

DecarbEurope – Palazzo della Farnesina

**Boosting energy efficiency in the public sector,
the case of the Italian Ministry of Foreign Affairs**

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- Where?
 - Company: Ministry of Foreign Affairs and International Cooperation
 - Location: Rome
 - Country: Italy
- What?
 - FEDERESCO, the Italian Association of Energy Saving Companies, designed a plan in 2016 for the implementation of several energy efficiency measures at the Palazzo della Farnesina in Rome.
- Benefits?
 - 1,166 tCO₂ emission reduction per year
 - Energy savings of 270 toe/year

What makes this site special?

The Palazzo della Farnesina, designed in 1935, is located in the Italic Forum, between Monte Mario and the Tiber river, and is the current headquarters of the Italian Ministry of Foreign Affairs.

With more than 1,300 rooms and nine floors, and a façade 169 meters long and 51 meters high, the Palace covers an area of 120,000 m² and has a built volume of 720,000 m³. La Farnesina is, together with the Royal Palace of Caserta, one of Italy's biggest public complexes.

Because of its age and intensive use, the Palace consumes large amounts of energy annually, which currently add up to 7 GWh. The building received a Class D energy efficiency label, demonstrating the large potential for improvement.

Having identified these deficiencies, the Ministry of Foreign Affairs in cooperation with Federesco, initiated a plan to boost energy efficiency in the Palazzo. The investment required for the execution of the measures adds up to EUR 30 M, with relatively long payback periods, that will be described further below.

The measures

In order to assess the status of the building in terms of energy efficiency and consumption, and later on identify sources of improvement, the first step conducted by FEDERESCO was an energy audit using a software tool. The output obtained from the calculations served as base for tackling the identified problems and included critical inefficiencies in terms of energy use and possible solutions for improving overall efficiency. Several measures were identified to be implemented with the goal of significantly reducing the Palazzo's energy consumption.

The aforementioned measures to be implemented were selected taking into account the following criteria and considerations:

- Firstly, the main maintenance exigencies of the building influenced the decision; in fact, since the windows needed to be renovated, this project gave the opportunity to refurbish them
- The second criterion considered was the impact on the reduction of the energy consumption; those measures with the most potential were selected to be implemented
- The aesthetic impact of the renovations was the third criterion considered, as the Palazzo is a historical building and certain structural characteristics must be maintained
- Lastly, because the renovations were financed via a government grant, payback times had to be considered

The first measure proposed was the **substitution of existing window frames**. Since the total existing glazed surface adds up to 9,400 m², potential savings are noteworthy. It was proposed to substitute single glaze windows for loss emissivity double or triple glazing ones, as well as going from metal frames to aluminium ones.

Another of the measures proposed was the **substitution of all the lights in the building** with LED lights, obtaining a power-use reduction of 342 kW.

Also implemented is the **regulation of the heating system** by installing thermostatic valves on each radiator and dynamic balancing valves on each vertical column of the distribution system, as well as the replacement of the existing pumps with electronical variable speed pumps. The main benefits obtained were:

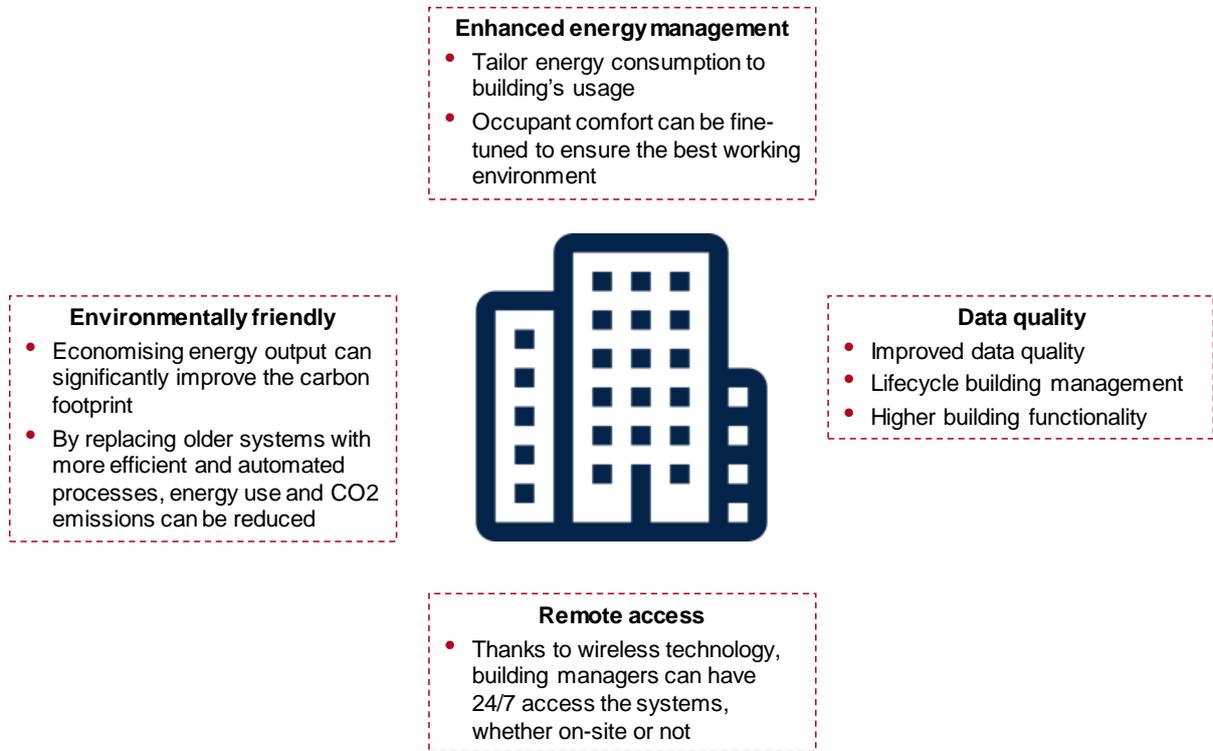
- Improvement of the overall efficiency of the heating system
- Elimination of thermal and hydraulic displacement
- Reduction of pump power consumption

A domotic system which manages the lighting, heating and air conditioning of the building is also to be installed. **Building Automation and Control Systems** provide more efficient building management by taking advantage of centralised networks that rely on both hardware and software to control different elements inside a building. The end result is a building with a better controlled environment, that presents fewer risks, and in many cases is more sustainable and cost-effective. The controlling variables of the system at Palazzo della Farnesina, which define how the savings are achieved, include:

- Internal temperature
- Windows (open/closed)
- Presence
- Luminosity

Savings will be achieved by installing devices which include motion and luminosity sensors, temperature sensors and thermostats as well as power supply. The advantages brought about by the implementation of the system are described in the Illustration below.

Illustration 1: benefits of BACS



Source: CREARA analysis

The fourth measure identified as a result of the audit was the implementation of a **trigeneration power system**. Trigeneration or combined cooling, heat and power (CCHP), is the process by which some of the heat produced by a cogeneration plant is used to generate chilled water for air conditioning or refrigeration¹. At the Palazzo della Farnesina, a trigeneration power system will be used for the Electronic Data Processing area, which has a flat cooling need all year long. The characteristics of the system are depicted in the Table below:

Table 1: trigeneration power system description

Characteristics of the trigeneration power system	
Net power output [kW_e]	211,00
Total heat recoverable [kW_t] (tolerance ± 7%)	267,00
Fuel Input [kW] (tolerance ± 5%)	540,00
Electric efficiency [%]	38,80

¹ Clark Energy

Thermal efficiency [%]	50,50
Overall efficiency [%]	90,30
Cooling Power [kW_{frig}]	232
Absorber Coefficient of performance	1,01

Source: FEDERESCO

Lastly, the buildings' frontal façade cooling system will be centralized, and 170 units will be replaced. The technology selected for this change are VRVs (Variable Refrigerant Volume) which is a type of multi-split central air conditioning system. It uses a refrigerant as a means of transmitting cold and heat. This refrigerant is conditioned by an external condensing unit and then circulates through the building to multiple fan coil units. This technology presents several benefits, according to manufacturers:

- Adaptable design: the modular design of outdoor units and wide selection of indoor units ensure system designs that are ideally suited to the environments where they are installed;
- Individual control: VRV systems enable individual climate control settings for each zone to provide the utmost in comfort to commercial building settings;
- Energy saving operation: individual control and inverter technology minimize energy consumption to deliver optimum energy savings.

Through this, higher efficiencies (COP) will be achieved and the renovation will add aesthetic appeal to the front of the Palazzo, which complies with one of the criteria considered for the selection of measures.

The results... and the costs

The implementation costs of each of the measures, as well as the potential environmental benefits generated as a result are described in the table below. It is important to keep in mind that so far only two measures have been implemented: the replacement of old windows with energy efficient ones and the installation of a heating system regulator. This is because given the importance of the building, both because of its historical value and because it houses the Ministry of Foreign Affairs, the process followed for the approval and execution of the necessary works is longer than usual.

Table 2: financial and environmental aspects

	Financial aspects			Environmental aspects	
	Investment Cost (EUR)	Savings (EUR/ year)	PBT (years)	Toe saved/year	tCO ₂ avoided/year
Energy Efficient Windows	8 035 964	165 706	48.5	54.7	283
Lighting substitution	1 851 670	283 720	6.3	91.0	530
Domotic system lights	283 292	14 654	15.9	6.9	29
Domotic system	506 887	36 952	10.5	17.5	72
Trigeneration power plant	467 884	196 800	2.4	59.8	57

Regulation of the Heating System	288 567	33 500	8.0	27.6	143
Centralization of the Cooling System	520 048	71 430	7.3	19.8	81

Source: FEDERESCO

The preliminary project has been approved and totally financed by Ministry of Economic Development, Ministry of the Environment and Protection of Land and Sea and Ministry of Infrastructures and Transport. The final and executive projects are being prepared and will be sent to the Technical Public Bodies for approval.

The case of the Palazzo della Farnesina highlights the importance of renovating historical buildings, as they often present important energy deficiencies. It also serves as proof of the willingness of Public Administrations to set an example in how to do so while preserving the construction. Although design efforts are usually greater than in standard buildings, the benefits are most often worth it.