“Policies and instruments for increasing buildings energy efficiency: Experience from the Greek Program “Energy Efficiency at Household Buildings”

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Buildings, as they are designed and used today, contribute to serious environmental problems because of excessive consumption of energy and other natural resources.

Demands of energy use in buildings and environmental damage arise because of energy-intensive solutions sought to meet the requirements of heating, cooling, ventilation and lighting.

Reducing building’s ecological footprint and minimizing the depletion of resources, serve as a common objective throughout the value chain.
Reducing energy consumption and CO2 emissions are among the main goals of the European Union to combat climate change, but also a vital step to achieve sustainable development.

With an estimated forty (40) % of total energy consumption, originating from buildings, the EU has introduced legislation to ensure energy usage is contained, taking into consideration the significant potential of consumption reduction through cost-effective measures, particularly in the building sector.

EU support, in the efforts to improve energy efficiency, is critical for the enhancement of competitiveness, the safeguarding of energy stocks and for the compliance to commitments on climate change, made under the Kyoto protocol.
Adding up the increasing demand for cooling, due to increasing population, rising temperature and humidity levels, one can conclude that cooling is a precious form of energy, which should be handled with care.

Keeping this in mind, we need to take a close look at the solutions available today.

Energy infrastructure plays a key role in maximizing our use of energy, and make scarce resources meet future demands.

This requires a transition to innovative, smart energy systems which are both simple, yet highly cost-effective and can deliver a sustainable performance throughout a long lifetime.
Buildings and transportation are the most energy-consuming sectors in Greece. Buildings account for approximately 36% of the total energy consumption.

Greek buildings consume so much energy because they are old and have no built-in state-of-the art technology, as well as due to the lack of relevant legislation over the last 30 years.

Most of these buildings have problems relating to:

- partial or total lack of heat insulation;
- outdated technology windows/doors (frames/single glazing);
- lack of sun protection on southern and western sides;
- inadequate use of Greece’s high solar potential;
- inadequate maintenance of heating/air conditioning systems, resulting in poor performance.
Another important factor affecting building’s energy performance is **tenant behavior**.

Users-tenants, who lack information about the rational use and management of energy, often tend to waste energy, e.g. by installing individual air conditioning systems without a relevant study, using low efficiency appliances, not performing maintenance of heating systems, etc.
Harmonizing building comfort, capital and environment, instead of compromising
Facility owners and managers make it a prime objective to guarantee this key necessity for their residents.

Large investments in often complex cooling networks are required to fit the purpose of providing long lasting and energy efficient cooling solutions.
Well-designed envelopes maximize cooling air movement and exclude sun in summer.

In winter, they trap and store heat from the sun and minimize heat loss to the external environment.

Energy consumption in new constructions can be controlled by way of adopting an integrated approach to building design.
Buildings Design

All NEW buildings can be designed to meet the occupant’s need for thermal and visual comfort at reduced levels of energy and resources consumption.

All EXISTING buildings can be improved its energy efficiency performance.
Based on bioclimatic principles, buildings design should:

**Location – Orientation:**
Maximize the use of natural resources for winter and summer

**Solar passive techniques**
to minimize load on conventional systems (heating, cooling, ventilation, and lighting)

**Energy-efficient infrastructure**
lighting and Heating, Ventilation, and Air-Conditioning systems.

**Renewable energy systems**
(solar photovoltaic systems/solar water heating systems) to meet a part of building load.

**Low energy materials and methods**
of construction and reduce transportation energy.

- Proper location and orientation
- Maximum utilization of the local climatic conditions
- Landscaping - improved microclimate
- Appropriate design and orientation of openings depending on the effects of insulation and the natural ventilation and daylighting requirements.
- Allocation of functions depending on usage requirements and comfort (thermal, natural ventilation and lighting)
- Application of at least one Passive Solar System (PSS) such as: direct solar gain openings, thermal storage walls, Trombe walls, sunspaces – greenhouses, hybrid systems
- Shading systems
- Application of natural ventilation techniques
- Visual comfort through artificial and natural lighting systems
Think and avoid
Just Remember
Response to Hellenic climate through history: (a double set of needs)

Ground floor responds to cooling needs (heat prevention through shade + mass).
Top floor responds to heating needs (Direct gains through wide openings + timber)

Integrating both actions; building responds to both situations

1800's

1900's

2000's
Energy Efficiency Policy and Measures in Greece

Steps since 1994 until tomorrow
Renovating the building stock to achieve high energy efficiency is one of the strategic investment fields, as in addition to ensuring energy savings and reducing carbon dioxide emissions, there are also other economic and social benefits, such as:

- employment,
- health,
- energy security
- and fighting energy poverty

A dynamic Energy Efficiency Incentive Policy together with energy efficiency demonstrated projects, especially in public sector buildings, such as schools, hospitals, military establishments, etc., and new Financing Mechanisms, such as Third Party Financing (TPF), have been install to support large scale energy efficiency investments for any buildings of public and private sector.
Towards a long-term national strategy for buildings energy efficiency

A clear target for the transition to a sustainable building stock by 2050

Ensure that 80% of the existing buildings become energy-efficient

Gradual and coordinated upgrade of the building stock, focusing mainly on the large number of typical Greek domestic residences, which number more than 4 million,

taking into account Greece’s individual targets and commitments, as well as the prevailing economic conditions.
Buildings energy efficiency: Towards a long-term national strategy

Provide a reference framework that is necessary for promoting the investments to be mobilised.

Further analyse the economic and additional social and environmental benefits resulting from the energy upgrade of buildings.

Stir the interest among investors in renovating the building stock.

Recognising that a more holistic, composite social and technical approach is needed.

Mitigate the risks and thus ensure future success.
Buildings energy efficiency: Towards a long-term national strategy

The key energy savings targets for our building stock can be achieved by formulating a strategy consisting in the implementation of measures and removal of obstacles emerging at three strategy implementation levels:

- governance
- structure
- practice
Energy Efficiency Policy and Measures in Greece

2010
Law 3855/10 (2006/32/EC)

2012
L. 4342/2015 (NationalGazette 143/9-11-2015)

2013
Recast L. 4122/2013

Towards nZEB
minimum energy efficiency requirements for new and existing buildings
concrete methodology for all required calculations, which are carried out with the software referred to, as TEE-KENAK, according to European and national standards.

First law 3661/2008
Measures to reduce energy consumption in buildings and other provisions
Requirements
New buildings

Inspections
Existing buildings

Inspections
Boilers & air conditioning
method for calculating energy performance according to the EN 13790 standard

4 climatic zones

minimum requirements for energy efficiency in buildings

minimum building requirements

technical characteristics of the “reference” building

structure and content of the Energy Efficiency Study

fees and energy efficiency inspectors
Since October 2010, a Study of Energy Efficiency is mandatory in order to issue a building licence for new and fundamentally renovated buildings,

Since the ninth of January 2011, Energy Performance Certificate is required for single buildings to be hired or sold.

Effective since the ninth January 2012, Energy Performance Certificate required for partial buildings to be hired or sold
The proper implementation of this institutional framework is controlled by the National Energy Inspectorate, a body established under the Special Secretariat for Environment & Energy Inspectorate of the Ministry and staffed with officials from the public and broader public sector.
Energy Performance Certificate
Building’s Assessment

It is in force, since the beginning of 2010, in order to issue building license.

In every case, an Energy Performance Study is mandatory to be submitted.

A Building Energy Rating System has been established (Energy Performance Certificate), together with:

- A performing Energy Audits of buildings, boilers and heating and air conditioning systems
- Buildings Energy Certification scheme, which defines the delivery of Energy Certificates through the appropriate energy audits, issued by an official Body of Energy Auditors.
Framework of Technical Guidelines (TOTEE) published by the Technical Chamber of Greece

1. Analytic standards for energy audits
2. Thermophysic and technical characteristics of construction materials and components
3. Installations of renewable energy in buildings
4. Bioclimatic architecture of buildings
5. Climatological data of Greek regions
6. Forms and instructions for completing energy inspections
7. Cogeneration plants, heating and cooling in buildings.
THE 4 CLIMATIC ZONES IN GREECE ACCORDING TO THE REGULATION (KENAK)

Areas with altitude over 500 meters are ranked to the next colder climatic zone.

All areas in climatic zone D are ranked in zone D regardless of altitude.

Definition of climatic zones according to the average temperature of each area.
Architecture - bioclimatic design

Insulation efficiency of the building shell

HVAC equipment and automations

Monitoring of the energy efficiency of the building

Steps – stages of the energy efficiency study
Path the Sky

North

Photovoltaic modules

Solar windows

South

June 21

December 21

East

1995 προκήρυξη κτίριου ΕΣΥΕ στην οδό Πειραιώς

1994-2000 Ε.Π.Ε. Β’ ΚΠΣ κτήρια ΚΕΠΥΟ & ΥΠΕΧΟΔΕ

1999 ενεργειακές προδιαγραφές για όλα τα κτήρια (Υπουργεία - Δ.Ο.Υ.)
HVAC equipment and automations

- Energy saving light bulbs with efficiency of at least 55 lm/W
- Separate switches for rooms >15m2
- Control of at least 50% of the light sources in rooms with natural light.

- Insulation inspection of distribution networks.
- Inspection of alternating curve circulators (Δp-v) in variable load distribution networks
- Existence of balance system in installations operating under partial load.
- Heat recovery by at least 50% for Central Air Conditioning Systems with ≥60% supply of fresh air.
- 60% of the hot water from solar collectors or other high performance system, such as RES, Cogeneration of Heat & Power (CHP), Teleheating or Autonomous heating.
The Energy Certificate is valid for ten (10) years.

It includes recommendations for an energy efficient building, so consumers are able to calculate their actual consumption and consider any opportunities for improvement.

relates to:
- 1. Buildings
- 2. Boilers & water heating
- 3. Air Conditioning Installations
A dynamic Energy Efficiency Incentive Policy
together with
energy efficiency demonstrated projects
especially in public sector buildings, such as schools, hospitals, military establishments, etc., and
new Financing Mechanisms
such as Third Party Financing (TPF),
have been install to support large scale energy efficiency investments for any buildings of public and private sector.
Since 2010 the Ministry, having completed the legal framework on buildings’ energy efficiency, has developed a set of financial incentives, with co-financing from the European Union, for the implementation of energy efficiency upgrading interventions in residential buildings, via the “Energy Efficiency at Household Buildings” Program.
Energy Saving at home

- 60% of all buildings are constructed before 1980, date of entry into force of Insulation Regulation

- A big percentage 27% relates to buildings with very low energy category H (173% energy consumption in relation to the reference building)

- 3.700.000 high energy consuming buildings

The Program offers citizens incentives to carry out the most important interventions, aimed at improving their houses’ energy efficiency.

At the same time contributes to the achievement of Greece’s energy and environmental targets; once completed, the Program will help save energy up to 1 billion kWh annually.
Energy Saving at home

Your old house could mark a new start

Program for Energy Efficiency Interventions in private household buildings
The co-financed Program concerns buildings which have a building permit or other legalization document,

are located in areas with an average zone price lower than or equal to 2,100 €/sq.m.,

are used as a residence, their owners meet specific income-related criteria and

are classified as low energy efficiency buildings.
Preparation

- Credit Ability Check/
  First Energy Inspection/
  Identification of Interventions

- Collection of Supporting Documents / Offers

Application Submission – Procedures

- Application Submission

- Evaluation/Approval of Application

Implementation – financing

- Loan Agreement / Implementation of Interventions

- Completion of Interventions – Financing
Energy Inspections

Program Implementation based on:

- Regulation for Energy Performance of Buildings
- the Energy Inspectors Registry (Law 3661/2008)

2 energy inspections

- Ex ante: First EPC + proposal for interventions with cost analysis
- Ex post: Second EPC + verification of implementation of interventions & energy saving results

Software developed for EPC issue

- Inspections by the Hellenic Energy Inspectorate (based on sample methodology)
PLANNING PROBLEMS ENCOUNTERED

- Long consultation with many stakeholders
- Managing Authority Competitiveness
- Financial institutions
- Market
- Competent authorities for buildings regulation
- Complexity of the building sector
- Absence of legislation framework before 1955
- Different authorities issued building permits before 1980
- New legislative framework through the Buildings’ Energy Efficiency Regulation
- New Inspectors Registry
PLANNING PROBLEMS ENCOUNTERED

- Set up of a complex administrative scheme in order to safeguard the EC money vs. simplicity for citizens
- Reluctance as to the attractiveness of the financial engineering scheme
- Need for shaping energy “culture” to citizens
- Long period for program maturity due to difficulty by all players to adapt to its philosophy and parameters
**Program Results (to date)**

<table>
<thead>
<tr>
<th>Category</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Applications:</td>
<td>251,570</td>
</tr>
<tr>
<td>Number of loan pre approval (credit control):</td>
<td>133,628</td>
</tr>
<tr>
<td>approved applications:</td>
<td>50,175</td>
</tr>
<tr>
<td>loan agreements</td>
<td>45,558</td>
</tr>
<tr>
<td>Completed applications</td>
<td>42,780</td>
</tr>
</tbody>
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**% of category interventions**

- Replacement of doors/windows (frames/glazing) 85%
- Installation of heat insulation 55%
- Upgrading of the heating and hot water supply systems 75%
Very low energy category of residential buildings was confirmed based on information contained in the energy certificates: the annual primary energy savings of 42,780 completed applications is 164 kWh/m² on average, which corresponds to a 43% reduction of primary energy consumption revealing the success of the program as well as the energy inefficiency of the existing building stock.

Total annual energy saving is estimated at 712 mio kWh based on the 42,780 completed applications.

Energy Category % of Completed Applications
D 9,2%
E 14,9%
F 17,5%
G 58,5%
BENEFITS to households owners

The average energy consumption decrease is estimated at about 43%. Energy savings accounts approximately to 1,200 euro / year. Owners do not have to pay for the renovation, that most probably could not afford.
BENEFITS to employment – job creation

More than 2,500 new jobs annually
- 1,700 employers
- 500 engineers (4,000 engineers are involved as energy inspectors, consultants, sub-contractors, etc)
- 300 bank employers

Direct Benefits to the economy

Until the end of the implementation of the program, more than 750 million Euros will be distributed in the real economy (0.35% GDP)

Directly turnover for specialized construction, aluminum, building materials, engineering work etc.

The investment in energy efficiency in buildings is considered as a basic pillar of the construction sector.
An efficient Incentive Policy “Building the future”

(a) Energy performance improvement of school buildings

(b) Program «energy save» for Municipalities
### (c) Large Scale Interventions

<table>
<thead>
<tr>
<th><strong>Residences</strong></th>
<th><strong>Commercial Building</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Replacement of window frames with new energy efficient ones in 20,000 residences</td>
<td>Installation of high performance window systems (frames, glazing and shading devices) in 3,000 buildings</td>
</tr>
<tr>
<td>Replacement of single paned windows with double paned low-(e) windows in 25,000 residences</td>
<td>Application of exterior insulation in 5,000 buildings</td>
</tr>
<tr>
<td>Installation of 5,000 solar collectors</td>
<td></td>
</tr>
<tr>
<td>Application of cool roof in 20,000 residences</td>
<td>Installation of high performance heating-cooling-ventilation system in 5,000 buildings</td>
</tr>
<tr>
<td>Insulation of roofs and exterior walls in 20,000 residences</td>
<td>Replacement of lighting system in 10,000 buildings</td>
</tr>
<tr>
<td>Replacement of 20,000 traditional heating systems with new high performance systems</td>
<td>Replacement or upgrade of energy management systems in 1,000 buildings</td>
</tr>
<tr>
<td>Green roofs</td>
<td>Cool materials</td>
</tr>
<tr>
<td>-------------------------</td>
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<tr>
<td>Green space measures</td>
<td>Renewable energy sources</td>
</tr>
<tr>
<td>Geothermal heat pumps</td>
<td>Advanced insulation</td>
</tr>
<tr>
<td>Intelligent networks</td>
<td>Window frames &amp; shading</td>
</tr>
</tbody>
</table>

(d) Green Pilot Urban Neighborhood

- All transformations will be carried out offering positions to the local workforce of the region.
(e) BIOCLIMATIC UPGRADE OF PUBLIC URBAN SPACES

Duration of Program:
August 1st 2011 – 31st December 2015
Budget: €60.000.000

open public urban spaces
• Protection of vulnerable population during the warmest periods of the year

• Improvement of the microclimate and levels of thermal comfort by at least 15%
(f) GREEN ROOFS ON PUBLIC BUILDINGS

Program Duration:
November 2011 – 31st December 2015
Budget: €20.000.000

• Reduction of air pollution
• Energy Savings in public buildings during the summer and winter periods
• Improvement of Thermal, aesthetic and environmental conditions in public buildings
• Improvement of the microclimate of the greater area

Public sector and greater public sector buildings
Sustainable Buildings

- Energy Efficiency
- Renewable Energy Sources (RES)
- Green Transport
- Waste Management
- Water Resource Management
- Green Entrepreneurship
- Responsible Sustainable Societies

Green Island and Rural Communities

Exemplary Programs of ESPA (Structural Funds)

- Total Budget: 50 mil. €
- Duration: 4 Years

Launch of Program

Current Emissions CO2e

«Green» Interventions

Completion of Program

Emissions Reduction

New emissions of pilot communities

Balance of Emissions

Zero Carbon Footprint
Towards nearly zero-emissions buildings
Thank you for your attention

Let’s wish that this meeting will lead to significant results, providing the opportunity to make a further step for the accomplishment of our common goal.
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