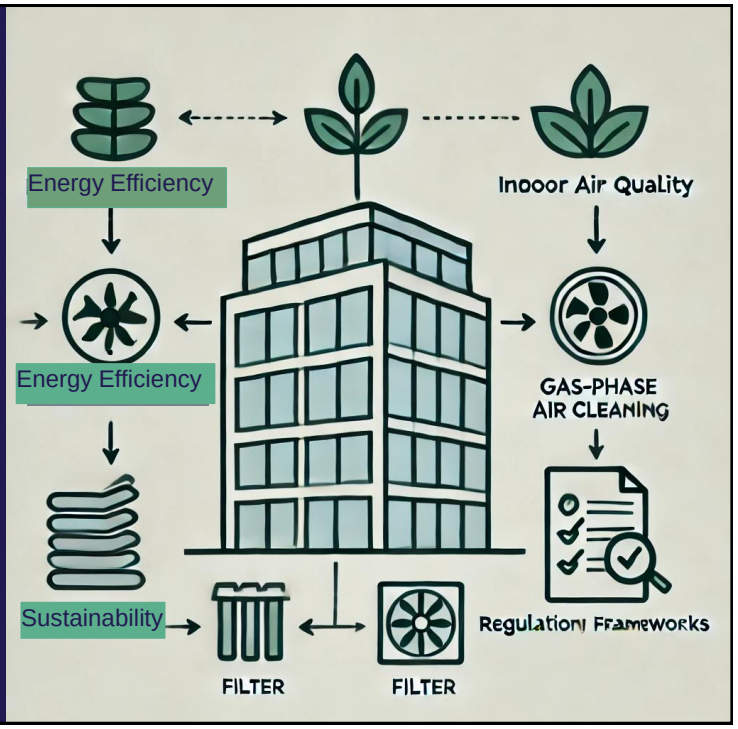
1

Background

- Increasing global focus on energy efficiency and sustainability in buildings
- Climate change driving demand for resilient HVAC solutions
- Growing health concerns highlight importance of indoor air quality (IAQ)
- Need for innovative approaches integrating energy performance and air cleaning



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System Configurations – How Air Cleaners Are Used in Buildings

- **Stand-Alone Units:**
  Portable air cleaners placed in rooms to clean the air around people.
- **Personal Ventilation Systems:**
  Small air cleaning units that deliver clean air directly to a person's breathing zone.
- **Beam-Based Systems (Chilled Beams):**
  Air cleaners built into cooling beams that clean the air while providing cooling.
- **Primary Air Supply:**
  Air cleaners placed at the main air supply point to clean outdoor air before it enters the building.

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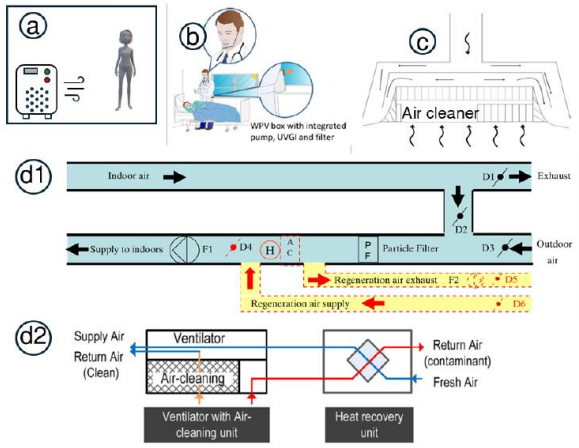

Air cleaning implementation:
a) Stand-alone unit,
b) Personalized environmental control systems (PECS),
c) Beam based,
d) Primary air supply

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Key Technologies

- **Activated Carbon Filters:** Absorb gases and odors, effective for VOCs.
- **Photocatalytic Oxidation (PCO):** Uses UV light and a catalyst to break down pollutants.
- **Air Ion Generators:** Release ions to neutralize particles and gases.
- **UV-Based Air Purification:** Kills viruses and bacteria.
- **Hybrid Systems:** Combine multiple technologies for better performance.

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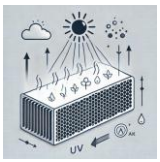

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Key Findings from Annex 78

- Gas-phase air cleaning technologies can reduce heating energy demand while maintaining IAQ
- Recirculation rates of 20%, 40%, and 60% in offices with HRV systems led to 8%, 16%, and 24% heating energy savings (Nourozi et al., 2022)
- Residential buildings with HRV showed minimal impact from air cleaning; without HRV, 3% savings per 20% recirculation increase
- Air cleaners integrated into active chilled beams yielded primary energy savings of 26% (Afshari et al., 2023)
- Energy savings observed across different climates, e.g., Copenhagen (9 kWh/m²/year) and Tokyo (5 kWh/m²/year) (Bogatu et al., 2024)

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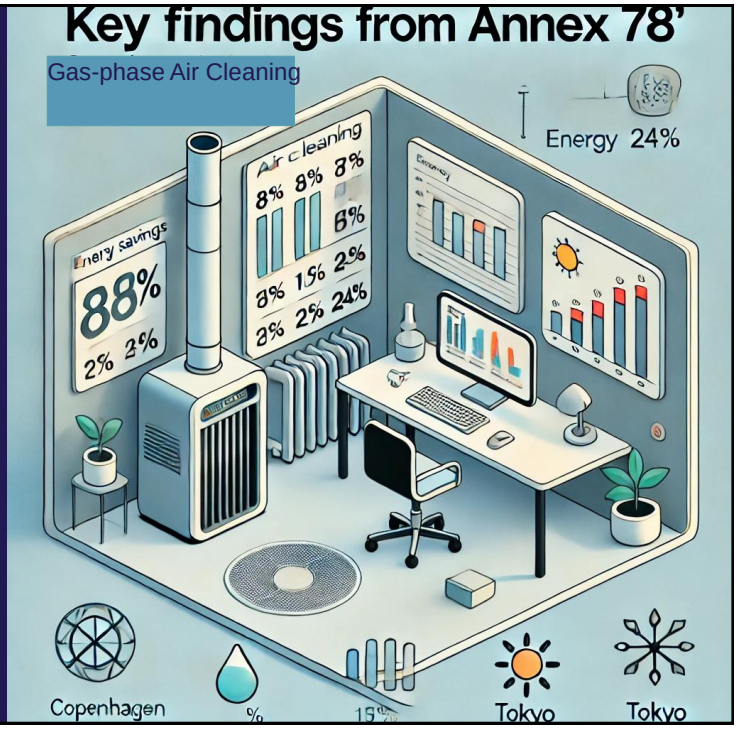

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Technology Readiness Assessment

- Preliminary assessment conducted in Annex 78 and 87
- Technology shows potential in different climates (e.g., Sweden, Tokyo)
- CADR/kWh metric emphasized for evaluation

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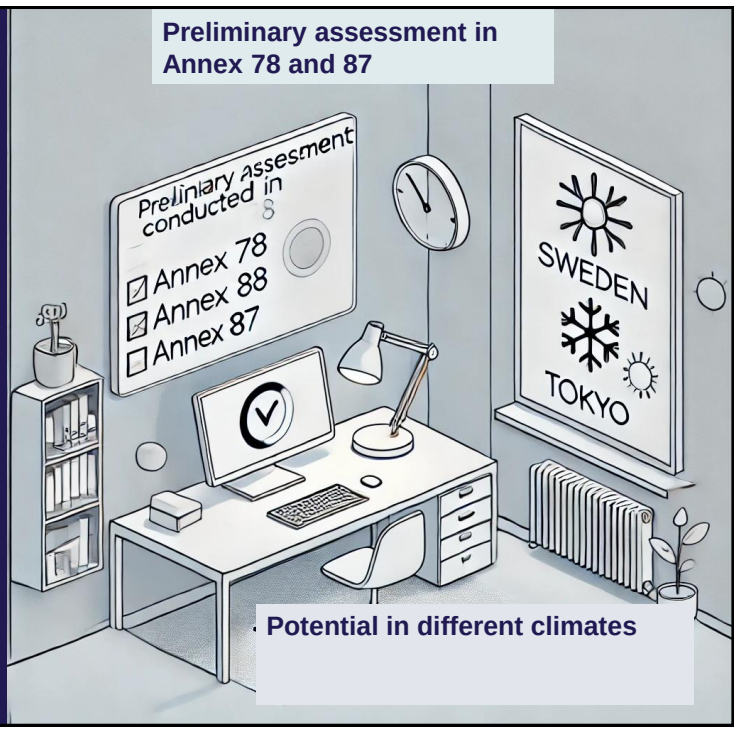

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Problem

- Balancing energy efficiency and indoor air quality (IAQ) in buildings
- Increased urgency due to climate change, heat waves, wildfires, and pandemics
- Traditional ventilation systems lead to high energy consumption

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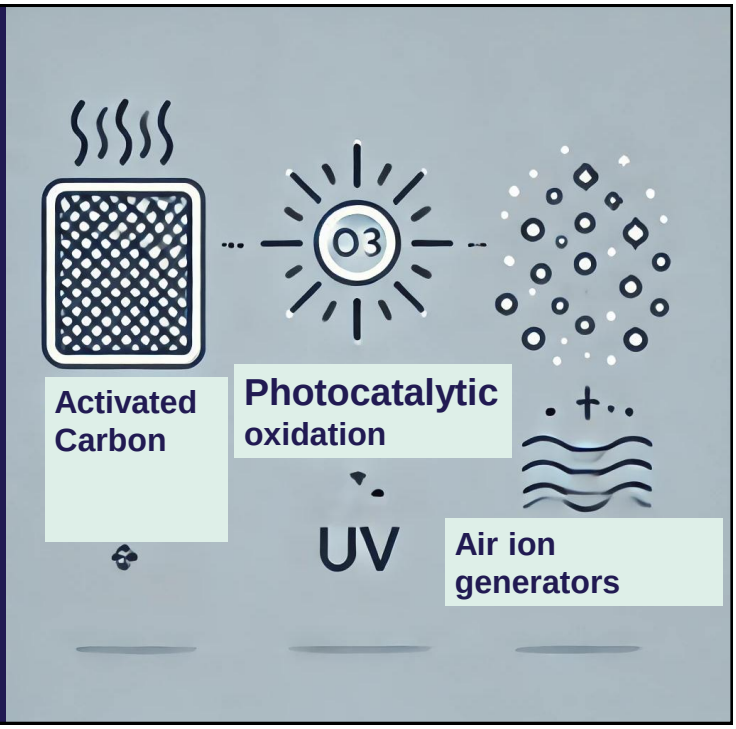
Approach

- Integrating advanced gas-phase air cleaning technologies:
  - Activated carbon filters
  - Photocatalytic oxidation
  - Air ion generators
- Combining with mechanical filtration
- Reducing outdoor air intake while ensuring pollutant removal



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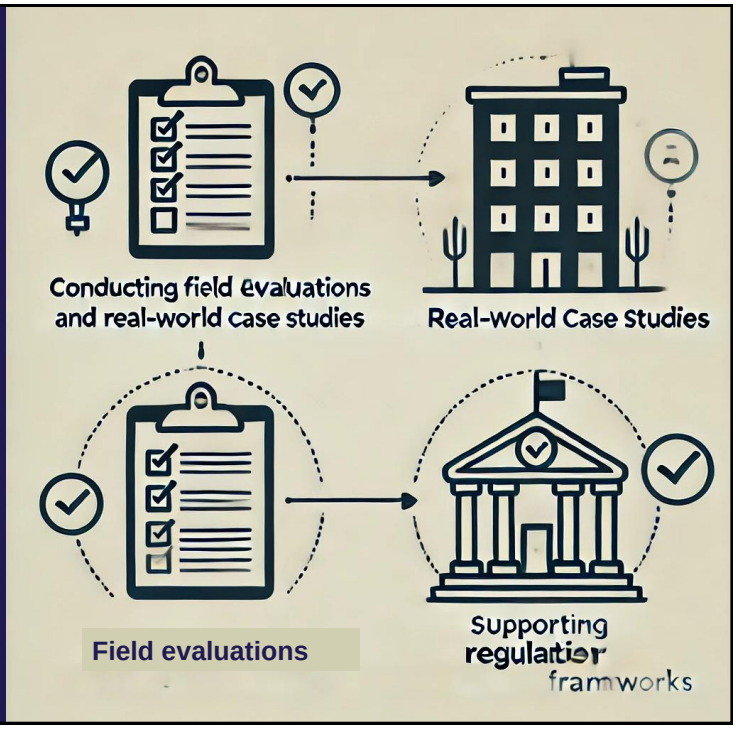
Objectives

- Develop a standardized framework for selecting and applying gas-phase air cleaning technologies
- Optimize energy performance across building types and climates
- Define selection criteria for air cleaning and filtration systems
- Standardize performance metrics (e.g., CADR/kWh)
- Evaluate energy-saving potential during overheating and climate events
- Conduct field evaluations and real-world case studies
- Support regulatory frameworks



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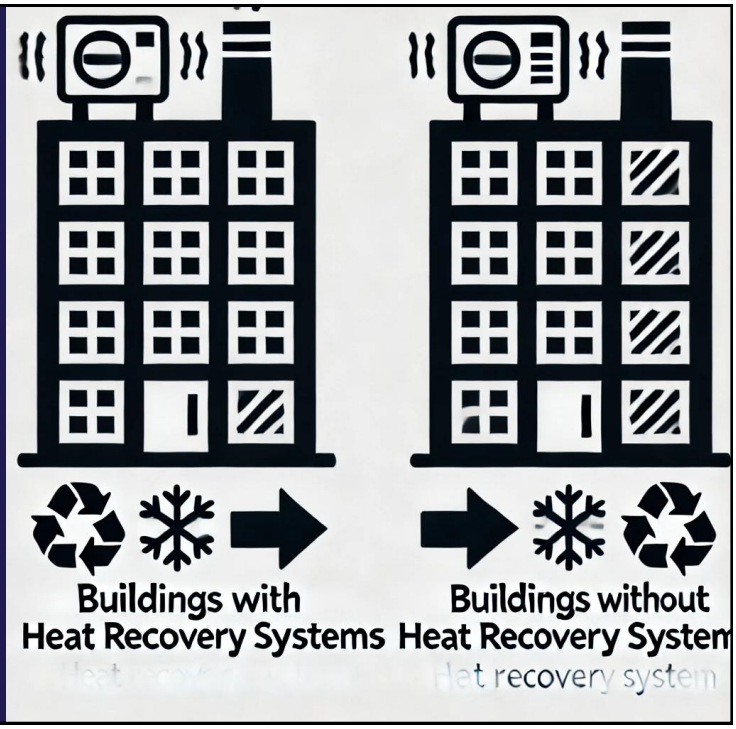
Scope

- Focus on office and residential buildings
- Two key scenarios:
  - Buildings with heat recovery systems
  - Buildings without heat recovery systems
- Field evaluations to validate real-world performance



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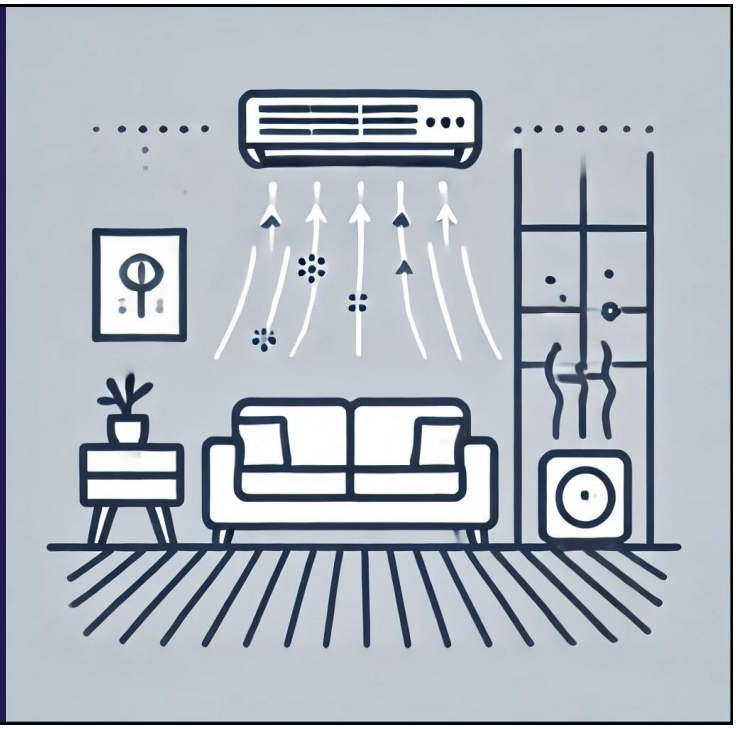
New Annex

- Shift towards energy efficiency improvements
- Investigating cooling energy recovery and high recirculation rates
- Combining air cleaning and filtration as an integrated strategy



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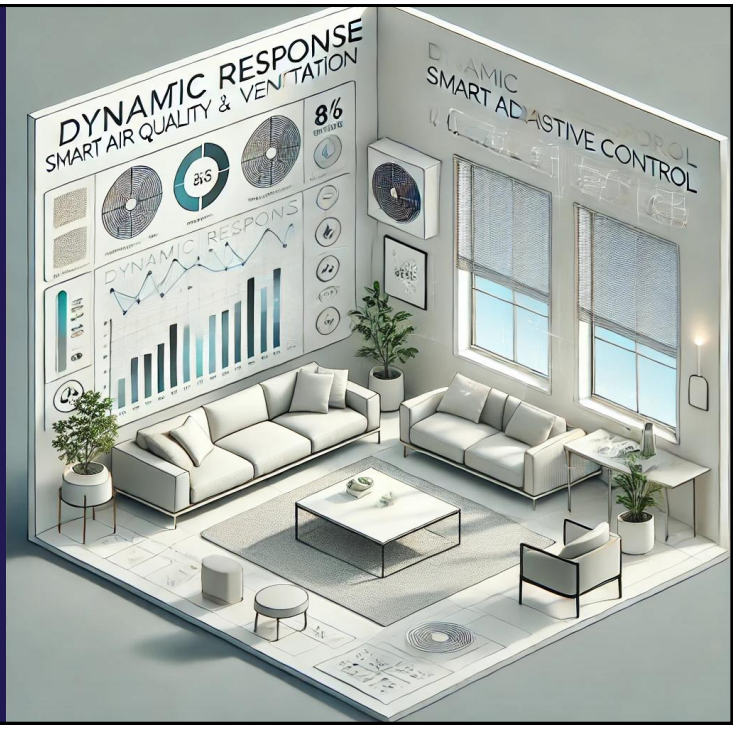
Field and Simulation Studies

- Conduct field evaluations and case studies
- Test protocols and energy savings assessments
- Develop adaptive control strategies for dynamic response



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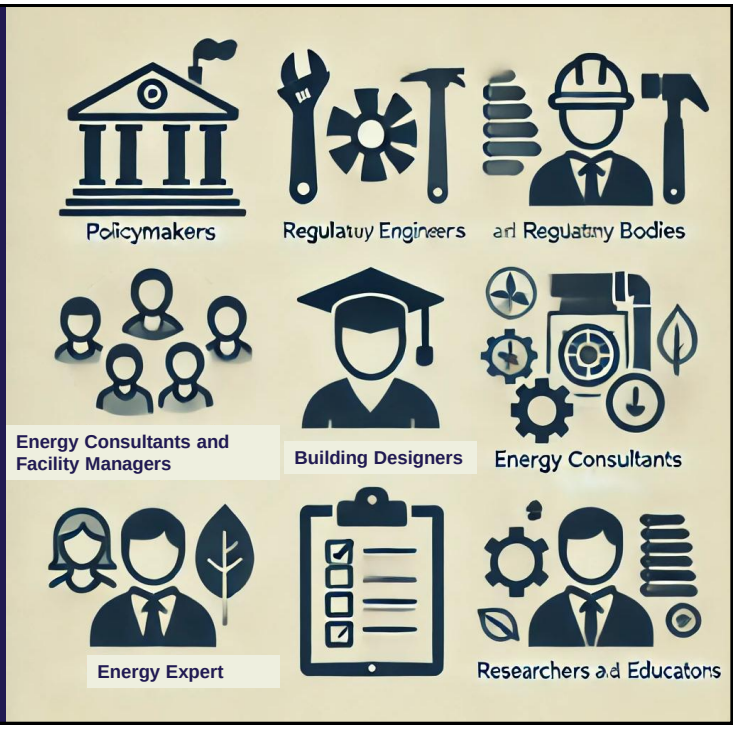
Target Audience

- Policymakers and regulatory bodies
- HVAC engineers and building designers
- Energy consultants and facility managers
- Sustainability experts
- Researchers and educators



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Relation to EBC Strategic Plan

- Supports EBC Strategic Plan 2024-2029
- Step change and disruptive impact:
  - Integration of air cleaning into HVAC for energy reduction
  - CADR/kWh as a performance benchmark
  - Holistic approach to lifecycle and environmental impact

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Required Expertise

- Advanced gas-phase air cleaning technologies
- Lifecycle assessment experts
- Regulatory framework analysts
- Data analytics and AI professionals
- Cross-disciplinary integration experts

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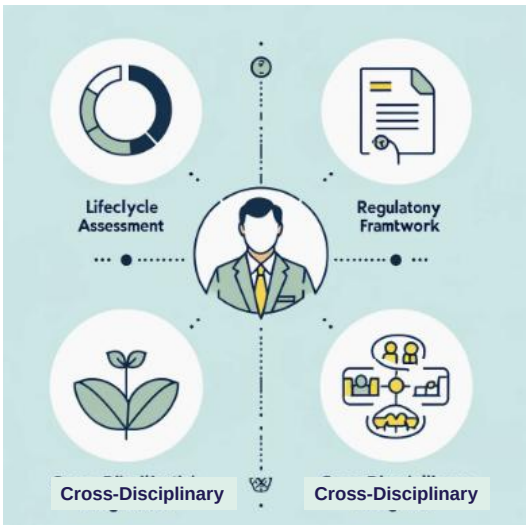

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Collaborating Organizations

- Technical universities (e.g., AAU, DTU, KTH)
- Industry partners (HVAC manufacturers, technology developers)
- Government agencies and policymakers
- NGOs and sustainability certification bodies

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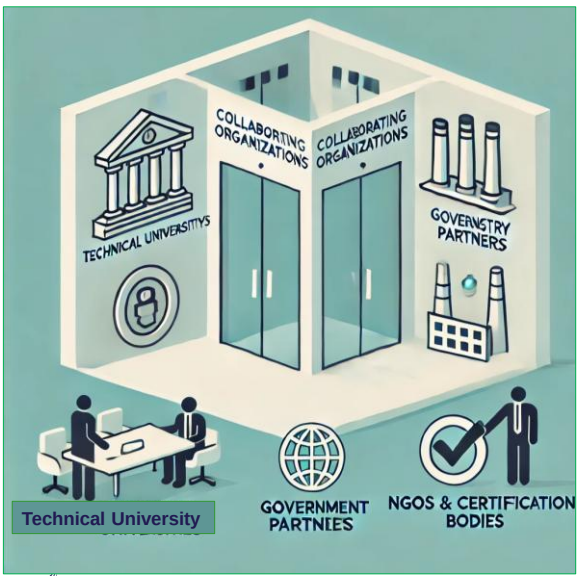

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