



SUSTAINABLE ENERGY MANAGEMENT FOR UNDERGROUND STATION

Project Presentation at the Smart Facility & Energy Management,
Smart City Exhibition, Bologna, 24.10.14

Alberto Giretti

Department of Civil and Building Engineering and Architecture
Università Politecnica delle Marche – Ancona – Italy – a.giretti@univpm.it



THE SEAM4US PROJECT



- Design and development of **smart systems** for optimized non traction energy management of metro stations
- Development of a pilot running on the *Passeig De Gràcia* metro station in Barcelona



SUSTAINABLE ENERGY MANAGEMENT
FOR UNDERGROUND STATIONS



THE PASSEIG DE GRAÇA METRO STATION IN BARCELONA

- The *Passeig de Gracia* pilot achieves **20% of energy saving**
- Scaled up to the whole metro network of Barcelona, this corresponds to **9.2GWh/year** (the energy consumed by 3000 households)

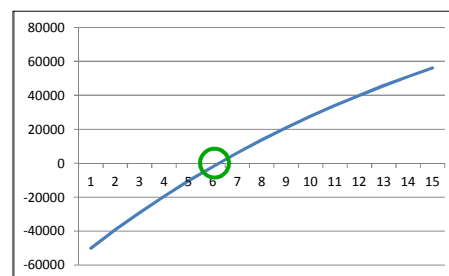


SUSTAINABLE ENERGY MANAGEMENT
FOR UNDERGROUND STATIONS



FINANCIAL SUSTAINABILITY

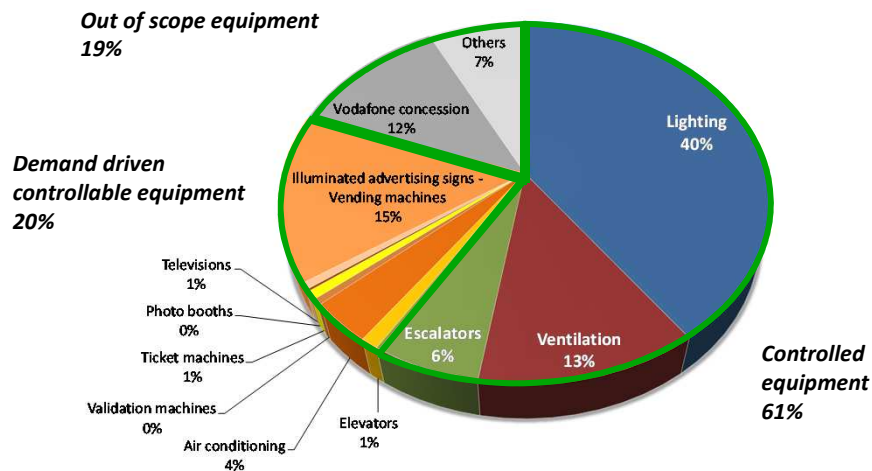
- The payback period establish the threshold that makes the technology marketable
- Assuming 11 cents (tax free) of Electric KWh, and moving from 10% of energy saving to 20% gets to **5.5 years payback**



SUSTAINABLE ENERGY MANAGEMENT
FOR UNDERGROUND STATIONS



ENERGY AUDIT

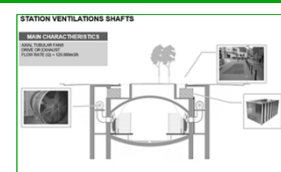


**SUSTAINABLE ENERGY MANAGEMENT
FOR UNDERGROUND STATIONS**



VENTILATION, LIGHTING AND PASSENGER TRANSFER

- ❑ Two **tunnel fans** and **two station fans** are managed according to a predetermined air-flow demand schedule
- ❑ **Lighting** is made of quite old fluorescent T8 technology. It is managed according to a predetermined schedule
- ❑ Passenger transfer is operate by means of **escalators** and lifts. Their operation is optimised according to local demand



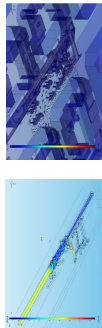
**SUSTAINABLE ENERGY MANAGEMENT
FOR UNDERGROUND STATIONS**



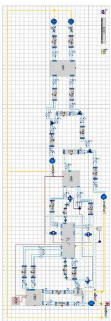
TECHNOLOGY – MODELLING AND CONTROL



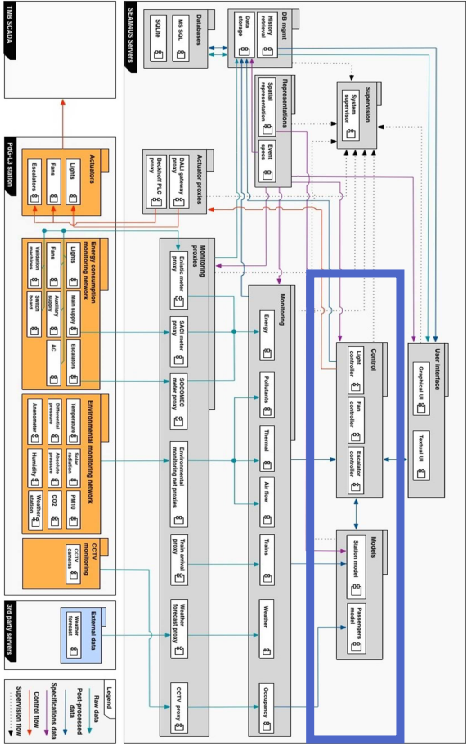
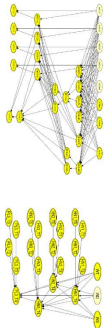
FINITE ELEMENT MODELLING



LUMPED PARAMETERS MODELLING



STATISTIC MODELLING

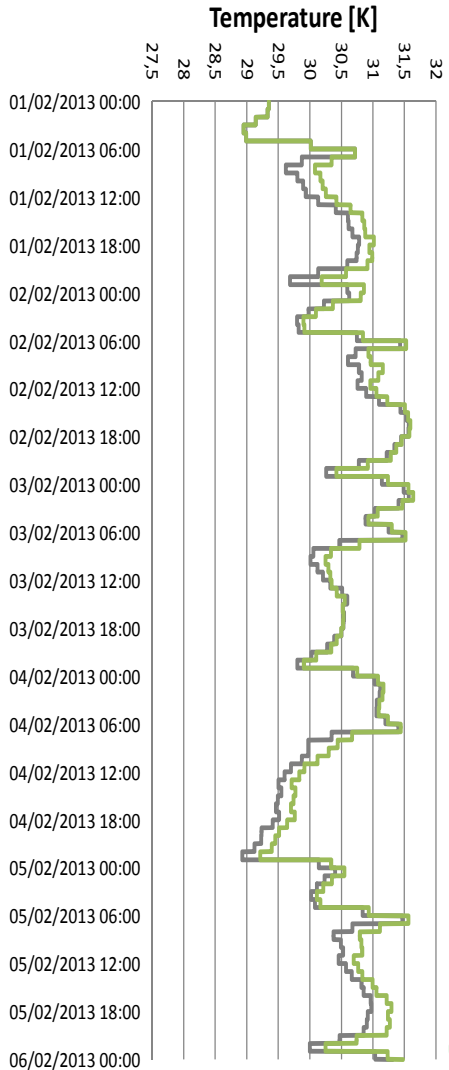


SUSTAINABLE ENERGY MANAGEMENT
FOR UNDERGROUND STATIONS



OPTIMAL CONTROL OF FANS

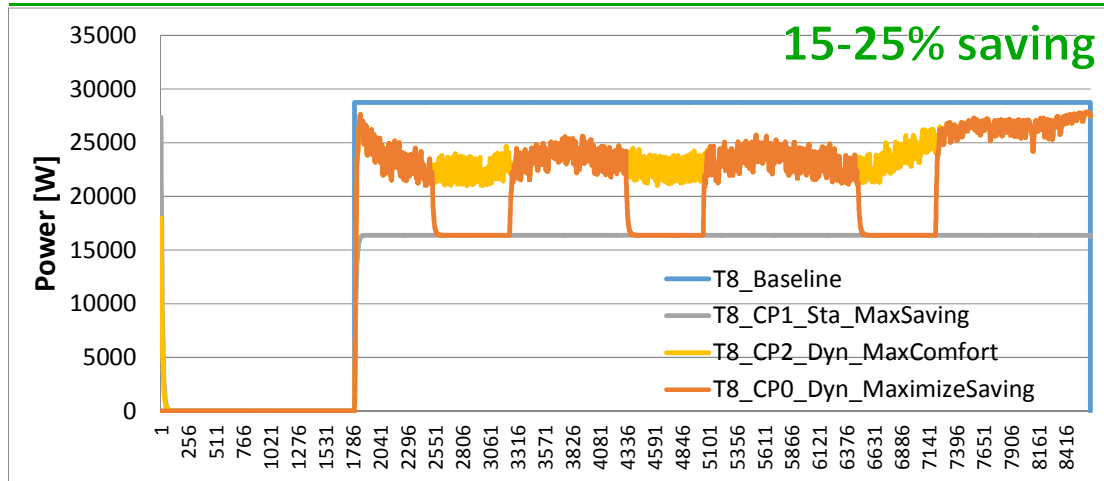
Summer 15-30% saving



SUSTAINABLE ENERGY MANAGEMENT
FOR UNDERGROUND STATIONS



DYNAMIC CONTROL OF LIGHTS



**SUSTAINABLE ENERGY MANAGEMENT
FOR UNDERGROUND STATIONS**

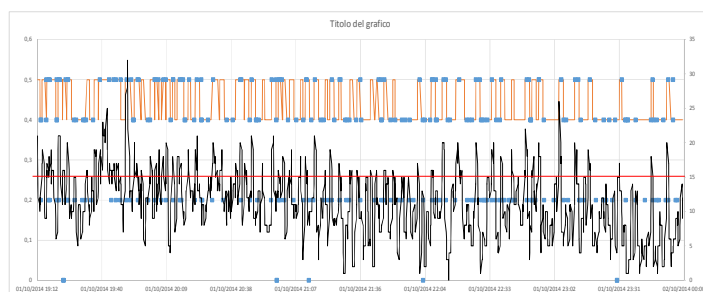
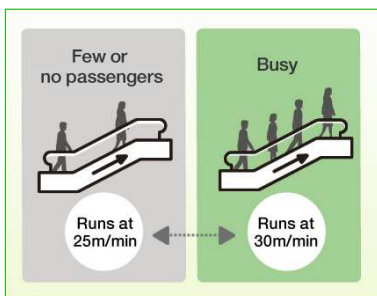


DYNAMIC CONTROL OF ESCALATORS

4-8% saving



The escalator speed is modulated according to the passenger flow

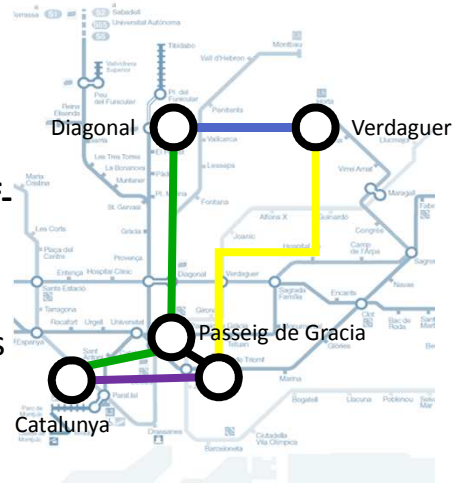


**SUSTAINABLE ENERGY MANAGEMENT
FOR UNDERGROUND STATIONS**



CONCLUSION - A SMART BUILDING EXAMPLE

- *Passeig de Gracia* is able to **adapt** its behaviour to the operational context
- *Passeig de Gracia* is able to perform **self-diagnosis**
- *Passeig de Gracia* is able to **negotiate** its performances



**SUSTAINABLE ENERGY MANAGEMENT
FOR UNDERGROUND STATIONS**



CONCLUSIONS - LESSON LEARNED

- **Intelligent system management** is a **valuable complement** to the standard passive energy efficiency solutions
- **Intelligent system management** is an **enabling technology** for the integration of buildings into the smart city context
- **Marketing challenges**
 - Reliable and effective solution engineering
 - Addressing the Open Source value chain model



**SUSTAINABLE ENERGY MANAGEMENT
FOR UNDERGROUND STATIONS**





SUSTAINABLE ENERGY MANAGEMENT FOR UNDERGROUND STATION

<http://seam4us.eu>

Alberto Giretti

Department of Civil and Building Engineering and Architecture

Università Politecnica delle Marche – Ancona – Italy – a.giretti@univpm.it

