Creating a hotel building stock model focused in energy consumption

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Final Energy Consumption by sector

Greece final energy consumption covers energy supplied to the final consumer's door for all energy uses.

Changes in final energy consumption by sector, between 1990-2007	
Industry	+32.4%
Transport	+48.0%
Agriculture	+5.6%
Households	+96.7%
Services	+204.7%
Final energy consumption	**+57.2%**

(Source: National Centre for Sustainable and Development Greece, 2009)

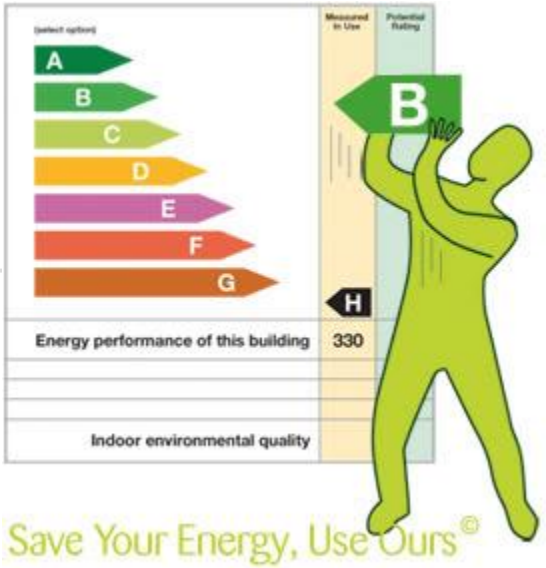
Services is the fastest growing sector with the 2007 final energy consumption being 3 times higher that in 1990.

Total Energy Intensity

- Total primary energy consumption in Greece grew by **13.4%** over the period **2000-2007**, at an average annual rate of **1.7 %** (NCSD, 2009).
- Gross Domestic Product (**GDP**) in constant prices 2000-2007 grew by **33.6%** at an average annual rate of **4.2 %.**
- **Total energy intensity** in Greece **fell by 15.1%** over the **period 2000-2007**, at an average annual rate of **-2.2%.**

1. Improvements in energy efficiency
2. Structural changes within the economy

EU Legislation



Directive 2002/91/EC on the Energy Performance of Buildings (EPBD)

Directive 2006/32/EC on the Energy-use efficiency and Energy services

Directive COM/2008/0780/ final – COD 2008/0223

Directive 2010/31/EU on the energy performance of buildings (recast)

- Minimum energy efficiency requirements
- Certifications – Inspections
- Zero net energy buildings
- Creation of an public, example building in every authority

That was the most far-reaching reform ever of European energy policy

Greek Legislation

Law 3661/2008 – *"Measures for the reduction of energy consumption in buildings"* .

Regulation on the Energy Assessment of Buildings— **KENAK**

Those two set a framework of:

- Regular inspection requirements in heating, cooling, air conditioning and lighting systems
- Inspections are compulsory for new constructions and existing buildings over 1000m^2 that undergo major renovations, and existing buildings with floor area of at least 50 m^2 when they are sold, rented or transferred to other relatives of the owners.

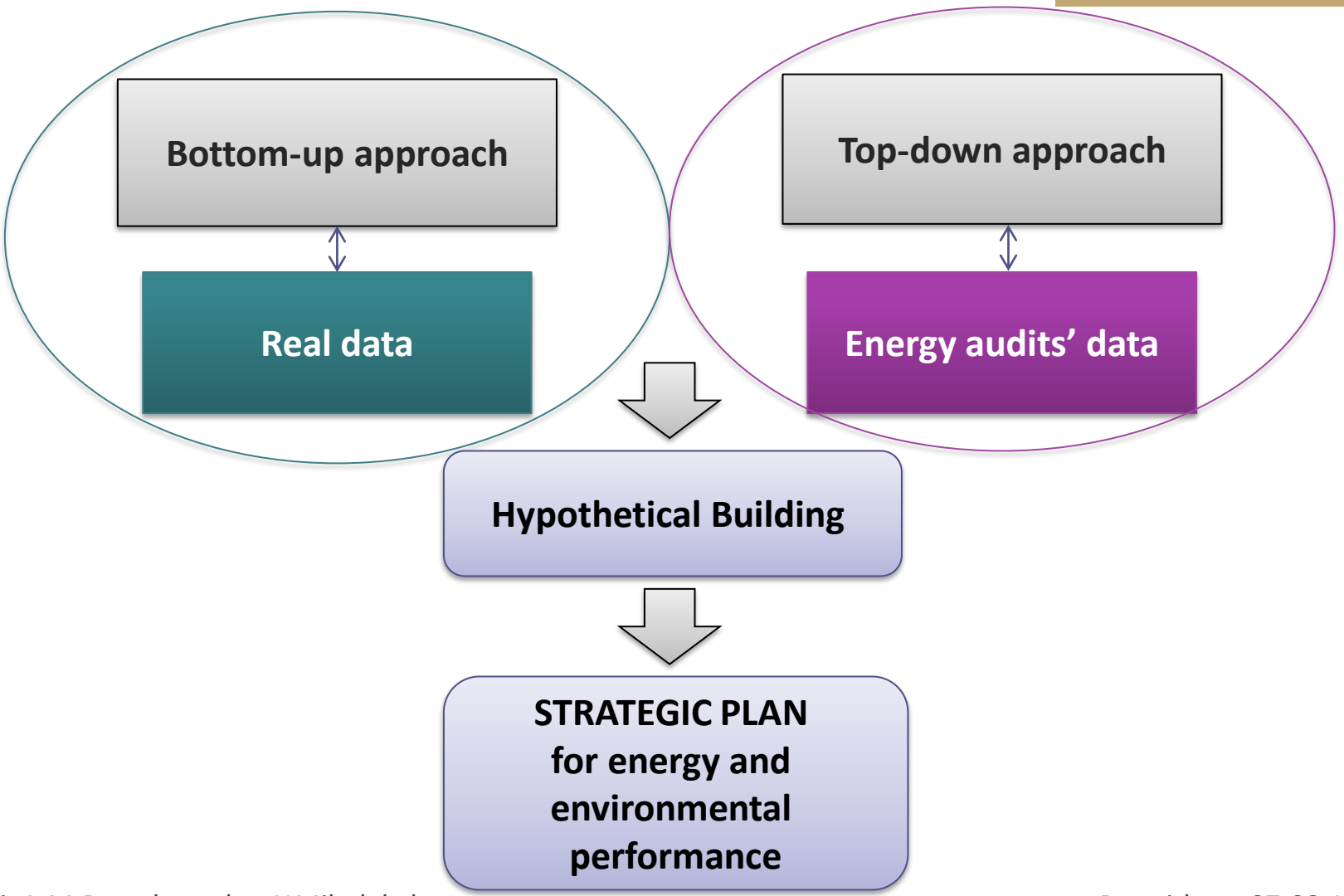
Expectations at the lodging sector

Expectations by WTO and WTTC:

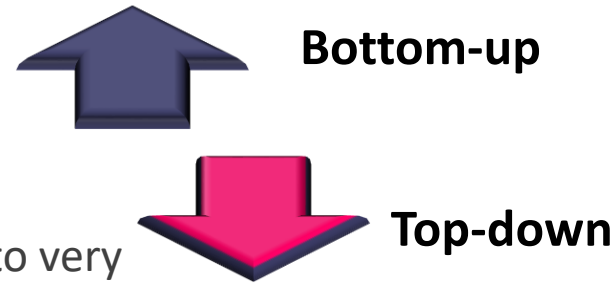
- International tourist arrivals in developing countries➔ a rise ~8% per year in the period 1992–96 to a total of 182.6 million.
- Economic development 29.9% of the global total (WTO, 1998).
- A rise from 9.2% in 2010 to 9.6% by 2020 is expected ➔ means real GDP growth average 4.4%/year ("WTTC-Progress and priority report", 2010).
- Employment rise from 8.1% in 2010, to 9.2% of total employment by 2020.

2009 and 2010 have been depressed years for touristical activity, so a to boost is expected.

Energy building stock model



Building's energy planning top-down and bottom-up approach



A simple comparison between those models can lead to very different results.

Bottom-up	Top-down
Regulation and detailed energy planning	Energy taxes
Restructuring of energy supply sector	Effect of different economic scenarios on energy and environment
Using standards for insulation and electric appliances	Macroeconomic consequences of changes in the energy system
Project the technological development in order to quantify the aggregated development in energy efficiency	General equilibrium effects

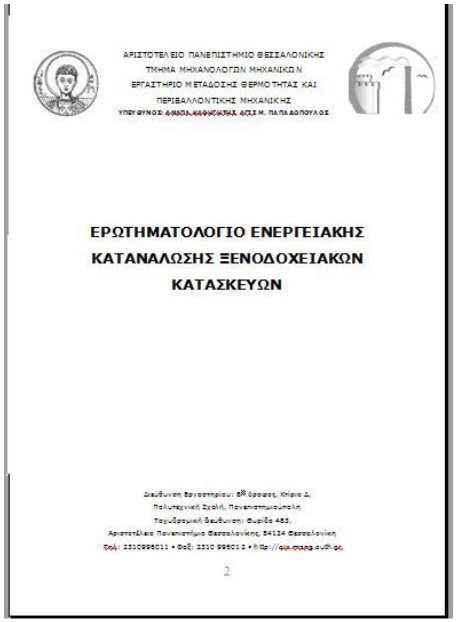
Jacobsen, 1998

Data base: Hotel's buildings stock top-down approach

- Data base of **55 hotels** all over Greece
- It was created with the use of questionnaires and audits based on the implementation of EPBD in Greek legislation.

Gathered information about:

- Hotel operation
- Building's identity and envelope
- Energy systems
- Energy and water consumption
- Average monthly occupancy levels in the auditing years
- Indoor environmental quality
- Interventions that was made during its operation or are planned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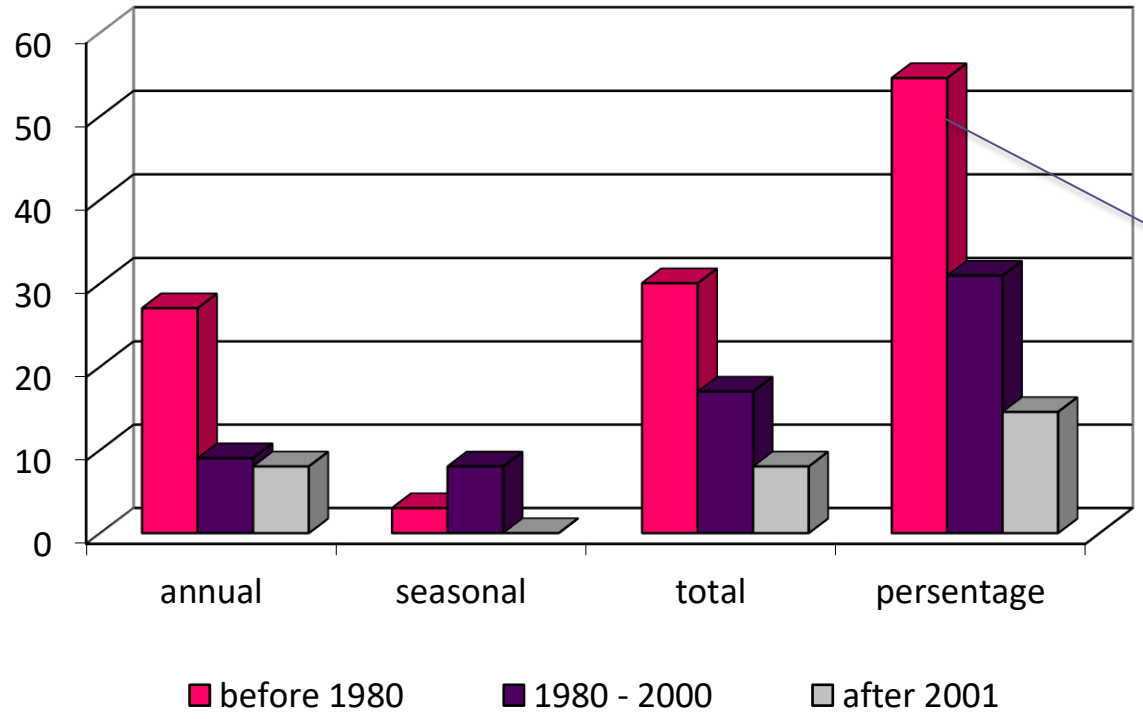
Data base

- 1% 1-star hotels
- 20% 2 -star hotels
- 22% 3 -star hotels
- 25% 4 -star hotels
- 24% 5 -star & LUX hotels

The collected data are mainly from Northern Greece

Data base



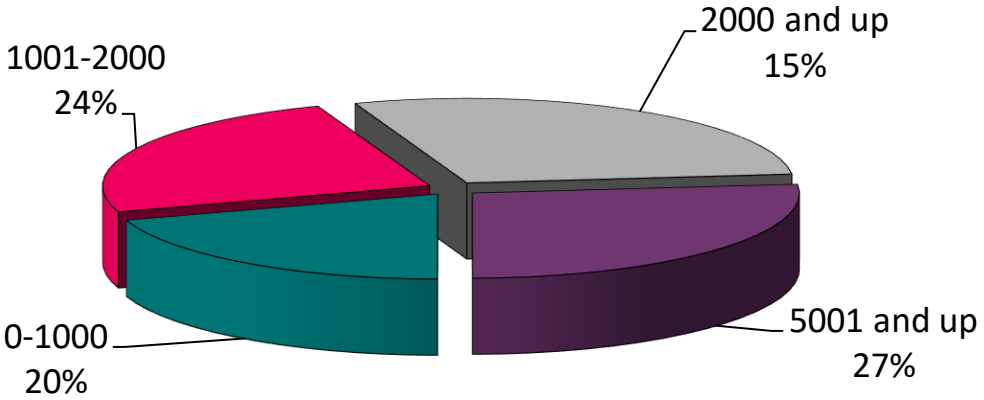
Building's age

- 55 % <1980
- 30% 1981 – 2000
- 15% >2001

But they were all renovated after 2000

Data base

Heated surface

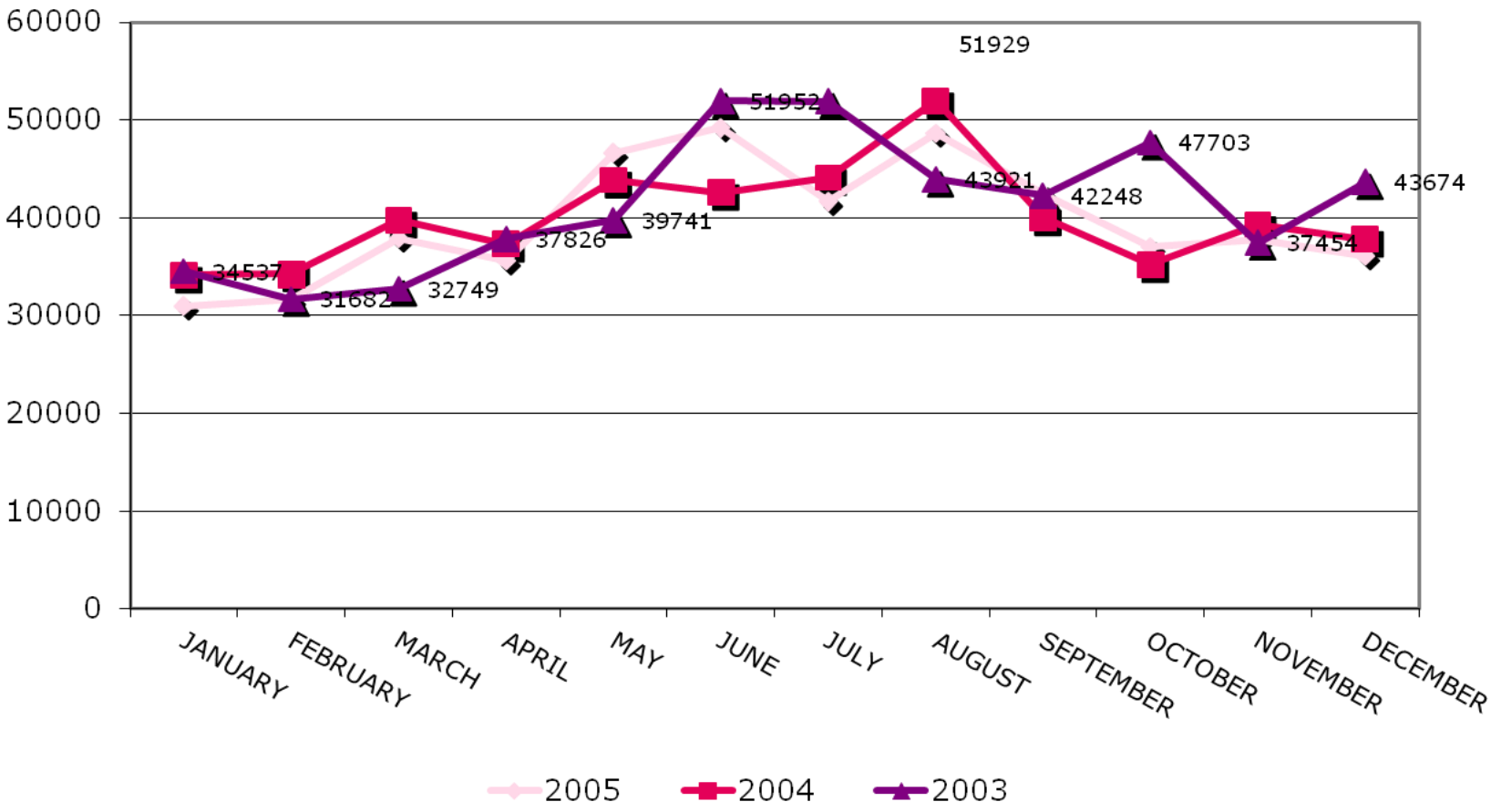


Electricity consumption

- Rural hotels up to 300 kWh/m^2
- Urban hotels up to 400 kWh/m^2

Data base

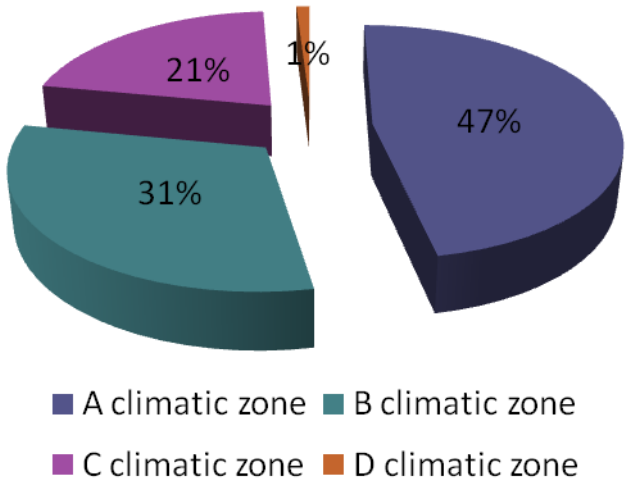
Energy consumption in a rural hotel



Real data

Characteristics of the Greek hotel sector:

- Existing hotel stock according to arrival data for the last five years shows that the available hotel stock exceed 184.7% of current demand (ITEP, 2010).
- Hotels represent 0.6% of the Greek building stock (712,052 m^2) , but consume 10% of the total primary energy consumption of the building sector (CRES, 2009).
- There are over 9,554 hotels over 700.000 rooms in operation, with 726.546 beds (EOT, 2010) with an average size of 76 beds per unit.
- 65.8% are classical hotels, 45.9% are 2-star hotels, 56.0% operates seasonally, 68.2% is constructed after 1979.



Real Data: Greek hotel sector features

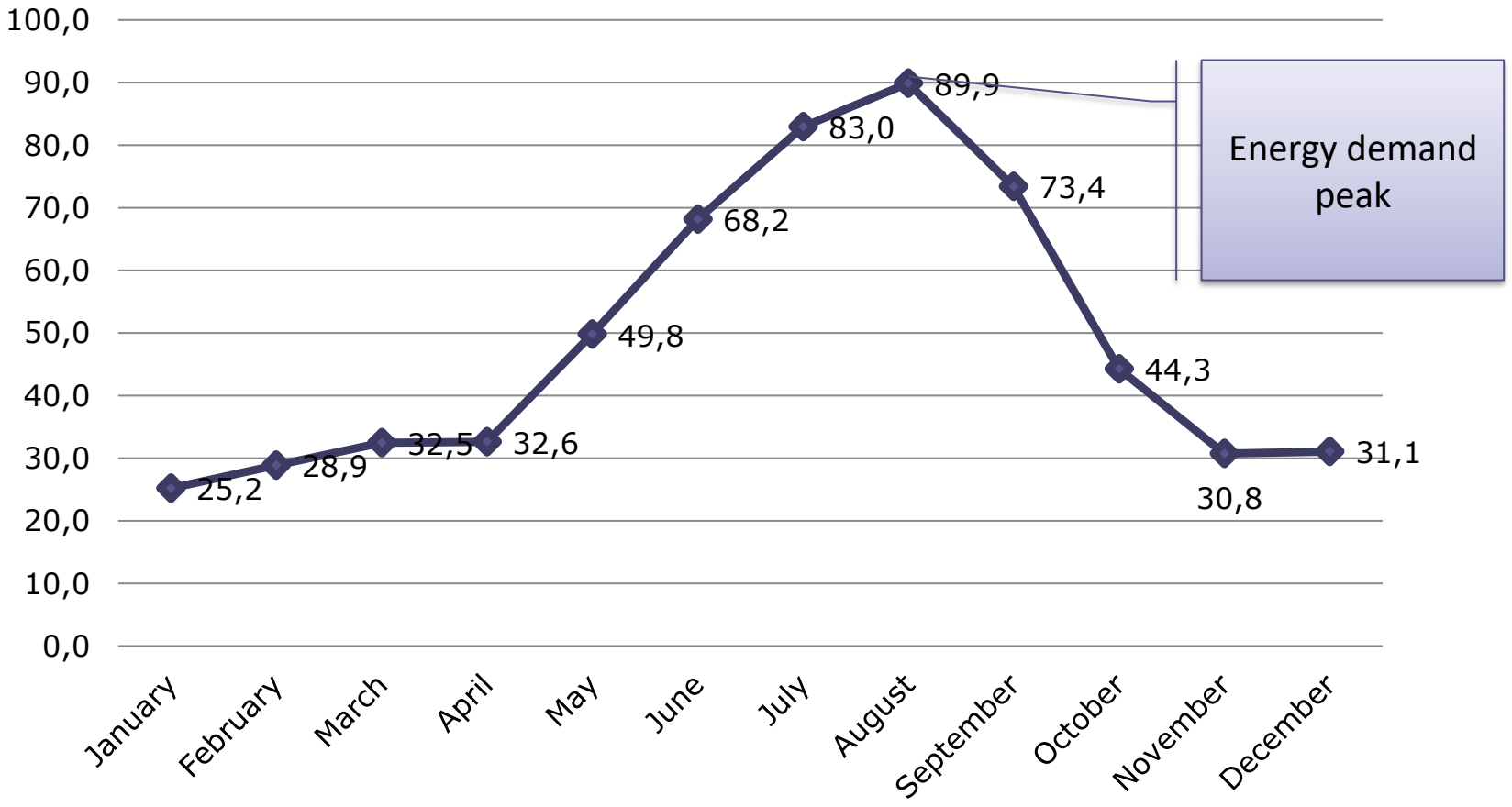
Room facilities

2-Star hotel	45.99%
TV	70.15%
HVAC	76.12%
Refrigerator	62.75%
Hair-dryer	40.65%
Fireplace	3.49%
MiniBar	57.51%

Hotel facilities

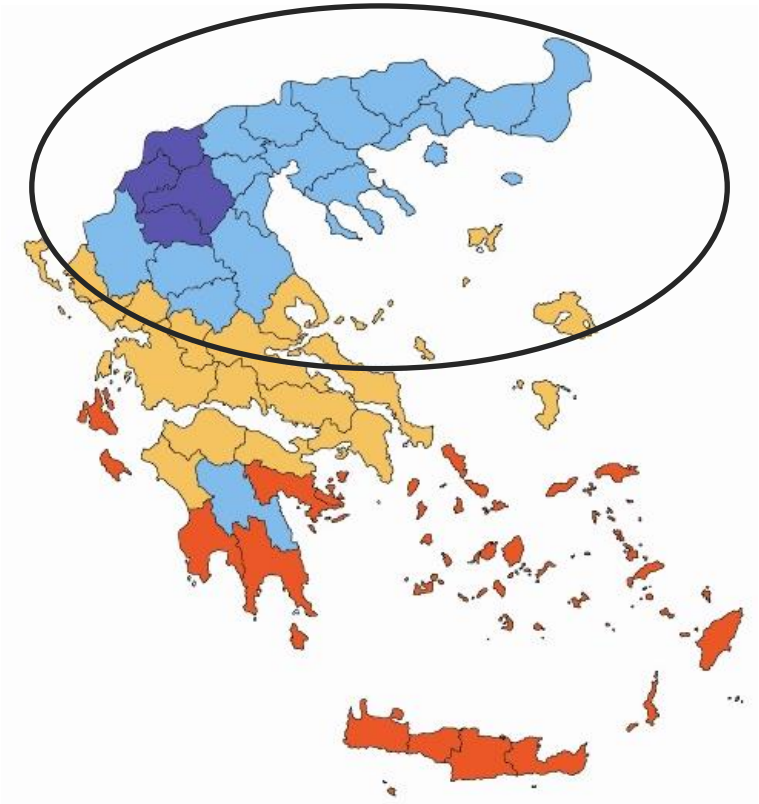
Restaurant	38.39%
Pool	35.78%
Internet-room	32.86%
Conference centre	3.35%
Certifications	3.53%
Meeting room	13.41%

Real Data: Complement of the Hellenic touristical sector



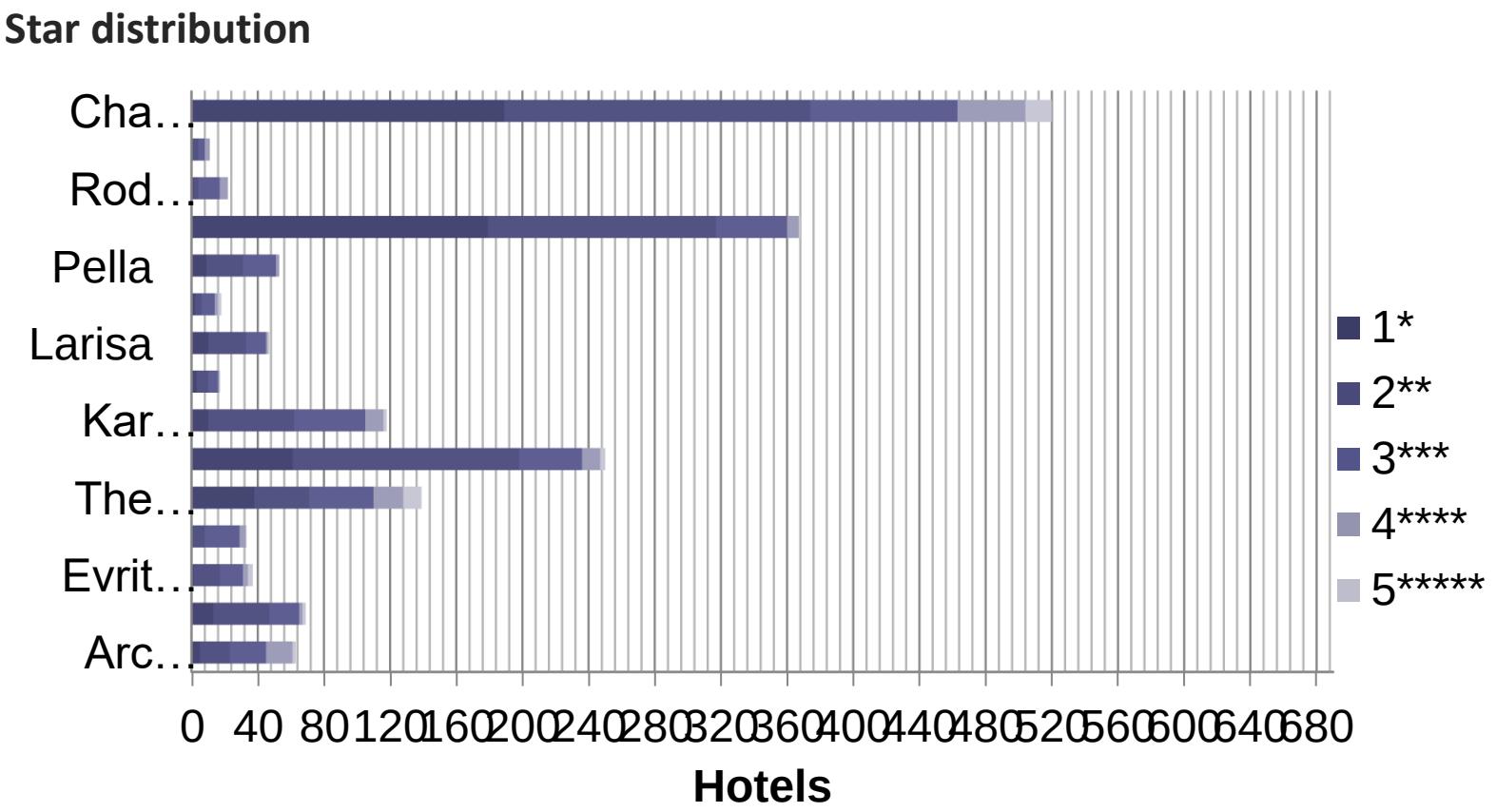
(Source: ESYE, 2007)

Real data: C climatic zone



- ➔ Is the second coldest zone in Greece
- ➔ It includes two of the most popular destinations in Greece, Chalkidiki and Pieria.
- ➔ 16.56% of the total hotel building stock is located here.
- ➔ 56% have annual operation and 44 seasonal.
- ➔ 38,4% are 2-star hotels.

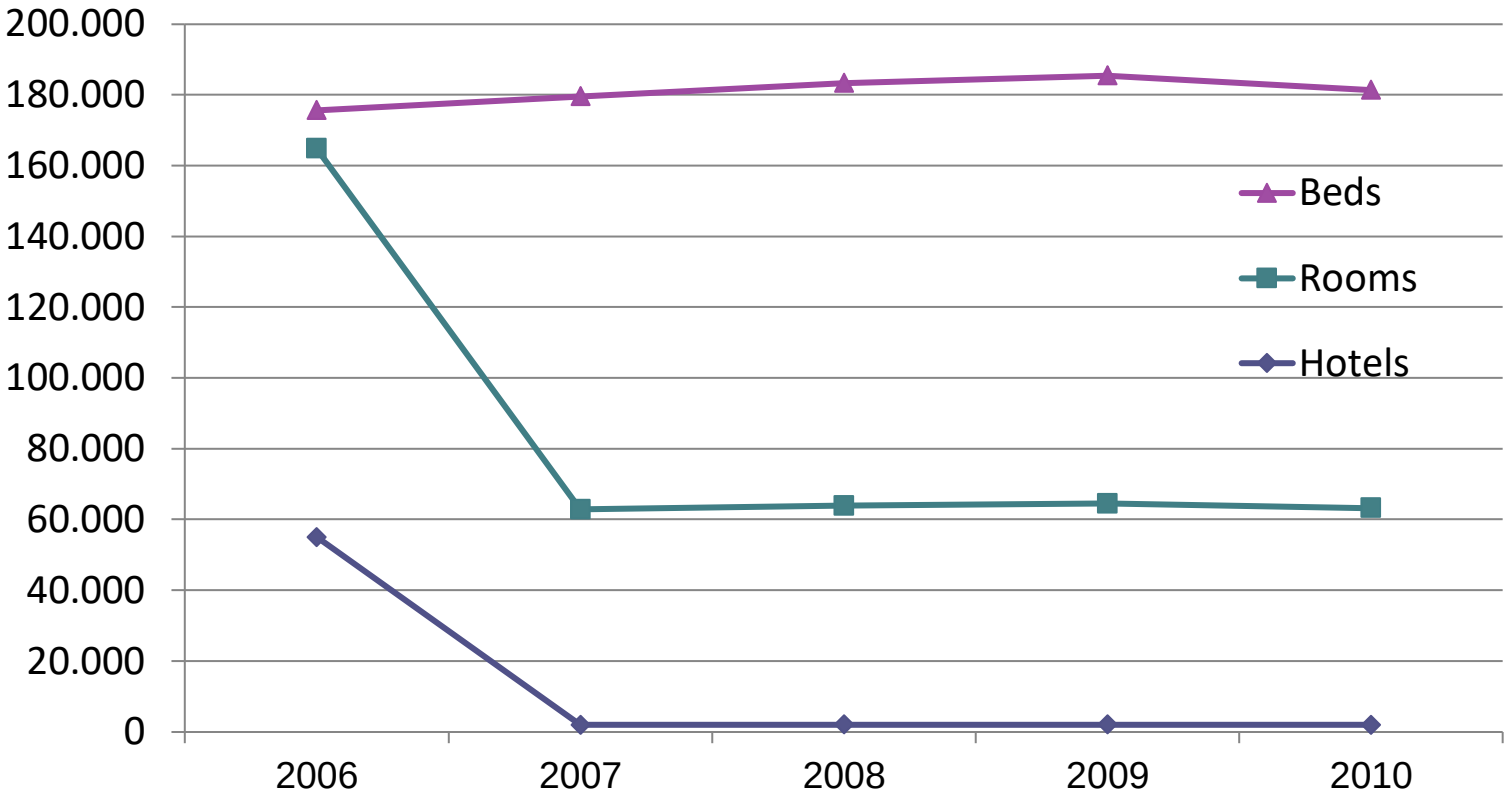
Real data: C climatic zone



Real data: C climatic zone

Number of hotels	1,949
Rooms	61,284
Beds	118,146
Use of HVAC	68.70%
Swimming pool	23.04%
Restaurant	39.05%
Conference centre	3.85%
Meeting rooms	14.88%

Real data – C climatic zone



Barriers for the promotion of energy conservation measures

The reasons for failing in the implementation of measures lies within:

1. The lack of information
2. Technical reasons
3. Financial reason
4. Personnel training
5. Legislative reason

Conclusions

- The hotel sector is of vital importance for the Greek economy, so its energy performance for the building sector.
- In the current study a snapshot of the Greek hotel industry.
- The basic aim was to gather energy data of hotels and to recognise the importance of an energy audit in order to label it.
- Audit procedures are of great importance. They should be carried out in a detailed level in order to determine the potential for energy savings.
- Collecting data of the facility, evaluating and judging properly, leads to better and more cost-efficient ways of conserving energy.
- The lack of validated and verified data on the energy performance and behavior of hotel's building stock leads to the necessity of statistical processes.
- Bottom-up and top-down approach can help in producing a strategy plan for the improvement of the hotel's energy and environmental performance.

Thank you very much for your attention.