



AIR QUALITY MONITORING IN INDOOR SPACES IN PORTUGAL

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Emissions and air quality impacts – different scales



Global scale

- Climate change,...



City scale

- Exposure to traffic emissions,...



Building scale

- Indoor air quality



Why museums are a special case?



Good indoor air quality allows to:

- **To ensure comfort and healthy environment for workers and visitors**
- **To preserve our cultural heritage**



Why museums are a special case?



Located in the centre of large cities

Various pressures and impacts

- **Road traffic emissions**
- **Air pollution**
- **Urban climate**

Why museums are a special case?



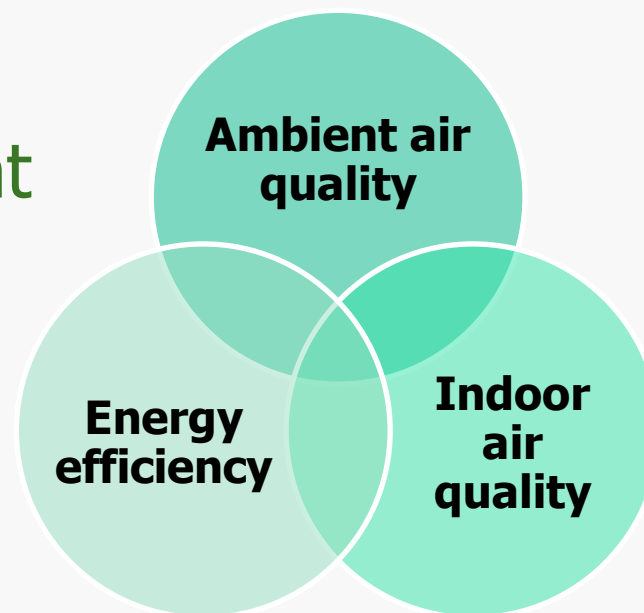
Museums are often inserted in **historic buildings**, with complex **HVAC systems**, to ensure adequate ambient conditions



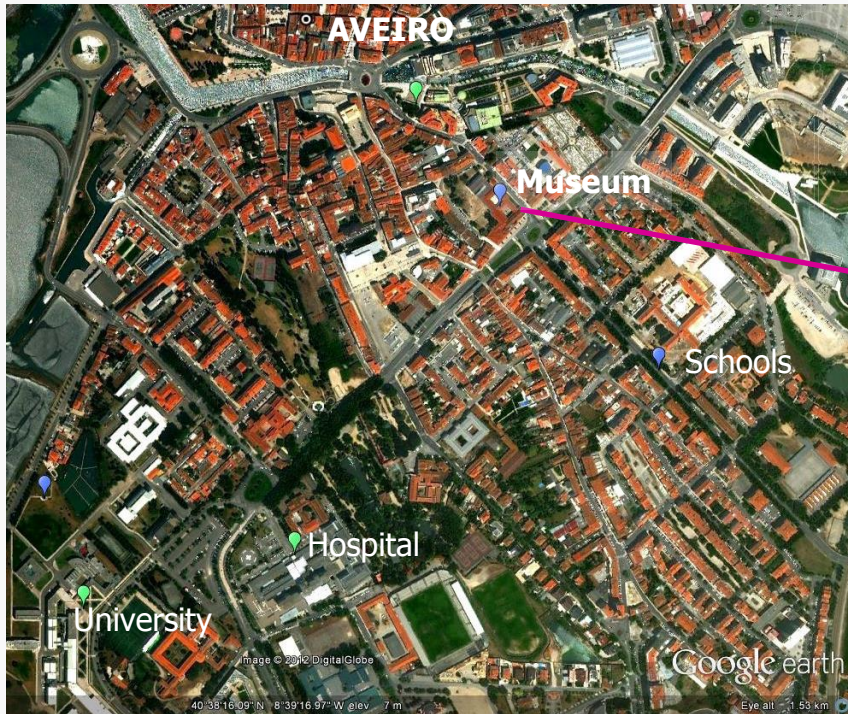
high energy consumption!

Can we identify actions and best practices to balance energy consumption and indoor air quality?

1. Energy simulations
2. Air quality assessment
3. Best practices

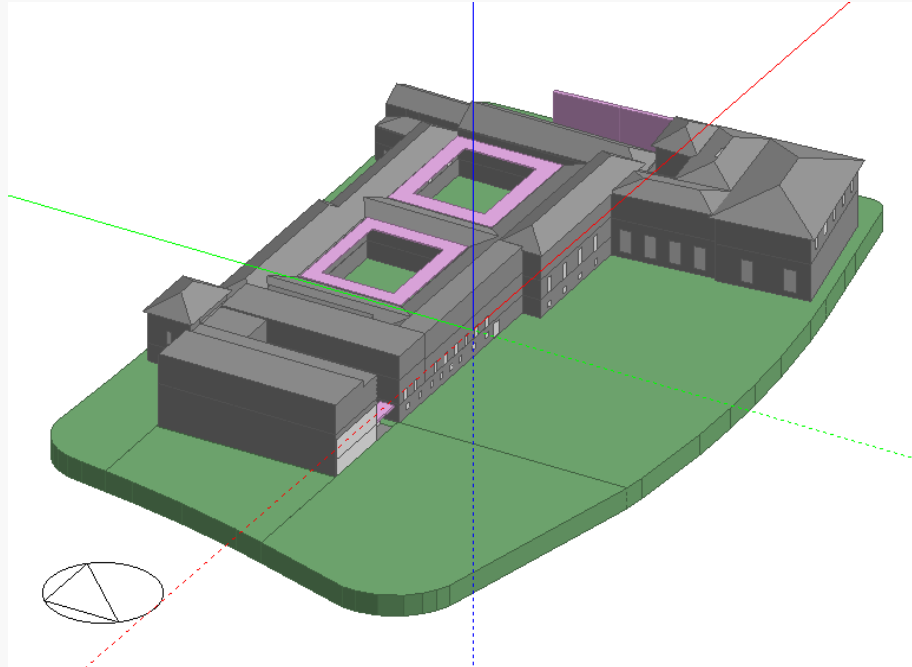


Case study Museum of Aveiro



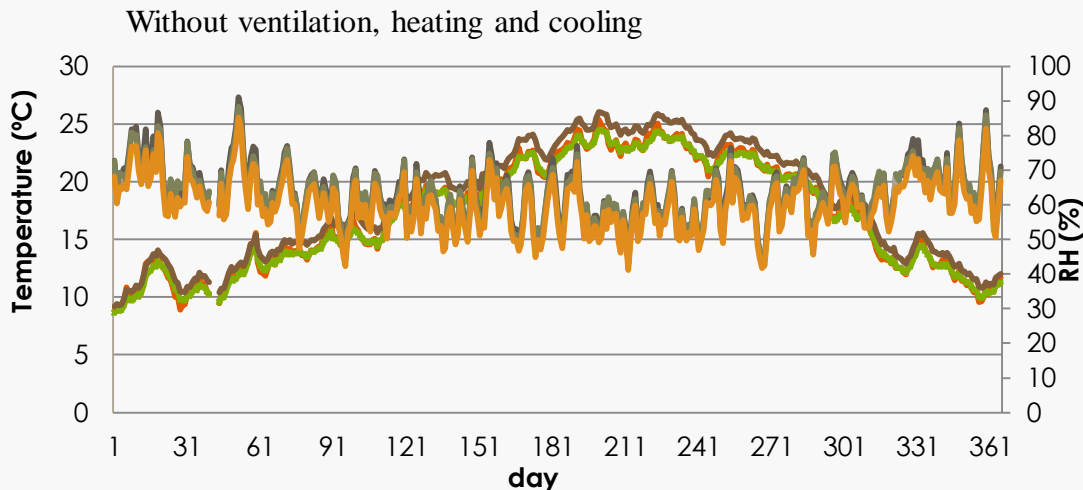
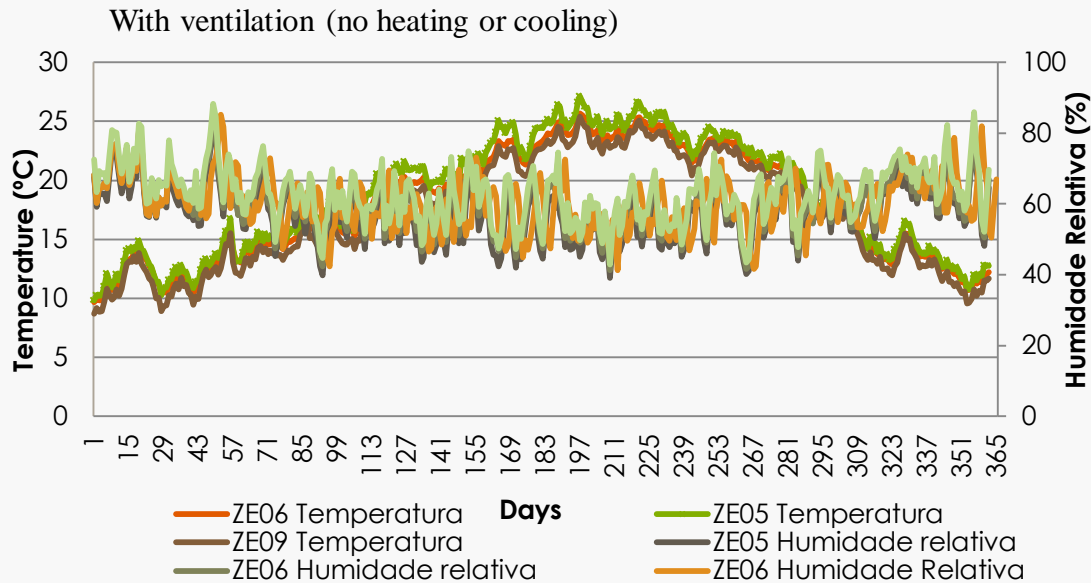
- **Located in Aveiro, Portugal**
- **Collection mainly from the Baroque period**
- **Monumental areas (15th century)**
- **Renovated areas (2008)**

Energy simulations



Building model – Museum geometry

Energy simulations

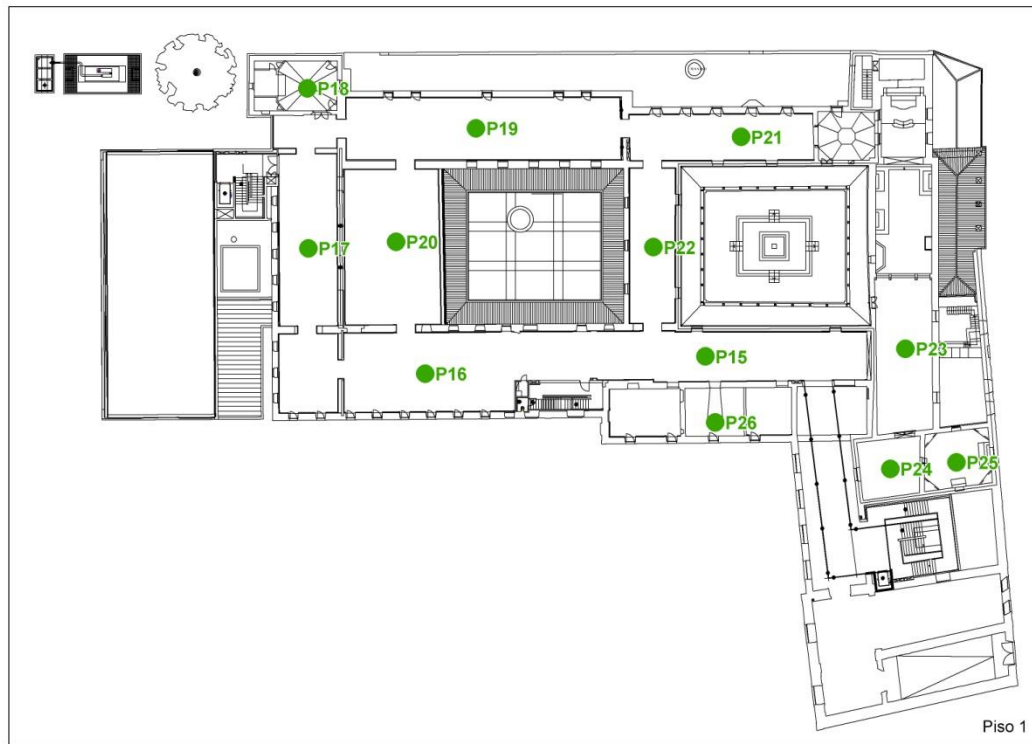


Examples of the simulations outputs (T and RH variation during 1 year)

Energy consumption and ambient conditions (T, RH) for different scenarios of HVAC operation

- **Computational model (Energy+)**
- **5 Scenarios: from no HVAC utilization to narrow variations of T and RH**

Air quality assessment

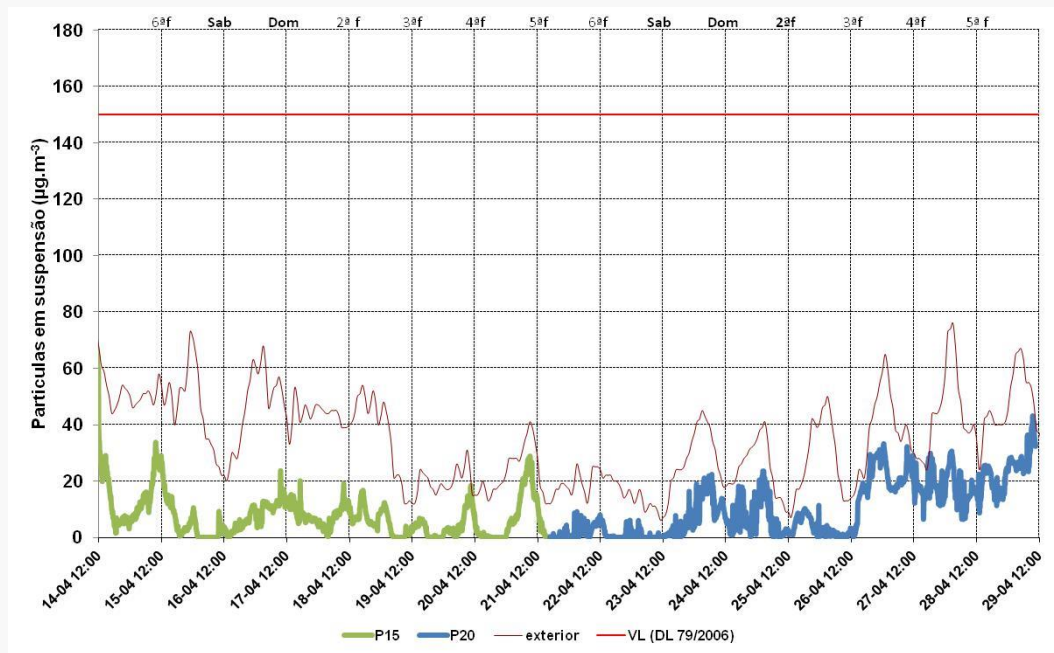


44 measurement points
Indoor air quality short-term and continuous measurements (PM₁₀, CO, CO₂, O₃, VOC, ...)

Analysis of outdoor air quality and data from a weather station

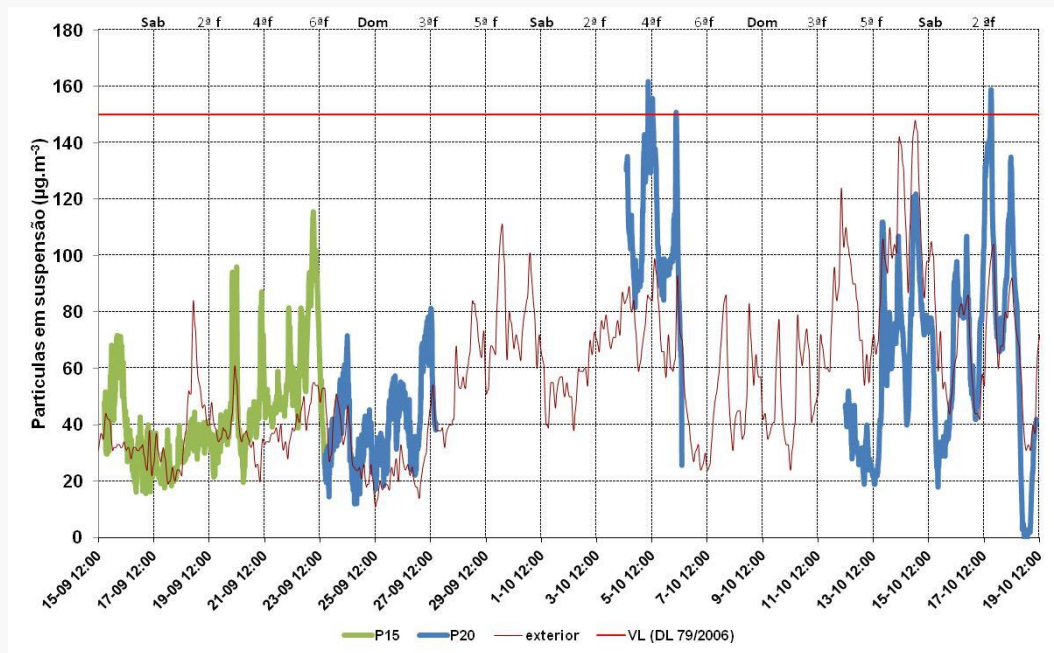


Air quality assessment



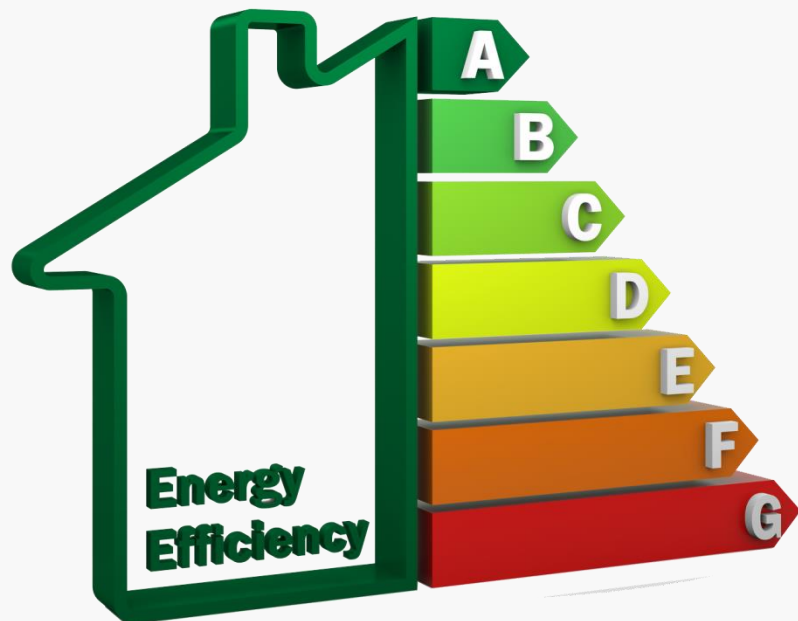
PM10 continuous measurements (1st campaign – April)

Air quality assessment



PM10 continuous measurements (2nd campaign – sept/oct)

Final notes

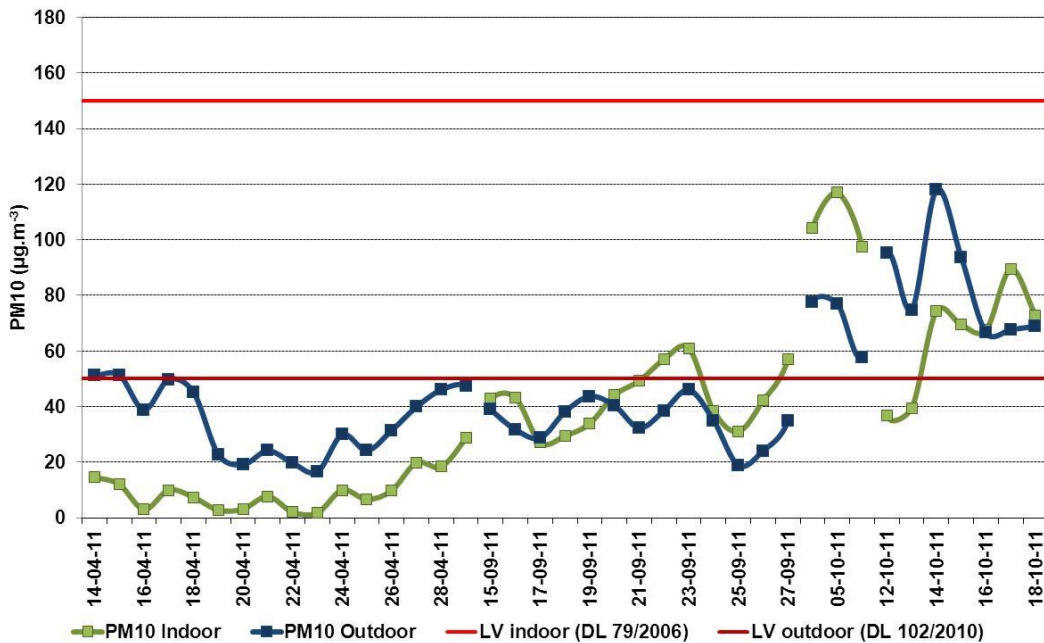


Potential saving of about **25%** in annual energy costs for the Museum



- **Optimization of the HVAC management, taking advantage of more favorable tariffs**
- **Utilization of mechanical ventilation system only in parts of the day**
- **Other interventions, without large investments** (review of energy contracts, elimination of reactive power consumption,...)

Final notes (cont.)



Influence of Ambient air concentrations in indoor air quality (PM10)

Significant difference between measurement campaigns (mechanically controlled environment vs natural ventilation)



- **Impacts on comfort/health of visitors and workers,**
- **Contributes to collection degradation**

Joint exercise with SGX Sensortech

Evaluation of micro-sensors against standard methods for air quality control during field campaigns



The application of new sensors side by side with standardised equipment in field studies will allow assessing the reliability and uncertainty of these low-cost sensors, especially regarding an accurate detection of pollutant concentration peaks.

The measurement campaigns of O_3 , NO_2 , CO/VOC are being conducted in two major Portuguese airports, Lisbon and Oporto, in 6 monitoring sites, from October 2013 to February 2014.