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Objective

Re-conceptualize shopping malls through deep retrofitting, developing innovative technologies and solution sets, and utilizing a comprehensive systemic approach

Methodology

The main concept is the shift from single-action refurbishment to a Systemic Retrofitting Approach (SRA)

Performance targets

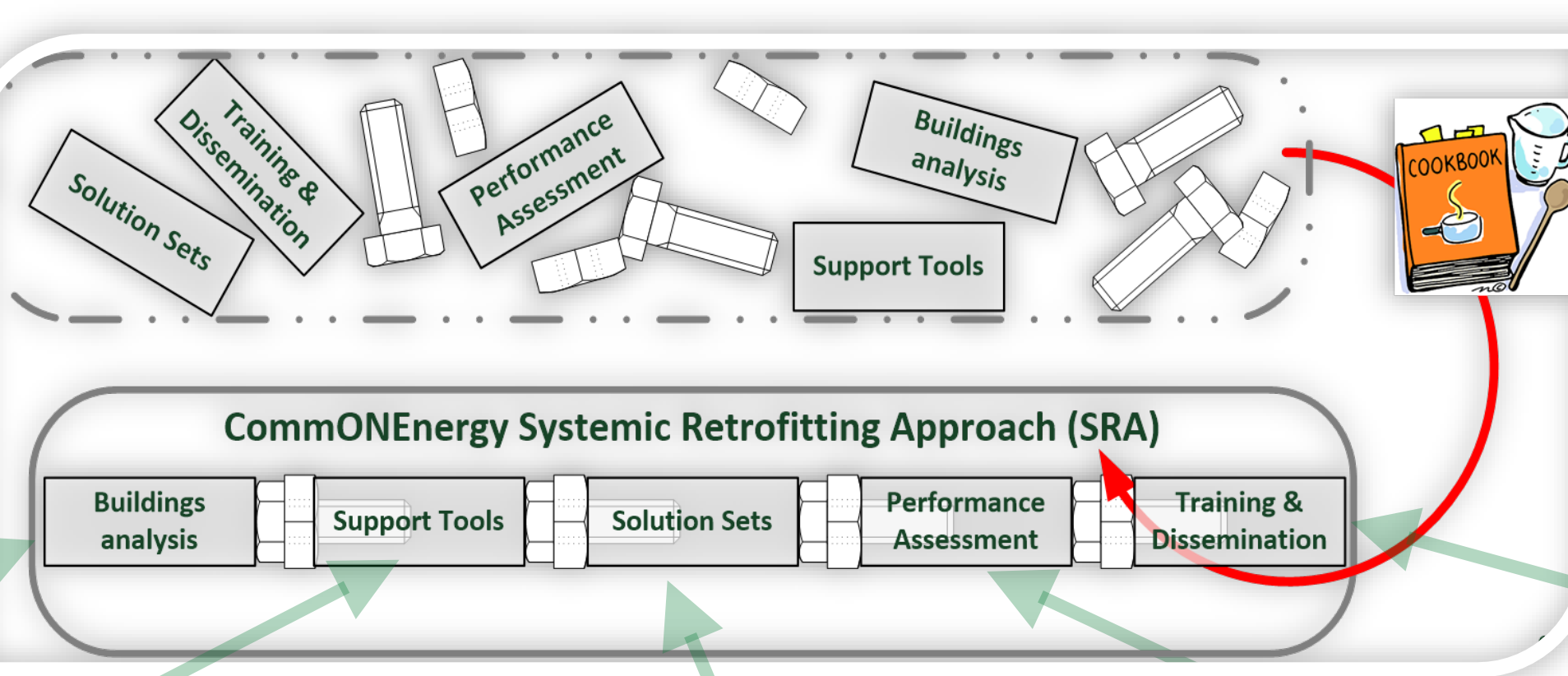
- Up to 75% reduction of energy demand (F. 4)
- Power peak shaving
- 50% increased share of renewable energy source
- Improvement of comfort and health conditions
- Short pay-back times (below 7 years)

1) Building analysis and potential

- Diagnosis techniques for building stock and building auditing to define saving potentials to be captured through a better use of the existing architecture and technologies
=> RETROFITTING DRIVERS (RD)
- Energy/economic evaluation tools to investigate the economic feasibility of shopping mall retrofitting for different scenarios, surrounding conditions and European climatic zones
=> SHOPPING MALL ASSESSMENT TOOL (SMA)
- Development of scenarios for the energy demand and uptake of renovation activities in the EU commercial building sector
=> REPLICATION POTENTIAL ANALYSIS

2) Supporting tools

- Integrated design process tailored to shopping malls retrofitting, to develop solution-sets focusing on energy, economic and environmental aspects
- Continuous commissioning to analyze monitored data and compare them in real-time with expected performance parameters
- Integrative modelling environment, as operative tool of the integrated design process
- Lean Construction Management procedures to reduce costs and resources waste during the retrofitting process and the operative phase



3) Solution sets

Cost-effective retrofitting solutions for reducing building energy needs, enhancing energy efficiency to provide appropriate indoor environmental quality (IEQ), fully exploring RES and smartly integrated in the local energy grid.

Architectural

Multifunctional materials, and components to improve the passive behavior of the building, including strategy to maximize the exploitation of local natural source for ventilation and daylighting

Intelligent Building Management System (iBEMS)

To increase the overall efficiency of the building by integration and controlling of the energy functions and fluxes and their integration with the energy generation sources and local grid

5) Training and dissemination

- Lean pool for craftsmen
- Specific training to promote new jobs and encourage the upgrade of industrial and handcraft activities to better answer the demand of market trends
- Dissemination strategies and actions that assign a new function to shopping centres by raising awareness on energy efficiency issues
- Shopping malls sustainability award
- Training workshops with practitioners
- Guidelines for approaching energy-efficient renovation of Shopping Cen.

4) Performance assessment

STANDARDIZED METHODS AND TOOLS
for energy, environmental and social assessment
of retrofitting actions,
allowing benchmarking and comparisons to support stakeholders choices along building life time.

Expected results will include:

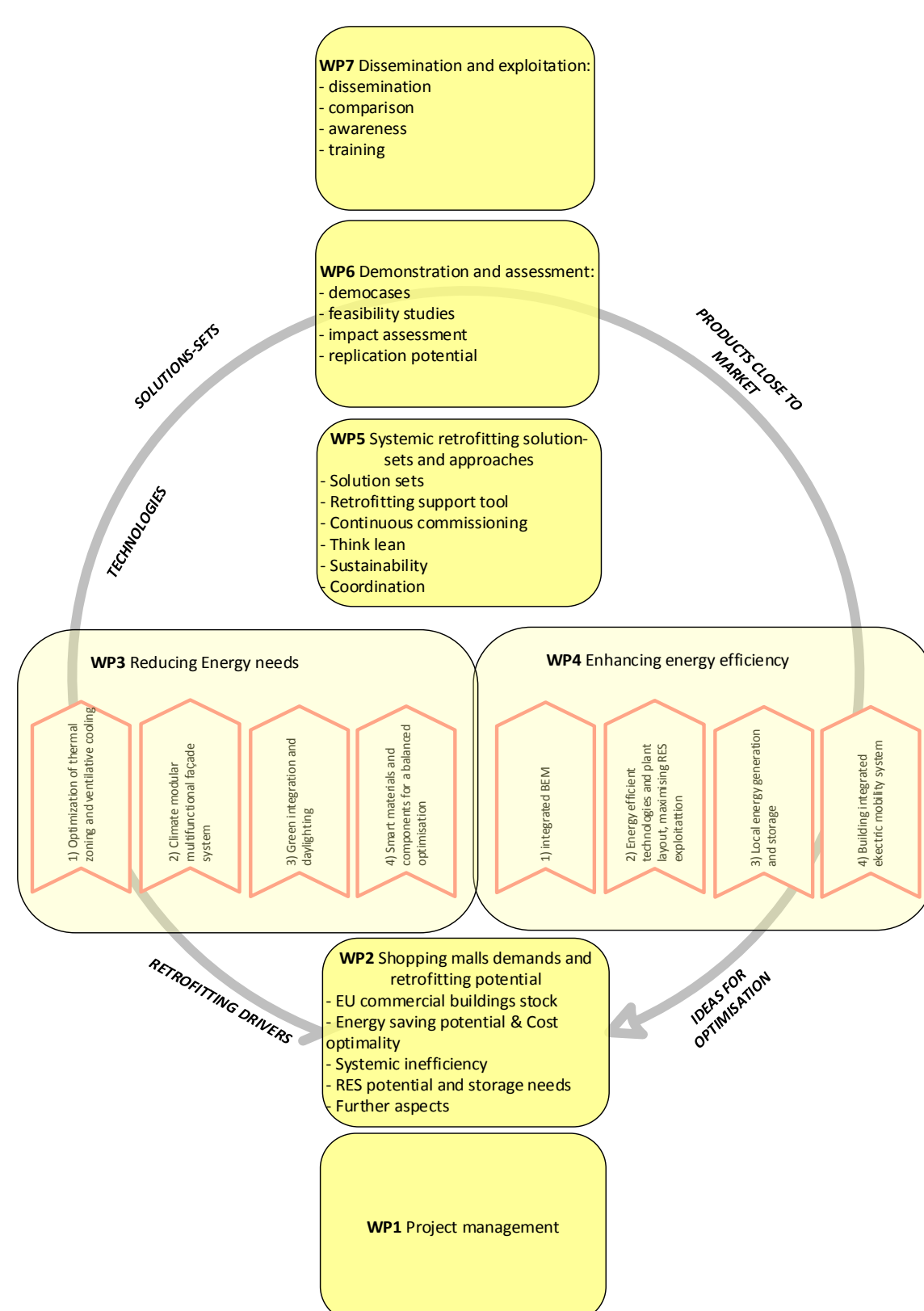
- 10-20 systemic solution-sets populating IDP library for mall retrofitting
- Shopping mall energy-economic assessment tool
- Procedures for application of LCM to shopping mall retrofitting
- Continuous commissioning tool to verify and optimize operation
- Procedure for (LCA based) impact assessment of mall retrofitting
- Interactive web-tool to evaluate uptake scenarios and replication potential
- SME and practitioners trained based on the train-the-trainer approach
- Craftsmen trained according to 'Lean thinking' education course
- Public events, professional video and further tools to exploit results with different target groups (e.g., owners, employees, policy makers)
- Creation of Shopping mall sustainability award to "label" shopping malls sustainability level
- Toolkit for awareness rising
- Guidelines on how to approach energy-efficient mall retrofitting
- Web platform to disseminate results also after project lifetime

Demonstration and assessment

The systemic retrofitting approach, as well as the support tools and methods, will be implemented in three demo cases and theoretical studied in a number of further real reference buildings, with high replication potential.

Some preliminary tastes of solutions that will be demonstrated:

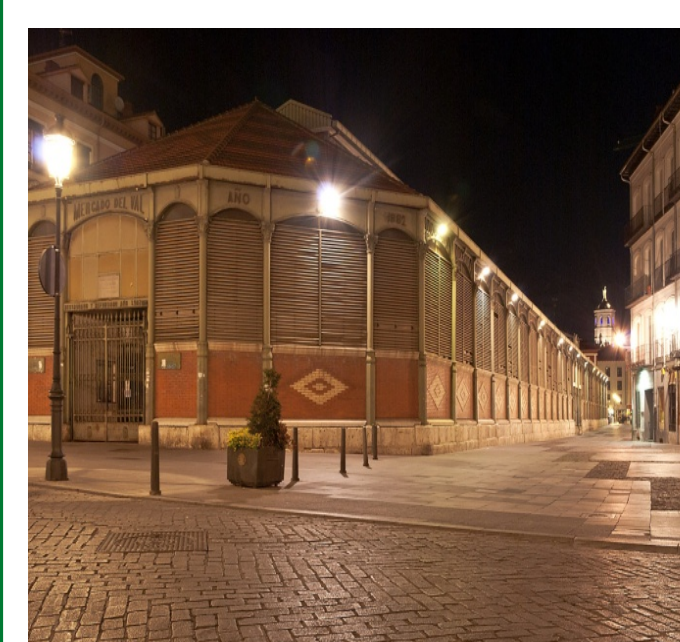
- Modular Multifunctional Climate adaptive Façade system: adaptable to architectural and urban context, exploiting climate potential
- Ventilative cooling: natural ventilation strategies based on openings and architectural features, driven by suitable control algorithms
- Internal micro-layout design to improve thermal zoning: refrigeration cabinets, HVAC and lighting systems combined layout, developed through CFD analysis to enhance comfort, functioning and energy performances
- Solar reflective coloured coatings: NIR reflective green colour coating with improved thermal insulation features, to reduce peak building thermal load and parking lots temperature
- Combined daylighting and efficient lighting approach: depending on climate and urban context and connected to iBEMS
- Thermal-insulation flexible "wall paper": anti-reverberation + insulation wall paper substitute for noising area (food court)
- iBEMS (intelligent Building Energy Management System): supervision platform to comprehensively control shopping centre
- Green areas: several strategies for building surround, envelope and interior for climatic- based solutions to reduce energy needs
- Integration of energy distribution and refrigeration system (HVAC+R): thermal cascade, water loop and trans-critical CO₂
- Renewable energy storage via hydrogen conversion and/or electric batteries: combined solutions for daily peak shaving of non-RES and long term RES energy storage
- Electrical mobility: use of batteries as distributed storage while encouraging "green" mobility (success depends on local policies on mobility)



Trondheim, NORWAY



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Duration: October 2013 - September 2017 (48 months)