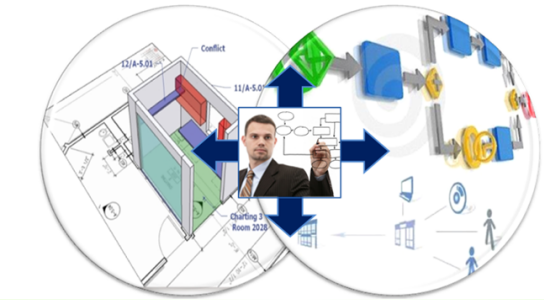
Adapt4EE

ENERGY PERFORMANCE USING OPENSTUDIO AND BUSINESS PROCESS DATA



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Universidad de Navarra

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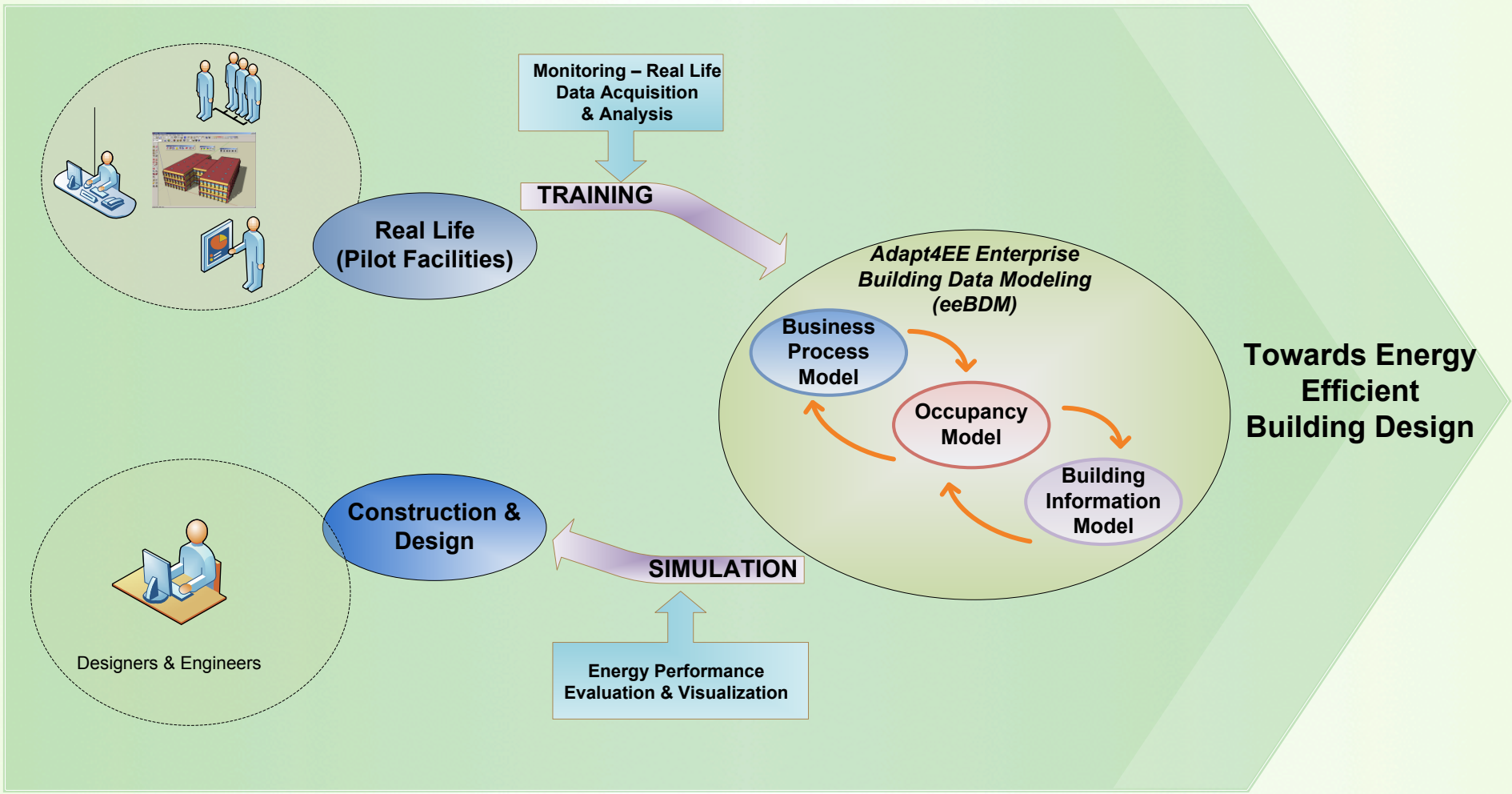
Adapt4EE overview

- The mission
  - Adapt4EE aims at **augmenting the contemporary architectural envelope** by **incorporating business and occupancy related information** to the early construction products.
  - Provides a holistic approach to the **design** and **evaluation** of the **energy performance** of construction products at an **early stage** and prior to their realization.

Adapt4EE Concept



Adapt4EE Innovation

- To identify the relation between energy performance and business performance taking into account ***occupant behavior*** in the intersection of BPM and BIM.
  - Incorporation of BPM and Simulation data within Enterprise Energy Performance Modeling
- To introduce a **hybrid method engineering** process to conceptualize and design (or adapt existing) modeling languages focusing on energy efficiency in buildings.
- To advance Energy Building Management Systems (EBMS) with **semantically enhanced** middleware framework for efficient and dynamic management of its multi-sensorial cloud.

Adapt4EE Innovation

- To provide a **semantically enhanced** Device Middleware
  - Extension of the Hydra Middleware to support conceptually the use of devices (e.g. sensors, actuators, etc).
  - Assure efficient interfacing between energy efficiency, business process and asset management
  - Delivery of a generic set of ontologies with different levels of abstraction (generic and specific domain models) that combine business, assets and other building information with energy profile definitions.
- To develop **visualization** and appropriate interaction mechanisms for the efficient detection of complex spatio-temporal patterns of space occupancy and energy consumption.

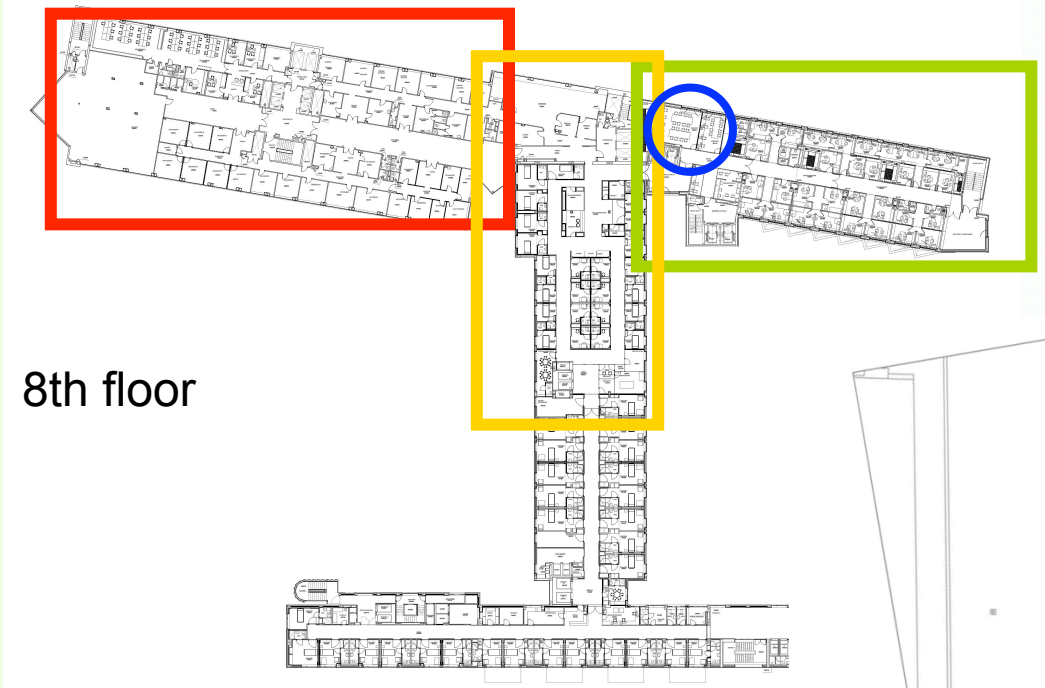
Why OpenStudio?

- The free software **OpenStudio** is being used to model the **energy performance** of the Pilot Sites
- Strengths
  - OpenStudio is a **free tool**.
  - OpenStudio is an **open source project**.
  - The OpenStudio graphical applications include the SketchUp Plug-in, the stand alone OpenStudio application, and ResultsViewer, providing a **friendly GUI** to Energy Plus.
  - The tools' analysis engine used is **EnergyPlus**.
  - Provides **templates** (constructions, schedules, loads) for a variety of building types.

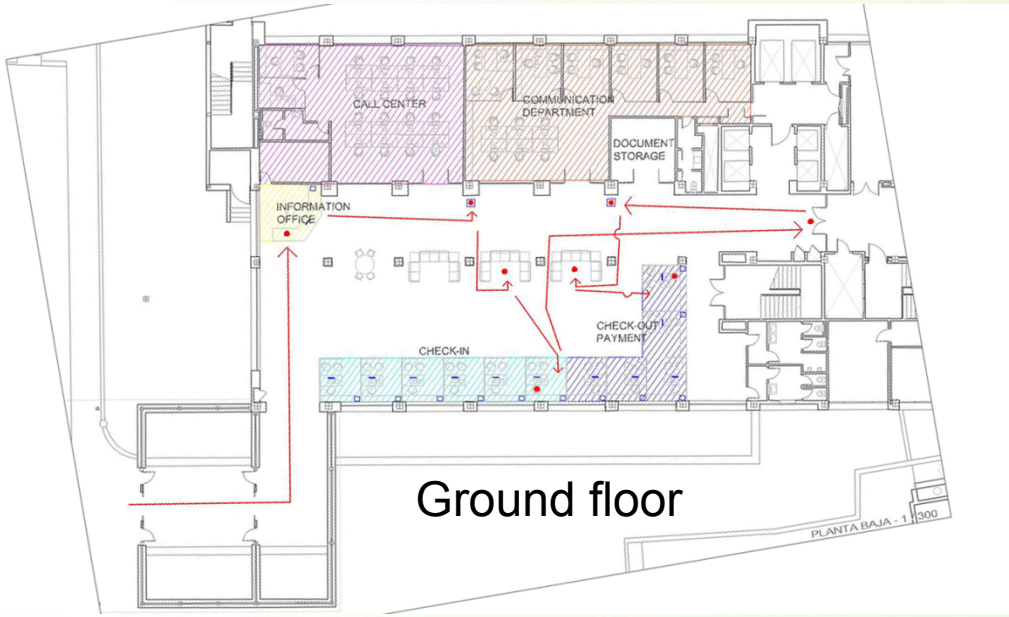
OpenStudio Models

- Models of the Clinica Universidad de Navarra
  - → Basic models ready **using default OpenStudio (OS) templates**
    - Eighth floor, four models:
      - Doctors and MIR offices
      - Two MIR meeting rooms
      - Day Care Hospital & Dialysis area
      - Consultation area
    - Ground floor, two models:
      - Administration Area (complete and only Coordination area)
  - → **Gather real info** regarding loads (people, lights, equipment) and schedules and collect BPM data. Construct **new schedules and loads**.

OpenStudio Models



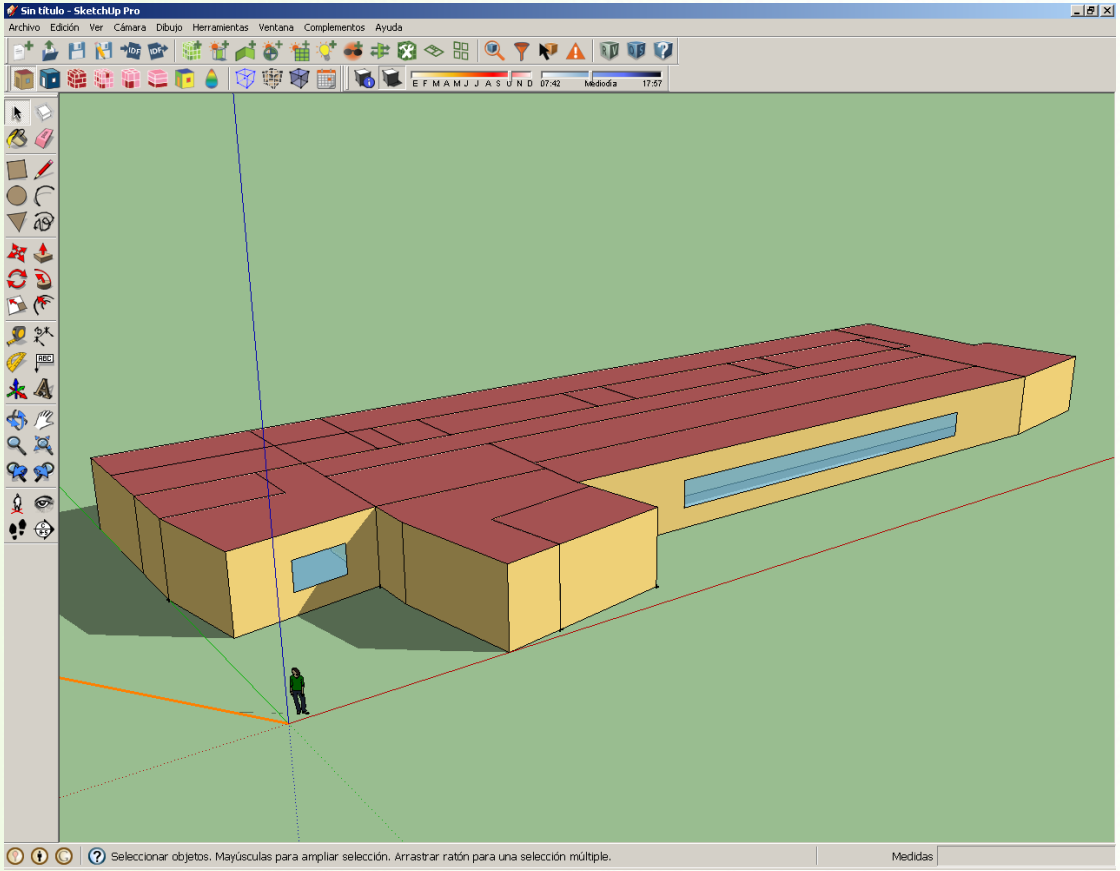
8th floor



Ground floor

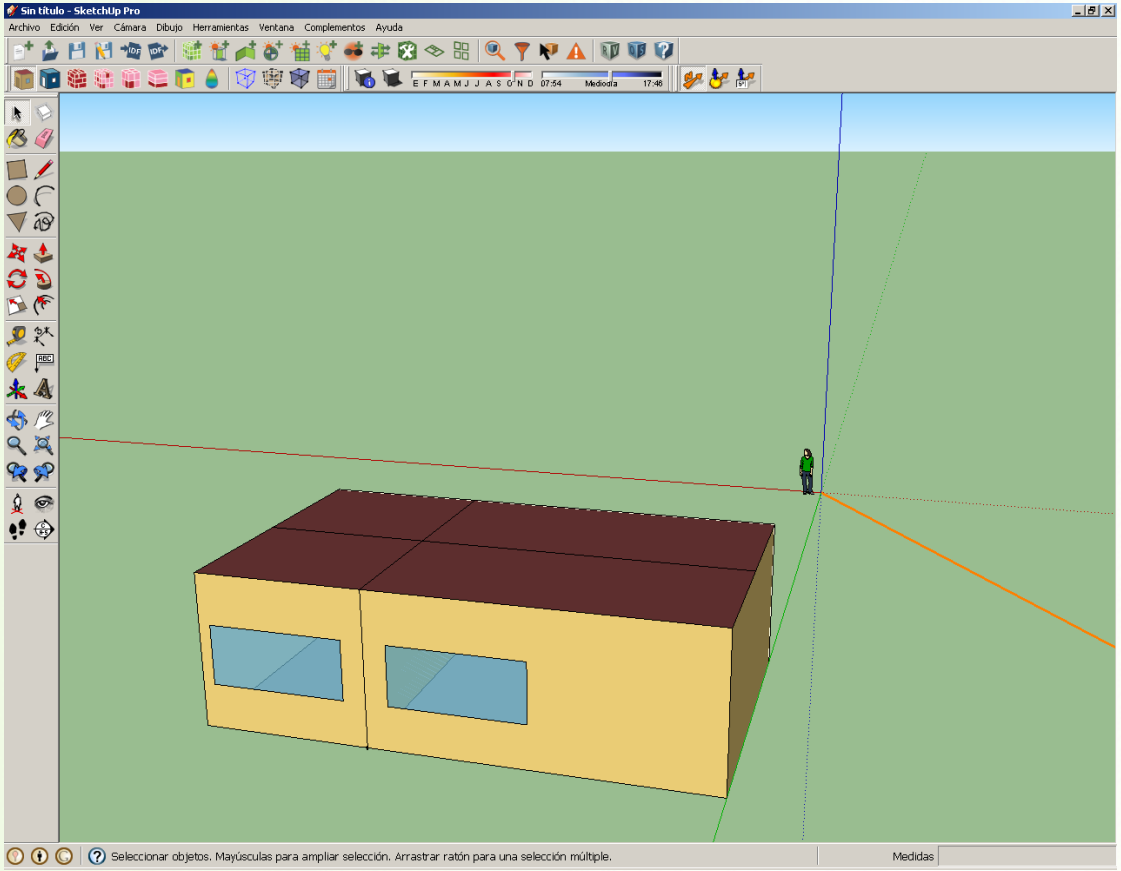
OpenStudio Models

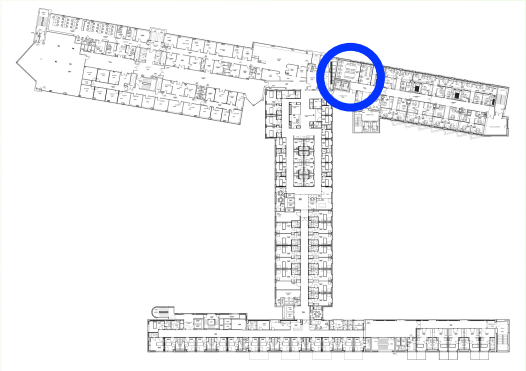
- Doctors and MIR offices



OpenStudio Models

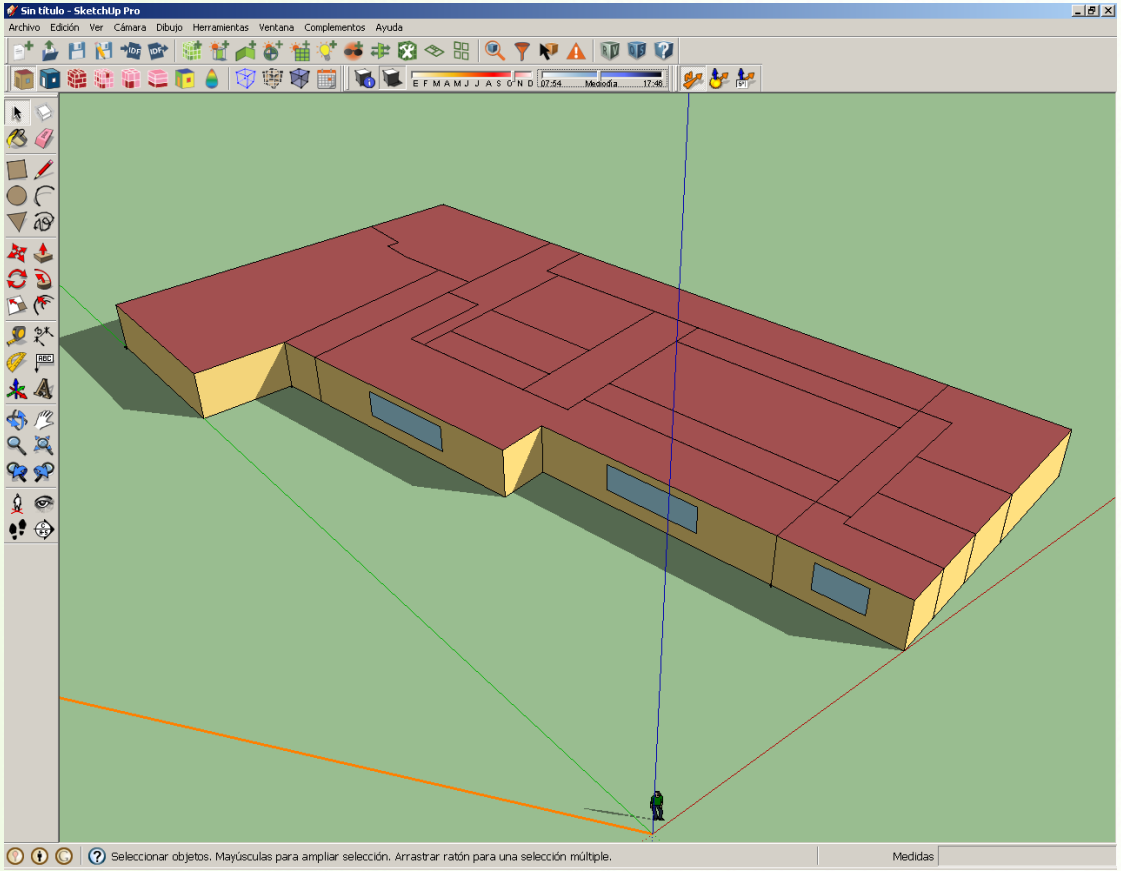
- MIR meeting rooms

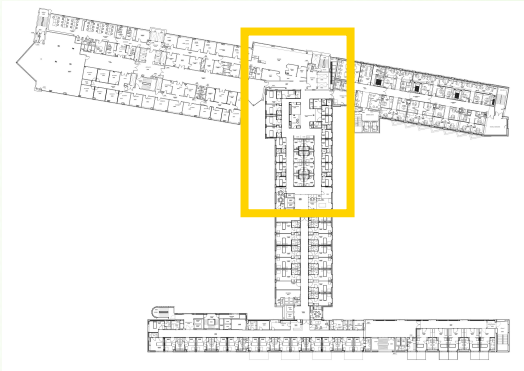




OpenStudio Models

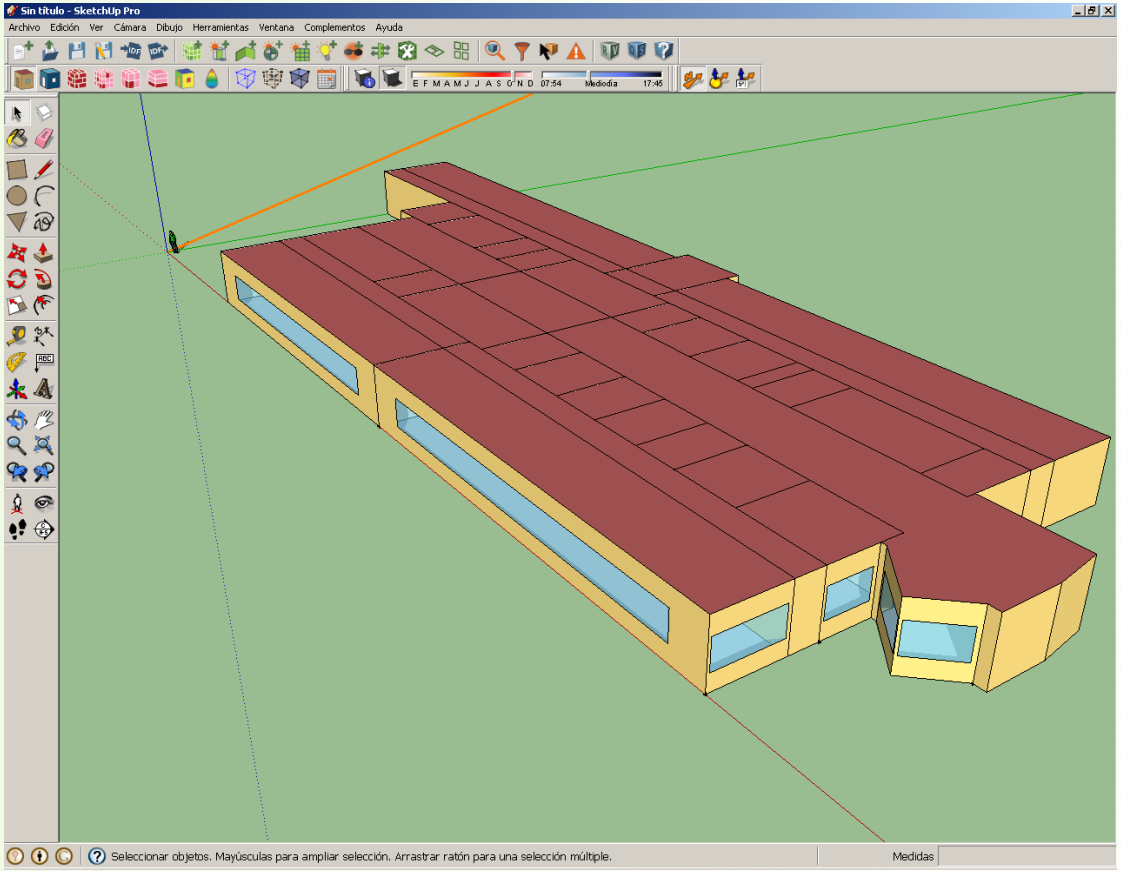
- Day Care Hospital & Dialysis area

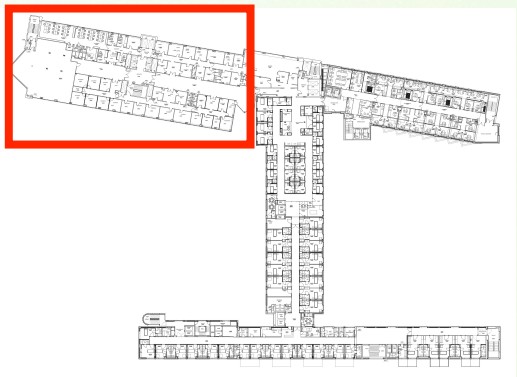




OpenStudio Models

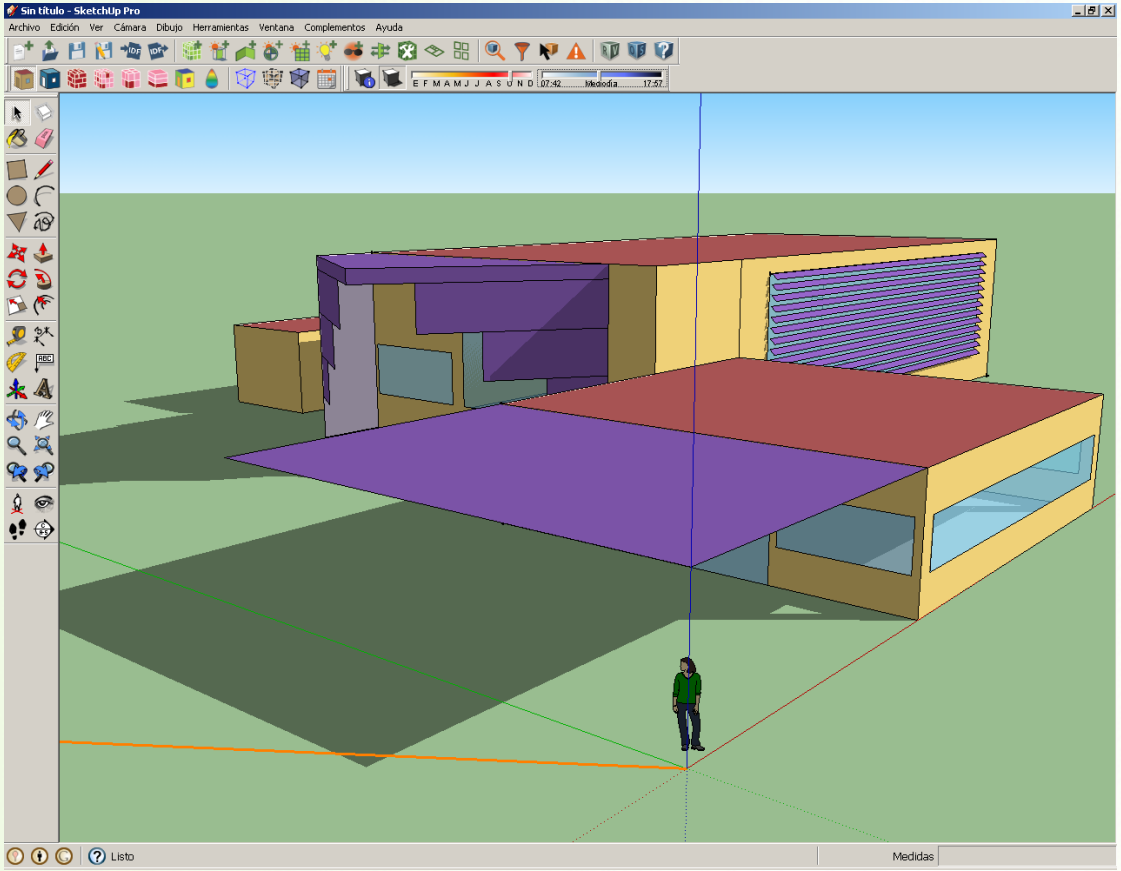
- Consultation area

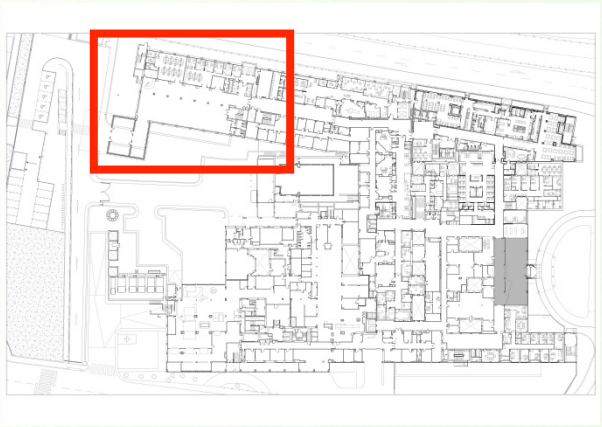




OpenStudio Models

- Administration area





Comparing Results

- Comparing templates and real data

  - OpenStudio provides **two templates for building types** that can be used in the CUN pilot site: **Hospital and Outpatient**.

  - We have modeled the two MIR meeting-working rooms using the **Hospital Office** and the **Outpatient Office space types**.

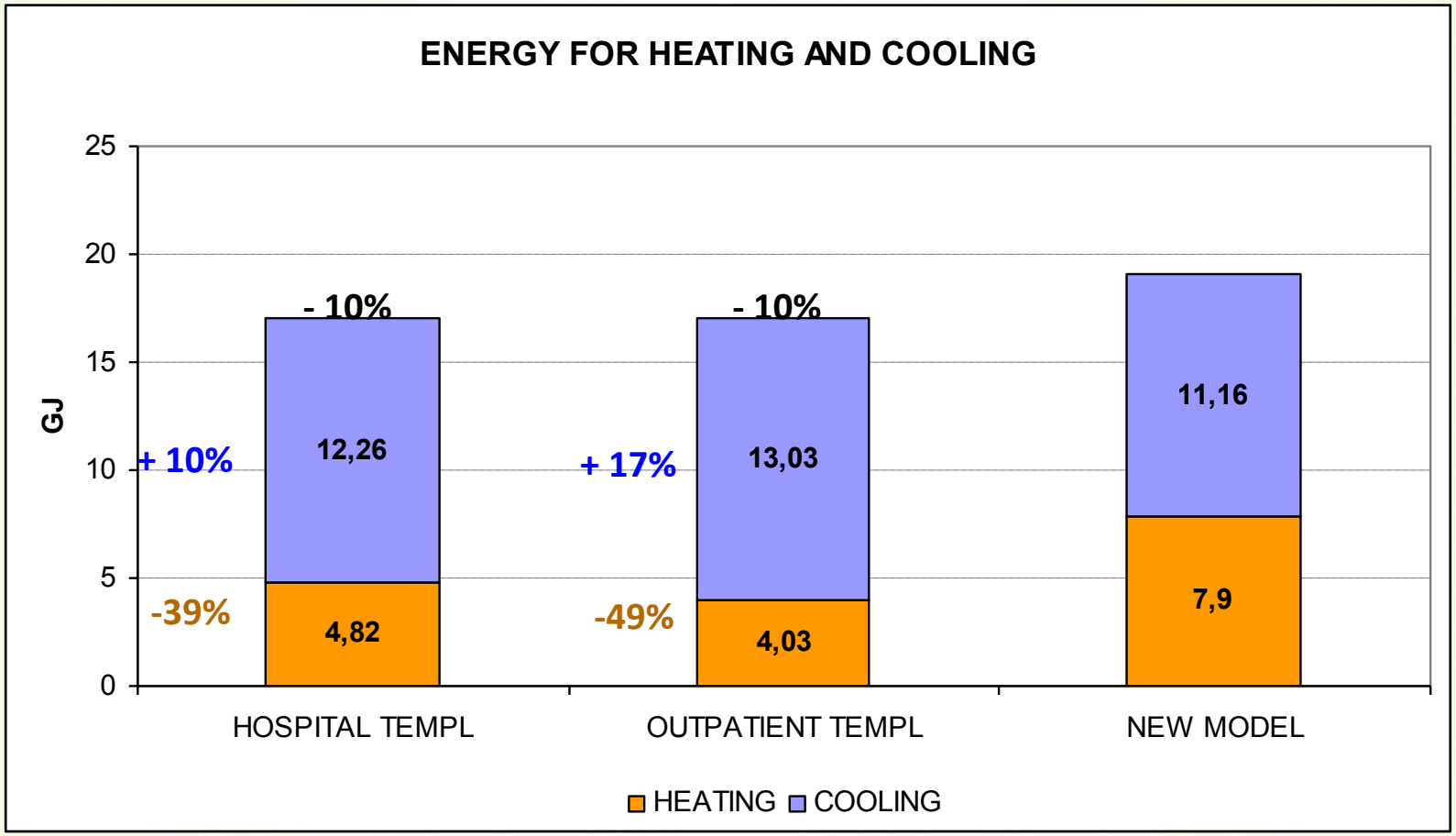
  - We have used the **info gathered** for the BPM and the actual data of loads (people, schedules, type of lights, number and type of equipment) to create a more realistic model of these meeting rooms, creating **new schedules and loads according to reality.**

Comparing Results

- Comparing templates and actual data
  - After this **first approach to a more realistic model** we have the following results regarding **energy consumption**, and the **heat addition due to the loads**.

Comparing Results

- Comparing templates and actual data



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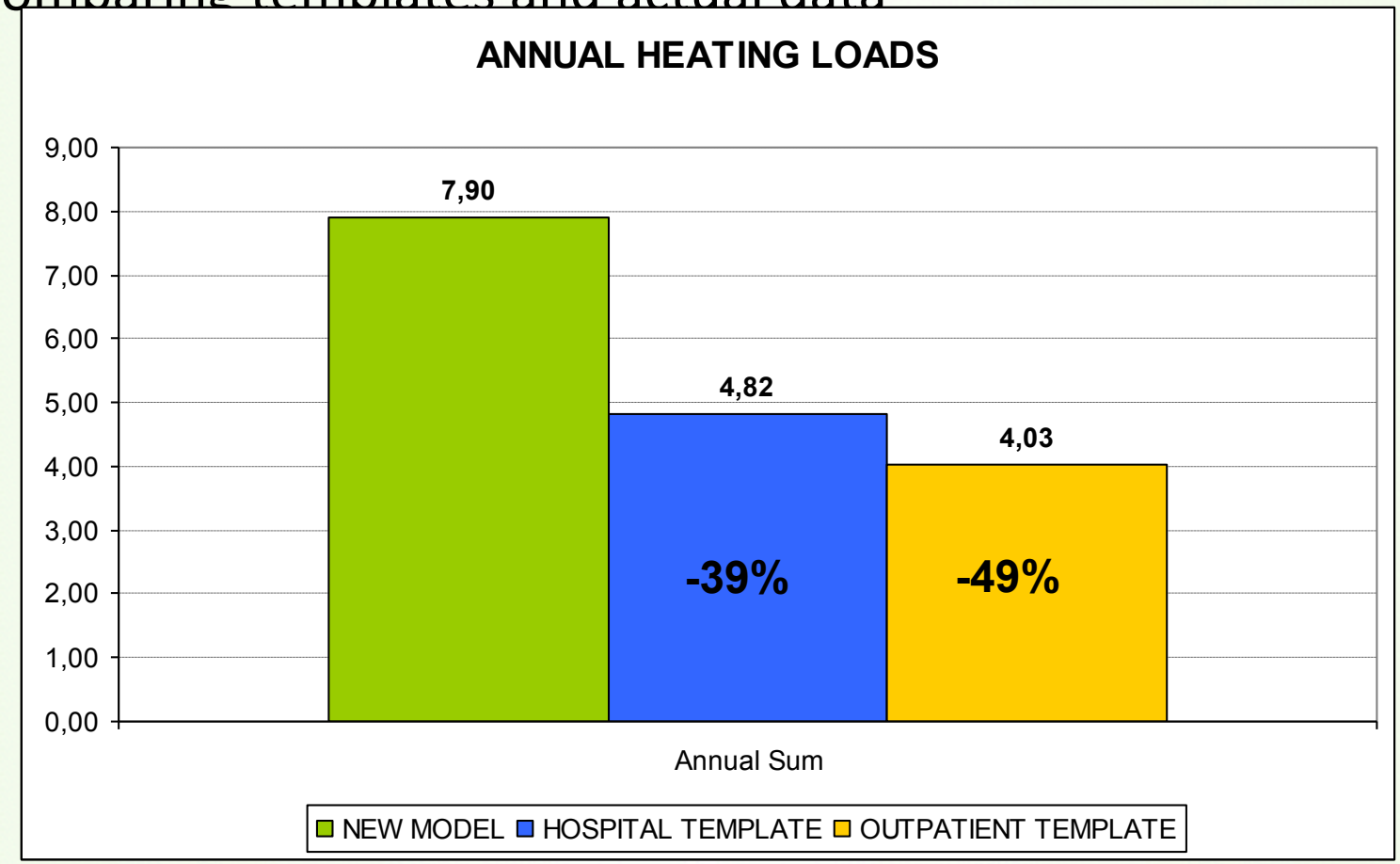

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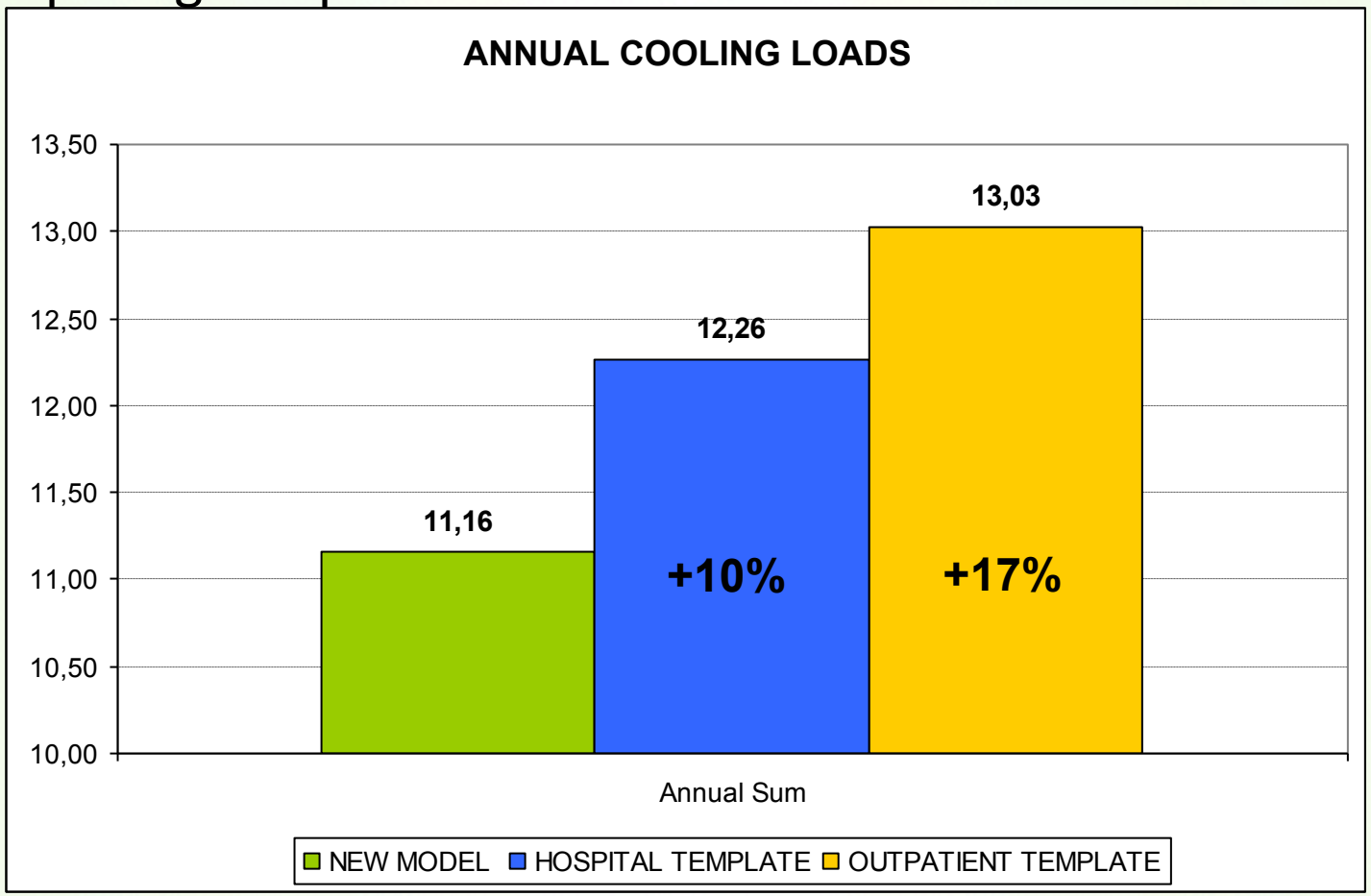

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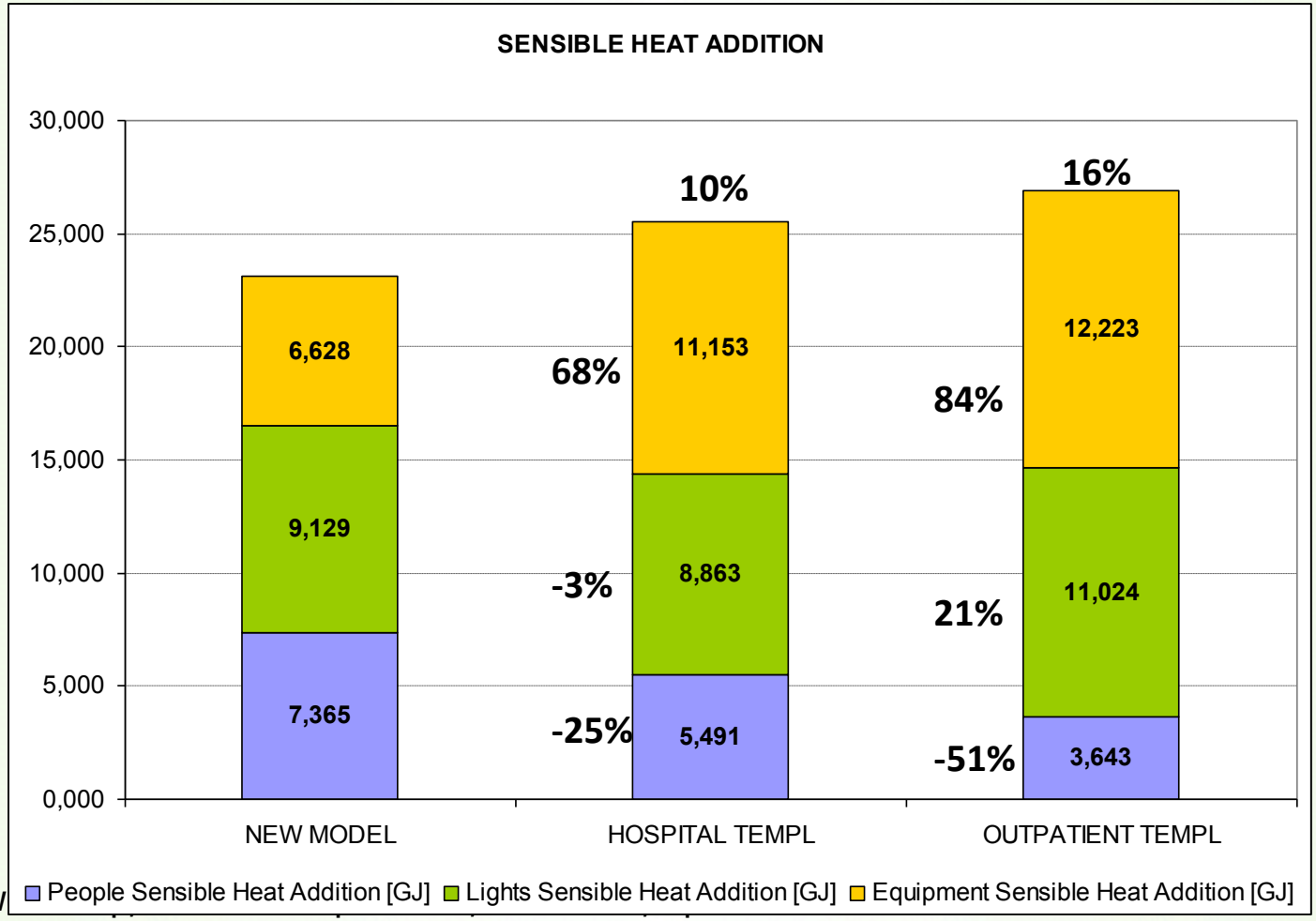

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Comparing Results

- Comparing templates and actual data
  - Despite the effort of making **real schedules and loads** there are a lot of **uncertainties** so we can not rely on this until the Pilot Sites are **monitored**.
  - **Occupant behavior**, Actual Weather and Infiltration, are the **main un-knowns**.
  - We have made many assumptions to design the schedules for lights and equipment. We can not know whether the users switch off lights or computers when they all leave the rooms in the morning or at night.
  - We have used average values recommended by ASHRAE 2009 to consider energy consumption of computers and monitors.
  - We are trying to do this effort with the Day Care Model but the degree of assumptions is even higher as the nurses move around the area the whole time.

Planning Next Period

- Pending tasks:
  - Gather more data of the different areas and design schedules and loads closer to real use of the building.
  - Include in the model the real HVAC systems (now ideal).
  - Enter into the models the data provided by the smart meters.
  - Compare results using the OpenStudio templates and the actual data.