Hospital Sudoe 4.0 is an international cooperation project between seven partners from Spain, France and Portugal, which was approved by the Programming Committee of the INTERREG V-B SUDOE COOPERATION PROGRAMME (INTERREG SUDOE).

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Hospital Sudoe 4.0 is a project that aims to provide users with knowledge about the high consumption and inefficiencies existing in the hospital and in turn offer them help to reduce them by developing renovation strategies specifically designed for the hospital through the data entered into the platform; the ultimate goal of the tool is to achieve maximum energy efficiency of the building and greatly reduce the direct and indirect emission of pollutants by converting the building into a nZEB (Zero Emissions Building).

The Hospital SUDOE 4.0 platform consists of two distinct parts, an "Energy Management System for Hospital Buildings" and a "Passport for the Renovation of Hospital Buildings".

- The energy management system is a digitalised tool for real-time consumption control and monitoring of facilities and supplies.
- The renovation passport is a procedure for defining adaptation and renovation strategies for each building in order to maximise its energy efficiency and use.

The project has analysed a multitude of parameters and variables related to the 5 key pillars chosen, which are Energy, Water, Envelope, Air and Self-generation.

Energy:

The objective of this pillar is the study and analysis of the key parameters related to electrical consumption, thermal consumption, fuels....

To analyse the key parameters related to energy consumption and use that take place in the hospital in order to be able to compare them and to know the energy efficiency of the building.

Sufficient parameters should be measured to characterise the general consumption of the building and of the main consuming equipment, therefore, for the latter it will be necessary to identify those equipment whose energy consumption accounts for a significant portion of the building's total consumption.

Water:

The objective of this pillar is to study and analyse the key parameters related to the building's water consumption at a general level and by use, in order to keep track of consumption and water use and identify irregularities and low efficiencies. Sufficient parameters must be measured to characterise the general consumption of the building and to know the distribution of water consumption among the different water-consuming systems. Dividing the parameters into IV categories, a general one that will affect the water supply from the service connection, another that will monitor the domestic hot water, the consumption of cold water will also be measured and finally the measurement of the DHW recirculation ring will be considered.

Envelope:

The aim of this pillar is to study and analyse the key parameters related to the energy performance of the building envelope, so that the current situation of the different elements that form part of the envelope and their behaviour in response to outdoor and indoor conditions can be known. On the other hand, it is important to plan the correct location of the equipment to be installed, which will require a prior study of the building, in order to know its physical conditions and identify the key surveillance locations. The envelope analysis has been divided into 4 fields, Outdoor Conditions, Building Elements, Indoor Conditions and Additional Control Parameters, this last field will serve to characterise the building after monitoring and to contrast the results of the measurements.

Air:

Building Indoor Air Quality (IAQ) is closely related to the health and comfort of building occupants, it can be affected by airborne elements such as gases, particles, microbes or other elements that can affect people's health and by the temperature inside the building. There are numerous methods to control air quality, from filtration to air renewal. The aim of this pillar is to monitor the amount of these suspended elements harmful to health and compare them with the admissible values, thus verifying that the admissible values of these pollutants and indoor temperature are met, as well as checking the efficiency of the air quality control systems.

Self-generation:

The objective of the self-consumption pillar is to measure the building's capacity for energy self-sufficiency, either at an electrical or thermal level, through renewable energies, on the other hand, the energy use of the energy discarded in the building is also a way of reducing the energy supply coming from external sources and therefore the measurement of this energy excess is also raised.

The types of facilities considered here are:

- Photovoltaic solar energy installation.
- Solar Thermal Energy Installation.
- Wind Energy Installation.
- Heat pump.
- Biogas installation.

The actions developed during the project are:

- The characterisation of the pilot buildings, collecting information on all construction parameters, materials, facilities, use profiles, setpoints, geometry, building use profiles, geometry ...
- Monitoring of the different variables of the pilot buildings.
- Construction and development of the "SUDOE 4.0 Hospital Platform" for the intelligent energy management of hospital buildings.
- Structuring of the "Passport for the renovation of hospital buildings".
- Impact of the project. Implementation of results :Training, promotion and dissemination
- Definition of public policies for the efficient management of hospital buildings. Continuity of the project.

The actions that have been developed have resulted in:

- Hospital Sudoe 4.0 monitoring platform.
- Building Renovation Passport.
- Impact study at Sudoe territory level.
- Training for building managers.
- Training for trainers.

Having developed a study of the state of the building stock in the Sudoe territory, having carried out a sample of more than 50 parameters in 37 hospitals, some of them are the climatic zone and altitude, area of influence, property regime, care purpose, age, occupancy rate, consumption...

The energy consumption data of 9.2 GWh/year and 54.7 Hm^3/year of water show the great energy impact of the hospital complexes surveyed.

The first of these hospitals is the Hospital de Perpetuo Socorro located in Badajoz (Spain), for which more than 169 variables of the building have been monitored, with special emphasis on the building envelope.

The second of the participating hospitals is the Ramsay Sante, Clinique Belharra, located in Bayonne (France), for which more than 124 variables related to self-

generation through renewable energies and other energy parameters have been monitored.

The third pilot hospital is the Santo André Hospital in Leiria (Portugal), where more than 98 variables related to the water, energy and indoor air quality pillars have been monitored.

To improve the accessibility and proper use of the platform, 45 hospitals have been trained, 15 technical training courses for trainers, 50 events to promote the creation of passports, 300 exhibitions of project results and participation in trade fairs, congresses and events to raise awareness of the tool and its applicability in different buildings.

The project has had a positive impact on public administrations, with estimated savings of between 5% and 25% with potential savings from the improvement actions, carrying out studies of partial implementations and cross effects.

Savings of between 2% and 10% have been established in the pilot buildings of the project.

The development of the project has shown the applicability of the Hospital Sudoe 4.0 platform and its potential for energy management and savings.

Being an application valid for any type of building, an accessible tool for non-expert users, allowing good practices for data capture, the comparison between the real and expected scenario, as well as the simulation of the impact of improvements.

And the renovation passport being an interactive document and the definition of a roadmap for the implementation of the improvements.