



Cost Efficient Options and Financing Mechanisms  
for nearly Zero Energy Renovation  
of existing Buildings Stock

## **DELIVERABLE 2.4**

### ***CATALOGUE OF MATERIALS, EQUIPMENT AND TECHNOLOGIES PERTINENT TO ALL MUNICIPAL BUILDINGS***

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## Deliverable D2.4: Short Description

### Short Description:

The catalogue presented in this deliverable is a list of materials, equipment and technologies used by project partners in the evaluation and selection of the renovation schemes proposed for the 4 Municipalities participating in the project.

Keywords: Energy demand reduction, Renewable energy sources, rational use of energy, equipment

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## Statement of originality

This deliverable contains original unpublished work except where clearly indicated otherwise. Acknowledgement of previously published material and of the work of others has been made through appropriate citation, quotation or both.

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## ABBREVIATIONS AND ACRONYMS

Acronym	Definition
BEMS	Building Energy Management Systems
CHP	Combined Heat and Power
DCV	Demand-Controlled Ventilation
GHP	Geothermal Heat Pump
HVAC	Heating, Ventilation, and Air Conditioning
ICTs	Information and Communications Technologies
PCM	Phase Change Materials
PV	PhotoVoltaic
PV-T	PhotoVoltaic-Thermal
VIG	Vacuum Insulated Glass

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## CERTUS PROJECT IN BRIEF

Southern European countries undergo a severe economic crisis. This hinders the compliance to the latest Energy Efficiency Directive, demanding strict energy efficiency measures for the public sector. Investments required to renovate public buildings and achieve nearly zero energy consumption have long payback times. So the interest of financing entities and ESCOs is small, especially when banks have limited resources. Many of the municipal buildings in Southern Europe require deep renovations to become nZEB and this should not be regarded as a threat but rather as an opportunity for the energy service and the financing sector.

The objective of the proposed action is to help stakeholders gain confidence in such investments and initiate the growth of this energy service sector.

Municipalities, energy service companies and financing entities in Italy, Greece, Spain and Portugal are involved in this project. The plan is to produce representative deep renovation projects that will act as models for replication. Twelve buildings in four municipalities in each country have been selected. The partners will adapt existing energy service models and procedures and will work out financing schemes suitable for the 12 projects. Consequently, the partners will create materials, such as guides and maxi brochures, suitable to support an intensive communication plan.

The plan includes four workshops with B2B sessions targeted to municipalities, ESCOs and financing entities. These actions shall be complemented by four training activities targeting municipal employees and the participation in international events targeting all 3 stakeholders. We expect that our action will have a significant impact by triggering investments in renovations to achieve nZEB and the uptake of the ESCO market in Southern European member states.

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## EXECUTIVE SUMMARY

During the last years, energy efficiency has become a fundamental topic for improving buildings sustainability. To this aim, the development of several technologies and renovation solutions which rapidly spread in the market has been one of the main drivers.

This deliverable summarises the analysis of potential materials, equipment and solutions considered in the project case studies to achieve Nearly Zero Energy buildings, focusing on:

- Reducing energy losses through the envelope
- Renewable energy sources
- Equipment for energy efficiency improvement
- Technologies for a rational use of energy

These categories have been selected according to main retrofitting requirements.

The **envelope** is one of the weakest points of the building in terms of **energy loss** and energy consumption can be significantly reduced by increasing the insulation level of the thermal envelope. The solutions provided in this catalogue address different type of insulation materials as well as windows and fenestrations. Different types of solutions of **renewable energy sources** are also analysed, including solutions for energy generation and storage. The improvement of the envelope insulation is directly connected to **energy efficiency equipment**, especially HVAC systems, both in winter and summer, to which special emphasis is given in this report. Technologies for a **rational use of energy**, such as lighting systems and monitoring and control systems are also presented.

These four categories have been divided in subcategories, according to the type of technology or system analysed. Each solution is presented in form of a short fact sheet, with a short technical description, including main advantages and disadvantages, conditions of use and specific application and state of the art. The fact sheet is accessible by selecting the corresponding link of the list detailed in this deliverable.

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## LIST OF MATERIALS, TECHNOLOGIES AND SYSTEMS

### 1. DEMAND REDUCTION THROUGH THE ENVELOPE

#### 1.1. NATURAL INSULATION MATERIALS

Bird Feathers  
Coconut Fibres  
Hemp Fibre  
Cork Panels  
Flax Fibres  
Granulated Cork  
Sheep Wool  
Straw Fibres  
Wood Fibres

#### 1.2. INSULATION MATERIALS

Cellular Glass "Polydros"  
Cellulose Fibres  
Expanded Clay Balls  
Glass Wool (Blankets Or Rigid Panels)  
Polystyrene Beads  
Polyurethane Foam  
Rock Wool (Blankets, Rigid Panels Or Projected)

#### 1.3. GLAZING

Vacuum Glazing

### 2. RENEWABLE ENERGY SOURCES (RES)

#### 2.1. PHOTOVOLTAIC

Photovoltaic Facade  
Photovoltaic Glass  
Photovoltaic Shingles  
Rooftop Photovoltaic

#### 2.2. SOLAR THERMAL

Solar Water Heaters

#### 2.3. WIND POWER



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Small Wind Turbine For Rooftop

[2.4. GEOTHERMAL](#)

Geothermal Heat Pumps

[2.5. FUEL CELLS](#)

Fuel Cells For Chp In Buildings

[2.6. ENERGY STORAGE](#)

Aquifer Thermal Energy Storage

Batteries

Borehole Thermal Energy Storage

Hot Water Tanks

Phase Change Materials

[2.7. BIOMASS](#)

Biomass For Chp In Buildings

[2.8. HYBRID PV/T PANELS](#)

Hybrid Pv/T Panels

[3. EQUIPMENT](#)

[3.1. HVAC](#)

Evaporative Cooler Utilizing The Maisotsenko Cycle

Open Absorption Cycle-Liquid Dessicant Cooling System

Combined Solar Power And Heat Generation (Pv-T)

Air To Water Heat Pumps

Solar Heat Pump / Closed Absorption Cycle

CO<sub>2</sub> Refrigeration Systems

Hydronic Radiant Systems

Solar Cooling System

Geothermal Heat Pumps

[4. RATIONAL USE OF ENERGY \(RUE\) - ICTS](#)

[4.1. LIGHTING](#)

Daylight Sensor

Motion Detection Sensor

Dimming Systems

[4.2. HVAC](#)

CO2 Sensor

Humidity Sensor

Smart Thermostat

#### 4.3. APPLIANCES

Remote Controlled Sockets

Sockets With Timer

#### 4.4. GLOBAL MONITORING AND CONTROL

Monitoring And Control Systems

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