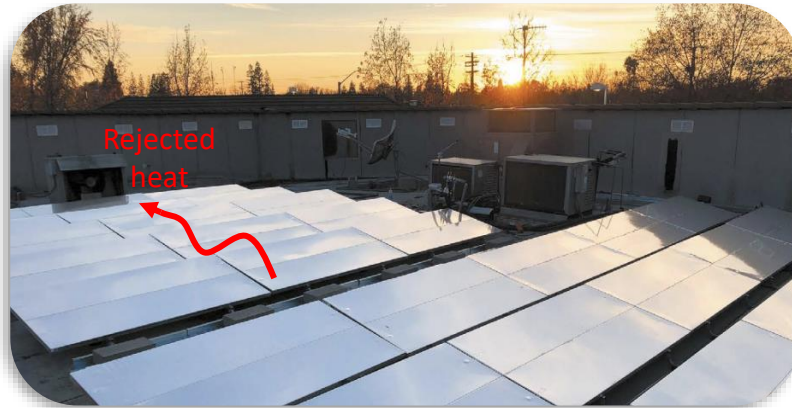
## hydro-fluorocarbon leakages and incorrect disposal



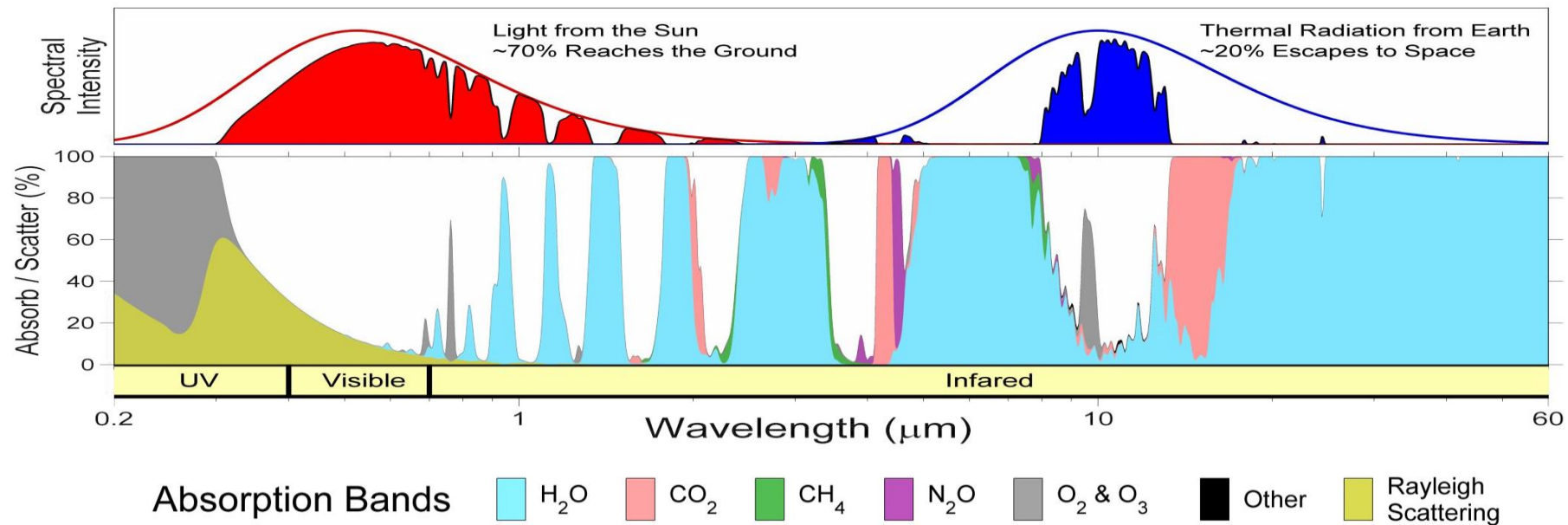
source: Center for Climate and Energy Solutions

source: the Green Cooling Initiative

# Radiative Cooling: principles



- ❖ Allows to dissipate heat towards space through the **wavelength range 8-13  $\mu\text{m}$** , in which the atmosphere is highly transparent.
- ❖ Materials are capable of staying colder than their surroundings even **under direct sunlight**
- ❖ Exploit **outer space as a ultimate heat sink**
- ❖ The material must **reflect the solar spec-trum** (200 nm–2.5  $\mu\text{m}$ ) and emit in the range of high atmospheric transmittance





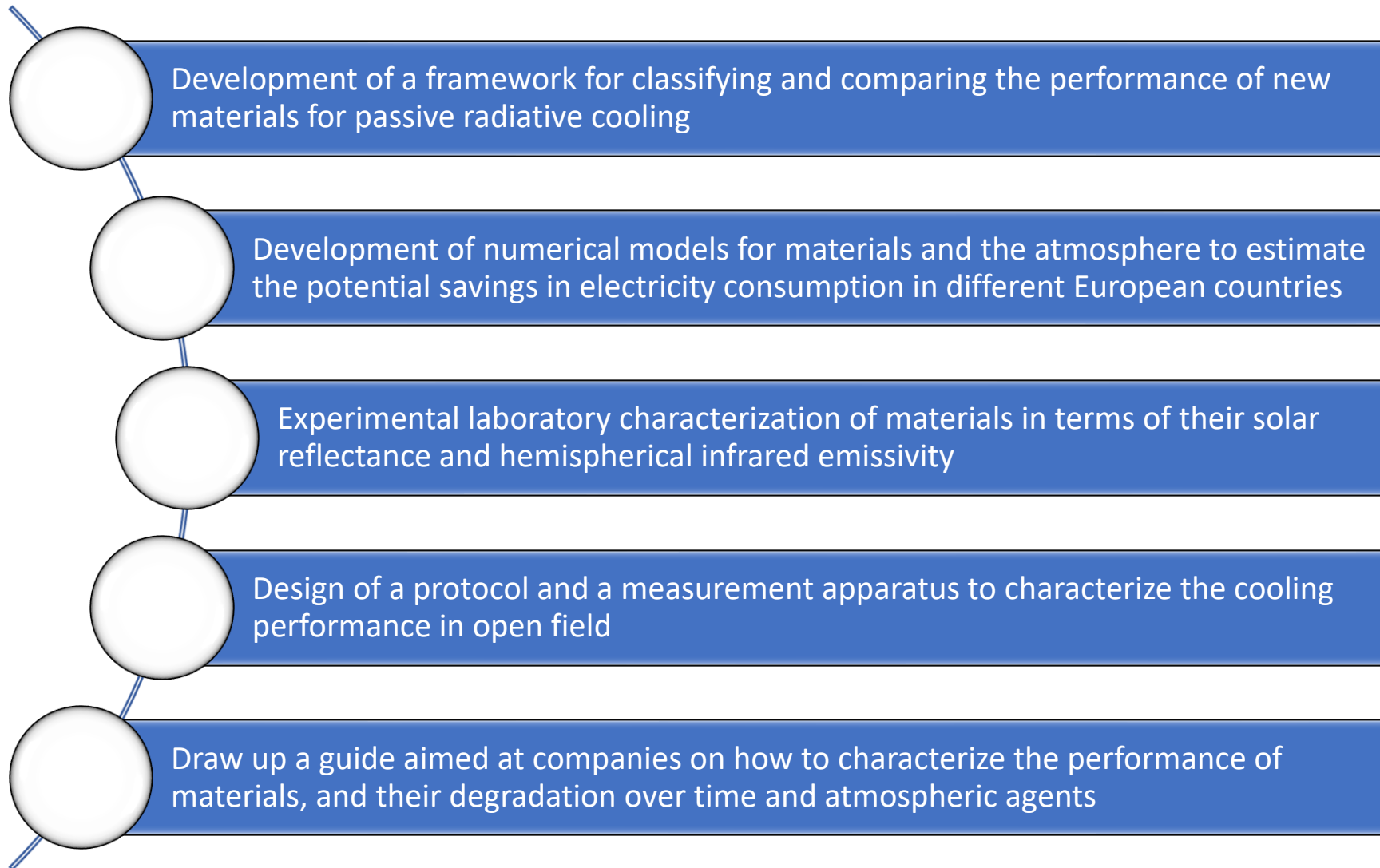
## Advantages

-  Renewable
-  Passive
-  Efficient
-  Almost no external energy input
-  Mitigate urban heat island effect

## Limitations

-  Still quite unexplored
-  Complex and hard-to-manufacture materials
-  Lack of modelling methods
-  Lack of a metrological framework for classification and comparison

## Goals



# Overcoming Challenges

- Upskilling construction professionals in Greece and Cyprus for deep energy efficiency renovations of school buildings

European Climate Initiative EUKI



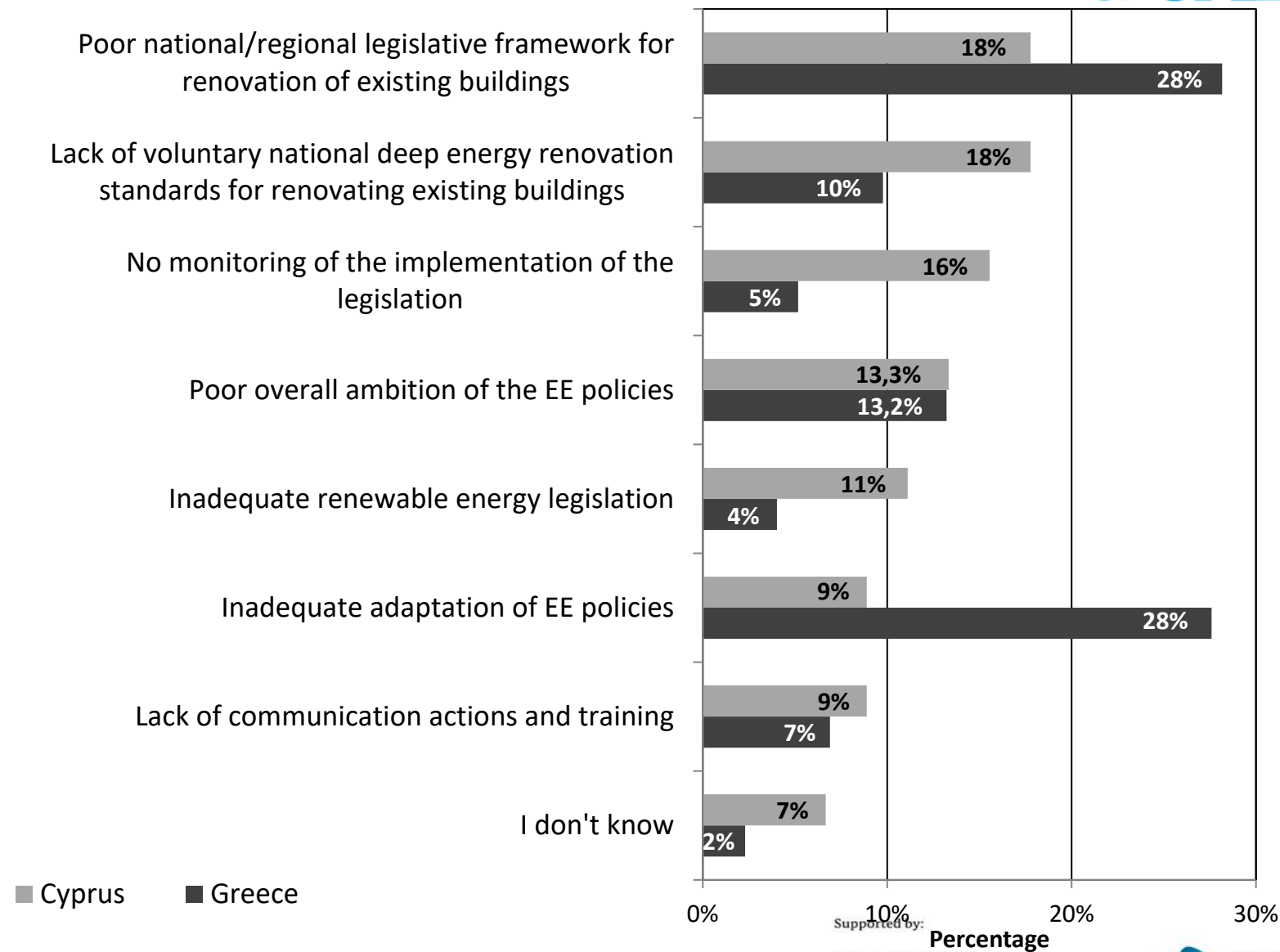


## Energy efficiency policy gaps

### Most important policy gaps for the applicability of energy efficiency policies

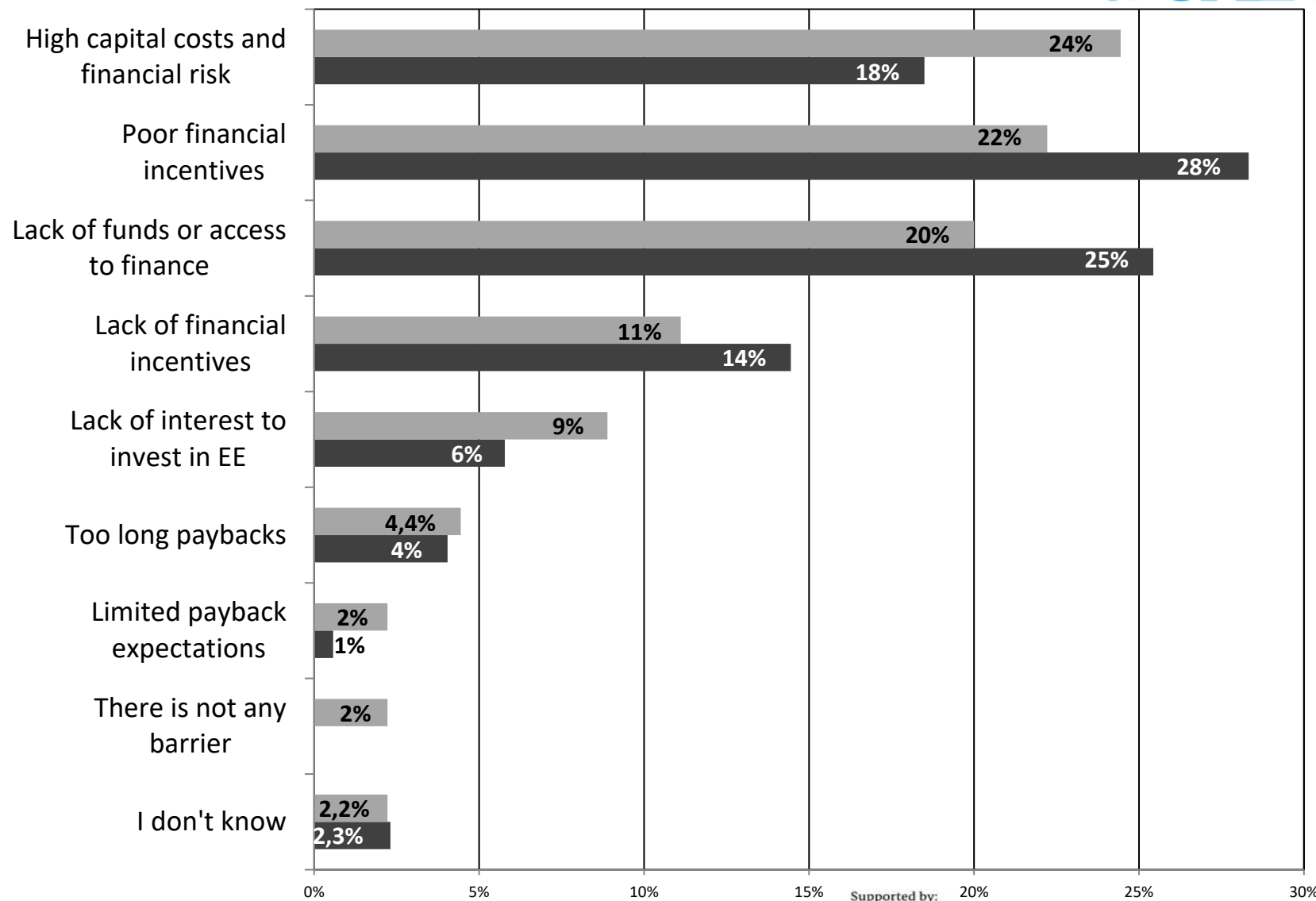
In Greece, “Poor national legislative framework for renovation of existing buildings” and the “inadequate adaptation of Energy Efficiency (EE) policies” were considered as the most important gaps in energy efficiency policies, selected by the 28% of the participants. Thirteen percent (13%) of those surveyed stated that “Poor overall ambition of the EE policies” is the most important policy gap.

In Cyprus, the options “Poor national legislative framework for renovation of existing buildings”, & “lack of voluntary national DER standards for renovating existing buildings” were the main energy efficiency policy gaps chosen by 18% while 16% regarded “No monitoring of the implementation of the legislation” as an impediment.



■ Cyprus ■ Greece

## Most prominent barriers for financing renovations



## Prominent barriers for financing building energy renovations

With regard to the financial barriers that pose a challenge for DER, the top 3 prominent barriers for financing building energy renovations are the same for Cyprus and Greece.

“Poor financial incentives” is regarded as the most important financial barrier in Greece, selected by the 28% of those answered while in Cyprus this option was chosen by the 22% of those surveyed. “Lack of funds or access to finance” was selected by the 25% and 20% of the Greek and Cypriot respondents respectively while “High capital costs and financial risks” was chosen by the 24% of Cypriot respondents and 18% of the Greek participants.

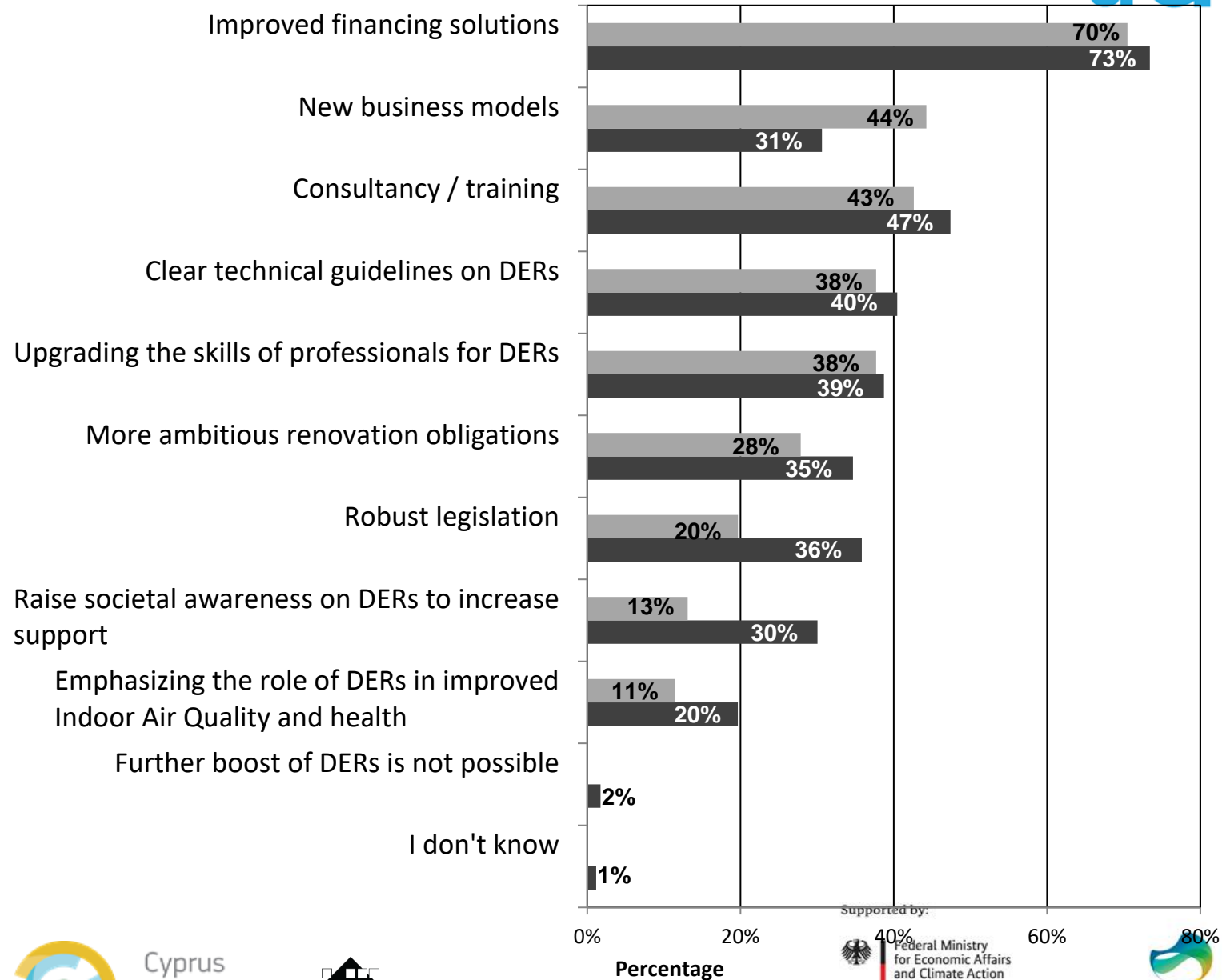
# Drivers that may boost the deep energy renovation projects

Finally, the drivers that may boost DER projects were examined. In both countries, the vast majority of respondents (70% Cyprus, 73% Greece) highlighted that “improved financing solutions” may boost the deep energy retrofits in buildings.

Fortyfour percent (44%) of the Cypriot respondents, stated that “New business models” would boost deep energy renovation projects whereas another 43% regarded consultancy and training on DERs as a mean to increase support and therefore boost deep energy retrofits as an important factor.

In Greece, 47% of the respondents answered that consultancy and training would be a tool to boost deep energy renovations in the country, followed by a 40% of those surveyed that regard “clear technical guidelines on DERs” and another 39% that consider “Upgrading the skills of professionals” as effective tools that could boost the deep energy renovation projects.

## Drivers to boost DER



Supported by:



Federal Ministry  
for Economic Affairs  
and Climate Action



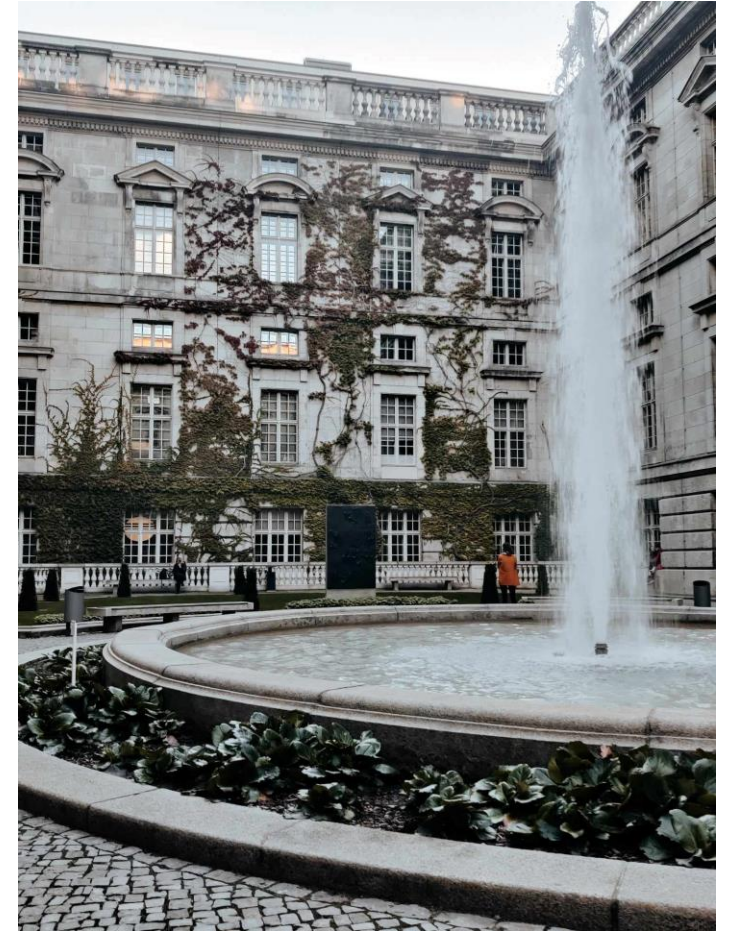
80% European  
Climate Initiative  
EUKI

on the basis of a decision



# Government Incentives and Regulations

Government policies play a pivotal role in supporting and promoting sustainable building practices. These policies help create an enabling environment for the construction industry to adopt environmentally responsible and energy efficient building practices.



# Government Incentives and Regulations

- **Building Codes and Standards** that mandate minimum requirements for energy efficiency, materials, safety, and environmental performance in construction.
- **Energy Efficiency Regulations** that mandate the use of energy efficient systems, appliances, and lighting in buildings and thus encouraging energy conservation and reduced greenhouse gas emissions.
- **Financial Incentives, Subsidies and Grants, tax credits, or rebates to developers and property owners** may be offered to those who invest in sustainable building practices, such as installing energy efficient systems, solar panels, or green roofs.
- **Mandatory Certifications and Labels** like LEED or BREEAM that demonstrate that the building meets specific environmental and energy performance criteria.
- **Green Procurement** - commitment to purchasing sustainable products and services, including construction materials and practices and thus creating a market for sustainable construction products and encourages suppliers to adopt ecofriendly practices.
- **Research and Development Funding** in the construction industry, supporting the development of innovative technologies, materials, and construction methods that are more sustainable and efficient.
- **Education and Training programs** to help professionals in the construction industry acquire the knowledge and skills required for sustainable building practices.

# Government Incentives and Regulations

- **Environmental Protection Laws:** Environmental laws and regulations, such as those related to water quality, air pollution, and land use, can influence building practices. These laws often require builders to mitigate their environmental impact during and after construction.
- **Sustainable Land Use Planning:** Government zoning and land use policies can promote sustainable building practices by encouraging mixed land use, higher population density, and efficient transportation systems, reducing the need for extensive infrastructure and promoting sustainability.
- **Infrastructure Development:** Government investment in sustainable infrastructure, such as public transportation and green spaces, can influence the development and location of sustainable buildings.
- **Emission Reduction Targets:** Many governments set emission reduction targets and require the construction industry to contribute to these goals. This can encourage the adoption of sustainable building practices to minimize carbon emissions.
- **Monitoring and Reporting:** Governments may establish reporting and monitoring requirements for building energy and water consumption, emissions, and sustainability performance. This data can be used to track progress and incentivize improvements.
- **Local Initiatives:** At the municipal or regional level, local governments can enact policies that encourage sustainable building practices specific to their communities' needs and characteristics.

Government policies are crucial in shaping the direction of the construction industry toward sustainability. They provide clear guidelines, incentives, and regulations that promote the adoption of environmentally responsible and energyefficient building practices, contributing to a more sustainable and resilient built environment.



# The **Future** of Sustainable Buildings



The future of sustainable buildings promises to be innovative, environmentally responsible, and technologically advanced. As the world deals with the challenges of climate change, resource scarcity, and growing urban populations, sustainable building practices will become increasingly critical.

# The **Future** of Sustainable Buildings

- **NetZero and Positive Energy Buildings:** Buildings will aim to generate more energy than they consume, contributing surplus energy to the grid. Advancements in renewable energy technologies, such as solar and wind, will make this more achievable.
- **Smart Building Technologies:** Sustainable buildings will be equipped with advanced automation and control systems to optimize energy consumption, lighting, temperature, and air quality. These systems will use sensors and data analysis to make real time adjustments for efficiency and occupant comfort.
- **Energy Storage:** The integration of advanced energy storage solutions, such as high-capacity batteries, will enable sustainable buildings to store excess energy for later use, reducing reliance on the grid during peak demand.
- **Circular Economy Construction:** Building materials will be designed for easy disassembly, reuse, and recycling at the end of a building's life. Circular economy principles will minimize waste and encourage the repurposing of materials.
- **Green Roofs and Living Walls:** More buildings will incorporate green roofs and living walls, not only for aesthetic reasons but also to improve insulation, reduce heat island effects, and promote biodiversity.
- **Water Reuse and Recycling:** Advanced water purification and recycling systems will allow buildings to capture and treat rainwater, greywater, and blackwater for various non potable uses, reducing water consumption.
- **Materials Innovation:** Sustainable construction materials will continue to evolve. This includes the development of low carbon and carbon negative building materials, such as carbon sequestering concrete, and the increased use of biobased materials like bamboo and mycelium.

# The **Future** of Sustainable Buildings

- **3D Printing:** The adoption of 3D printing in construction will allow for efficient, customized, and resource efficient building designs. It can also reduce waste in the construction process.
- **Passive House Standards:** More buildings will be designed to meet or exceed Passive House standards, which emphasize super insulation, airtightness, and energy recovery systems to minimize energy consumption.
- **Biophilic Design:** Building designs will incorporate more natural elements, like plants and natural light, to improve indoor air quality and occupant wellbeing.
- **Resilient and Disaster Resistant Structures:** Sustainable buildings will be engineered to withstand extreme weather events and natural disasters, using resilient construction techniques and materials.
- **Regenerative Buildings:** Some buildings will not only aim to be energy efficient but regenerative, contributing positively to the local ecosystem, improving air and water quality, and providing habitat for wildlife.
- **Public Private Collaboration:** Governments and private sector partners will collaborate to develop policies, regulations, and incentives that drive sustainability in construction and promote the development of sustainable buildings.
- **Prefabrication and Modular Construction:** Offsite construction methods will become more prevalent, reducing waste, enhancing quality control, and speeding up construction timelines.



# The **Future** of Sustainable Buildings

- **Community Integrated Designs:** Sustainable building projects will focus on creating ecofriendly and inclusive communities rather than isolated structures, with integrated transportation, green spaces, and shared resources.
- **Sustainable Certifications:** Green building certifications like LEED, BREEAM, and Living Building Challenge will remain important tools for assessing and recognizing sustainable building practices.



**The future of sustainable buildings is a multidimensional issue that combines advanced technology, innovative materials, and a deep commitment to reducing the environmental impact of the built environment. It's not just about creating structures that use less energy and fewer resources, but about designing buildings that actively contribute to the health of the planet and its inhabitants.**

# Questions and Discussion

ENVIRONMENTAL  
SUSTAINABILITY NINJA



LEAVES NO FOOTPRINT

WWW. ROCK PAPER CYNIC .COM

## Thank You For Your Attention

Margarita-Niki Assimakopoulos

[masim@phys.uoa.gr](mailto:masim@phys.uoa.gr)



HELLENIC REPUBLIC  
National and Kapodistrian  
University of Athens

