Compact hybrid electrical-thermal storage for historic BIPV applications in the Mediterranean

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Outline

- Introduction - Motivation
- Literature Review (Solar technologies for building integration, case studies)
- Methodology
- Conclusions

Introduction -Motivation

- Climate change
- Increasing number of buildings → Energy demand is rising
- European Commision → Promotion of RES
  - ✓ 20% reduction in greenhouse gas emissions
  - ✓ 20% renewable energy consumption
  - ✓ 20% reduction in energy consumption

Introduction -Motivation

- Installation of RES in a historic building enable best balance between:
- saving energy
- Reducing carbon emission
- Sustaining heritage-significance
- Maintaining a healthy building area

Introduction -Motivation

- Our motivation is to minimize the energy consumption of buildings by combining both passive and active systems
- Compact hybrid electrical-thermal storage system
- Application into demo-sites

Literature Review

❑Solar systems for buildings

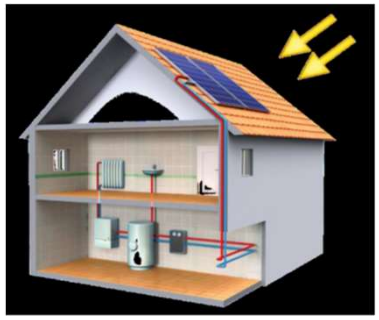
○ Solar Thermal System

- Glazed Flat Plate Hydraulic Collectors (Glazed Flat Plate Hydraulic Collectors)
- Unglazed Flat Plate Hydraulic Collectors
- Flat Plate Air Collectors
- Vacuum Tube Hydraulic Collectors
- Concentrating Hydraulic Collectors
- Unglazed Plastic Collectors

Literature Review

❑Solar systems for buildings

- **Photovoltaic systems**
  - BAPV
  - BIPV
    - Flexible (Foil) BIPV
    - BIPV tiles
    - Solar Cell Glazing
    - Other technologies



Literature Review

❑Historic preservation designation

- preservation of the original form and value of the historic district
- recognize the importance of accommodating renewable energy technologies
- Based on ICOMOS Charter for the Conservation of Historic Towns and Urban Areas , article 8, “new functions and activities should be compatible with the character of historic town or urban area”. Furthermore, “adaptation of these areas to contemporary life requires the careful installation or improvement of public service facilities”. Active solar systems are considered as contemporary elements. Thus, according to Article 10 of the same charter, these “should be in harmony with the surroundings” and should not be discouraged since (they) can contribute to the enrichment of an area” (ICOMOS, 1987, Bougiatioti and Michael 2015).

Literature Review

❑Case studies

- Integrated PV in façades
- BAPV on the roof

Building of the Tourist Office in Alès (France)

Reichstag parliamentary building in Berlin

Paul VI Audience Hall

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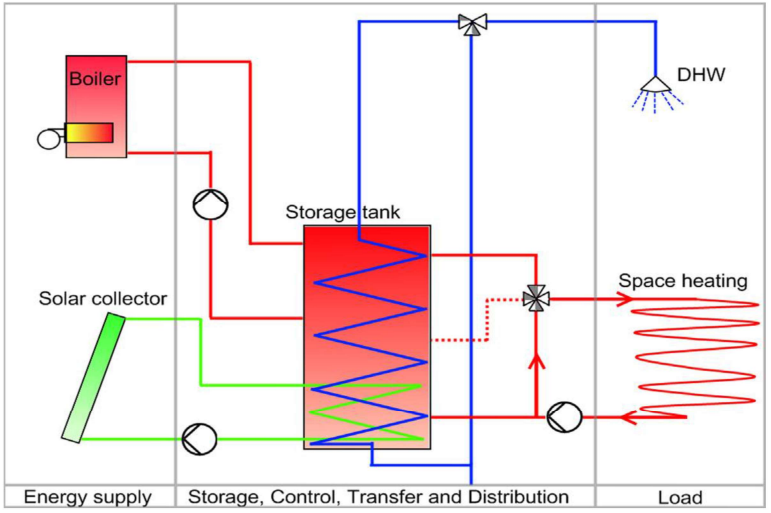
❑Energy storage systems

Electric Energy storage
---Batteries**---**

Thermal Energy Storage



HyBuild Project

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❑Direct Current (DC) distribution in buildings

Building with PVs and Batteries

+

DC distribution system

→ **Energy Savings**

- Centralizing the power conversion → Efficiency advantage
- Cost of AC system is higher than the cost of DC system

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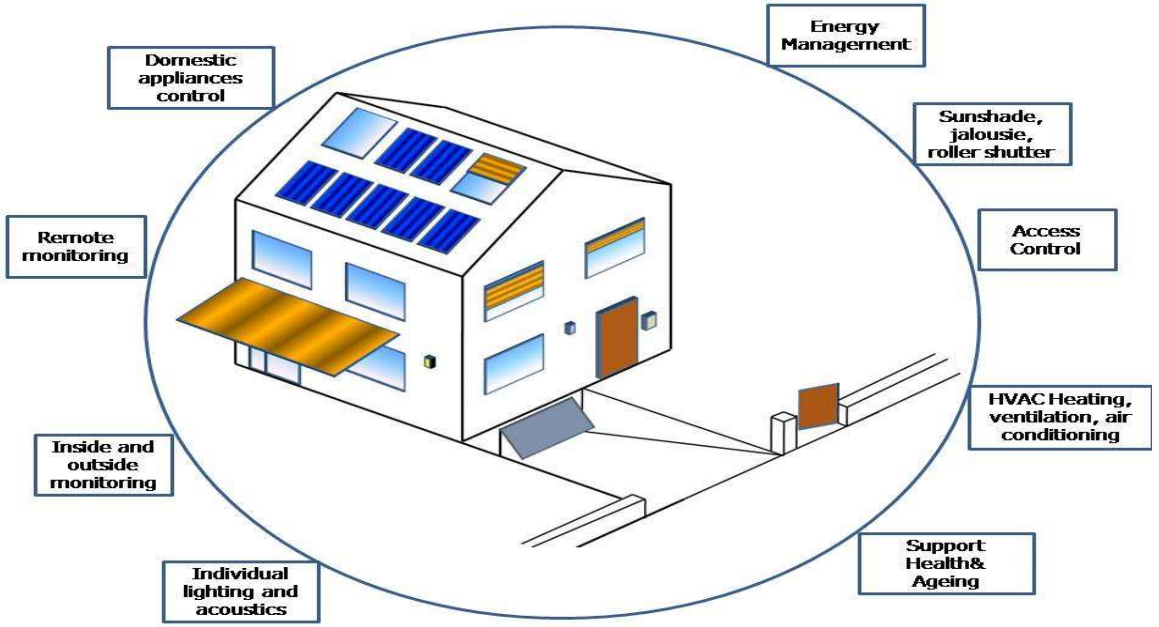
❑Technical Systems

- Heat Pumps
- Building Energy Management System



Methodology

Project HYBUILD → Two innovative compact hybrid electrical – thermal storage systems

Mediterranean Climate

- **Priority:** Cooling Operation
- Solar Energy → PV System
- Solar Thermal
- Low Temperature Latent Storage
- DC distribution system

Continental Climate

- **Priority:** Heating Operation
- Solar Energy → PV System
- High Temperature Latent Storage
- DC distribution system

Mediterranean climate

- **Aglantzia Municipality (Cyprus)**

Site description: Public building

Date of construction: 2005

Area: 140m^2

Mediterranean climate

- **Aglantzia Municipality (Cyprus)**

Exterior Perspective View

nterior Perspective View

Mediterranean climate

- **Almatret (Spain)**

Site description: Residential house
Date of construction: 1970
Area: 107m^2

Continental climate

❑ Bordeaux (France)

- **Site description:** Nobatek building
- **Date of construction:** 1960
- **Area:** 100m^2 (2 floors of 50m^2 each)

Synopsis

- **Overall Objective:** Development of an interdisciplinary and holistic approach that incorporates energy generation, energy distribution and energy storage for cooling and heating energy provision and DHW production, suitable for both the Mediterranean and Continental climates
- **Project Scientific Objectives**
  - Development of hybrid energy storage technologies
  - Development of efficient, compact electrical architecture (DC bus)
  - Development of smart control and management system
  - Install and monitor the developed systems in real demo – sites in three countries with different climatic conditions.

Synopsis

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❑ Architectural integration objectives

- Explore the sensitive issue of integration into listed buildings
- local authorities, professional, agencies and historic organization should work together
- guidelines that will help designers for historic evaluation and solar design integration
- a formation of designers and decision makers that will provide technical and formal possibilities of PV systems.

Consortium


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Thank you for your attention