

CASCADE

ICT for Energy Efficient Airports

Information Brochure

»Airports consume as much energy as small cities. CASCADE project will help to reduce their energy needs by developing an ISO 50001 Energy Management System, based on advanced Fault Detection and Diagnosis tools.«

Profile

CASCADE is a project funded by the European Union under FP7.

Project title: ICT for Energy Efficient Airports
Project acronym: CASCADE
Starting date: 01/10/2011
Duration in months: 36
Call (part) identifier: FP7-2011-NMP-ENV-ENERGY-ICT-EeB

Our objectives

- Support airport energy managers in their daily operation by developing an ISO 50001 energy management system re-enforced by automated Fault Detection and Diagnosis
- Implementation and validation of the developed solution in two major European airports: Milano Malpensa and Roma Fiumicino
- Energy savings and CO_2 reductions with a short ROI (Return on Investment)

Project partners

Fraunhofer ISE, Freiburg, Germany (COORDINATOR)
software, data handling, ongoing commissioning, dynamic building simulation, FDD, hardware, R&D energy efficiency, passive buildings, net zero energy buildings, building/district/grid concepts, PV, solar thermal plants
www.ise.fraunhofer.de

Projects in Solar Energy PSE AG, Freiburg, Germany
software, energy management systems, hardware, R&D energy efficiency, EU project management
www.pse.de

D'Appolonia S.p.A., Genova, Italy
ongoing commissioning, dynamic building simulation, airport HVAC, R&D energy efficiency
www.dappolonia.it

National University of Ireland, Galway, Ireland
Informatics Research Unit for Sustainable Engineering (IRUSE)
dynamic building simulation, FDD, R&D energy efficiency
www.nuigalway.ie/iruse/

Enerit Limited, Galway, Ireland
software, energy management systems, ISO 50001, R&D energy efficiency
www.enerit.com

Sensus Mi Italia S.r.L., Italy
software, data handling, ongoing commissioning, FDD
sensusmi.com/

Societa per azioni Esercizi Aeroportuali SEA Spa, Milano, Italy
energy management systems, airport HVAC, R&D energy efficiency
www.seamilano.eu

Institut Mihajlo Pupin, Belgrade, Serbia
software, data handling, FDD, R&D energy efficiency
www.pupin.rs

Aeroporti di Roma Spa, Italy
energy management systems, airport HVAC
www.adr.it

Why Cascade?

Air transportation is often associated with high energy consumption and greenhouse gas emissions. But it is not only the aircrafts; the airports are also responsible for a considerable amount of energy needs and CO_2 emissions. In the last decades, airports have developed as gathering centers with complex and diverse buildings, large transportation networks, energy consumption and ICT networks like in a small city. Airports are used daily by thousands of employees and travelers whose requirements in terms of comfort and security have to be fulfilled. Also, in terms of energy supply and consumption, airports are comparable to small cities. In many airports energy is generated by large tri-generation plants. These plants provide terminal buildings, hangers, office buildings, hotels, etc. with power, heating and cooling energy. For example, the yearly electricity consumption of our CASCADE pilot airport, Roma Fiumicino, is about to 170 GWh. This corresponds approximately to the electricity consumption of 40,000 households. The daily operation of these complex and high environmental-impacting systems is a big challenge for airport energy managers, who are under constant pressure and need new ICT solutions to save energy and reduce their CO_2 emissions.

In the framework of CASCADE, our consortium is developing and implementing new tools in collaboration with two of the biggest European airports, Roma Fiumicino and Milano Malpensa airports, which will help airport energy managers in their daily energy and maintenance operation. The heart of the solution consists of an ISO based Energy Management System supplemented by automated Fault Detection and Diagnosis algorithms. A significant part of the energy consumption of building energy systems, such as chillers, heating and cooling circuits, air handling units and lighting systems is due to poor performance. These systems are currently using modern operating Building Automation Systems (BAS) and Building Management Systems (BMS), but in the majority of cases they are not designed to perform detailed energy monitoring with advanced visualization and they do not detect energy faults and system malfunctions at an early stage.

Typical examples of faults in building energy operation are:

- **Scheduling problems**. Drives like pumps and fans are operating during the entire day and on the weekend, even when they are not required.
- **Simultaneous heating and cooling**. Due to incorrect set points, the same zone is simultaneously supplied with heating and cooling energy, thereby increasing the energy consumption.
- **Faulty controls**. The desired comfort or planned energy efficiency is not reached due to programming mistakes in the system control, despite correct specification, or the sensors or actuators are not positioned correctly.
- **Deactivated or falsely set controls**. When problems appear, the controls are often taken out of operation or rudely adjusted in order to compensate for other defects in the system.
- **Calibration is lacking**. Sensors which are used for controlling systems give invalid values due to lack of calibration or calibration that was falsely performed. As a result, these values negatively influence the indoor climate and/or energy consumption.
- **Lack of maintenance**. Due to lack of maintenance, the function or efficiency of the components is limited.
- **Lack of hydraulic balancing**. Pipe and duct systems are often not hydraulically balanced, especially after re-constructions or changes in use. Generally this results in increased energy consumption and/or decreased comfort.
- **Under- or oversizing**. Many HVAC systems are under- or over-sized leading to inefficient operation.

Our solution

In CASCADE, the faulty energy operation of typical building energy systems will be automatically detected and diagnostics will be provided to the airport maintenance team over an ISO 50001 based Energy Management System. The developed solution will be measurement-based, technology neutral and will integrate with various systems offering large connectivity and interoperability. Our main objective is to help airport managers to radically reduce the energy consumption (20%) and CO_2 emissions (20%) of the targeted systems within a 3 years payback period.

From Analysis to Energy Savings, the Energy Management Action System

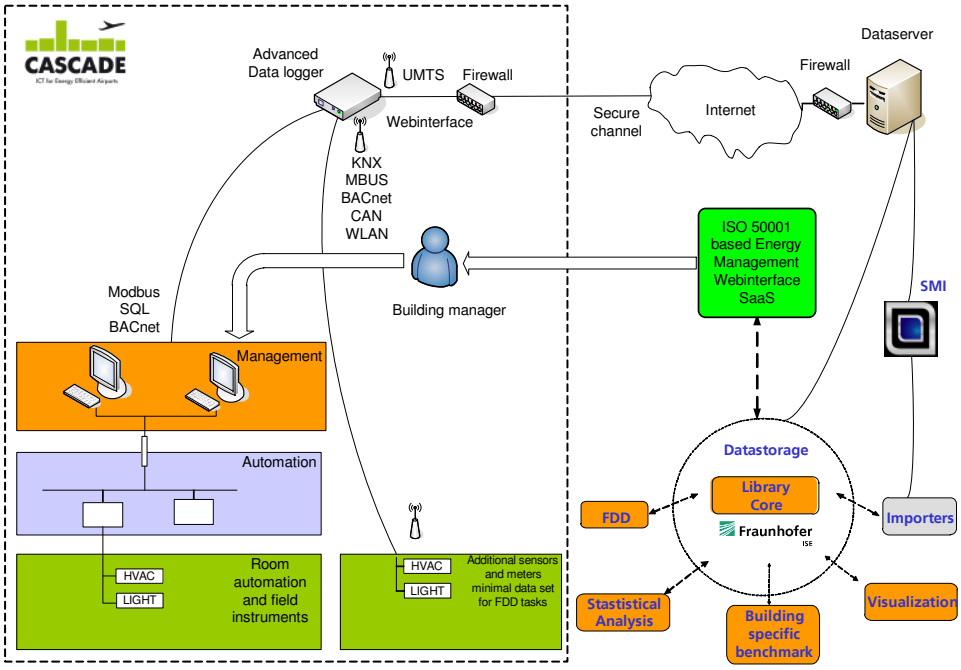
The new ISO 50001 Norm defines the condition to put in place an operational Energy Management System which will be developed with airport energy managers. Fault Detection and other feedback from control and monitoring systems will be integrated with ISO 50001.

The EN 50001 approach helps solve the major questions of the “energy management challenge”, which are:

- How do you help busy managers to reduce energy costs at many buildings?
- How do you achieve energy savings quickly?
- How do you continue to reduce energy, year after year?

The CASCADE solution will answer these questions through:

- Engaging the airport energy management teams, determining their needs and motivating them.
- Integrating new ICT technologies with existing ICT and energy systems in airport facilities
- Collecting data and providing advanced visualization on building equipment operation and performance
- Applying Fault Detection and Diagnosis methods and forwarding the results to the energy team
- Making an energy action plan that links actors, actions, the ISO 50001 standard and provides cost/benefit ratios



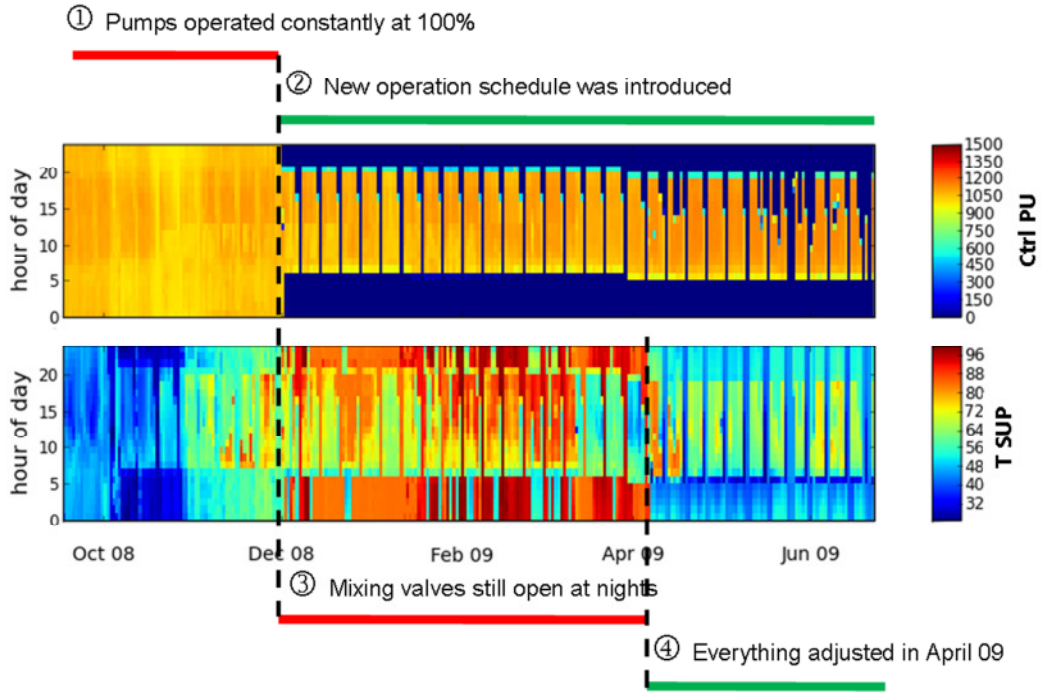
The **diagram above** shows the simplified CASCADE architecture. High time resolution data will be collected over existing BAS/BMS or from additional measurement sensors connected to an advanced data logging system with a

high connectivity and interoperability. Once collected, the data will be transferred over a secured channel to remote servers and forwarded to an analysis system, which will perform data aggregation, filtering, benchmarking, visualization and search for faulty operation of the considered systems. The information and the visualization extracted from this level will then be forwarded to the airport building manager over a web-based ISO 50001 Energy Management System. This information will enable the building manager to allocate the appropriate actions to maintenance teams and to monitor the energy efficiency and savings of the implemented measures in terms of energy, CO_2 and financial savings.

Why Fault Detection Diagnosis (FDD)?

Fault Detection and Diagnosis aims to recognize faults quickly, systematically and – as far as possible – automatically before additional damage to the system occurs, or before too much energy is wasted.

The **figure below** shows one result of FDD in a German office building. It is a set of carpet plots indicating the variation of the supply temperature in a heating circuit (T SUP) and the operation of its supply pump through visualization of its control signal (Ctrl PU) over a time period of 8 months from October 2008 to June 2009. The plot begins with the pump operating 24 hours per day (section 1) and ends with optimized supply temperature and pump operation. Between those two dates, the changes in the typical patterns of the supply temperature and of the pump control signal result from a series of interventions over the time period. The optimization of the pump operation resulted from simple set point changes and implementation of a more effective schedule (section 2). Regarding the supply temperature, a mixing valve failure was detected through a deeper analysis of the temperature profiles (section 3). Once the valve had been replaced, a final satisfying operation could be achieved by simultaneous saving of heat and electrical power (section 4).



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