

Επενδύοντας στην Ενεργειακή Αποδοτικότητα, Αθήνα, 24 Μαΐου 2018

5<sup>η</sup> Συνεδρία: «Ενεργειακή Αναβάθμιση Κτηρίων - Ο Ρόλος των Κτηρίων Δημόσιου Τομέα - Καλές Πρακτικές»

## TOWARDS ZERO ENERGY BUILDINGS IN THE PUBLIC SECTOR HOSPITALS AND A MUSEUM

**DIMOUDI** Argiro,  
Associate Professor,  
Department of Environmental Engineering,  
Democritus University of Thrace



## BACKGROUND

- One of the basic energy objectives of EU is to decouple energy consumption from economic development.
- To meet the challenge, EU is setting specific energy efficiency and carbon emission goals for the years 2020, 2030 & 2050. The long term goal of EU for 2050 is to achieve a reduction of the CO2 emissions to 85% with respect the 1990 levels.

There is considerable work in EU on the definition of nearly  
Zero Energy residential buildings, offices, hotels

**BUT NOT for hospital buildings.**

# HOSPITAL BUILDINGS

- Hospital Buildings are complex, energy wise, buildings with poor energy efficiency profiles since most of the buildings were built before the introduction of concrete energy efficiency specifications.
- The advancement of new energy technologies provides for the improvement of the energy characteristics of hospital buildings.
- Energy consumption in EU hospitals is estimated at 6% of total energy consumption in non-residential buildings. According to recent work on energy consumption in hospitals, 80% of the consumed energy goes for lighting and HVAC functions.



# ZenH Balkan

## TOWARDS ZERO ENERGY HOSPITALS IN THE BALKAN REGION



ΔΗΜΟΚΡΕΤΕΙΟ ΠΑΝΕΠΙΣΤΗΜΙΟ ΘΡΑΚΗΣ  
DEMOCRITUS UNIVERSITY OF THRACE

Project coordinator



Albania



Bulgaria



Cyprus



FYROM

Project co-funded by the European Union

# Overall Objective of the Project

The **overall objective** of the project is to contribute towards improving the energy efficiency of the building sector and specifically **towards energy efficient hospital buildings**.

In addition, the project aims to facilitate the implementation of the EPBD **by defining the characteristics and Standards for Zero Energy Hospitals**.

## Specific Objectives:

- Benchmark and define the **Near Zero Energy Hospital Building** under specific regional climate conditions;
- provide technical guidelines towards near zero energy hospital buildings to hospital's management and technical staff;
- demonstrate the technical viability of ZenH and its profitability;
- advance the quality of hospital building data in the existing building Hubs;
- support capacity building of technical staff towards zero energy buildings in the public and private sector;
- advance the scientific knowledge towards Zero energy buildings and Hospitals in a Europe wide level;
- improve the maturity of future energy efficiency investment opportunities in the hospital building sector and in the building sector in general
- transfer concepts and techniques to other building types with similar characteristics.

# Expected results of the project

- 27 short energy audits with interviews with the managerial and technical staff of hospitals (8 in each GR and BUL, 5 in Cyprus, 3 in each Albania and FYROM)  
**27 short energy audit reports**
- 17 standard energy audits of public and private hospitals (5 in each GR and BUL, 3 in Cyprus, 2 in each Albania and FYROM) selected from the previous 27 hospitals fulfilling specific criteria.  
**17 energy audit reports**
- Prepare **Benchmarks** (modular technology based units) that can be used in the design of nZEn Hospitals. Case studies will be assessed.
- Theoretically test the benchmarks in 7 hospitals (2 in GR and BUL, 1 in Cy, Alb and FYROM), assessment of consumptions levels (simulations). These pilot case studies will lead to specific **technical solutions** that could be transferable to other type of buildings.



Perkins+Will's Kenya Women and Children's Wellness Center Takes National Healthcare Award for 2012

## Expected results of the project (cont.)

- ❑ Implement 5 **capacity building activities (Workshops, Seminars)** open to relevant audience.
- ❑ One **Handbook** on ZenH that will include technical guidelines, promising and financial affordable Energy Efficient and Renewable Energy technologies and design examples that many of its sections can also be applicable to other building categories. This is the contribution to the development towards nZEB.
- ❑ **International Conference** on ZenH open to audience
- ❑ **18 articles on Zero energy buildings and/or hospitals** in local and national press
- ❑ **Hospital consumption profiles** in building data hubs
- ❑ **6 technical reports** (4 in WP4 and 2 in WP5)



World's Most Advanced Hospital - the new Karolinska Solna University Hospital (Stockholm ) Will Also Be Green



# **A nearly Zero Energy Museum Hosted in a Listed Building**

**MUSEUMS** represent the culture, tradition, customs and customs of man and that is why they are a very important subject of study. The museums are buildings that are visited by millions of visitors everywhere in the world and are also converted into landmarks and symbols of the region (Tombazis A., 2004).

The great recognition they enjoy from the public has made them an integral part of the **economy** of the particular place, as tourism is growing and booming. Their expressive and **educational character** attracts thousands of tourists who also help the region's well-being (Papadopoulos A., Avgelis A., Santamouris M., 2003).

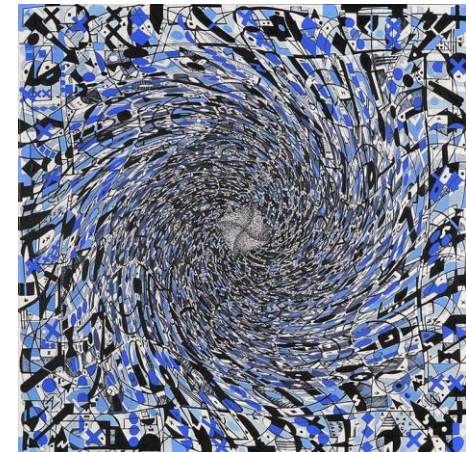
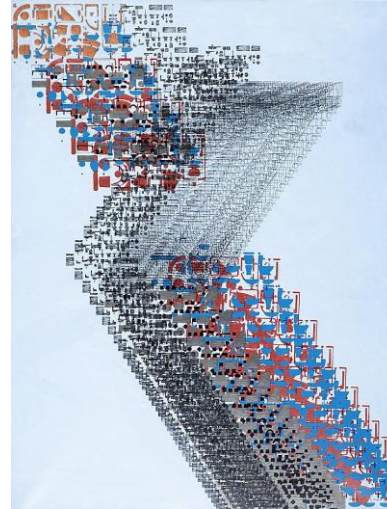
The complex and multifaceted operation of these buildings results in the consumption of **large amounts of energy**. Instead, materials and electromechanical equipment are required to ensure the necessary conditions for both people and works of art (Farreny R. et al, 2012)

Acropolis Museum



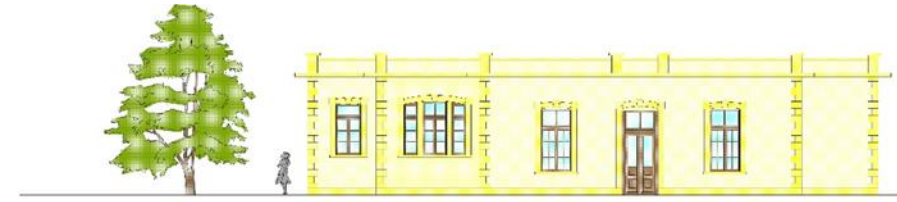
## CONSTANTIN XENAKIS ART MUSEUM

An Art Museum dedicated to the internationally known Greek artist **Constantin Xenakis** will be created in Greece with permanent exhibition of pieces of his art.

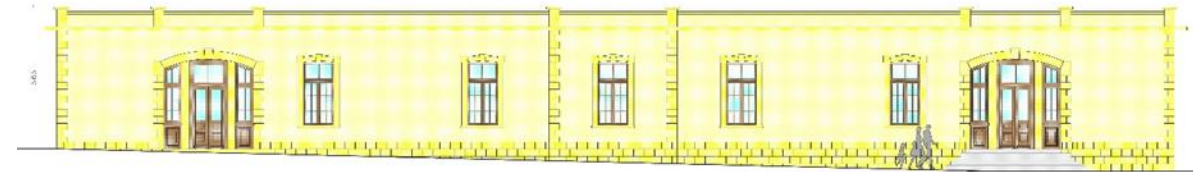


## Location

The museum will be located in an existing building of the former camp "Papalouka" in Serres, a city in Northern Greece, where the whole area according to the General Urban Plan is intended for cultural and recreational activities.



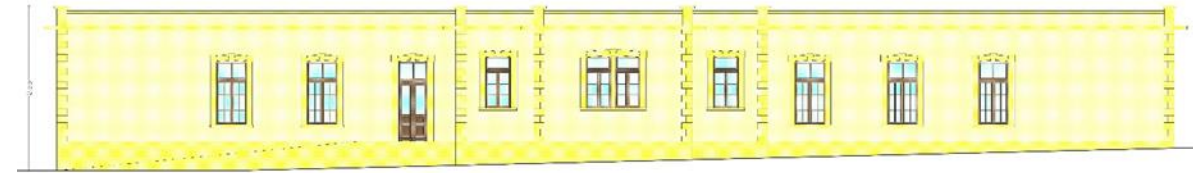
ΒΟΡΕΙΑ ΟΨΗ



ΔΥΤΙΚΗ ΟΨΗ



ΝΟΤΙΑ ΟΨΗ



ΑΝΑΤΟΛΙΚΗ ΟΨΗ





## Aim of the energy upgrade of the building

The proposed interventions aim to energy upgrading of the building to achieve the goal of the “**Nearly Zero Energy Building (NZEB)**” (primary energy consumption <60 kWh / m<sup>2</sup> as defined by CRES\*).

The interventions concern:

- Energy savings - Energy consumption reduction
  - Interventions in the building shell
    - Thermal insulation
    - Low thermal characteristics windows
- Implementation of RES - for achieving the NZEB objective
- Interventions in electromechanical equipment

The energy upgrade of the building is funded by the **INTERREG Greece – Bulgaria programme.**

\* Centre for Renewable Energy Sources (CRES)



## Proposed Interventions – RES use

Proposed interventions:

- Installation of a closed, horizontal layout, geothermal heating and cooling system with fan coil units in the office zone and vendor zone and Central Air Conditioning Unit (CCS) in the exhibition area.
- The proposed geothermal heat pump (GHG) has:
  - thermal capacity 58,22 kW with a power factor of 3.8 and a total consumption of 15.9 kW
  - cooling capacity of 52.6 kW with a power factor of 3.8 and a total consumption of 11.55 kW.

## Energy Consumption – Geothermal Energy

The specific energy consumption (EC) and primary energy consumption (PEC) of the building (in kWh/m<sup>2</sup>) after the integration of the geothermal heat pump is:

$$\text{EC} = 15,70 \text{ kWh / m}^2$$

$$\text{PEC} = 45,52 \text{ kWh / m}^2$$

Taking into account the consumption of general lighting in public areas (7.8 kWh / m<sup>2</sup>), **the primary energy consumption is 53.33 kWh / m<sup>2</sup>.**

Thank you

