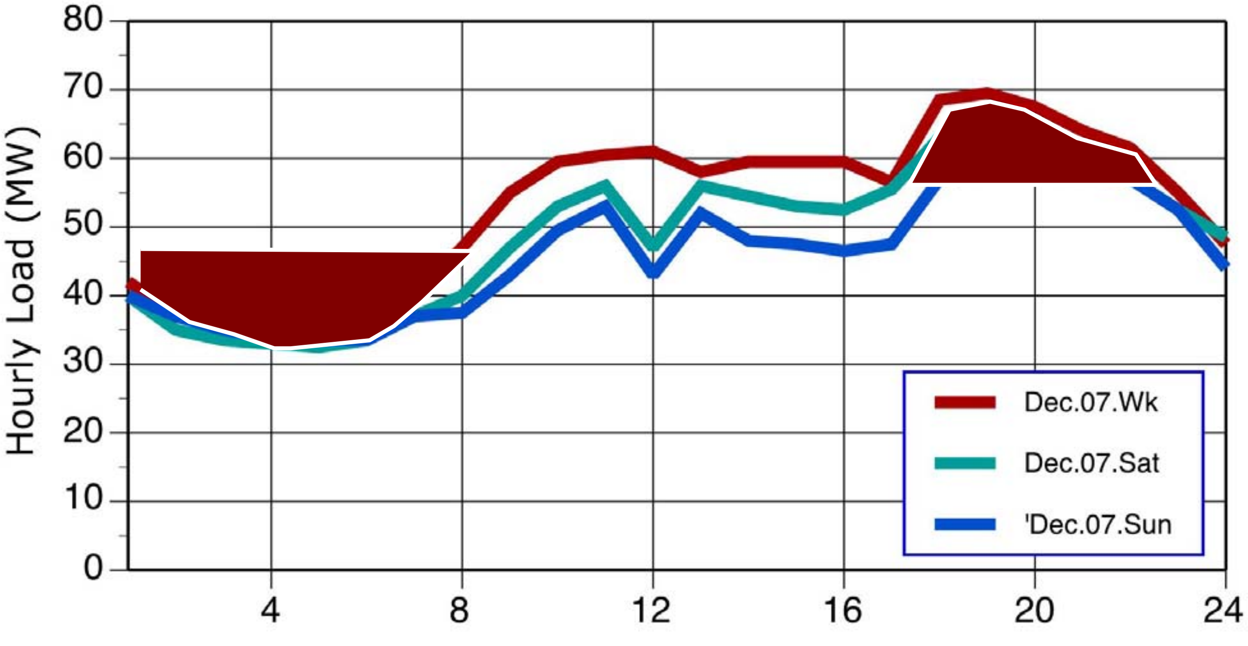
## 2nd Meeting of the Monitoring and Control Cluster on Smart Buildings/Smart Spaces

# ...a biased view on the IST Energy Initiative

Paulo Ferrão

# A major challenge



# Why is this a challenge?

A Cost-Effective and Implementable Transition Requires…

- A detailed understanding Renewable energy *resources*

… including their daily, seasonal, and inter-annual variability

… where and when they best fit the current and future energy system

… where, when and under what circumstances renewables complement or conflict one another

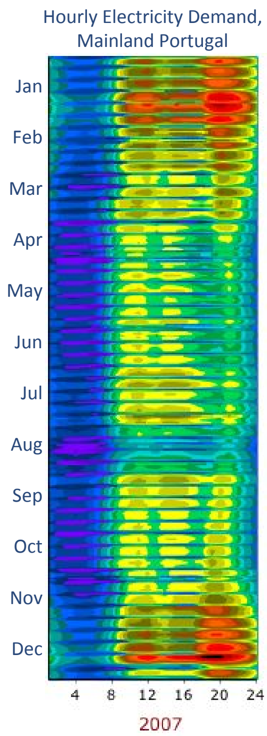
- A detailed understanding for *energy service needs*

… including detailed energy demand patterns, both behavioral and technological

… economic, demographic and other trends affecting demand

… **understanding the technology** and **its interaction with people**

- Smart solutions

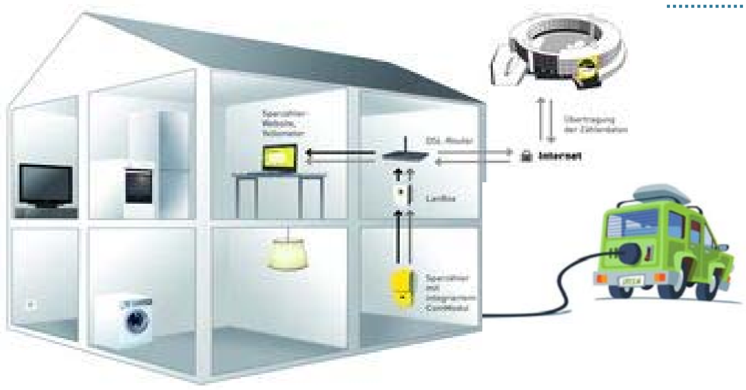


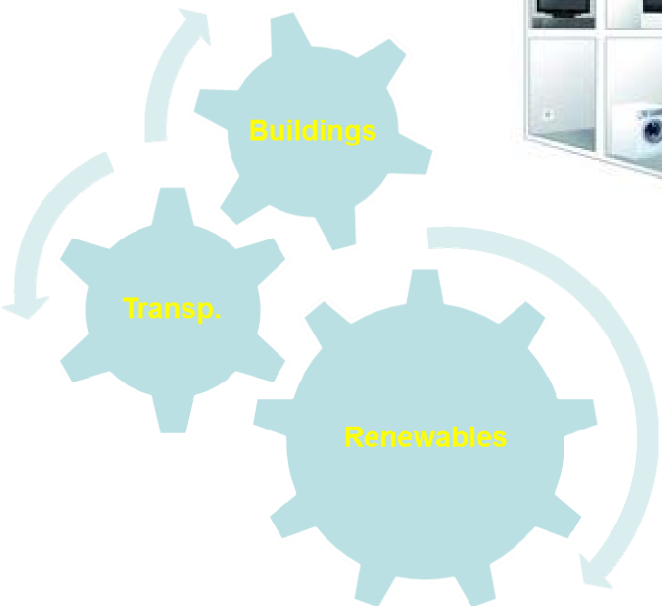

# Main Challenges

**Present** — Future Alternatives →

- **Do "nothing" status quo**
- **Reduce demand**
  - – Improve efficiency
  - – Demand Side Management
  - – Pricing mechanisms
- **New Energy Sources and Technologies**
  - –wind, solar, biomass, geothermal…
  - –nuclear, tar sands,…
- **Smart Cities– the ENERGY and MOBILITY SOFTWARE**
  - – Intelligent networks, smart grids
  - – New vehicle energy paradigms
  - – Better integration, **the individual as an actor of the energy system**

# The challenge



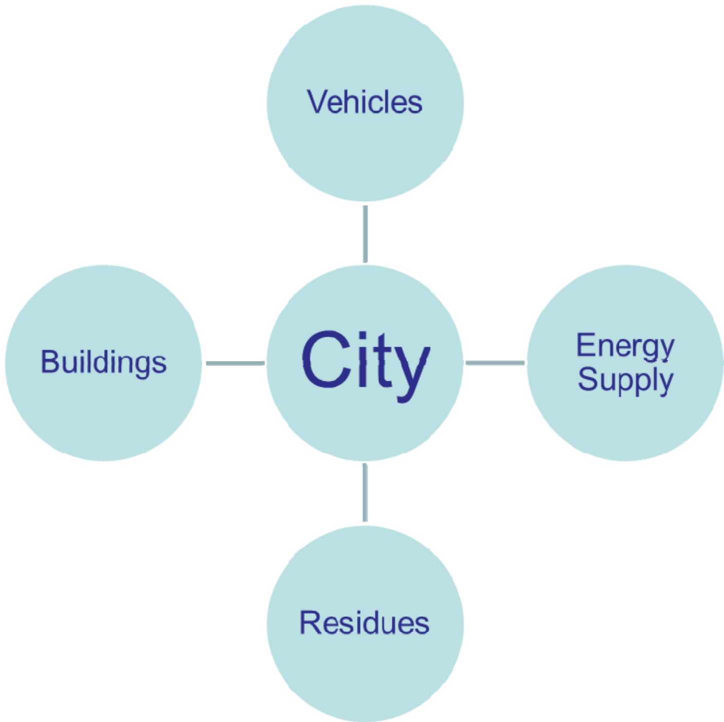



The “secret” is that they need to cooperate, and interact with the people!


- **A MULTIDISCIPLINARY CHALLENGE**

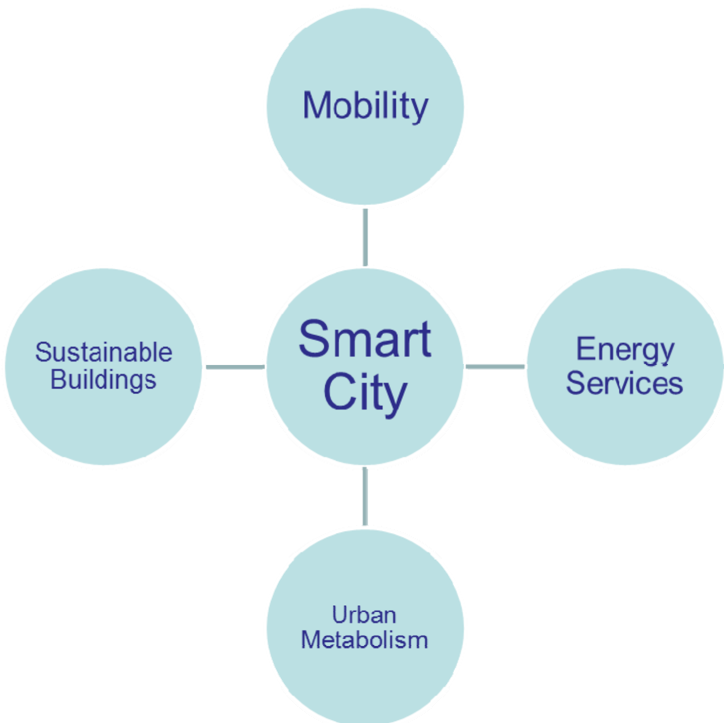
- An opportunity for cooperation between departments

# City – The Ultimate Living Lab Infrastructure

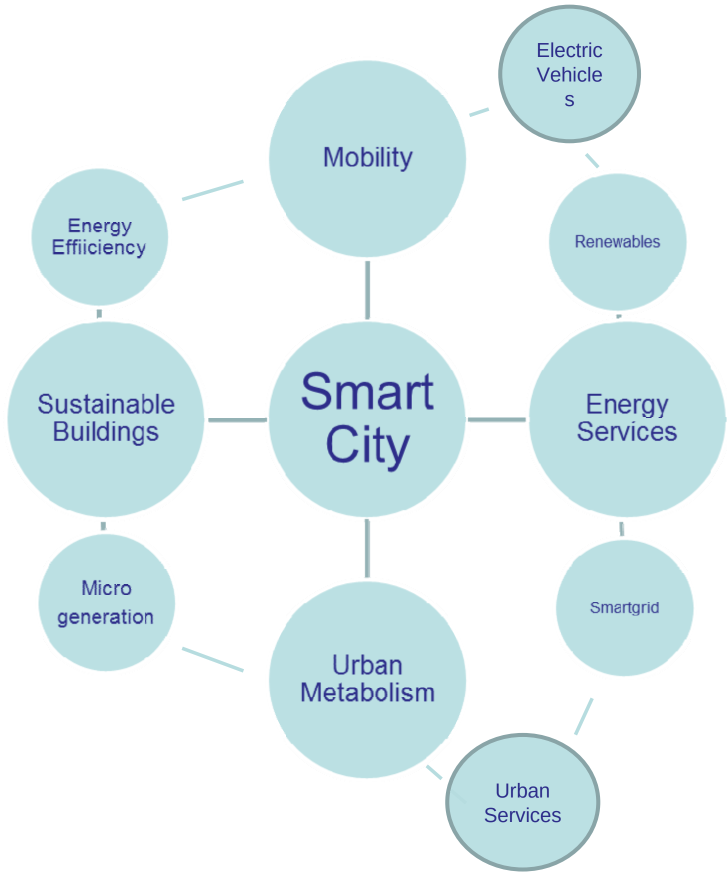



# *Smart City – Services to the **people***

***…technology addressing problems that WE do not care enough to change our behavior***



# *Smart* City – a Complex **System: Technology & People**




# Main Challenges – Energy Initiative in the context of the MIT-Portugal Program

- Renewables Integration
- Electric Vehicles
- Buildings Retrofit
- Buildings Efficient Design
- Energy as a Service
- Urban Metabolism

# Renewables Integration

## Hourly dynamics of supply and demand in energy systems planning tools

André Pina

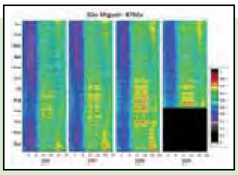


*Fig. 1.* Electricity demand variation in São Miguel

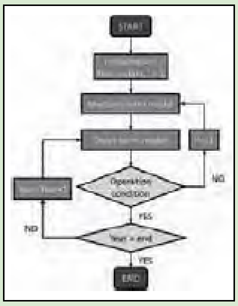


*Fig. 2.* Integrated modeling framework

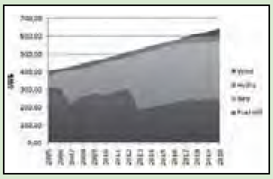


*Fig. 3.* Fig 3: Electricity production scenario using TIMES

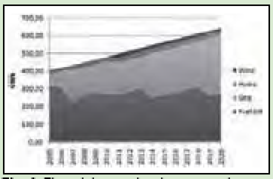
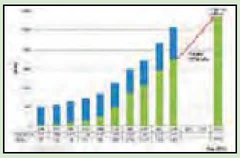


*Fig. 4.* Electricity production scenario using the developed framework

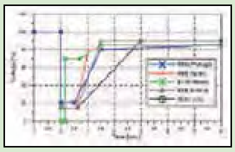
## Grid management for large renewable penetration

António Santos

Portuguese installed Wind Power



Fault Ride Through capability:



Simulation results:

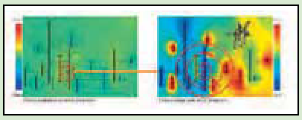


*Fig.1* Short circuit simulation with the loss of large wind power generation

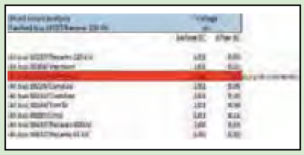


*Fig.2* Voltages drops after short circuit simulation

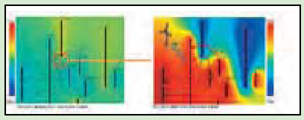


*Fig.3* Short circuit simulation without the loss of wind power generation

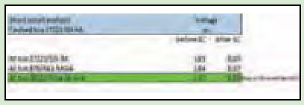
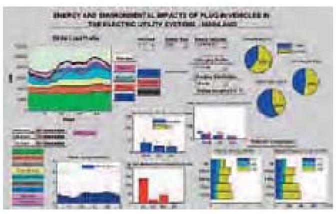


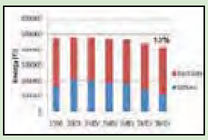
*Fig.4* Voltages drops after short circuit simulation

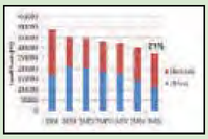
# Electric Vehicles

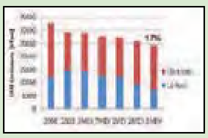
## Economic and environmental impact of EV in Electric Systems

Cristina Camus









## Impact of V2G in grid operation

Filipe Soares

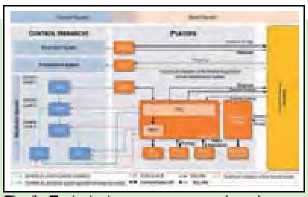


*Fig. 1.* Technical management and market operation framework for EV integration into electric power systems.

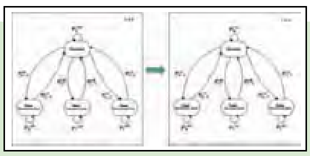


*Fig. 2.* Markov chain to simulate the drivers' behaviour

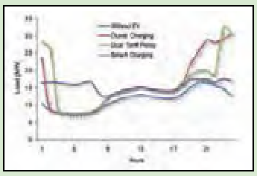


*Fig. 3.* Load diagram for a scenario with 50% of EV

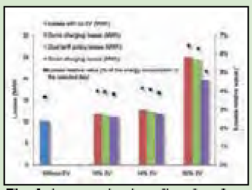
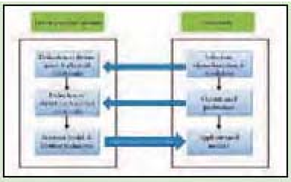


*Fig. 4.* Losses absolute (bars), referred to the left vertical axis, and their value relative to the overall energy consumption (crosses), referred to the right vertical axis.

# Buildings Retrofit

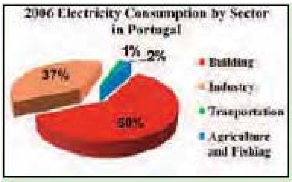
Ehsan Asadi

## Multi-objective optimization of retrofit strategies



Expected Result

Courtesy to C. Brown's work



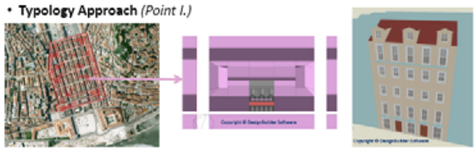

Dom Dinis Secondary School, Photography: Fernando Guerra e Sérgio Guerra

## Energy Efficient Retrofit in Lisbon

Nuno Clímaco

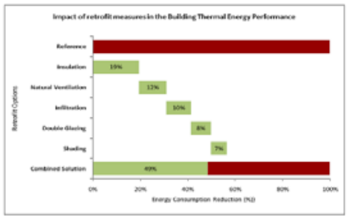
*2 of the 6 typology monitored buildings*


- **Typology Approach** *(Point I.)*

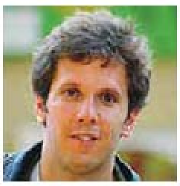


- **Results** *(Point II. and IV.)*

Not just energy savings (49%) but also the improvement of coupled comfort, air quality and health dynamics.




# Buildings Design



Gonçalo Cardoso

## Decentralized Energy Production for sustainable built environmet

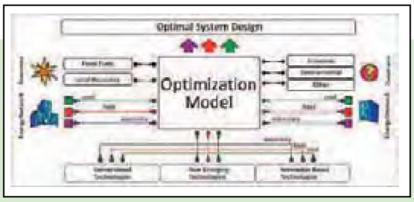



Fig 1.

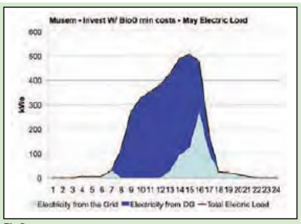


Fig 2.

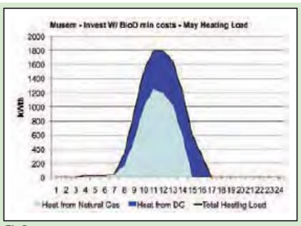


Fig 3.

## Design of Carbon Neutral Buildings

Maria Kapsalaki

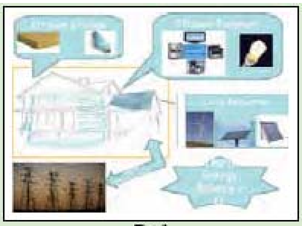


*Fig. 1*

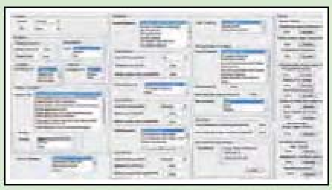


*Fig. 7*

*Fig. 2 e 3*

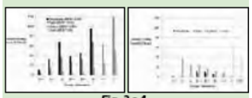


*Fig. 3 e 4*

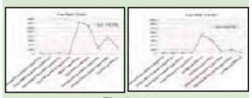


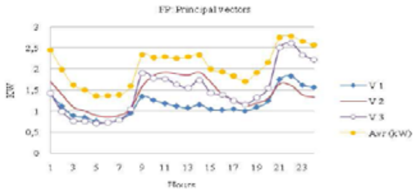
Fig. 5 e 6

# Energy as a Service - DSM

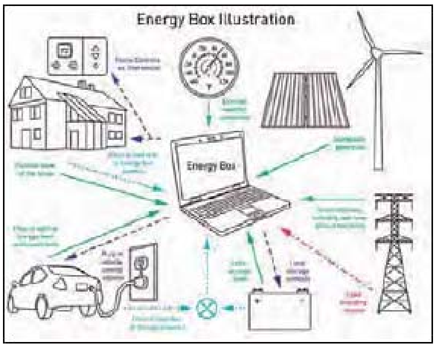
Daniel Livengood

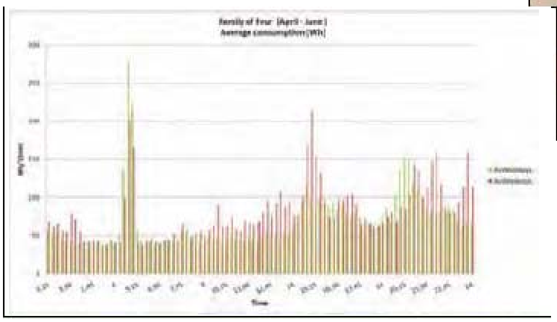
Locally automated control of residential energy use

Demand response in residential sector




Joana Abreu



# Urban Metabolism

Daniel Wiesmann

Analysis of Urban Resource Consumption

Modeling consumer material flows

Leonardo Rosado

*Fig 1:* Visualization of data of global cities

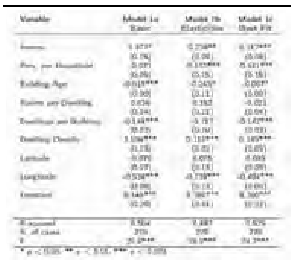


*Fig 2:* Land cover map of San José in Costa Rica

*Fig 2:* Perspective on 3D model of Lisbon in Google Earth

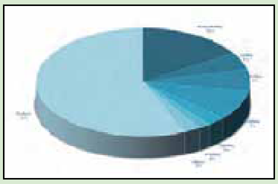


*Fig. 1.*

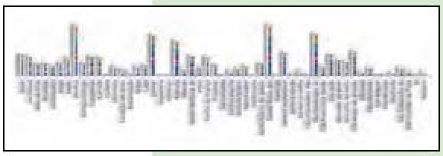


*Fig. 2.*

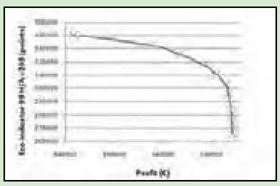
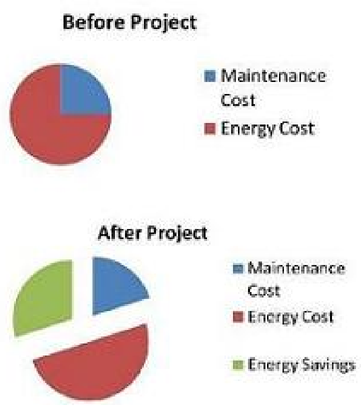
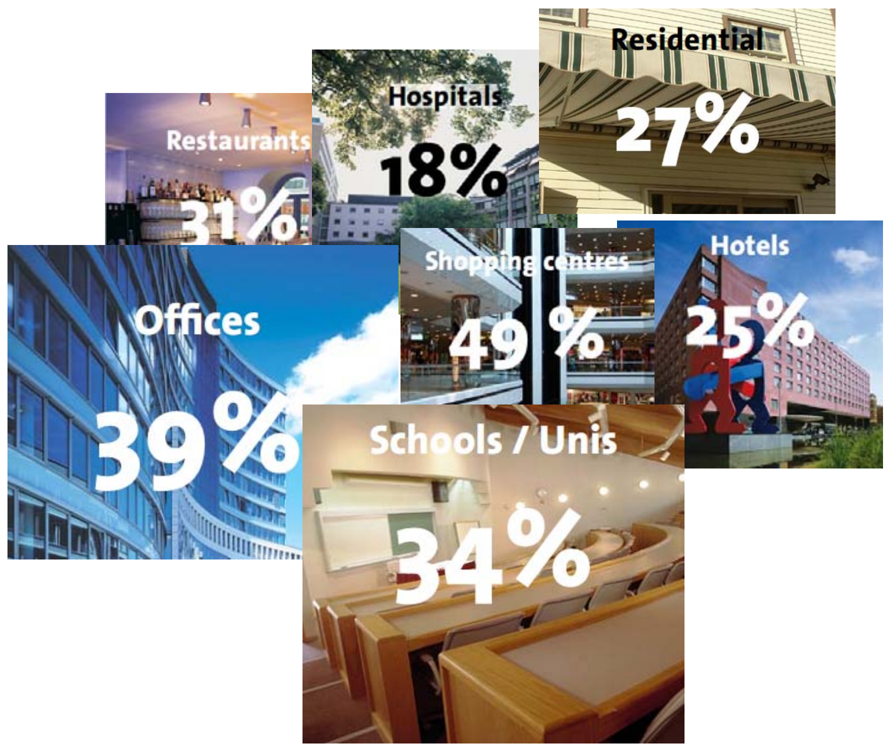


*Fig. 3.*

# SMART CAMPUS

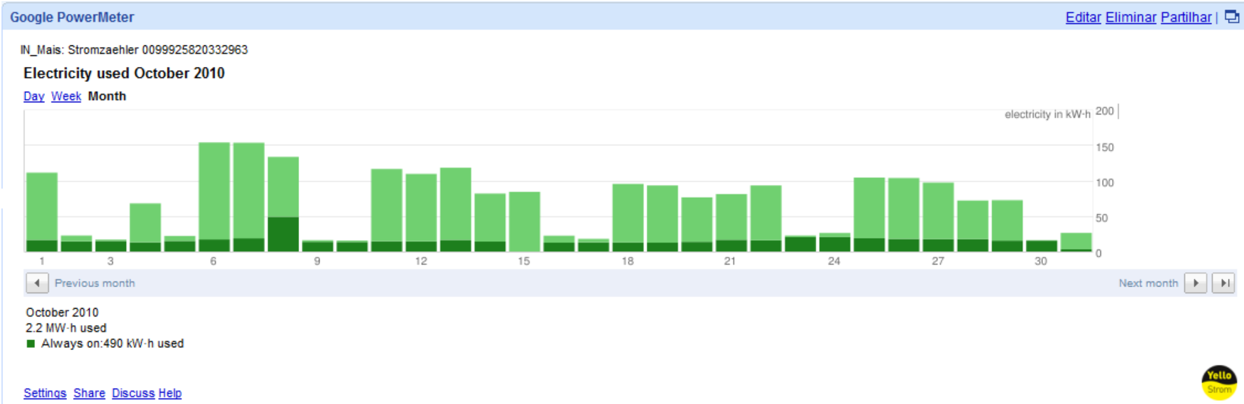
# Energy Efficiency in Buildings

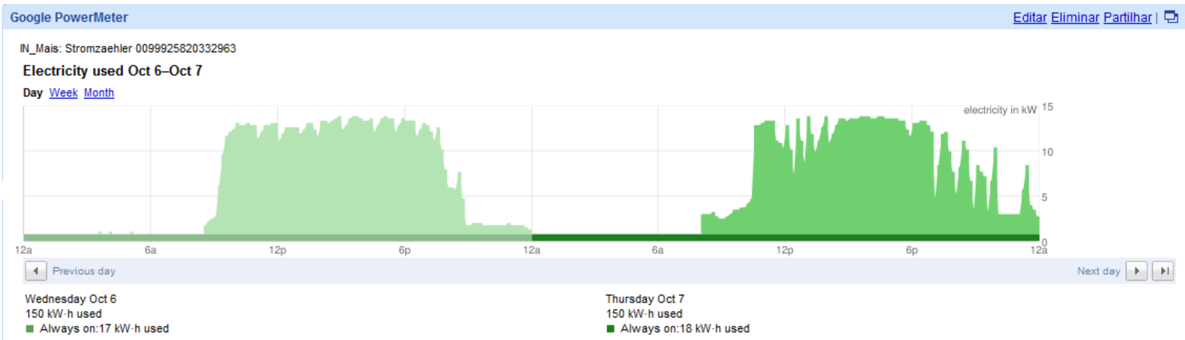



Energy efficiency potential (*source: eubac*)

# IST – IN+ @ google powermeter




# IST Tagus

- 44 electric meters
- 19 gas meters
- 72 enthalpy meters