REPLICATE	Project no. 691735 REPLICATE PROJECT Renaissance of Places with Innovative Citizenship And Technology	This Project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement Nº 691735

REPLICATE PROJECT

REnaissance of PLaces with Innovative Citizenship And Technology

Project no. 691735

H2020-SCC-2015 Smart Cities and Communities

Innovation Action (IA)

D3.12 Report on smart buildings and homes

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1. EXECUTIVE SUMMARY

SmartHomes is a project led by Fomento de San Sebastián as agent in the field driving innovation in the city, in association with Public Housing Company Etxegintza and San Sebastián Municipality. The Smart courses of action on the REPLICATE project include a technology project with substantial monitoring of building and housing systems with a view to improving and boosting their energy efficiency and management.

The focus of the project is the new Txomin-Enea development which has an official subsidised rented housing complex promoted by San Sebastián Municipality, with a total of 162 homes in 11 separate blocks. This housing complex was built with Passivhaus criteria in terms of heat insulation, heat-recovery ventilation, sealing, enhancements of heat bridges, etc. It also has photovoltaic panels to generate electricity and supply demand from general services in the buildings. Heat demand, i.e. heating and domestic hot water, is supplied by Biomass District Heating, managed by Fomento de San Sebastián.

The building has a capacity control system to provide anonymous information on the number of people inside at any time, in addition to complementary monitoring systems. All housing units have a system to monitor heating and Domestic Hot Water (DHW) consumption, indoor temperature, humidity and CO2 in the home, in addition to electricity consumption. This data is displayed via an online platform accessible by each home.

Two Smart Home pilot projects (two apartments) has also been deployed with additional sensor equipment, domotics[1] systems, smart management of household appliances, presence-detection lighting etc. The two pilots will serve as specimen apartments to identify major services that could be useful to the occupants, and as a knowledge generator to transfer positive results and success stories to the neighbourhood, other districts and other cities.

The general characteristics of the Txomin SmartHomes project are as follows:

- Social housing: a building used for official subsidised rented homes.
- Minimum energy demand: a building designed and built to Passivhaus criteria, in order to reduce the building's energy demand as much as possible through holistic design strategies.
- Environmental sustainability – Renewable energies: a portion of the energy used by the building is generated by the building itself and the DH, and this is renewable energy:
    - DH for heating purposes and domestic hot water by means of biomass.
    - Photovoltaic solar panels for the building's general electricity consumption.

[1] Domotics (from the Latin word "domus", house), is the encounter of information technology, electrotechnics and electronics that makes a home become "smart".

- Integrated solutions – Integration of systems for the building: the design phase took account of integration of the various systems, connectivity, wiring, cables etc. required to deploy technology for the purposes of integration with the building's centralised energy management platform. Control and connectivity; comfort and lighting; energy management, and smart household appliances in two pilot homes.
- Monitoring of the building: design and definition of the Key Performance Indicators (KPIs) to enhance overall building management and maintenance.
- Non-intrusive monitoring of homes: specific indicators for the housing units through the building's platform, for better management and use of the home. Anonymous comparisons with data on the other homes. An environmental awareness and sensitisation objective geared towards the optimisation of usage of resources in the homes, and economic savings.

2. REPLICATE

The main objective of REPLICATE project is the development and validation in three lighthouse cities (**San Sebastián** – Spain, **Florence** – Italy and **Bristol** – UK) of a comprehensive and sustainable City Business Model to enhance the transition process to a smart city in the areas of the energy efficiency, sustainable mobility and ICT/Infrastructure. This will accelerate the deployment of innovative technologies, organizational and economic solutions to significantly increase resource and energy efficiency improve the sustainability of urban transport and drastically reduce greenhouse gas emissions in urban areas.

REPLICATE project aims to increase the quality of life for citizens across Europe by demonstrating the impact of innovative technologies used to co-create smart city services with citizens, and prove the optimal process for replicating successes within cities and across cities.

The Business Models that are being tested through large scale demonstrators at the three cities are approached with integrated planning through a co-productive vision, involving citizens and cities' stakeholders, providing integrated viable solutions to existing challenges in urban areas and to procure sustainable services. Sustainability of the solutions is fostered in three areas: economic and environmental and finally, fostering transparency in the public management.

In addition, the Model features the replicability of the solutions and their scale up in the entire city and in follower cities, particularly in three follower cities (**Essen** – Germany, **Laussane** – Switzerland and **Nilüfer**-Turkey) that are involved in the project and therefore, have access to know-how and results achieved on the project so they can apply the developed model. At the moment, there are 2 observer cities, Guanzhou (China) and Bogota (Colombia).

3. INTRODUCTION

3.1 Relation to Other Project Documents

This Deliverable *D3.12 Report on smart buildings* and homes has relation with the *D3.3 Report on DH construction including the maintenance program*, since this last document describes the District Heating installation which supplies the SmartHomes building. The *D5.1 240 homes Retrofit* of Bristol City Council includes information about SmartHomes deployed in the city.

3.2 Reference documents

This document is based in the following projects level documents:

Ref.	Title	Description
REPLICATE Grant Agreement signed 240713.pdf	Grant Agreement	Grant Agreement no. 691735
DoA REPLICATE (691735)	REPLICATE Annex 1 – DoA to the GA	Description of the Action
REPLICATE Consortium agreement signed December 2015 (7th December version)	Consortium Agreement	REPLICATE project – Consortium Agreement
REPLICATE Project Management Plan	D1.1 Project Management Plan (v.1) (29/04/2016)	REPLICATE Project Management Plan
REPLICATE District Management Plans	D1.4 District Management Plan San Sebastian D1.5 District Management Plan Florence D1.6 District Management Plan Bristol	REPLICATE District Management Plans

REPLICATE Communication Plan	D11.1 Communication Plan	REPLICATE Communication Plan
REPLICATE San Sebastian Pilot	D3.3 Report on DH construction including the maintenance program	REPLICATE San Sebastian Pilot
REPLICATE Bristol Pilot	D5.1 240 homes Retrofit of Bristol City Council	REPLICATE Bristol Pilot

Table 1: Reference documents

Where there are contradictions, the documents listed above supersede this deliverable. The Grant Agreement is the contract with the European Commission so takes precedence over all other documents.

3.3 Abbrevations list

GA	Grant Agreement
CA	Consortium Agreement
DoA	Annex I–Description of the Action
EC	European Commission
H2020	Horizon 2020
PC	Project Coordinator
PL	Pilot Leader
PMP	Project Management Plan
TC	Technical Coordinator
WP	Work Package
WPL	Work Package Leader
DH	District Heating
SCADA	Supervisory Control And Data Acquisition

Table 2: Abbreviations list

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4. DELIVERABLE DESCRIPTION

This Deliverable describes work in relation to design, development and implementation of the SmartHomes project led by Fomento de San Sebastián in a social municipal residential block in the Smart Txomin Neighbourhood of San Sebastian lighthouse city. This section describes the contents of this document.

Section 1 Executive Summary provides a brief description of the contents and general scope of the SmartHomes project, its criteria with regard to the types of systems monitored in the building, general characteristics of the project, etc.

Section 5 Project Background describes the framework and origins of the project, mainly in terms of the Smart strategy in the Urumea Riverside district, and the action taken in this district in relation to energy and energy efficiency, sustainable mobility, infrastructures and ICTs/infrastructure, etc.

The technical criteria and scope of the project are described in detail in section 6 SmartHomes Project Design. An explanation is provided of the three levels of monitoring considered and of the specific systems monitored, one by one, with the devices used for this purpose.

Section 7 Building and Infrastructure provides a general description of the type of building in which the SmartHomes project was carried out, including a number of plans of the building's location, and the existing District Heating infrastructure used to integrate and monitor data.

The criteria for utilisation and integration of data are described in the Data Management section, along with the general architecture deployed to this end, levels of supervision, communications network, controllers etc.

The Project Execution section briefly describes execution of the project at the building, with schematics and photographs of the work carried out.

The Data Display and Exploitation section uses schematics and illustrations to show the various types of data displays.

The Citizen Engagement section describes the process carried out with the organisation managing the municipal residential block to involve the occupants and help them benefit from the project's data and results.

Finally, the Innovation and Impacts and Lessons Learned and Conclusions sections provide a general description of the innovative features and impacts created, the learning aspects generated, and the major conclusions drawn from the project.

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5. PROJECT BACKGROUND

SMART TXOMIN

The Txomin residential neighbourhood is located in the Urumea Riverside District in Donostia. It constitutes a strategic space for the materialisation of integrated projects to turn it into a Smart district with practically zero emissions, thereby generating a local Smart sustainability and innovation brand and identity.

Figure 1: Urumea Riverside District projects

In 2008 Donostia / San Sebastián Town Hall drew up a special Urban Plan to regenerate the district, by way of a response to problems relating to flooding caused by the River Urumea nearby, focusing on revitalising the residential area by building 1,500 new homes, improving communications with the city centre, and fostering the transformation of local economic activity.

As part of the city Smart Plan[2], which establishes the city's comprehensive Smart strategy plan, featuring the main challenge of drawing up a strategic line with shared objectives to bring coherence and coordination to public activities, Fomento de San Sebastián concentrates its work on the Urumea Riverside District.

In the case of the Txomin neighbourhood, a portion of the Smart implementations is materialising itself through the European REPLICATE[3] "lighthouse" project, co-funded by the H2020 programme, coordinated by Fomento de San Sebastián. The project objectives are implementation and validation in the lighthouse cities (pilots) of Donostia / San Sebastian (Spain),

[2] Donostia / San Sebastián Smart City Plan http://www.fomentosansebastian.eus/images/sectores_emergentes/smart-energy/plan_smart/PLAN_SMART_DONOSTIA_EN.pdf

[3] REPLICATE contract number 691735 - call number SCC1 Smart Cities and Communities

Florence (Italy) and Bristol (United Kingdom), of a business model for a sustainable city, to boost the transition process towards a SmartCity in terms of energy efficiency, sustainable mobility and ICTs/Infrastructures, stepping up the pace of deployment of innovative technology, improving the living standards of local people, and embarking upon the replication process. The scenario of the Replicate project is the Urumea Riverside District which, alongside other courses of action carried out but not funded on the same project, are making the Txomin neighbourhood a benchmark of smartness and sustainability, considering the neighbourhood as a space for experimentation and pilot projects, to test its potential for replication in other parts of the city or in other European cities.

Figure 2: Txomin Residential Neighbourhood and DH

In this context, Fomento de San Sebastián is working to turn Txomin Enea into a district that can be a benchmark of sustainability and smartness, considering the neighbourhood as a space for experimentation and pilot projects, to test its potential for replication in other parts of the city or in the territory of Gipuzkoa. Specifically, the activities already carried out or ongoing in the neighbourhood are as follows:

Energy Efficiency

- Household energy refurbishment: 156 homes in 10 blocks. The scope of the project included refurbishment of facades, roofs and windows. The housing units also have a connection to the urban heating system and local domestic hot water (District Heating). The benefits of the project were enhanced comfort, savings on expenditure and fewer CO2 omissions, and the housing units were integrated with new homes, thereby enabling them to be upgraded.

Figure 3: Refurbished homes in Txomin

- Centralised urban District Heating system: a District Heating thermal power unit was built to supply over 1,500 homes. The heating service and urban domestic hot water are owned by the Town Hall, through Fomento San Sebastián. The thermal power unit has a power output of 7,400 kW, with two 1,400 kW biomass boilers (renewable energy). Some of the benefits of the project are greater comfort for local people, with a heating service available 365 days a year, 24 hours a day, fewer hazards in homes because the building does not contain any combustible features, fewer CO2 emissions, and access to a monitoring platform for users.

Figure 4: DH building in Txomin

- SmartHomes pilot project: this has been carried out in the building with 162 subsidised homes with real-time monitoring of electricity consumption, thermal power for DHW and heating and temperature, a smart lighting system, production of renewable electricity (PV panels), a domotics control system, heat-recovery ventilation system etc. Two apartments in the building also have more advanced devices to control lighting, smart control of household appliances, window-opening sensors etc.

Figure 5: SmartHomes Building in Txomin Residential Neighbourhood

Sustainable Mobility

An electric bus route was provided to give the Txomin district better links with the city centre. Electric vehicles were also purchased for the municipal fleet (motorbikes and cars), and the city's e-taxi service was promoted. An integral management platform was introduced to administer mobility in the city.

Figure 6: Sustainable electric mobility

ICTs and Infrastructures

Turning to ICTs and infrastructures, a Smart City platform was designed and developed with a number of city information sources. High-speed connectivity infrastructure was deployed in the district as backup to public services, and smart public lighting was also installed in the "Polígono 27" industrial complex.

Figure 7: Smart public lighting

Citizen Participation

Alongside the implementation of courses of action in the fields of energy, mobility and ICTs/infrastructures, a participative process was set up in the neighbourhood, with collaborative reflection to involve local people in the joint design of the district, using surveys of people's needs, concerns, habits and perceptions, individual interviews across a range of groups (technology companies working in different Smart areas, new and former inhabitants of the neighbourhood, property managers, retail outlets), and a number of group workshops which conducted an analysis of possible future scenarios, and co-designed and prioritised proposals of future courses of action at local level.

6. SMARTHOMES: PROJECT DESIGN

The starting point on this project was based around the concept of a Smart Building and a Smart Household in a public building used for social rented housing units. To this end Fomento San Sebastian (FSS) carried out a survey of the state of the art of general principles, contents and technology, and availed itself of technical experts to move the solution towards the specific case of the subsidised municipal residential block.

As a result of this project, FSS drew up a project design with the collaboration of Etxegintza, with three monitoring levels:

- General monitoring of the building
- Monitoring of the homes
- Pilot apartments and domotics

In terms of general monitoring of the building, a non-intrusive capacity control counting system was installed to ascertain how many people are in the building at any given time, along with other systems for general services, lighting, PV panels etc. All homes have access to a system to monitor their consumption of heating, DHW, indoor temperature, humidity, CO2 and electricity. All these data are sent to the central DH server via the complex's communications infrastructure, a SCADA (Supervisory Control And Data Acquisition platform) system which calculates and analyses indicators and readings of all the variables recorded. From this local SCADA system, a selection of readings and indicators are uploaded to the DH Cloud, which provides input for the general public's information display website and the platform showing the consumptions of each home, as explained in more detail in section 6 Data Management.

More specifically, the project presented here meets the need for installation and monitoring of the following aspects.

<u>General residential building with 11 separate blocks:</u>

The general systems installed in the building are as follows:

- Monitoring of photovoltaic solar power.
- Electricity consumptions of services common to all 11 blocks.
- Electricity consumptions of the lifts in the 11 blocks.
- Electricity consumptions of garages.
- Monitoring of heat-recovery ventilation.
- Electricity consumption of heat-recovery ventilation in the 11 blocks.
- Two sensors for outdoor temperature, humidity and CO2 measured on the roof.
- Two air quality sensors on the roof.
- Two solar radiation sensors on the roof.
- A brightness sensor.

- Garage and entrance door open/closed status.
- Capacity control for people in the building and access to garages

Systems installed in the homes

Various monitoring systems have been installed in 160 homes, providing information on the unit's energy consumption and conducting an analysis of comfort.

Specifically, the variables monitored are as follows:

- Electricity in the home.
- Heating and DHW.
- Whether the heating thermostat is on or off.
- Indoor temperature, humidity and CO2.
- Water consumption.

The occupants have access to this information on an online web platform with personalised user name/password access. All occupants can consult all information on their own home, with indicators and graphs to provide a simple display of the information available, thereby improving their consumption habits and reducing their energy bill.

Pilot apartments (2 homes):

A number of different monitoring systems have also been fitted to the two pilot homes, with greater detail of a number of specific indicators in addition to those obtained from the building's other housing units.

Specifically, the variables monitored are as follows:

- Electricity in the home and electric circuits for: lighting, general electricity power points and refrigerator, cooker and oven, washing machine, dishwasher, bathroom and kitchen (power points).
- Heating and DHW.
- Whether the heating thermostat is on or off.
- Indoor temperature, humidity and CO2 in four rooms in the home.
- Water consumption.

The occupants have access to this information on a web platform that may be consulted on Internet, with personalised user name/password access. All occupants can consult all information on their own home, with indicators and graphs to provide a simple display of the information available, thereby improving their consumption habits and cheapening their energy bill.

The homes also have the following systems:

- two smart household appliances: washing machine, fridge and dishwasher
- domotics systems:
    - o electric control of blinds

- lighting with presence detection
- window status sensors.

This design of the SmartHomes project, defining and specifying the systems to be monitored, produced the technical solution required to address all aspects: architecture, management system, teams, sensors, communications, display etc.

The following subsections describe the design criteria of the management system (BMS) to meet the monitoring requisites, and to analyse optimum conditions for energy savings and comfort in terms of temperature, humidity, CO2 etc.

SmartHomes actions cover several objectives. From a building management point of view, this solution contributes to better and more efficient building management and maintenance. As for the occupants of the dwellings, they will have at their disposal detailed information and indicators about their dwellings that will allow them an optimal use of the resources of their dwelling, minimizing energy consumptions and reducing their energy bills. These objectives are possible thanks to the complete monitoring system designed and implemented in the project, which consists of the following levels of monitoring:

Monitoring of electrical systems

- Recording and reading of electricity consumption by services in the areas common to the 11 blocks.
- Recording and reading of electricity consumption by lifts in the 11 blocks.
- Recording and reading of electricity consumption by air recovery units in each building.
- Recording and reading of electricity consumption by the 162 homes.

Monitoring of temperatures/humidity/CO2/outdoor conditions.

- Recording and reading of temperatures/humidity/CO2 in the 162 homes.
- Recording and reading of outdoor temperatures.
- Recording and reading of outdoor humidity.
- Recording and reading of solar radiation.
- Recording and reading of outdoor air quality.

Monitoring of other systems

- Recording and reading of entrance door opening/closing, access to garages and garage doors.
- Capacity control of people in the building.
- Recording and reading of recovery unit parameters and efficiency
- Domotics systems in the two pilot apartments

- Recording and reading of water consumption.
- Recording and reading of heat and DHW consumption.

6.1 General description of monitoring

For general monitoring of the building's common areas, the intention is to record consumptions of electricity, status of garage doors and entrances to housing blocks, external sensors, air recovery units, capacity control and photovoltaic systems.

The objective is to monitor the status of the building, to get the general and common data that allows to get general information of the building for a better understanding of its behaviour. As a result, the management of the building will be optimized having better and more complete tools for it. The knowledge acquired and lessons learned will serve also for the management improvement of other housing buildings.

The following the following sections include detailed information on the equipment and systems installed.

6.1.1 Electrical monitoring of common areas

A Schneider A9XMWA20 unit is used to monitor electricity consumption in common areas (image). The unit is fitted to each switchboard in common areas in the various housing blocks.

It collects electricity data from each of the areas listed below using the Modbus IP communications protocol, and data are uploaded to the platform to be recorded and processed.

- o Electricity consumption by housing blocks.
- o Electricity consumption by stairs
- o Electricity consumptions by lifts
- o Electricity consumption by recovery units

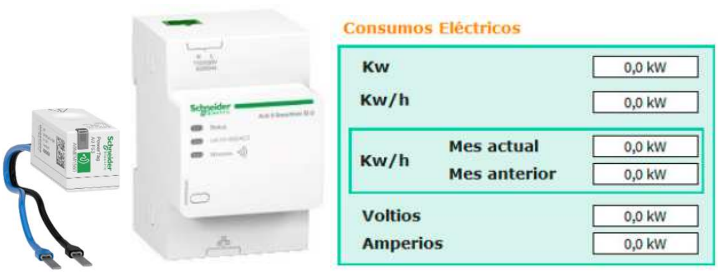

Figure 8: Electrical monitoring

6.1.2 Monitoring of the status of garage doors and entrances

Magnetic door contacts are used to monitor the status of the doors to the 11 blocks, 2 garage access doors and the garage door. These contacts are wired to the logic controllers in each of the control boards at each housing block. The logic controllers are Schneider TM221CE (image).

The controllers are connected to the building's Ethernet unit, and the Modbus IP protocol is used to integrate them in the platform to be recorded and processed.

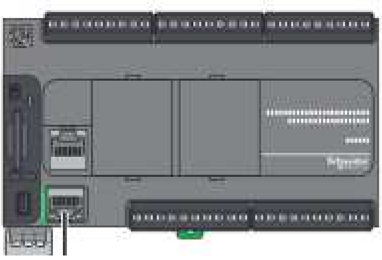

Figure 9: Monitoring of garage doors

6.1.3 Monitoring of outdoor sensors

There are two control boards on the roof to monitor various parameters of outdoor conditions. The control boards are at two different locations. They have a connection to each of the logic controllers in the boards. The logic controllers are Schneider TM221CE (Drawing 2).

The controllers are connected to the building's Ethernet unit, and the Modbus IP protocol is used to integrate them in the platform to be recorded and processed.

The parameters to be monitored are as follows:

- o Outdoor temperature
- o Outdoor humidity
- o Outdoor CO_2
- o Air quality
- o Solar radiation

6.1.4 Monitoring of air recovery units

There are two buses on the roof with a connection to the roof control boards to monitor the parameters of the air recovery units. The eleven recovery units are integrated using the Modbus RTU communications protocol. The variables to be monitored are shown below.

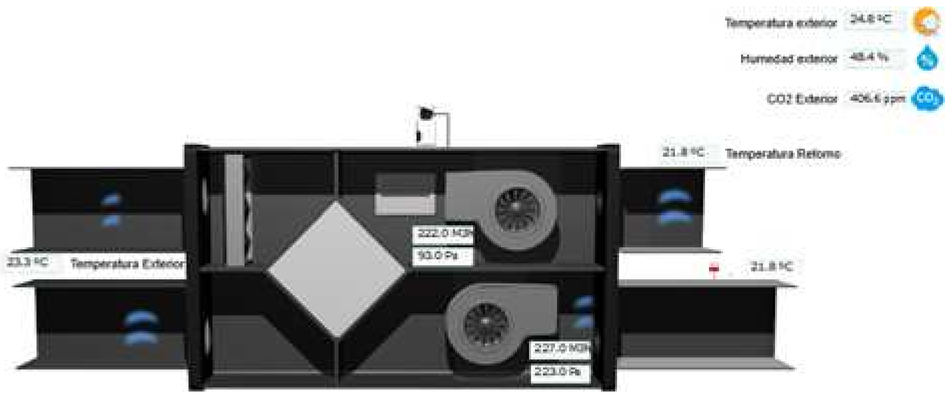

Figure 10: Air recovery units

6.1.5 Monitoring of photovoltaic units

An analyser is included in the Modbus RTU protocol to monitor the parameters of the photovoltaic facility. It is installed in the -1 basement control board, where the PV system will inject power into the building grid to cover partially the heat recovery systems. The variables monitored are shown below.

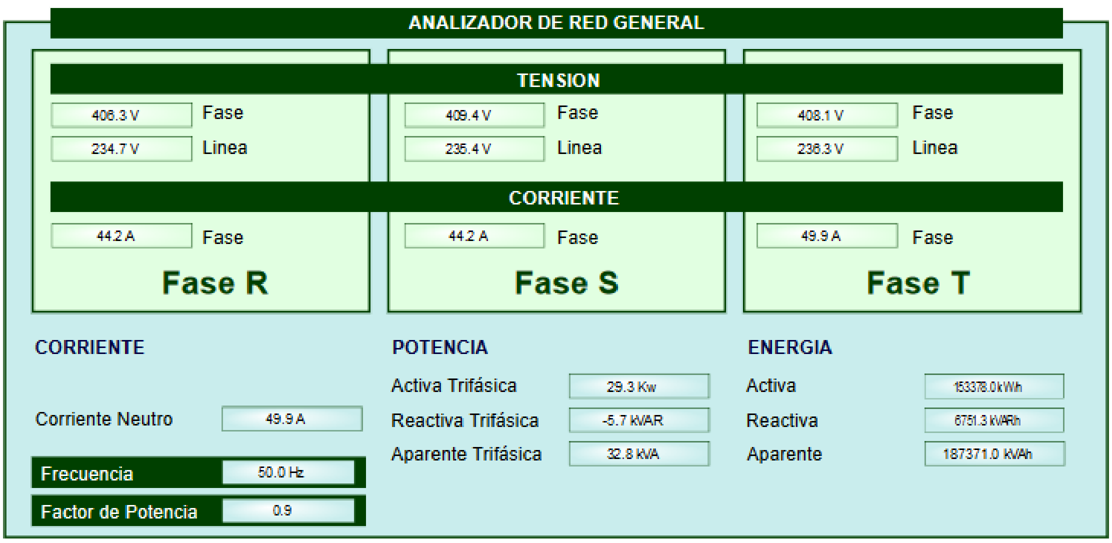

Figure 11: General Network Analyser

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6.1.6 Monitoring of capacity

This proposal establishes the system to count people at 43 locations in the building:

- 17 housing blocks
- 22 building entrances from garages
- 2 exits to the square outside
- 2 garage entrances for vehicles

The block diagram shows this distribution:

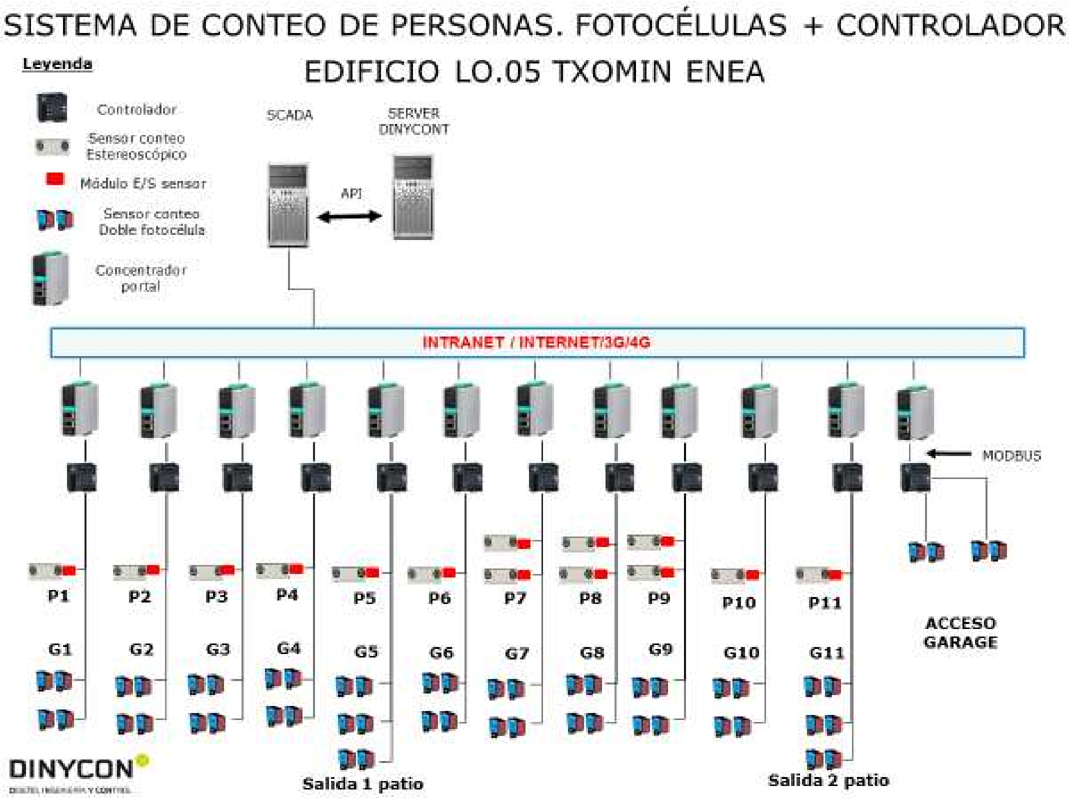

Figure 12: Block diagram for capacity monitoring

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Functioning

Stereoscopic sensor

The sensor's detection field is established when it is installed, and is an approximate square on the ground, and the side of the square is slightly longer than the height of the facility; to configure it, one or more virtual lines are drawn inside the detection area, and a routing is drawn up in full accordance with the entrance for better accuracy; each line counts the people going past in both directions, with a distinction made between the two directions. Counting does not start until subjects have completely left the detection area, and so if they move across the lines, the system will not count the times they cross them, and will count the movement once only, when they leave the scenario. The sensor detects subjects within its field of vision, tracks them and follows them until they disappear from the scenario, and at this point it counts them. In addition, the counting system can measure separately adults and child entering the building.

Figure 13: Detection sensor

The sensors have a direct connection to the PLC controller through a number of wires which send incoming and outgoing movements to the PLC and also provide input for the sensors. The PLC is connected to the Ethernet system in each building.

Photocell for garage access count

A number of photocell count sensors have been installed for all garage accesses. This system contributes to counting the existing influx in the building at a given time. These devices have two components; a photoelectric cell and a reflector. These components are

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located opposite each other in the area to be controlled. The photoelectric sensor is 24-volt. The reflector is located directly opposite the sensor, so that the beam of light from the detector is reflected by it.

The photoelectric sensor emits a beam of light, which is returned to it by the reflector. When the beam is traversed, a signal shows that someone has gone through it in either direction. To ascertain whether this person has gone in or gone out, two photocells are used at each garage access. This creates a movement sequence between the photocells, which is then sent to the PLC and processed as an entry or an exit.

Central SCADA post:

All the count data recorded by the sensors are uploaded to a PLC accessed via the concentrator. The communications PLC gathers count data from each of the sensors in real time and sends them on to the concentrator at each housing block.

The data control and processing station receives information from the concentrator, and processes them to be used and processed in turn by the SCADA software.

MAIN CHARACTERISTICS

These are the main characteristics of the system:

1. Scalable system in terms of hardware, since it uses the Ethernet TCP/IP communications standard, whereby integration of new sensors merely requires new communications switches, and also in terms of software, which has been designed to add in unlimited extensions of access points and areas; for future extensions, the data accumulated are kept, and the new tables are created in the database to record traffic at the new access points.

2. Autonomous data recording. In the event of a communications outage, systems continue to record counting data and then upload them to the concentrator, when the system is operational again or communications have been restored.

3. Open system, allowing information to be exchanged with any other system; data may be exchanged with other systems via data files or tables, and a communications protocol may also be integrated to carry out this function.

6.2 Description of the monitoring of homes

To monitor each of the homes, the system sets out to record parameters for electricity consumption, temperature, humidity, CO2, thermal power meter, heating demand.

6.2.1 Electrical monitoring of homes

There is an electricity power meter in each home to measure electricity consumption. The Schneider A9MEM2055 power meter is fitted to the home's ICP box. The meter is integrated by the Modbus RTU protocol. The variables to be monitored are shown below.

Figure 14: Electric power meter

The power meters are integrated from the boards located in the utility ducts. Each of the utility duct boards has a Schneider TM221CE logic controller, connected to a Modbus RTU communications bus for several power meters in the housing units, as shown below.

The controllers are connected to the building's Ethernet unit, and the Modbus IP protocol is used to integrate them in the platform to be recorded and processed.

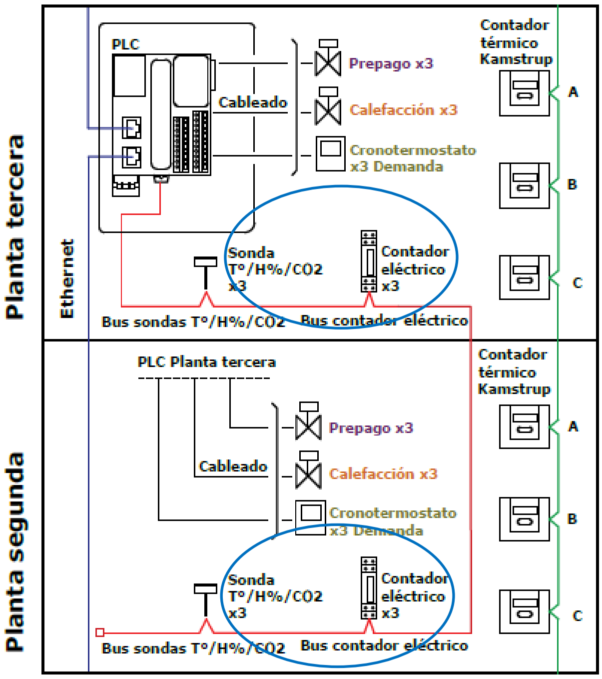

Figure 15: Power meters monitoring

6.2.2 Monitoring of temperature/humidity/CO2

A sensor has been fitted to each home to monitor temperature/humidity/CO2. A Belino 22DTM-15 sensor is fitted to the home's return air duct. The temperature/humidity/CO2 sensor is integrated by the Modbus RTU protocol. The variables to be monitored are shown below.

Figure 16: Temperature/humidity/CO2 sensors

The temperature/humidity/CO2 sensors are integrated from the boards located in the utility ducts. Each of the utility duct boards has a Schneider TM221CE logic controller, connected to a Modbus RTU communications bus, which covers several temperature/humidity/CO2 sensors in the housing units, as shown below.

The controllers are connected to the building's Ethernet unit, and the Modbus IP protocol is used to integrate them in the platform to be recorded and processed.

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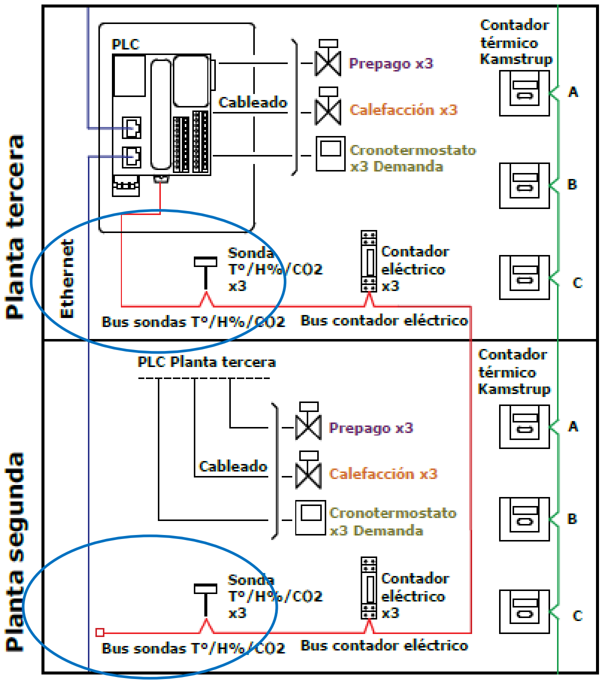

Figure 17: Temperature/humidity/CO2 sensors monitoring

6.2.3 Monitoring of heat demand

A chrono-thermostat activation signal is used to monitor heating demand for each home. The signals are picked up by the boards located in the utility ducts. Each of the utility duct boards has a Schneider TM221CE logic controller (Drawing 2). This unit will pick up physical signals of heating demand from several homes, as shown below.

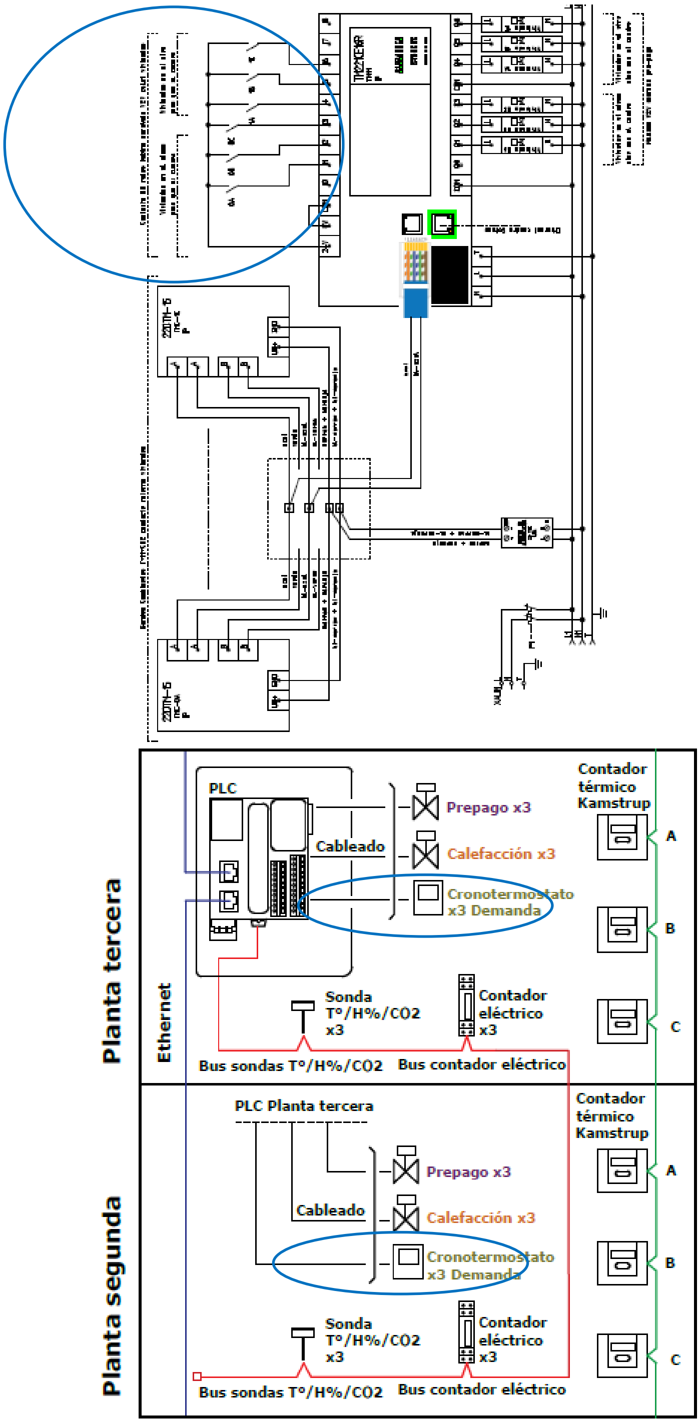

Figure 18: Heat demand monitoring

6.2.4 Monitoring of DHW and heat meter

There are two ultrasonic heat meters to monitor thermal consumption for heating and DHW in the housing units. The units proposed are Kamstrupp Multical 404 meters, fitted to the heating and DHW modules in the utility ducts. The meter is integrated by the Mbus protocol, and operates at 230 Vac.

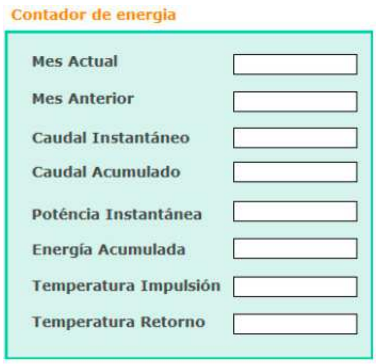

Figure 19: Heat meters monitoring

6.2.5 DHW and heating on-off system

The Stechome is installed, as a tool for the economic management of heating and domestic hot water consumption in homes with a centralised production unit. One of the system's primary features is the real-time information provided for users on consumption and cost.

Specifically, this solution includes supply, installation and programming of actuation devices, control and communications network, individual terminals and mobile accessibility. Additionally, it includes a central communications and control unit for energy self-management of heating and domestic hot water and integration of consumption data from heat meters, electricity meters or cubic-metre flow meters.

The facility affords integral control of individual energy consumption and cost, it also allows the facility's economic performance and general functioning to be supervised and serves as an active feature for users and their energy efficiency.

The facility is composed of the following:

1. Control system.
2. Display system (screens).
3. Actuation system (solenoids and controllers).

4. Supply system.
5. Metering system.
6. Start-up and instructions document.

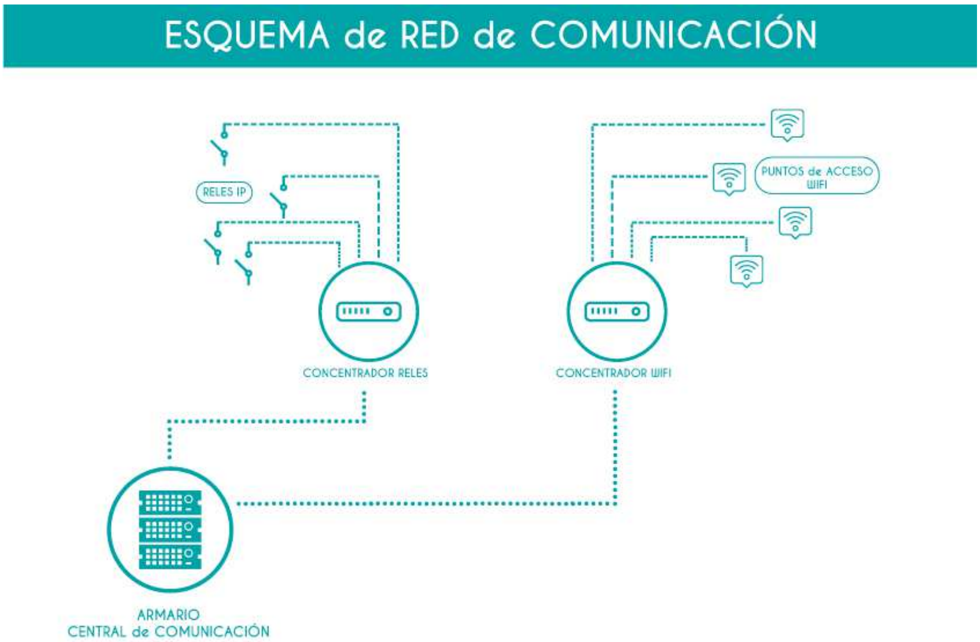

Figure 20: DHW and heating on-off system

6.3 Description of smart homes

A KNX control system has been installed to monitor and control the two homes with domotics systems. This feature enables users to control and monitor the following in rooms:

- Lighting control in all rooms.
- Control of blinds.
- Detection control.
- Monitoring of temperature/humidity/CO2 in bedrooms and the lounge.
- Open/closed window status.
- Web server to control the home.

The necessary KNX devices were installed to supervise these aspects.

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Lighting control in main bedroom:

To control the lighting in the main bedroom, a Schneider MTN6180-6035 KNX push-button system was fitted at the entrance, and two KNX push modules at the head of the bed on either side, to enable users to control the lights from any part of the room. They also have the option of web control using mobiles or tablets.

Figure 21: Lighting control in main bedroom

Lighting control in lounge:

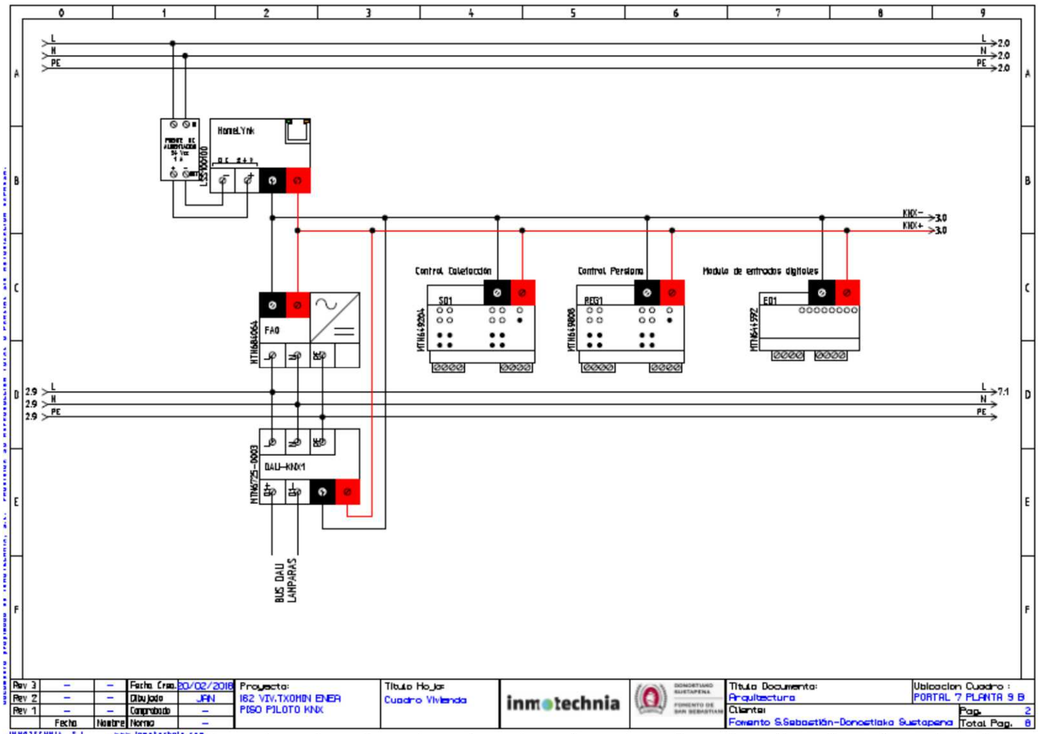
To control the lighting in the lounge, a Schneider MTN6180-6035 KNX push-button system was fitted at the entrance for the two lighting zones – this unit acts on both zones in the lounge. Users also have the option of web control using mobiles or tablets.

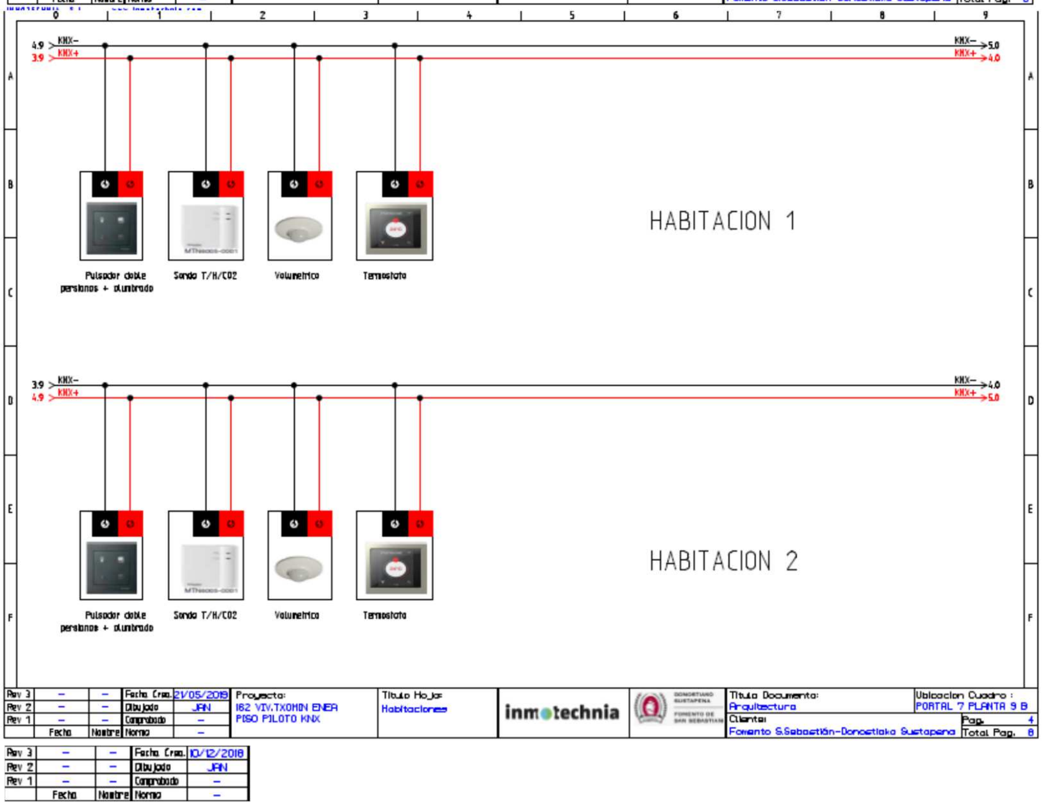
Figure 22: Lighting control in lounge

Lighting control in kitchen:

To control the lighting in the kitchen, a Schneider MTN6180-6035 KNX push-button system was fitted at the entrance for the kitchen lighting zone. A conventional push-button is used with a KNX adapter for outdoor lighting. Users also have the option of web control using mobiles or tablets.

Figure 23: Lighting control in kitchen


HomeLYnk
FA0
DALI-KNX1
BUS DALI
LAMPARAS
Control Calefacción
Control Persianas
Modulo de entradas digitales
KNX-
KNX+
Proyecto:
162 VIV.TXOMIN ENEA
PISO PILOTO KNX
Titulo Hoja:
Cuadro Vivienda
inmotechnia
Titulo Documento:
Arquitectura
Cliente:
Fomento S.Sebastián-Donostiako Sustapena
Ubicacion Cuadro :
PORTAL 7 PLANTA 9 B
Pag. 2
Total Pag. 8


HABITACION 1
HABITACION 2
Pulsador doble
persianas + alumbrado
Sonda T/H/CO2
Volumetrico
Termostato
KNX-
KNX+
Proyecto:
162 VIV.TXOMIN ENEA
PISO PILOTO KNX
Titulo Hoja:
Habitaciones
inmotechnia
Titulo Documento:
Arquitectura
Cliente:
Fomento S.Sebastián-Donostiako Sustapena
Ubicacion Cuadro :
PORTAL 7 PLANTA 9 B
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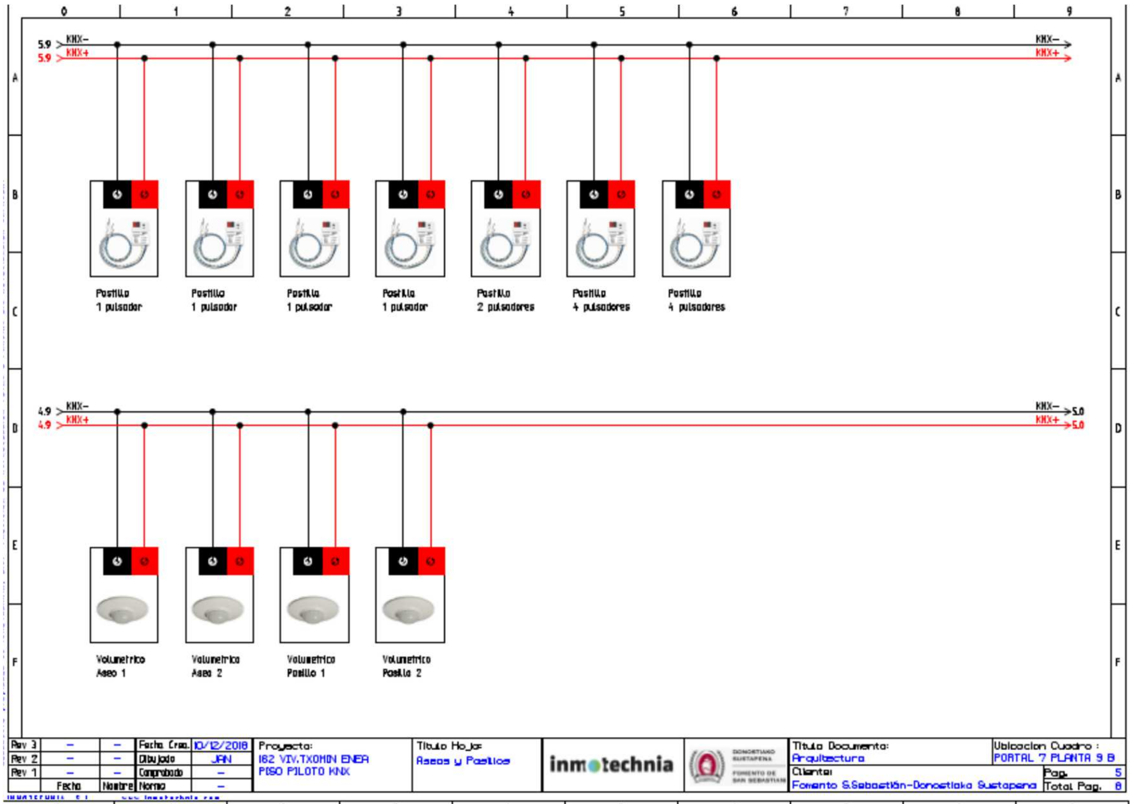

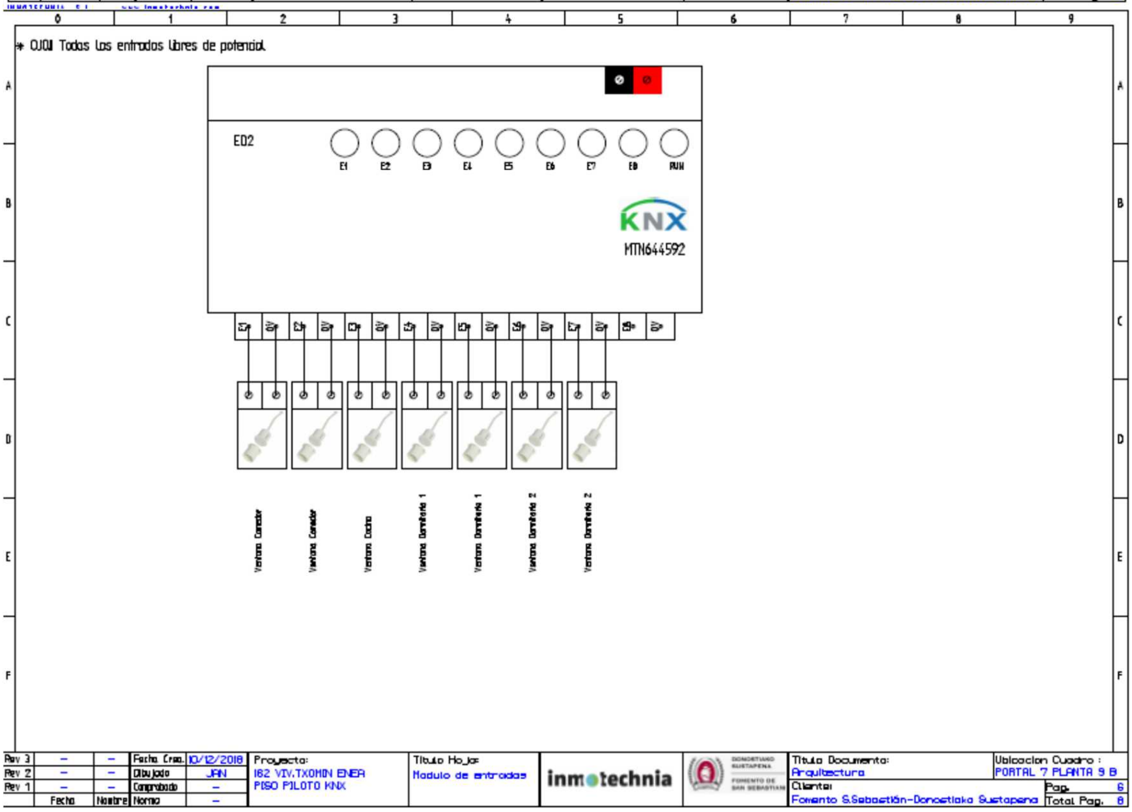

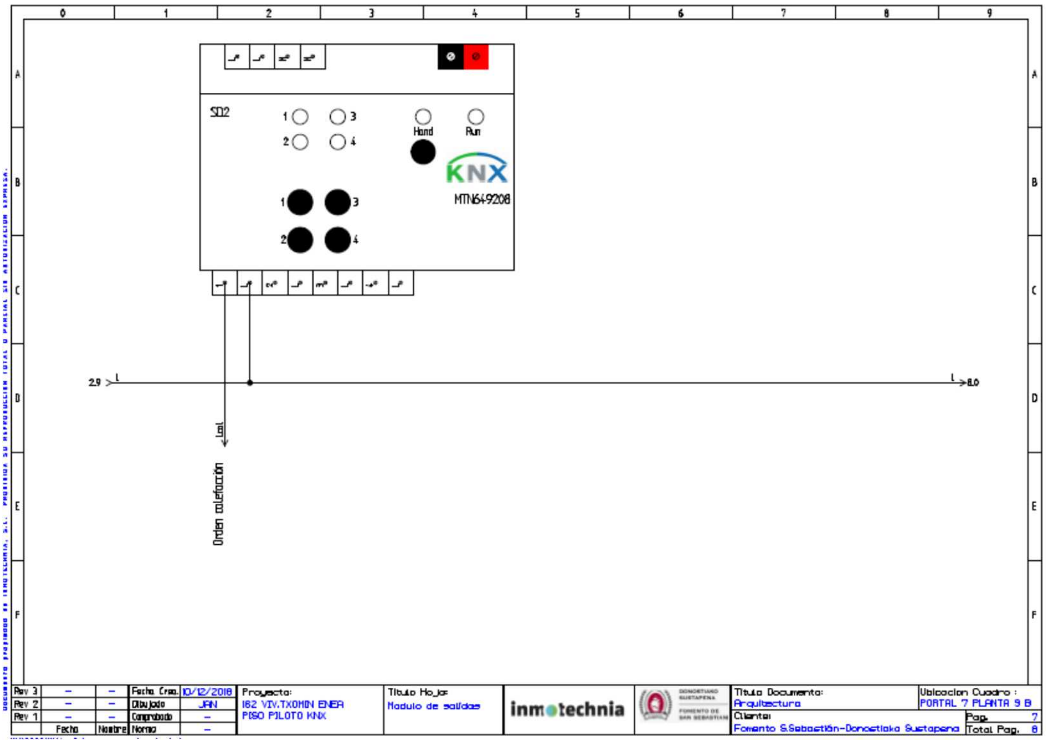

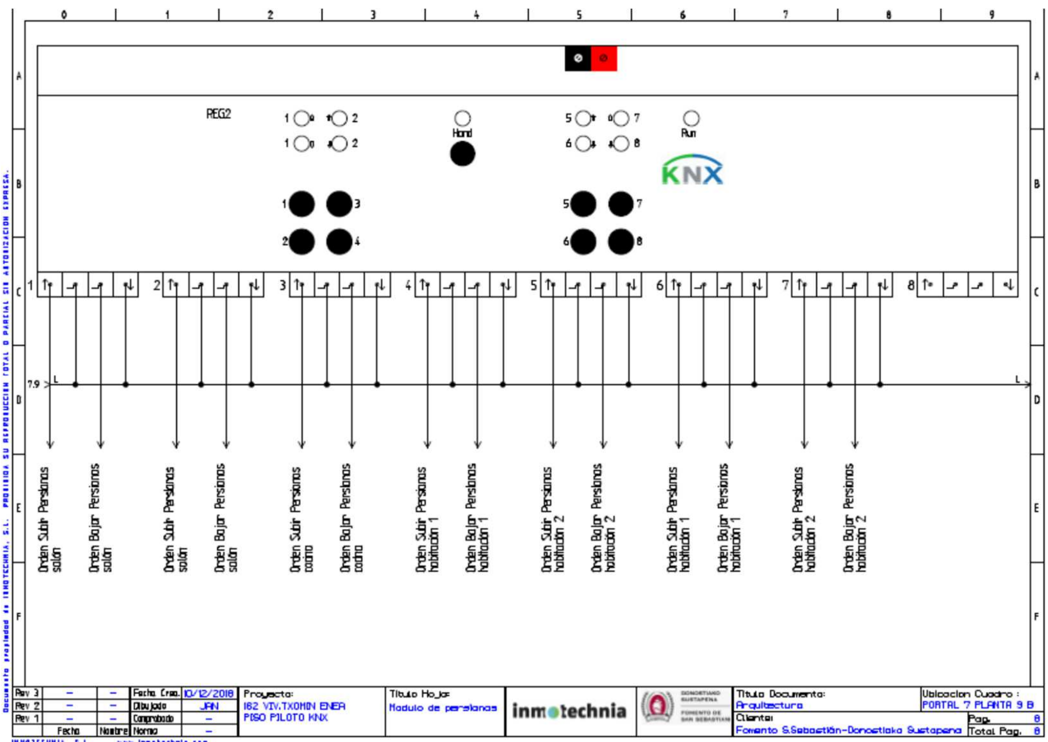

Figure 24: Lighting control system scheme

7. INFRASTRUCTURE AND PROJECT BUILDING

The building is an official social rented housing complex with a total of 162 homes in 11 blocks, promoted by San Sebastián Town Hall. It is located in the Txomin Enea neighbourhood in the Urumea Riverside District, as already mentioned. The following image shows the location marked in blue on the plan of the city, the location of the building in the neighbourhood, and its orientation with respect to the four points of the compass.

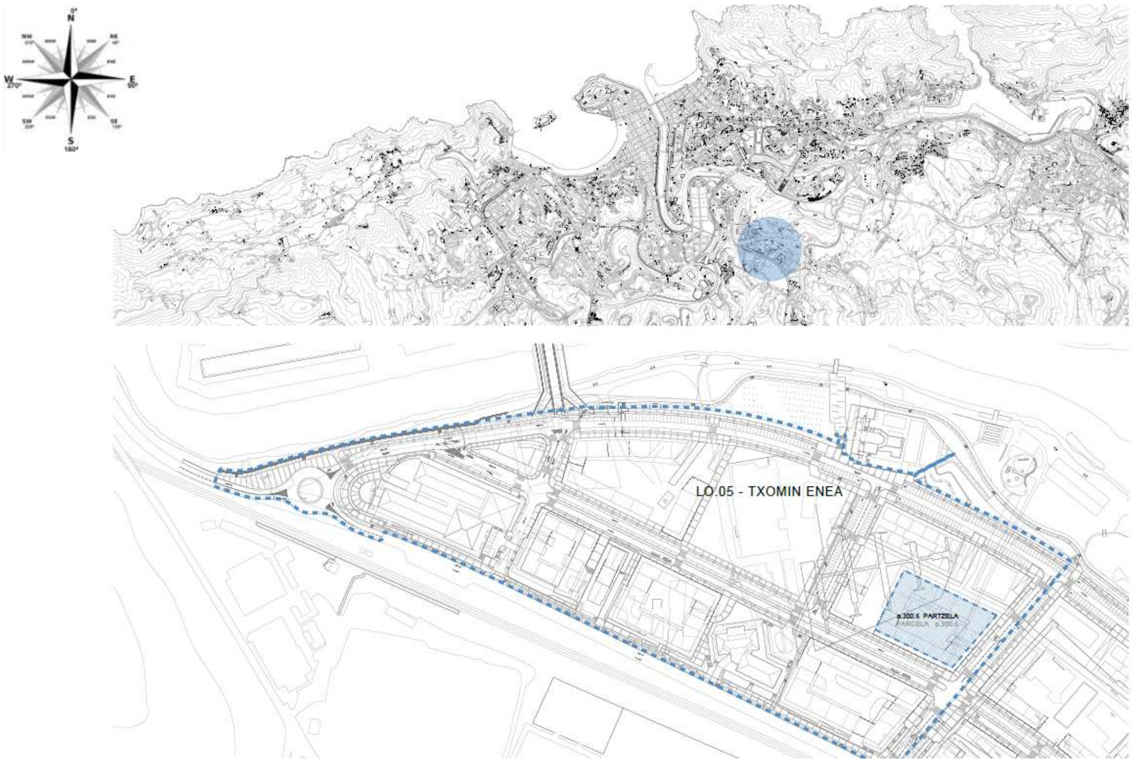

Figure 25: Txomin-Enea location in map

The building has two below-grade parking floors, two commercial mezzanine floors, and six residential floors. The layout of Image shows the block of houses with a facade facing north-east.

This housing complex was built with Passivhaus criteria in terms of heat insulation, heat-recovery ventilation, sealing, enhancements of heat bridges etc. It also has photovoltaic panels to generate electricity.

The total buildable surface areas is 13,970 m². There are a total of 162 homes - 5 with three bedrooms, and 157 with two bedrooms. Most of the two-bedroom and three-bedroom homes have two bathrooms, one of which is a full bathroom.

The building is managed by Etxegintza, the Town Hall's Municipal Housing Company, tasked with management and drawing up rental contracts with the occupants, in addition to maintenance of the building's facilities. The SmartHomes project was promoted by Fomento San Sebastián in collaboration with Etxegintza, and the systems installed are managed and maintained on a joint basis by the two organisations.

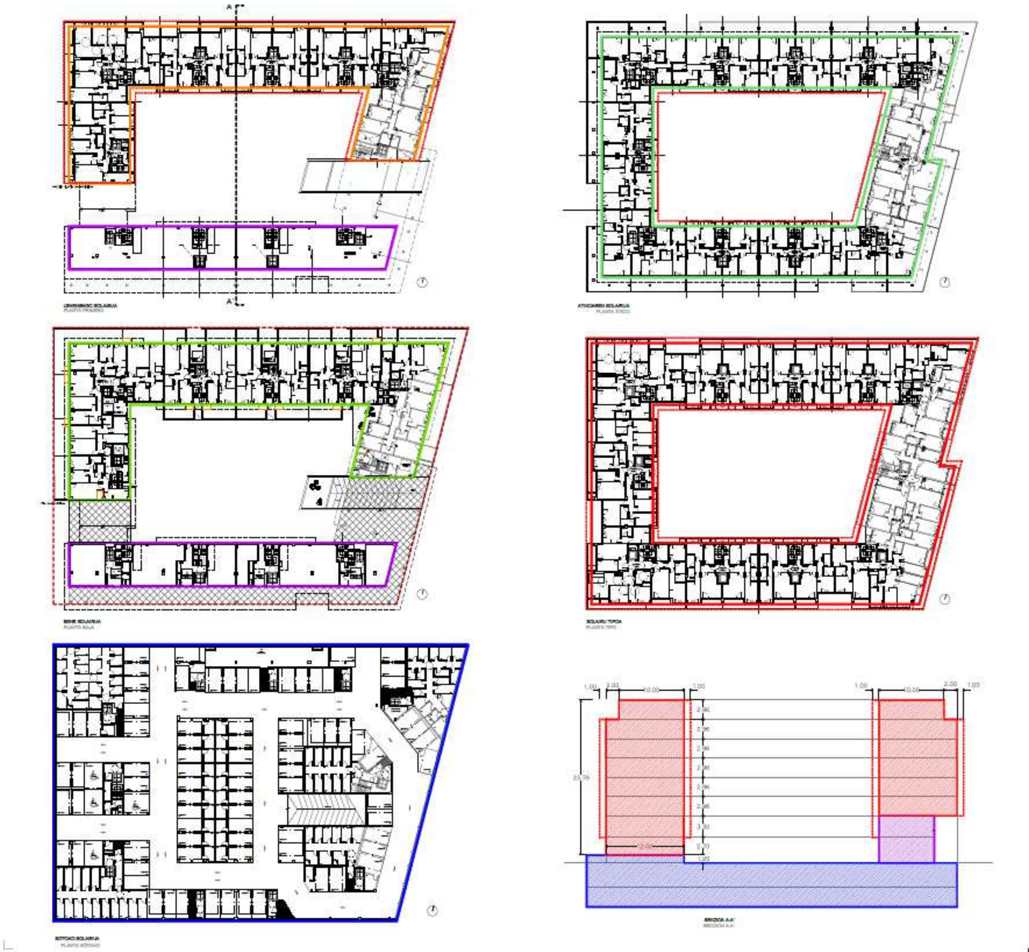

Figure 26: General layout of the building

Figure 27: Pictures of the building

The building is connected to the district heating network, the central unit of which is located in this same neighbourhood.

Heat demand, i.e., heating and domestic hot water, is covered by this heating network, the main primary source of which is biomass. This District Heating is administered by Fomento de San

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Sebastián, and it provides a service for all the homes in the neighbourhood. Detailed information on DH is available in Deliverable D3.3_Report on DH construction.

The DH has a communications infrastructure to take up and administer readings of heat meters from all the homes. This infrastructure is used to manage, store and exploit the SmartHomes project data, as explained in more detail in the next section.

Figure 28: Pictures of the DH and the SmartHomes building

8. DATA MANAGEMENT AND SYSTEM STRUCTURE

The SmartHomes project has deployed an internal network of communications and controllers to pick up and process all the signals and data generated by the sensors inside the building and in the homes. This SmartHomes network forms part of the existing DH network, through which all the project information is sent to a local post at the DH station.

The local post at the DH station manages all the SmartHomes project's information and data through a SCADA system, which is described in this section. The SCADA system receives all data and calculates operational indicators to monitor and analyse in-depth the behaviour and efficiency of the systems in the building, the facilities, the homes etc. The Data Display and Exploitation section provides more extensive details of the type of SCADA display, and the indicators used.

A number of indicators and data from sensors in real time are uploaded to the cloud, with two objectives. Firstly, to store valuable information in the cloud that may be necessary in the event the local post ceases to be operational, and secondly to use an API to provide input for a further two display platforms: the project's open public web, and a platform displaying the consumption data of each home.

The two platforms have different objectives. The public web displays general project data in an open, anonymous format, on the building, the systems installed such as temperatures, building capacity, general consumption figures, PV production etc. The occupants' display platform shows the monitored data of each home via the DH platform. The Data Display and Exploitation section shows these displays in schematic format.

There follows a more detailed explanation of the general architecture, the characteristics of the supervision process, communications and controllers.

8.1 General architecture

The proposed management system for the SCADA is flat architecture using a communications standard such as Ethernet, in which no component is dependent on others for proper functioning. It is an open system which places no restrictions on possible extensions to the building.

The control system is a single unit for total control of all the facilities (readings of sensors, electricity consumption, heat consumption, door status etc.), to bring about synergy among common features (computers, communications network, maintenance and operational tasks etc.) and to economise and optimise resources for installation and also for the purposes of maintenance and operation by reducing the need for spare parts etc.

Fully programmable controllers have been installed to adapt the building management system (known as "SGE") to the building's needs and peculiarities on a standard Ethernet system.

The control system as planned can integrate third-party systems in the various communications protocols such as the ModBus RTU, Modbus IP or Bacnet IP, Mbus etc. The parameters integrated are temperatures, humidity, CO_2, operational statuses, heat consumption, electricity consumption etc.

The controllers pick up building status signals such as sensors gauging temperature, humidity, the operational status of pumps, lighting, alarms indicating malfunctions, maintenance alerts etc. These parameters are monitored from the SCADA in the DH system with local access or web access. The local SCADA post stores all the values monitored for the purposes of comparing, evaluating and studying various items of data during the building's lifespan.

The management system may be broken down into the following levels:

- IQvisión supervision level (District heating)
- Communications network level
- Level of multiprotocol controllers

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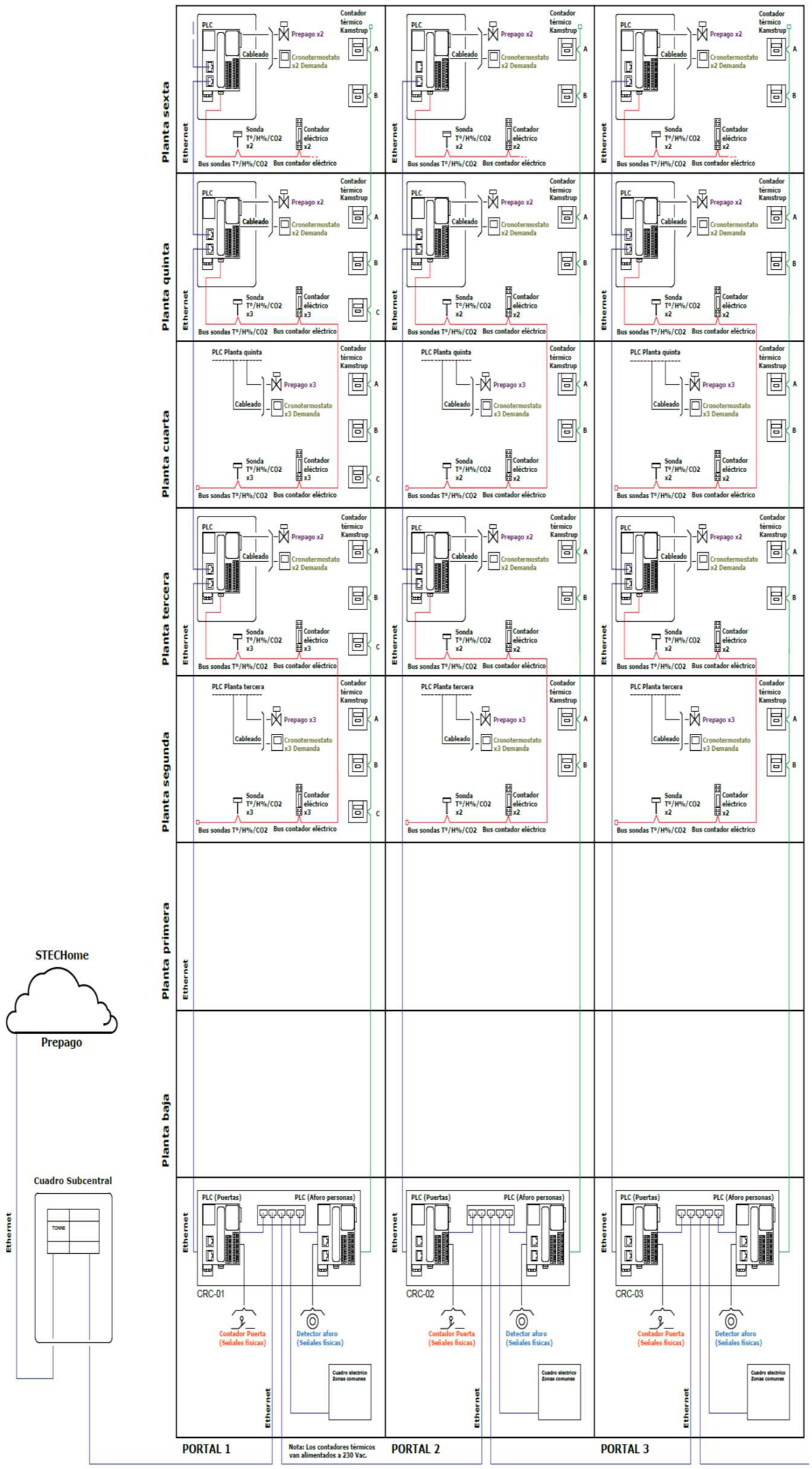

Figure 29: General architecture

8.2 Characteristics of supervision

The system has a single supervisor, a web server connected to the District Heating Ethernet system, and an IT maintenance platform that can be directly connected to the supervision station or to each of the IPs of the District Heating controllers. This monitors processes within the building and provides historical data that may be consulted at any time. Both signals connected to controllers and signals integrated through multiprotocol platforms are picked up.

MANAGEMENT OF USERS

The management software has a strict structure, with up to 255 different levels of access to the system. These levels of access are configured in groups, so that each group has a level of access to the system and each user in the group has the same privileges in the supervision software. These levels can be defined in accordance with the needs of each.

The parameters that can be displayed, selected or changed can be defined in each group of users. A parameter is understood as any setting, timetable, schematic page, or any other individual software component. Each of these groups may also choose its home page, the non-activity time allowed before the user's session is closed down, or whether the user even has permission to close down the software.

GRAPH PAGES

These show the full schematics of facilities for rapid monitoring and operation of the system. The schematic pages show the various areas of the building, along with their associated graphs. Users work interactively in monitoring and controlling the various points of the building.

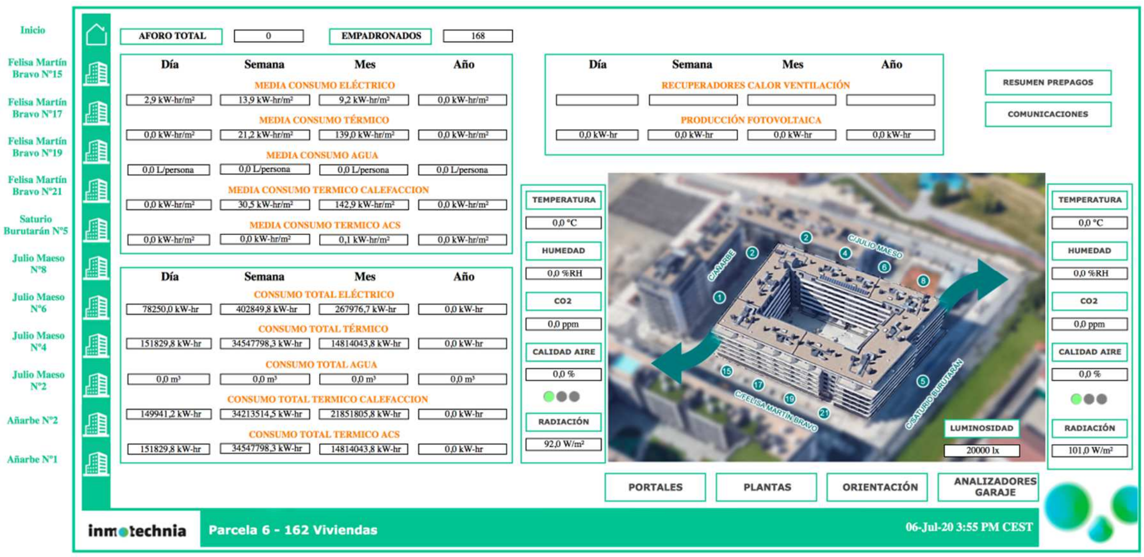

Figure 30: SmartHomes building monitoring

Many windows of different sizes may be displayed simultaneously (overlapping or in mosaic format) as "emerging windows". Large-format schematics can be managed, such as floor plans etc., and may be represented with a freely-selectable size to facilitate display.

Settings, alarms etc. may be changed directly on the schematics. Values may be changed by clicking on the object representing them. The values measured, settings, modes of operation and alarms are shown on screen in real time, and updated constantly.

The changes are indicated by the symbol of the object, for example, with an animation device or a change of shape or colour, or a change in the colour, shape, text or movement of the values concerned.

In addition to the specific characteristics of the settings, other general characteristics are considered:

- Multiwindow with update and full range of functions of all active pages
- Operation and monitoring focused on object
- Window size may be changed by the user to administer several pages simultaneously on screen
- Page selection using a tree format (browser graphic tool bar), a context menu or page jumps (hyperlinks).
- Standard functions such as Last / Next / Main etc.
- Interapplication browsing focusing on the needs of the facility.
- Definition and rapid access to "Favourites" pages.
- ToolTips for all dynamic objects with the option of designation of user, technique or system (emerging aids)
- Possibility of adding context information to any dynamic object, such as text, photos, maintenance information etc.
- Black and white or colour printouts of graphs
- Support for 32-bit Windows graph formats, BMP, JPG, GIF, JPEG, WMF…

ALARM DISPLAY

The supervisor provides a detailed view of the alarms in the system that have gone off in the facility, rapidly locating and eliminating faults. Alarms are generated in controllers with a buffer, and they are sent to the supervisor or to the location that has been configured for alarm conveyance.

The alarm display shows the alarms in the system, and gives the user valuable information such as the kind of action required. The alarm display provides simple, rapid access to the information required through its filtering and ordering functions.

In large systems with several customers, all customers access the same alarm database. An alarm may be added to the database, and displayed automatically for all customers connected to the supervisor.

Alarm display functions:

- Display, recognise and eliminate single or multiple alarms.
- Show the list of properties associated with the alarm, along with detailed information on the location concerned.
- Show the help text associated with the alarm, with detailed user-configurable instructions for operation.
- Management of alarms, depending on alarm priority. Up to 255 alarm priorities may be administered.
- Statistics report on the number of alarms, depending on alarm priority.
- Multiple alarm filters for a rapid analysis of the anomalies.

The alarm management system shows previous alarms, system error messages, and the activities of users. Information is stored in chronological order, and may be filtered and ordered to carry out an assessment at any time. This information is stored by a supervisor service, which records the following types of data on a continuous basis:

- Alarm events from controllers, such as plant alarms.
- High-priority alarms. The alarm is recorded when it occurs, and it can also be recognised, reset and restored to normal status.
- System events relating to supervisors and process controllers.
- Some examples of these events are disconnection, dial-up, start-up, shutdown etc.
- User events to report on user activities at management stations. These include system accesses, modification of values, parameters, settings etc.
- Status events originated by process levels such as start-up / shutdown of units etc.

PAST EVENTS DISPLAY

This enables adjustments to be made to the plant through analysis of historical data recorded in the system. Data are initially stored in controllers and are sent to the central unit for storage.

In the event of a computer incident, data will not be lost over a certain period because they are stored in the controllers. For example, if data relating to consumption of electricity are stored in the controller every 15 minutes, no data will be lost over more than 10 days. If they are stored in a multiprotocol gateway, the time varies depending on the number of variables and regularity, but they can be stored over longer periods of time.

The graph display application conducts an analysis of process data in real time (online) and of past data (offline) recorded over a period of time. The graph display is a user-friendly tool which can optimise operation of the facilities and lower costs.

Characteristics of the graph display feature:

- Recording of process values and values measured over a period of time.
- Monitoring of up to 10 trend lines simultaneously on a single graph.
- Monitoring of the current plant conditions.
- Optimisation and adjustment of the facilities.

Several graphs may be displayed simultaneously in different windows. Both online and offline data can be displayed in different windows at the same time, allowing users to compare present data to past data.

Data on trends may be displayed in at least three different ways:

- Online data: Display process data that are updated every time there is a change of value (COV) or as the result of a scan process.
- Offline data: Display process data that have been transferred to a database at management level (historical data).
- Data on file: Display old data previously sent from the database (historical data) to records files.

WEB CUSTOMERS

Web customers access the software via a web browser such as Internet Explorer or Firefox. The web customer has access to pages on schematics, the display of alarms, display of teams, timetables and calendars and server status, depending on the level of access defined for the user entering the system.

The web customer permits access to the system via a browser, using the integrated web technology. An unlimited number of customers have simultaneous access to the system.

The web customer's management system provides information on the building for anyone requiring the information at any location. The web customer does not use script components on the customer side. All processing is carried out at the web server. This means that web customers may work with no need to download any software.

Users are authenticated by integrating access to the Windows network and authorised users of the management system. Every time a user enters the system, their access rights as a user of the management system are assigned to the web pages shown.

- The index page is the equivalent of the home page. This either gives users an overview of the system, or they may start browsing through the facility.
- Specific points may be administered directly on the graphs.
- Graphic pages may be generated from the schematic pages, and so they will have the same appearance as in the management system. No special web tools are required.
- The events recorded at the management station may be examined. All activities carried out from the web browser are added, along with user information, to the normal database inputs at the management station.
- The user information option shows the user's reading and writing privileges.

8.3 Characteristics of the Communications Network Level

The "communications network" level is tasked with connecting the supervision level to the control level housing the facility's controllers. The cabling used at this level depends on the type of controller or communication protocol. The following are the main criteria to be met in this section:

- Meet the cabling specifications, as per the communications protocol being used.
- Minimum number of communications components (switches, hubs, routers etc.), making use of the building's structured cabling whenever possible.
- Communications cables cannot be allowed to run around locations that could be affected by electrical or electromagnetic interferences which could impair communication.

<u>Ethernet</u>

The controllers use the building's Category 6 Ethernet network cables. The Ethernet network cables connecting devices meet the UNE-EN 50 174-1:2011 and UNE-EN 50173-1:2009 standards, which, among other aspects, stipulate design criteria:

Minimum distance is: Extreme cases: 90 m parallel section

Data cable type	Electricity cable type	Separation
Unscreened	Unscreened	300 mm
Screened	Unscreened	70 mm
Unscreened	Screened	30 mm
Screened	Screened	15 mm

Table 3: Network cables

- The distances stipulated are for up to 500 V at 50/60 Hz.
- Minimum distance to neon lamps, incandescent lamps and high-intensity fluorescent tubes is 130 mm.
- Data cables and electricity cables can run together over maximum section of 5 m (although they cannot be in contact) in final downward contact at walls.

MODBUS RS485 (Integrations)

Modbus RS485 cabling is as per the technical data sheet for bus components. This section, however, describes how these items are cabled, in the event no manufacturer documentation is available. The structure of the Modbus RS485 network is as follows:

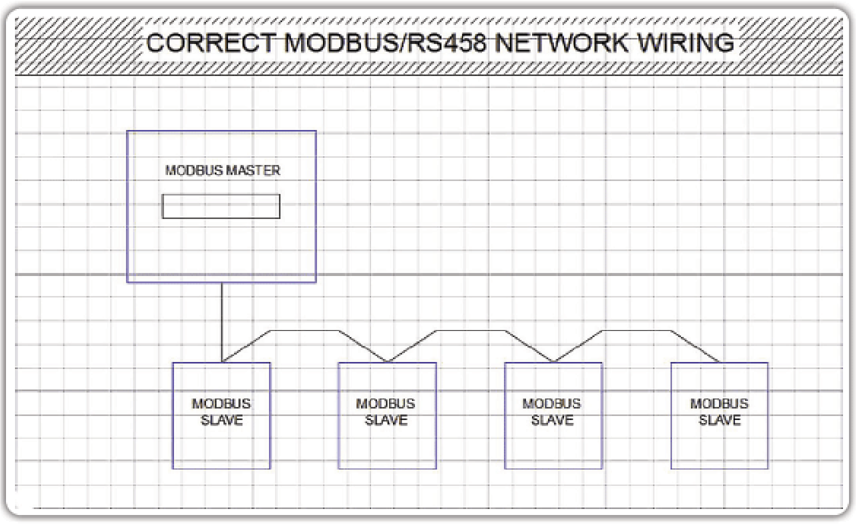

Figure 31: Modbus network wiring

Modbus cabling is as follows:

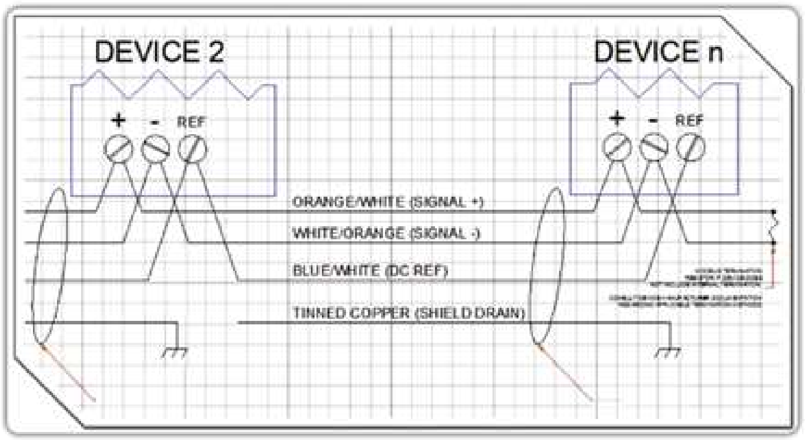

Figure 32: Modus cabling

8.4 CHARACTERISTICS OF THE CONTROLLER LEVEL

The TONN[4] (Trend Open Network Node) multiprotocol gateway and controller is a network device for communication with third-party systems using different protocols such as BACnet, LonWorks®, Mbus, MODBUS, SNMP and KNX. It uses the NiagaraAX Framework® for integration with heating, ventilation, air conditioning, lighting systems etc.

The TONN integrates the necessary data of third-party systems inside the Trend system, to enable their parameters to be written and read automatically for third-party controllers with no need for any intermediate software or hardware, setting up peer-to-peer communication with all items connected to them.

Figure 33: Trend Open Network Node

[4] https://partners.trendcontrols.com/trendproducts/cd/en/pdf/en-ta201413-uk0yr0917a.pdf

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9. PROJECT EXECUTION

The various systems were deployed and installed during construction of the building - devices, communications network, control boards, electric switchboards etc. This optimised the installation process, and lowered project costs.

During the project, progress was supervised and monitored alongside the companies tasked with installation of the systems, coordinating the action taken by other parties and companies on other kinds of work.

When the installation had been completed, adjustments were made and the systems were commissioned. By way of a first step, all the communications features of the network as deployed were checked, and a check was also run to ensure that all the sensors and devices installed were communicating and sending data. This was an extremely important process which required checks in the field and via the central SCADA unit. When it had been confirmed that the physical installation had been carried out properly in terms of communications and devices, an analysis was conducted of the data received by the SCADA unit, in order to ascertain their consistency, proper display, and stability over time. This phase was a continuous process of verification and checks, mainly concerning the process of the occupants' arrival in their new homes, as explained in greater detail in the Citizen Engagement section.

The project was carried through satisfactorily with all the tests applicable. The checking and validation of execution and start-up was a complex process calling for an in-depth analysis of the entire facility, of the integration and consistency of data, and of the indicators defined.

There follow a number of photographs to provide an overview of the installation and the devices monitored.

Figure 34: Adapted apartment

Figure 35: Apartment devices

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Figure 36: Smart Appliances

Figure 37: Smart Appliances

Figure 38: Heat Recovery and PV

Figure 39: Exterior sensors

Figure 40: Counting control system

Figure 41: Counting control system

Figure 42: Electric control

10. DATA VISUALIZATION AND EXPLOITATION

This section shows the three types of display generated during the project:

- SCADA: a central post to store and display all the information generated during the project. A system designed to display and analyse the information for the project manager and the manager of the building.
- Public web: information available to the general public for an attractive display of the general project indicators. Information and indicators in their respective groups.
- The occupants' display platform: this shows the specific data for each home in terms of heat consumption, electricity consumption, indoor temperature, humidity and CO2. These data may be consulted by means of graphs, average, maximum and minimum values etc.

10.1 SCADA

The structure and functions of the SCADA system are described in the Data Management and System Infrastructure section. This section describes the display at various levels in the building, and the indicators generated for monitoring purposes.

Technical and cross indicators for the building in the SCADA system

Levels:

1. First screen General Building

   1.1. New screen with general photo of the building in 3D
   1.2. Total capacity in real time
   1.3. Average electricity consumption in homes (kWh/m2) the previous day; month and year
   1.4. Average heat consumption in homes (kWh/m2) the previous day; month and year
   1.5. Separation DHW/total heating: and graphic representation.
   1.6. Average water consumption in homes (l/person/day) the previous day; month and year
   1.7. Measurements of outdoor temperature, humidity, CO2, air quality, brightness, radiation (daily minimums, maximums and averages)

1.8. Total daily consumption of electricity and heat (kWh); month and year
1.9. Total water consumption (m3); month and year
1.10. PV production; month and year
1.11. Contribution to ventilation by heat recovery units; month and year

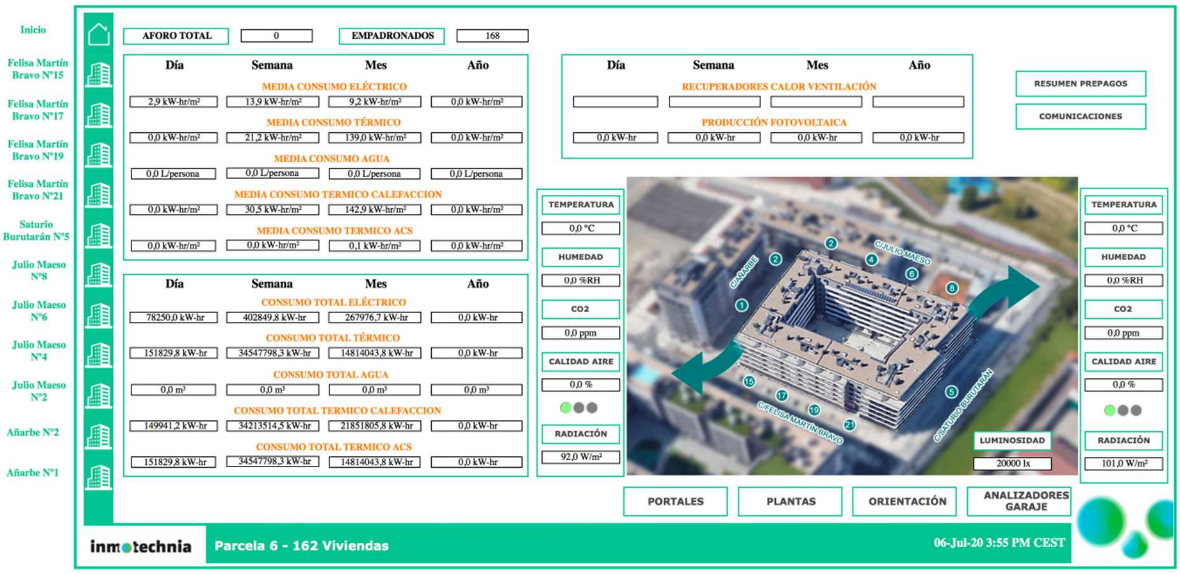

Figure 43: SCADA General Building main screen

2. <u>Second screen General all housing blocks</u>

2.1. Screen showing plan of housing blocks
2.2. Total capacity in real time
2.3. Capacity for each housing block (considering garage access for each block)
2.4. Average electricity consumption in homes (kWh/m2) the previous day by housing blocks
2.5. Average heat consumption in homes (kWh/m2) the previous day by housing blocks
2.6. Average water consumption in homes (l/person/day) the previous day by housing blocks
2.7. Total daily consumption of electricity and heat (kWh) the previous day by housing blocks
2.8. Total water consumption (m3) the previous day by housing blocks
2.9. Measurements of indoor temperature, CO2 and humidity inside homes the previous day

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2.10. Measurements of outdoor temperature, humidity, CO2, air quality, brightness, radiation (daily minimums, maximums and averages). On a general section of the screen.

2.11. Contribution to ventilation by heat recovery units, by housing blocks

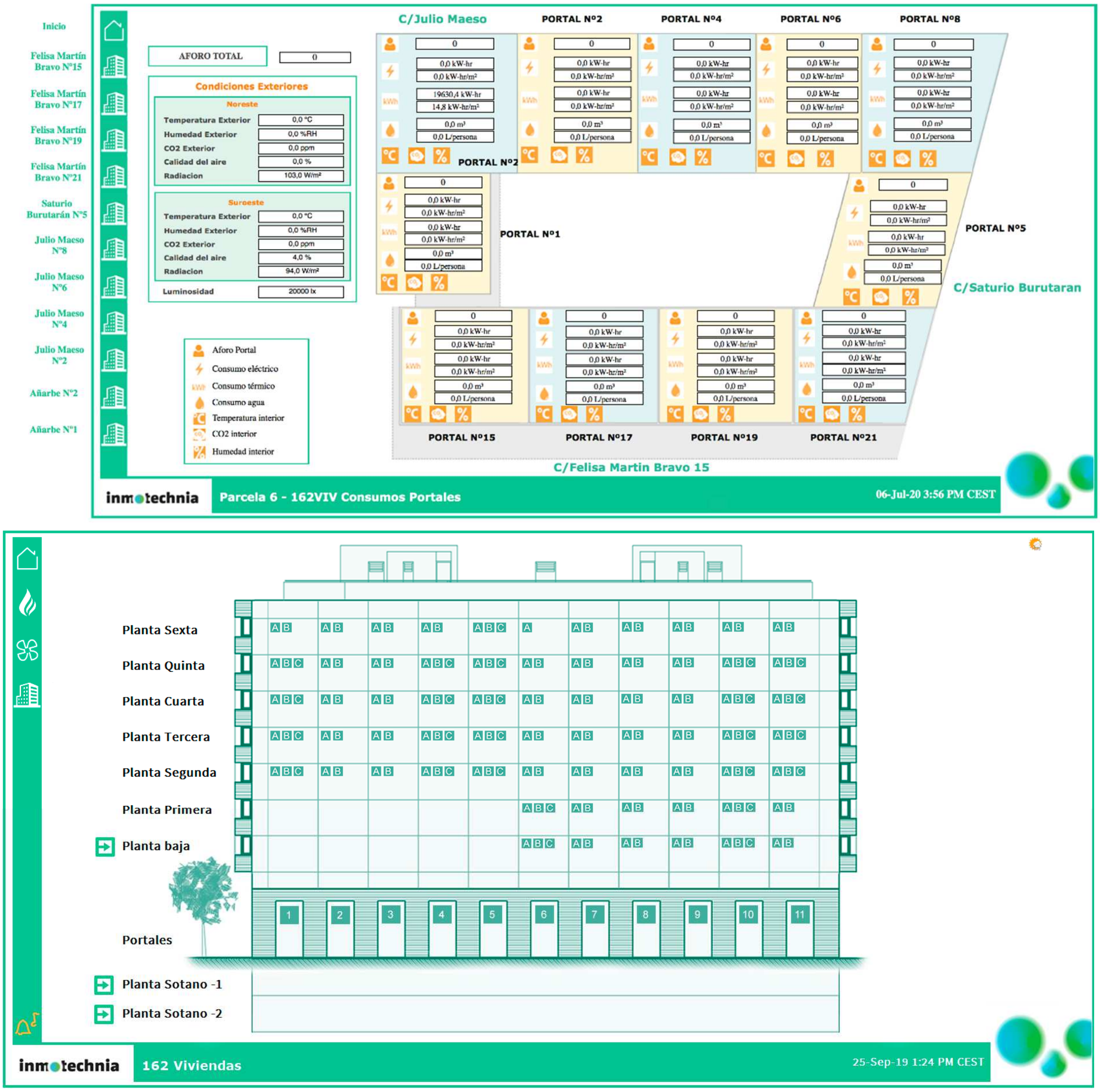

Figure 44: SCADA General Building second screen housing blocks

3. Screen showing information by floors:

3.1. Average electricity consumption in homes (kWh/m2) the previous day by housing blocks
3.2. Average heat consumption in homes (kWh/m2) the previous day by housing blocks
3.3. Average water consumption in homes (l/person/day) the previous day by housing blocks
3.4. Total daily consumptions of electricity and heat (kWh) the previous day by housing blocks
3.5. Total water consumption (m3) the previous day by floors

Figure 45: SCADA General Building information by floors

4. <u>Screen showing information by orientation:</u>

4.1. Average electricity consumption in homes (kWh/m2) the previous day by housing blocks
4.2. Average heat consumption in homes (kWh/m2) the previous day by housing blocks
4.3. Average water consumption in homes (l/person/day) the previous day by housing blocks
4.4. Total daily consumption of electricity and heat (kWh) the previous day by housing blocks
4.5. Total water consumption (m3) the previous day by orientation

5. Screens for each housing block

5.1. Total capacity in real time
5.2. Block capacity (considering garage access)
5.3. Average electricity consumption in homes (kWh/m2)
5.4. Average heat consumption in homes (kWh/m2)
5.5. Average water consumption in homes (l/person/day)
5.6. Total daily consumptions of electricity and heat (kWh)
5.7. Total water consumption (m3)
5.8. Measurements of indoor temperature, CO2 and humidity inside homes
5.9. Measurements of outdoor temperature, humidity, CO2, air quality, brightness, radiation (daily minimums, maximums and averages).

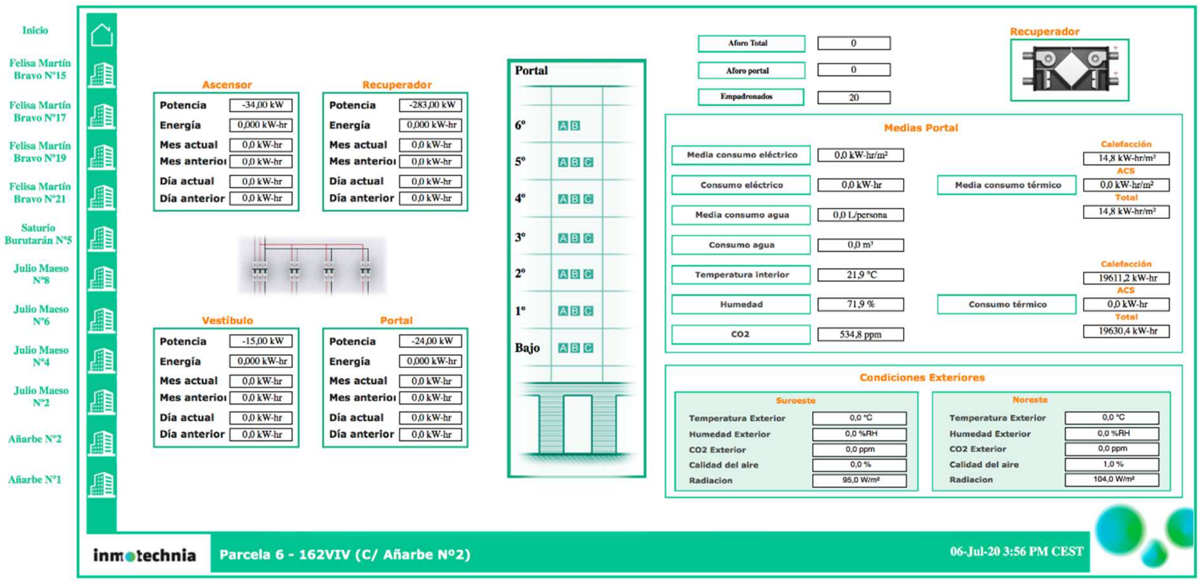

Figure 46: SCADA General Building information by housing block

6. Screens showing homes

6.1. Average electricity consumption in homes (kWh/m2)
6.2. Average heat consumption in homes (kWh/m2)
6.3. Average water consumption in homes (l/person/day)
6.4. Total daily consumptions of electricity and heat (kWh)
6.5. Total water consumption (m3)
6.6. Measurements of indoor temperature, CO2 and humidity inside homes

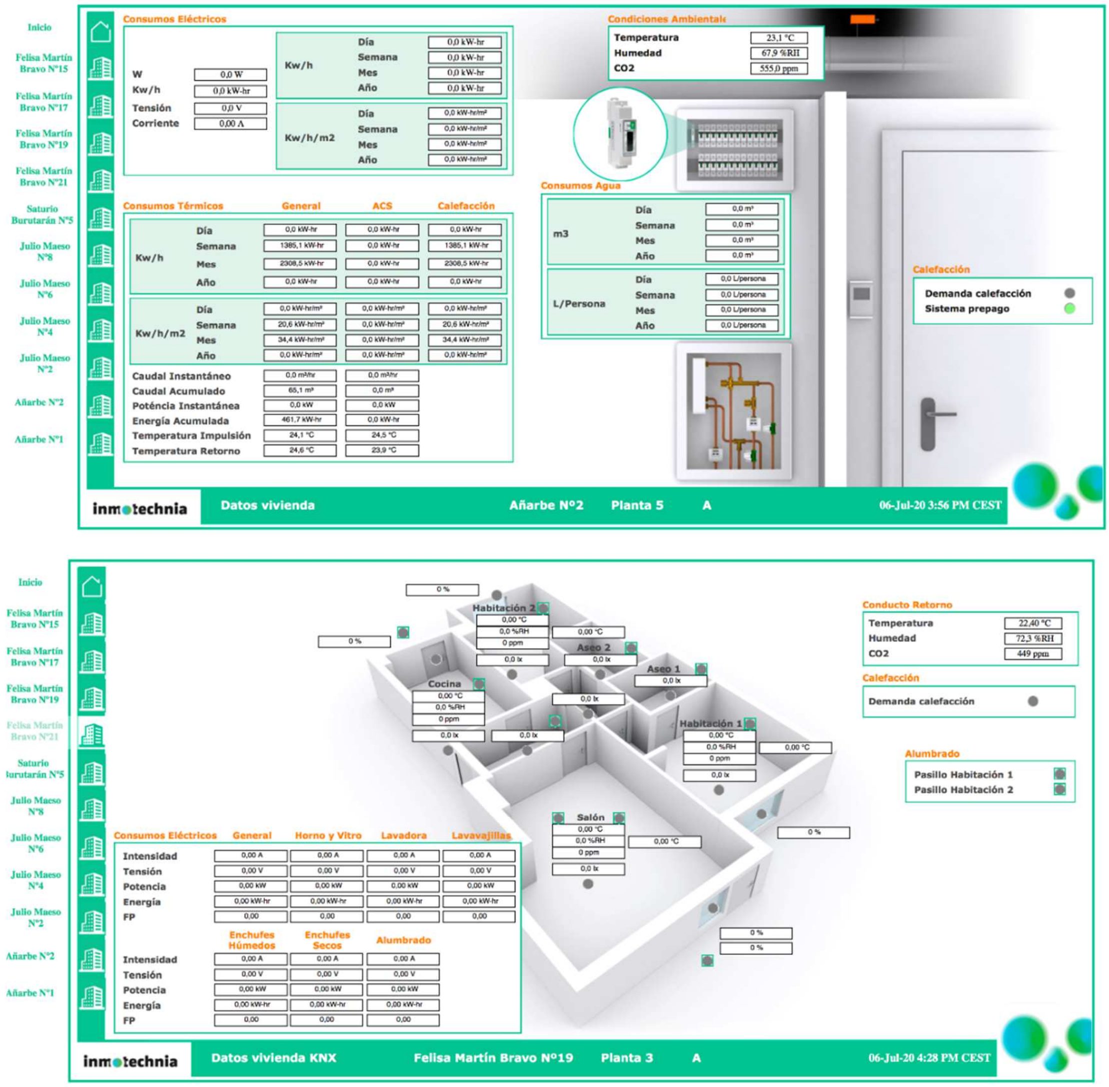

Figure 47: SCADA Information by home

Cross indicators (examples):

- Heating consumption with outdoor temperature and humidity / indoor temperature and humidity / radiation
- Electricity consumption / brightness
- Heating consumption by floors / orientation / housing blocks, along with outdoor temperature
- Consumption of DHW with outdoor temperature
- Heat consumption (separate readings), total electricity consumption of homes by total capacity

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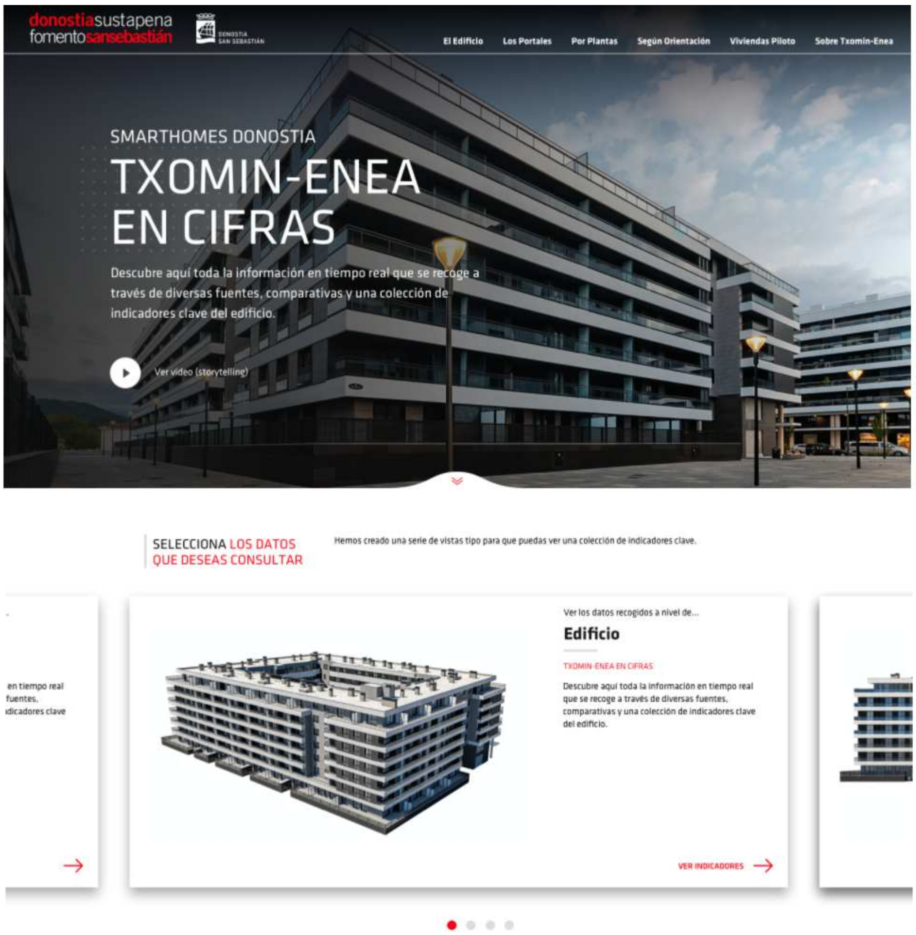
10.2 Open web display

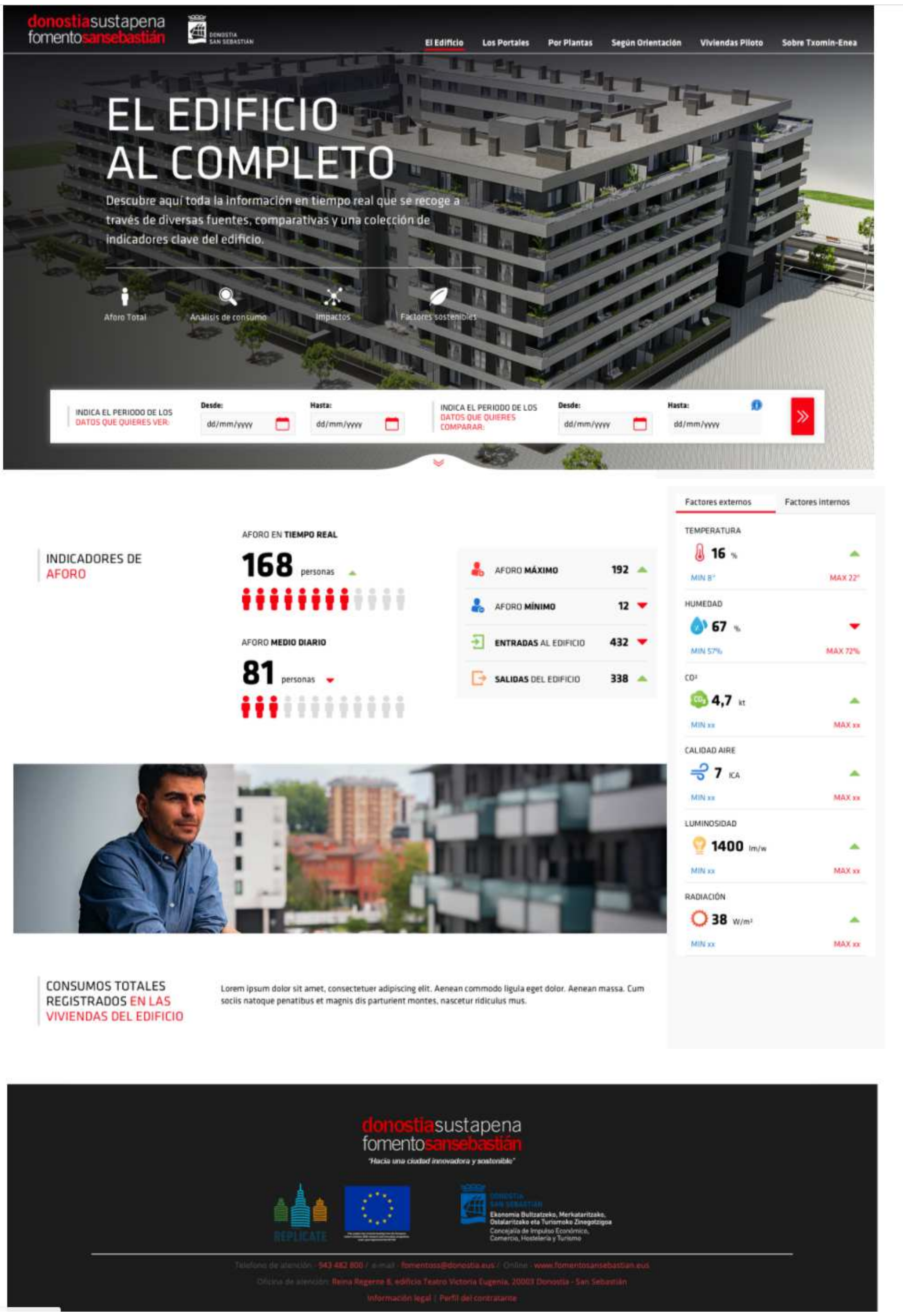
The images below provide a general summary of the display feature.

As may be observed, there is an upper menu with several display levels:

- Building
- Housing blocks
- Floors
- Orientation
- Pilot homes
- General Txomin – Enea

Each shows information and data for that level, in an anonymous grouped format. For example, data on the building's general capacity, external factors such as temperature, humidity, CO2, air quality and radiation, data on consumption, orientation menus etc.





donostiasustapena
fomentosansebastián
El Edificio
Los Portales
Por Plantas
Según Orientación
Viviendas Piloto
Sobre Txomin-Enea
EL EDIFICIO
AL COMPLETO
Descubre aquí toda la información en tiempo real que se recoge a través de diversas fuentes, comparativas y una colección de indicadores clave del edificio.
INDICADORES DE AFORO
AFORO EN TIEMPO REAL
168 personas
AFORO MEDIO DIARIO
81 personas
AFORO MÁXIMO 192
AFORO MÍNIMO 12
ENTRADAS AL EDIFICIO 432
SALIDAS DEL EDIFICIO 338
Factores externos
Factores internos
TEMPERATURA
16
HUMEDAD
67
CO²
4,7
CALIDAD AIRE
7
LUMINOSIDAD
1400
RADIACIÓN
38
CONSUMOS TOTALES REGISTRADOS EN LAS VIVIENDAS DEL EDIFICIO
Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Aenean commodo ligula eget dolor. Aenean massa. Cum sociis natoque penatibus et magnis dis parturient montes, nascetur ridiculus mus.
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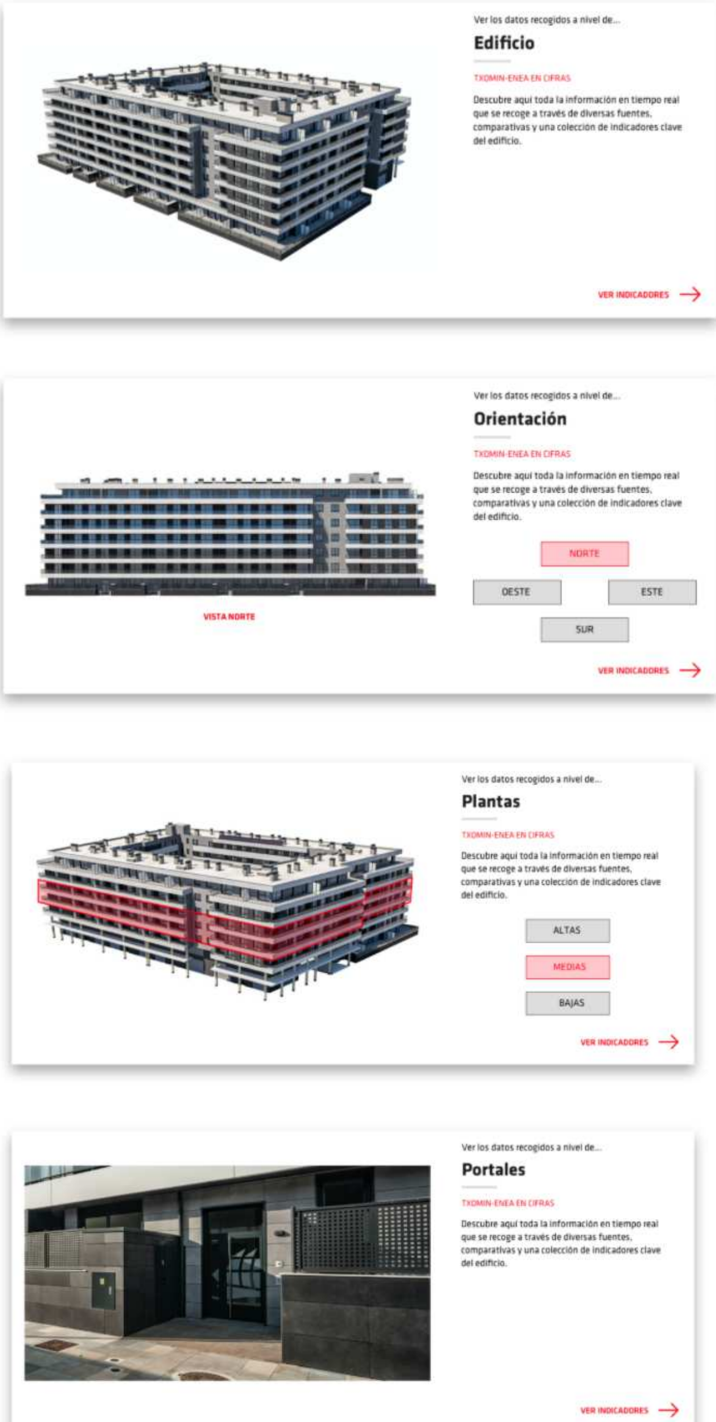
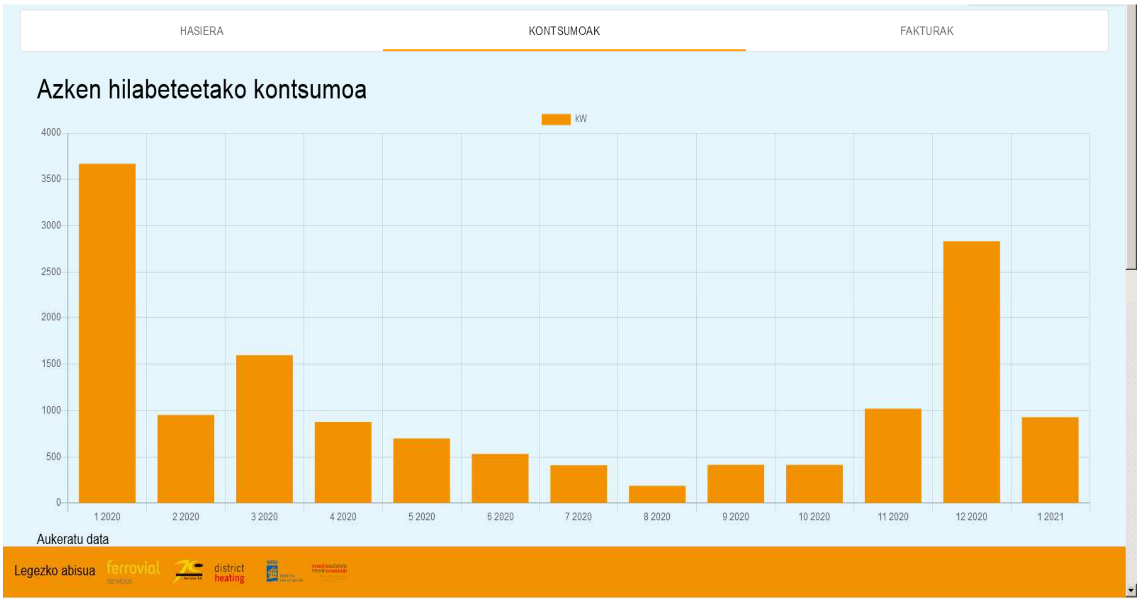
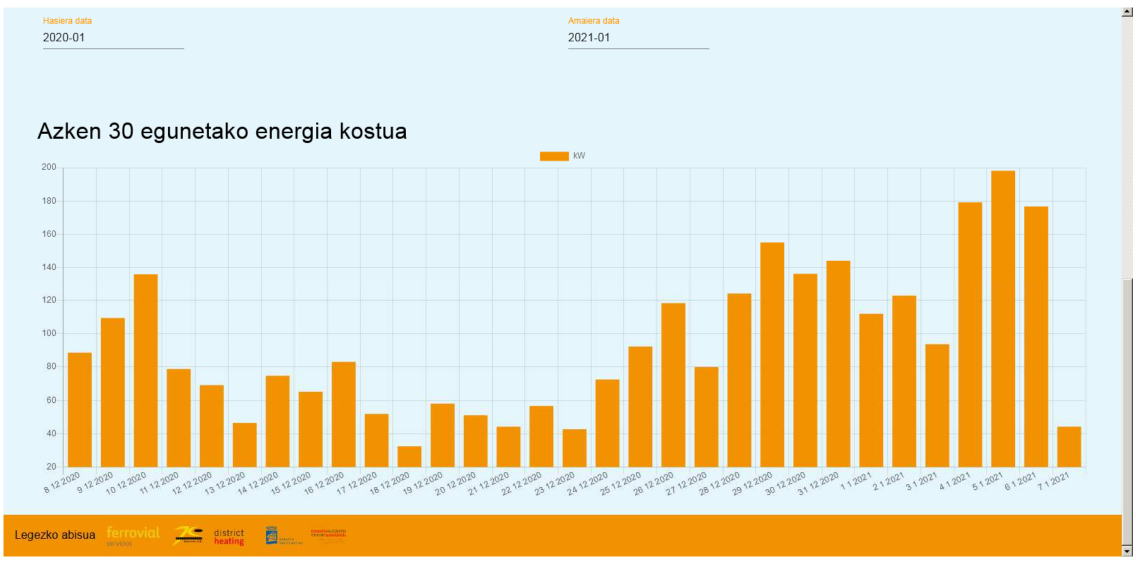


Figure 48: Open web displays

10.3 Occupants' display platform

The occupants' display platform for the SmartHomes project is integrated in the DH platform for the entire neighbourhood and shows the specific data for each home in the building. Each home has access to data on heating consumption, electricity consumption, indoor temperature, humidity and CO2. These data may be consulted by means of graphs, average, maximum and minimum values etc. Here below some screenshots of the DH platform are showed.





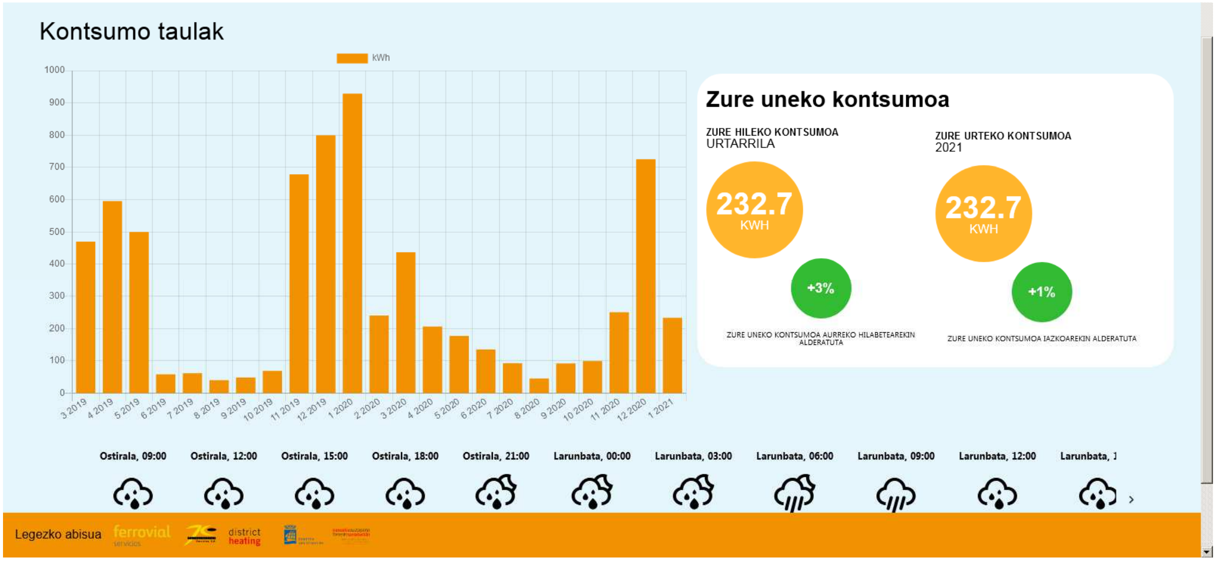


Figure 49: DH platform visualization for homes

By way of conclusion, the SmartHomes project offers detailed monitoring at the level of building management, housing tenants' level and at a general level with 3 differentiated visualization tools.

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11. CITIZEN ENGAGEMENT

The SmartHomes project was designed and implemented in a subsidised municipal residential block, and the homes were allocated to the occupants after the building had been constructed and finalised. In principle housing tenants were supposed to be engaged during the construction phase however, several reasons contributed to the delay in the allocation process. Finally, allocation of the 162 homes began in September 2020, and the process is almost completed.

When the allocation process has been completed and all the contracts with occupants have been signed, the designed phase of direct contact will achieve for a deeper engagement, informing the occupants about the project, explain the systems installed in the building and in their homes, give them access to information and data via the DH platform and offer them specific services in order to maximize the energy efficiency in their new homes.

They will be given project information in a descriptive format, with an informative document on all the items installed in the building, the general goals of the project, the criteria of the REPLICATE project of which it forms part, the systems fitted in their homes, monitoring of their home data via the display platform, the possibilities of boosting their comfort, and energy-saving potential.

In the case of the two pilot homes, each of them will have a detailed user's manual for the domotics systems, a description of the specific features fitted, access to the platform to monitor the systems installed and their consumptions etc. A training session will also be arranged for each of these homes, so that the occupants can easily understand the administration and utilisation of the systems fitted, and can use them to the best possible advantage.

Fomento San Sebastian has drawn up a communication plan for the project to cover all the necessary phases of communication for the occupants, internal organisational concerns, and external concerns with regard to the general public and the media. In terms of communication with the occupants, documents, flyers, posters etc. have been provided to serve as backup during the occupants' contact and training process, in a bid to explain the project and provide them with all the important information.

In terms of Protection of Personal Data, an analysis has been conducted of all the aspects to be taken into account in order to ensure compliance at all times with the GDPR and to guarantee proper processing of data.

The platform used to display data for the occupants and the public project data website are two communication tools for both the occupants and the general public, and they will be explained and demonstrated to the occupants during the direct-contact process.

The SmartHomes occupants are being additionally invited to participate in the individual energy efficiency advisory service provided by Fomento San Sebastian, to all the Txomin Enea district citizens. That way, citizens will have all the tools and capacity to improve their homes energy management and use, contributing to minimize their energy consumption while reducing the related invoices and contributing as a result against climate change.

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12. INNOVATIONS, IMPACTS AND SCALABILITY

12.1 Innovation solution

- This project is particularly innovative because it brings technology to a social municipal residential block, providing the occupants with information to make better use of resources and raise more sustainability awareness, contributing to mitigate climate change.
- This initiative constitutes a chance for the Txomin-Enea district to furnish an innovative response to environmental, sustainable and digital challenges, undertaking them in a collaborative and inclusive manner.
- SmartHomes project has the objective to boost the city's competitiveness by involving its stakeholders (citizens, businesses, etc.). This is all geared towards improving the living standards of local people and the efficiency of resources in the city of San Sebastián.

12.2 Social impacts

- Human beings are increasingly aware of the capacity of technology in the home to create a smart, eco-friendly dwelling by using sensors and controllers integrated with the systems operating in the home. Smart technology for the home also enables users to save energy by controlling the lighting, HVAC systems, height of blinds etc. The occupants can use Internet to gain access to the systems from any part of the world at any time.
- Smart technology is the medium and the tool to enable people to take intelligent effective action and also action that is sustainable from both the environmental perspective and the economic perspective.
- The project set out to assist the general public and also to help local residents play an active role in implementing solutions and services in their own neighbourhood to turn it into a benchmark as a sustainable smart district.
- The ability to measure indoor temperature, humidity and CO2 in their homes enables the occupants to control ambient conditions there, thereby boosting the comfort of those inside, and creating a healthier indoor ambiance.
- The project also sets out to raise awareness concerning the use of technology to the benefit of people, and more efficient use of resources.

12.3 Environmental impacts

- Smart technology gives people some extremely useful information on their own homes, with tools to take action to enhance their use of resources, reduce and optimise energy consumption and boost their comfort inside the home, in order to save money on household bills.

- The main added-value component furnished by SmartHomes technology is that it helps improve management of energy resources and assists with energy efficiency and economic savings for both users and those managing the building. These homes have technology which gives users information they did not previously have, and this constitutes the main tool to enable them to take their own decisions and convey them to their homes to optimise usage of where they live, its components and facilities, and also to bring down their energy costs.

12.4 Replication and scalability potential

- This type of technology is now moving into other sectors such as schools, offices, shops and airports, although residential buildings do not usually have these facilities.
- From the market perspective, expectations are that demand for this technology will increase in the years ahead, due to increased awareness of the benefits of the smart home.
- It is a successful solution for building managers as they have individual and global building indicators in an integral platform, that allow them to make the best decisions for better management and use of the building.
- Additional complementary services (advice on energy efficiency, etc.) are being offered to the home occupants, providing them with a series of tools that will allow them to optimise the energy management and use of energy of their homes.

12.5 Economic feasibility

- It is necessary to carry out a follow-up during the following months to be able to measure and evaluate the savings in consumption and the improvements and savings in the management, maintenance and use of the building and homes. In this way, the most appropriate measures would be identified for replication, focusing efforts and investing in the most appropriate systems.
- In addition to the building level savings, economic savings will be achieved by the occupants through the reduction of energy consumption and a better use of the home resources.

12.6 Impact on SME´s

- The project has generated business for local SME companies, and at the same time, has allowed them to participate in an innovative project, with development of a new approach for homes and management.
- Companies that collaborate with the project may offer additional services, designing and developing new innovative tools for homes.

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12.7 Other

- Smart components and sensors had been planned for the SH project from the outset, improving the construction process, installation and integration of teams, which improves project management and maintenance, and also lowers the cost of the facility.
- From the point of view of management of the building, the systems and sensors installed make the building's management and maintenance more efficient, with first-hand knowledge of usage of the facilities, the status of devices and property, the condition of the homes, necessary maintenance etc. All this information is integrated and centralised in a SCADA system, which can be used to carry out monitoring processes, consult information and indicators, trends, status of systems etc.

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13. LESSONS LEARNT AND CONCLUSIONS

In the SmartHomes project, complex monitoring and communication systems have been implemented, involving various agents in the design and installation process, so a clear definition of tasks, together with planning, coordination and close monitoring have been essential for the correct development of the project.

One of the key points of this project is that the installation of the equipment has been carried out in parallel with the construction of the building, so that all technical requirements have been taken into account at the time of execution. In this sense, the construction process and the installation has been improved, which facilitates project management and maintenance, and also helps reducing the global cost.

Municipal coordination between the main agents has been a fundamental factor in achieving the objectives set. Throughout the project, work has been done in coordination and continuous contact between Fomento San Sebastian, promoter and manager of the SmartHomes project and the Etxegintza municipal Housing Society, promoter and owner of the building.

Thanks to the systems and sensors installed, the owner of the building has information and added value indicators of the entire building and homes, and so the building's management and maintenance will be more efficient, with first-hand data of usage of the facilities, the status of devices and the condition of the homes.

From the user perspective, the smart devices installed in the apartments highly valuable and useful information of their homes, which help them to improve their use of resources, reduce and optimise energy consumptions in order to save money on energy bills. In addition, indoor temperature, humidity and CO2 data inside the homes enables the occupants to control ambient conditions, improving the comfort and creating a healthier indoor ambiance.

In conclusion, in this project, Smart technology is the tool that allows, on the one hand, building managers to optimize building management and, on the other hand, it enables occupants to take intelligent and effective actions to reduce their energy bills and improve their air quality and comfort within their homes, thus helping to mitigate climate change. The learning derived from the project will be used for application in other social housing buildings and will also be extended to private housing in the city or in other European cities.