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**17-21 MAY SOFIA BULGARIA** 2015

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**A tool to facilitate energy retrofitting policies for urban residences in Greece**

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## Aim

**Build a tool to support local energy saving policies**

## Significance

**Minimise living costs**  
**Maximise the effectiveness of policies by promoting location based decision making**  
**Minimise the effect of dwellings on the environment**

## Objectives

**Map energy consumption of the residential building stock**  
**Visualise and evaluate various retrofitting interventions**  
**Assist in energy performance certification with minimum cost**



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## Background

### Building stock models

#### Top-down Vs Bottom-up Models

#### Statistical Vs Engineering Approach

#### The role of GIS

Heiple & Seilor (2008), Theodoridou et al. (2012) and Caputo et al. (2013). In the work of Dall'O' et al. (2012a, 2012b)

### Legislative framework

#### "Energy Efficiency at Household Buildings" program

Intervention 1: Improvement of the building envelope - Roof and façade insulation

Intervention 2: Use of solar thermal power for hot water provision

Intervention 3: Windows replacement



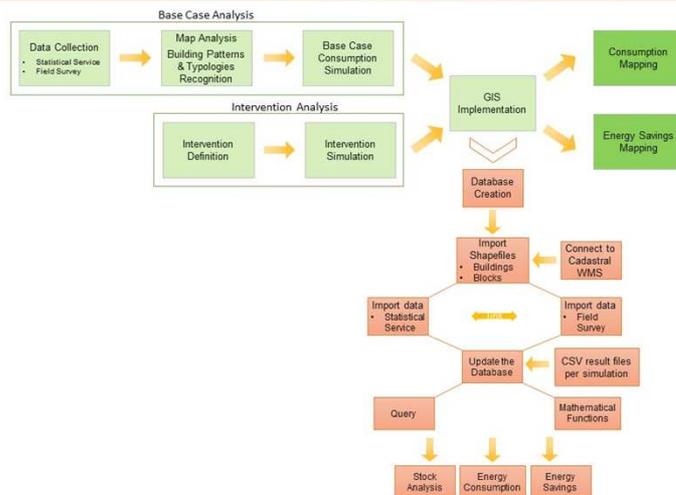
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## Methodology



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### Case Study

Study Area: **Kos, Greece**

Climatic zone A, 601-1100 heating degree days (HDD) (TOTEE, 2010).

Permanent dwellings - continuous occupancy throughout the year.



Building Archetypes (TABULA, Daskalaki et al., 2011)

Classification	Construction period	Percentage of buildings per age group
Class A	1919-1945	9.15%
Class B	1946-1980	56.86%
Class C	1981-1990	25.33%
Class D	1991-2010	8.66%

14 building classes according to materials and building practices



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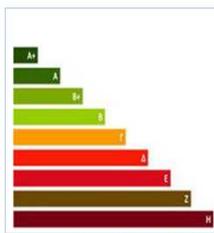


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### Results

#### Energy Performance of the Existing Stock



Energy Class
A+
A
B+
B
C
D
E
F
G



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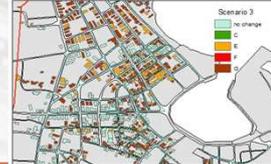
## Results

### Evaluating the Different Interventions

Solar thermal panels for DHW make the most remarkable difference at **individual dwelling level**, reducing total electrical energy consumption by 25-50% with a payback time of 2.5 years on average.

At **city scale**, the **insulation scenario** provides the greatest decrease of heating energy demand and consequently of total energy consumption.

The decision for the best intervention is dependent on the final **objective**.



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## Results

### Clustering Analysis



Clustering analysis identified areas at excessive risk and great need for policy measures.

Local indicators of clustering are used to detect areas with excess consumption. Neighbourhoods are detected, where high consumption clustering is noted.



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## Conclusions

- This bottom-up, engineering approach for mapping energy consumption with the use of building typologies, adapted to the characteristics of the city, proved to be efficient and in connection to GIS provides a way to compare different retrofitting scenarios, observe the different results in space and detect areas at excess risk.
- This database can facilitate the Energy Performance Certification, make it faster and cheaper and reduce the costs of real estate transactions.
- It can be adapted to every city and national context, considering its special characteristics and practices.
- It assists local authorities, which have an important role in the implementation of energy policies and energy planners, local administrators and other stakeholders who can take more effective actions at managing their stock.



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## Further Research

- Design a WMS for the public to get informed about the results and make them more involved.
- Incorporate more detailed input data about buildings and energy consumption. Promote public participation.
- 3D city models could highly contribute to local governments' long-term energy policy and provide vigorous visualisations of the results of the various scenarios.



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**Thank you!**

More details: <http://www.geos.ed.ac.uk/~mscgis/13-14/s1368699/>

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