Pilot Projects

Booklet 5

NewTREND

NewTREND, Booklet 5: Pilot Projects.

Contents of the Booklet by Melinda Orova, Szabina Várnagy (ABUD), Victor Martinez, Pau Asens, Gerard Riba (Sant Cugat), Ken Dooley, Davor Stjelja (Granlund).

Editing and layout by Elena Bazzan (iiSBE R&D).

Published June 2018 © 2015 NewTREND Consortium Partners. All rights reserved. This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no. 680474. The document reflects only the authors' views and the European Union is not liable for any use that may be made of the information contained therein.

http://newtrend-project.eu/home-it/

Table of contents

1. Introduction

NewTREND seeks to improve the energy efficiency of the existing European building stock and to improve the current renovation rate by developing a new participatory Integrated Design Methodology targeted to the energy retrofit of buildings and neighbourhoods, establishing energy performance as a key component of refurbishments. The methodology fosters collaboration among stakeholders in the value chain, engaging occupants and building users and supporting all the refurbishment phases through the whole life cycle of the renovation.

Several NewTREND tools have been developed to support the Integrated Design Methodology.

The NewTREND methodology and tools are validated in real refurbishment projects in Hungary, Finland and Spain. The case studies provide a fundamental contribution for the validation of the Integrated Design Methodology at a real scale by addressing all phases of the refurbishment process. The involvement of all the stakeholders in the design process is evaluated and specific activities were dedicated to inhabitants and users. These case studies will be the examples of Best Practices on which to base the promotion and dissemination of the advantages of using the NewTREND methodology and software in the future. At the same time, demonstration projects provided essential feedback for the refinement process of NewTREND.

Each case study has been selected with specific criteria in order to provide a homogenous picture of European cities characteristics, namely:

- European area and climate conditions;
- Problematic historical periods;
- Architectural and urban patterns;
- Level of energy consumption.

Demonstration sites where the newly developed NewTREND methodology and tool are tested.

District level analyses are being carried out in case of three demonstration sites from the three countries:

- Budapest site;
- Seinäjoki site;
- Pilot No. 2. Pins del Vallès School in Sant Cugat.

Building level evaluations are conducted in case of five demonstration sites:

- Budapest site;
- Seinäjoki site;
- Pilot No. 1. 35 rented apartments for young people in Sant Cugat;
- Pilot No. 2. Pins del Vallès School in Sant Cugat;
- Pilot No. 3. 2 private houses in Les Planes in Sant Cugat.

The objectives of the demonstration sites are to collect all the relevant information on the existing buildings to be renovated applying the new approach and support tool proposed, to engage with all the relevant stakeholders involved in each pilot project, including occupants, to apply with them the new design methodology, platform and tools in the real project design phase, to evaluate the impacts of the new design approach according to indicators and post-retrofitting controlling through monitoring the occupants' behaviour and performance of retrofitted buildings.

Pilot Project in Finland

2. Finnish Pilot Project: Seinäjoki, Finland

Figure 1: Old hospital area in Seinäjoki, Finland

2.1 General information about pilot project

The pilot project neighbourhood is located in the city of Seinäjoki, Finland. Seinäjoki is a relatively small city located in the centre of South Ostrobothnia with a population of 61 500 residents. Seinäjoki is located about 300 km north of Helsinki in the western part of Finland. Its climate is characterized as continental subarctic or boreal (taiga) climate. The Köppen-Geiger classification is Dfc. Solar radiation and weather data with hourly resolution was available from the Meteonorm 7 database for Kauhava (latitude 63°10'N and longitude 23°03'E), Kauhava is located about 35 km north of Seinäjoki. Therefore, the weather data for Kauhava has been used for this study. The annual average temperature is 4.5°C. Total minimum temperatures in winter are often dropping below -20.0°C. However peak temperatures in summer are exceeding frequently the 20.0°C mark. Finland in common is highly influenced by its massive difference in sun shine hours between summer and winter period. Longest day of the year has about 20:00 hours of daylight, shortest day not even 5:00 h. Wind conditions can rather described with moderate breezes, main wind direction is south.

Figure 2: Old hospital in Seinäjoki, Finland

Figure 3: Old hospital in Seinäjoki, Finland

2.1.1 District area description

Table 1: General information of Seinäjoki demo district area

General Information of the Demo District Area	
City / Country	Seinäjoki, Finland
Address/Location of the District	Keskuskatu 32 A
District Function	Originally hospital, nowadays educational and commercial use
Year of Construction	1929
Gross Build Area	12 789 m^2
Net Build Area	11 090 m^2
Number of Buildings	4
District Morphology	Campus

The neighbourhood consists of four buildings that were originally built in 1930 to serve as county hospital of Seinäjoki, but since the 1980s the hospital moved elsewhere.

2.1.2 Building description

Table 2: General information of Seinäjoki demo building number 1

General Information of the Demo Building Number 1	
City / Country	Seinäjoki, Finland
Address/Location of the Building	Keskuskatu 32 A
Building Function	Main building: Music school and applied sciences
Year of Construction	1929
Gross Build Area	7 727 m^2
Net Build Area	6 900 m^2
Maximum Height of Building	21.5 m

Table 3: General information of Seinäjoki demo building number 2

General Information of the Demo Building Number 2	
City / Country	Seinäjoki, Finland
Address/Location of the Building	Keskuskatu 32 K
Building Function	Office building: dental and health services
Year of Construction	1929 /2004 renovated
Gross Build Area	3 944 m2
Net Build Area	3 266 m2
Maximum Height of Building	17 m

Table 4: General information of Seinäjoki demo building number 3

General Information of the Demo Building Number 3	
City / Country	Seinäjoki, Finland
Address/Location of the Building	Keskuskatu 32 M
Building Function	Heat distribution centre and office building
Year of Construction	1929
Gross Build Area	677 m^2
Net Build Area	600 m^2
Maximum Height of Building	10.8 m

Table 5: General information of Seinäjoki demo building number 4

General Information of the Demo Building Number 4	
City / Country	Seinäjoki, Finland
Address/Location of the Building	Puskantie 36c
Building Function	Child welfare league NGO
Year of Construction	1929
Gross Build Area	441 m^2
Net Build Area	324 m^2
Maximum Height of Building	8.5 m

Today, the buildings are owned by the City of Seinäjoki and are being used for multiple different purposes. Main building, which is also the largest of them functions as an educational building, roughly half of it being used by musical school and other half is used by vocational school. Second largest building serves as office building and partly as dental clinic. Next building is used as heat distribution room, while part of it is used for office purposes. Last building named Kivirikko house was used in the old times as a house for director of the hospital, while nowadays is used by Mannerheim league, an NGO that promotes wellbeing of children and their use of the building could be characterized as children day care.

Current technology of the building is consisted of two layer brick walls with a gap (U-value around 0.9 W/m2K), double glazed windows, recently renovated roof with 200 mm mineral wool insulation, mechanical ventilation system with low airflow and water based heating which is connected to district heating network.

2.2 Main stakeholder involved

2.2.1 District area stakeholders

Building users

- Dental clinic Seinäjoki City;
- Different departments of Seinäjoki city (such as environmental department);
- The Mannerheim league – Children welfare league.

Client

- The city of Seinäjoki: owner of the buildings.

Designers

- Architectural
  - Architects of the city of Seinäjoki

2.2.2 Building area stakeholders

Building users

- The Music School: Etelä-Pohjanmaan musiikkiopisto, South Ostrobothnia Music Institute (current, will continue after the retrofit);
- The Vocational College: SeAMK (Seinäjoen ammattikorkeakoulu) (current, leaves after retrofit);

- Institute of Adult Education, Seinäjoen Kansalaisopisto (future tenant, replaces SeAMK);

Client

- The city of Seinäjoki: owner of the buildings.
- Designers
- Architectural
  - Architects of the city of Seinäjoki
- Engineering
  - MEP design: Granlund Pohjanmaa Oy
- Consultancy
  - Granlund Oy / Granlund Consulting Oy

2.3 Retrofit measures

2.3.1 District area planned measures

In the district old boiler house (which has not been used for a long time), will be turned into classroom and meeting room which will be used for theater and music performances by Adult education center.

Also the addition of renewable energy sources was analyzed. Such as hybrid heating system (district heating + ground source heat pump) and solar PV panels. As the retrofitting project continues after the NewTREND project finishes, we don't know what will be final measures.

Figure 4: Heat distribution building

2.3.2 Building planned measures

Project's objectives for the Seinäjoki pilot site is to retrofit and refurbish existing buildings. In occupant surveys, occupants were complaining about bad indoor conditions, mostly they were concerned with moisture problems, stuffy air, rooms being too cold during winter and too hot during summer. Owner of buildings (city of Seinäjoki) wants to save on operating costs while improving indoor conditions for occupants. As these goals are usually conflicting, owners are interested into decision making procedure supported by optimization to select the design solution.

So far building energy simulation has been done for the pilot site area, where main building was simulated in advanced mode and other three buildings were done in basic mode. In the potential retrofit analysis renewable energy sources will be included. Such as hybrid heating system (district heating + ground source heat pump) and solar PV panels.

Another aspect in this pilot site is data collection from end-users. This is going to be done using classical questionnaires and modern feedback tools, such as Granlund Pulse, a tool which focuses on user satisfaction, internal environmental conditions, energy efficiency and technical functionality.

Figure 5: Main entrance of the building

2.3.3 Implemented measures during the project lifetime

At the beginning of the project plan was to retrofit the whole building completely, but for now most of work will be done in the half of the building where Adult Education Centre is moving in. Work that will be done in Music school is work concerning floor insulation and replacement of underground piping (since it would be unreasonable to change it only in half of the building). And certain repairs in outside façade. Also probably LED lighting will be done as well in both parts of the building. At this moment few inner windows of main building were taken to a workshop where single glazing will be replaced with double-glazing to assess the ability of retrofitting inner windows and its costs. Regarding HVAC system, one half will get new ventilation system and all radiators will get new thermostatic valve (with remote temperature sensor).

Another thing which was decided to be done is to retrofit another building in the district as well, the so-called boiler room into performance center (musical and theatre performances).

Design should be finalized by September 2018, which means that final decisions and construction work won't be done during NewTREND project lifetime.

2.4 Interconnection with NewTREND

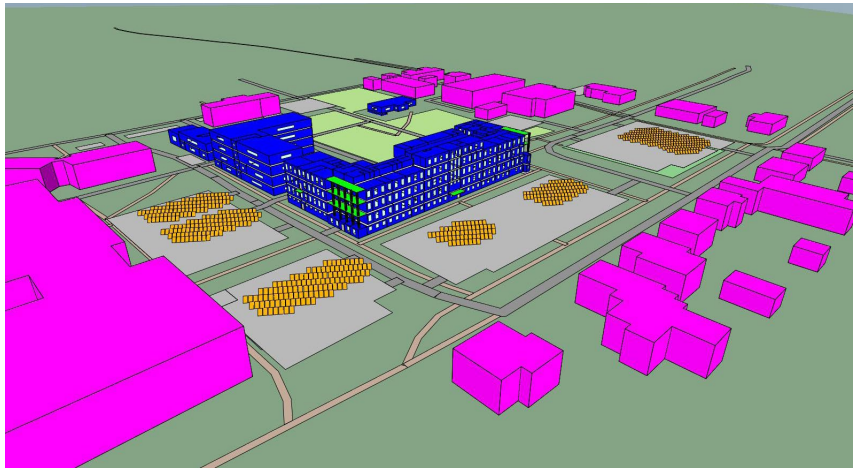


Figure 6: District analysis for solar potential in Finnish pilot site

In the beginning of the retrofit project in Seinäjoki, Finland, data collection has been done in a NewTREND approach. First, brief data collection of the district was made for the simple building/district performance analysis, this coincides with NewTREND basic mode. Results of basic mode study have been used as a help for additional data collection, where more accurate information was acquired. Thereafter detailed building performance analysis was done, coinciding with NewTREND advanced mode and this analysis was used to find optimal building retrofit solutions.

Following the NewTREND approach district context was taken in consideration in the early stages of planning the retrofits. Four buildings belonging to pilot site, were simulated with potential retrofit measures and this analysis has helped to select the main building as a main target for retrofit, as it showed the highest perspective for it. Furthermore district context was used when analysing the effect of retrofit on the district heating needs and assessing the renewables potential.

In the NewTREND project, one of the main goal is to increase the end-user perspective (people) in building retrofitting projects. In Finnish pilot, focus to people was done in two ways: by analysing comfort in the building and by including users into design. Comfort analysis was done, by measuring current indoor air quality in certain spaces in the building, simulating the comfort after the potential retrofit measures are applied and including comfort indicator in selection of optimal retrofit solution.

Users of the building have been invited to workshops where designers and decision makers were involved and could express their opinions on the building and the upcoming retrofit. Additionally end users (including students of the school) have had possibility to add their opinion through questionnaires about the building.

NewTREND tool is as well tested by stakeholders such as owners and designers of the Finnish retrofit pilot site and they have given their suggestions for further development of the tool, but have also discovered the possibilities of the tool.

Pilot Project in Hungary

3. Hungarian Pilot Project: Bókay Árpád School

Figure 7: Location of The demo Buildings and district, Bókay Primary School – view from the inner courtyard, Bókay Primary School – view From the street

3.1 General information about pilot project

Location: Pestszentlőrinc, XVIII. District, Budapest, in a suburb area.

The climate of Budapest is humid continental that is mild with no dry season. The Köppen-Geiger climate classification is Dfb. The average annual temperature is 10.2-10.6°C in Budapest. The average temperature of the summer is 17.0-17.5°C, the number of days with no frost is between 186 and 196 (typically April 10-15 and October 20-25). The highest annual temperature is expected between 34.0-34.5°C and the lowest is between -11.5°C and -14.5°C (multi-annual averages). The number of sunny hours per year ranges from 1910 to 1940, in summer 770-780 hours, in winter 180 hours. The average annual rainfall is 564 mm. Heavy precipitation occurs during mild winters. The spring months (March and April) have variable conditions, with a rapid increase in the average temperature. Budapest's long summer—lasting from May until mid-September—is warm or very warm. The dominant wind direction is S-SE, an average speed of 2.5-3 m/s.

Regarding the project that motivates this report, the buildings and district in Budapest have been selected to represent the Eastern area of Europe with a continental climate.

3.1.1 District area description

Table 1: General information of Budapest demo district area

General Information of the Demo District Area	
City / Country	*Budapest, Hungary*
Address/Location of the District	*Bókay Garden, 1181*
District Function	*Public park with recreational and educational facilities*
Year of Construction	*1930*
Gross Build Area	*103 604.95 m2*
Net Build Area	*5 137.08m2*
Number of Buildings	*24*
District Morphology	*Free-standing buildings*

Compared to the Budapest area, the share of the green area is favourable in the district, as 17.5% of the area belongs to a green area or a forest area. The Bókay Garden, one of the district's public parks, is one of the largest and most significant green areas in the district. The garden is used as a multifunctional public park, it is a recreational / leisure centre. The 16-hectare garden serves as a community venue and provides many different sports facilities for residents. There is a "four-season" ski slope, a beach and indoor swimming pool, garden cinema, gym, football, basketball and tennis courts, as well as the Bókay Adventure Park in the park. The several playgrounds, sports grounds and the open-air stage attracts the district's residents who want to play sports and relax. Among the users, the runway is also popular, as well as the large community space in the garden, which is suitable for holding large-scale events. Many of the features here also attract the residents of surrounding districts. Part of the alley surrounding the park is protected, such alleys represent the linear elements of the green surface system that connect the large green areas of the district.

Table 2: General information of Budapest demo building number 1

General Information of the Demo Building Number 1	
City / Country	*Budapest, Hungary*
Address/Location of the Building	*Szélmalom Street 29-31, 1181*
Building Function	*Kindergarten*
Year of Construction	*~1970*
Gross Build Area	*1 066 m2*
Net Build Area	*888 m2*
Maximum Height of Building	*7 m*

Table 3: General information of Budapest demo building number 2

General Information of the Demo Building Number 2	
City / Country	*Budapest, Hungary*
Address/Location of the Building	*Városház Street 40, 1181*
Building Function	*Swimming pool*
Year of Construction	*~1970*
Gross Build Area	*1 735 m2*
Net Build Area	*1 446 m2*
Maximum Height of Building	*8.29 m*

Table 4: General information of Budapest demo building number 3

General Information of the Demo Building Number 3	
City / Country	*Budapest, Hungary*
Address/Location of the Building	*Szélmalom Street 53-55, 1181*
Building Function	*Primary School*
Year of Construction	*~1960*
Gross Build Area	*926 m2*
Net Build Area	*772 m2*
Maximum Height of Building	*4.5 m*

Table 5: General information of Budapest demo building number 4

General Information of the Demo Building Number 4	
City / Country	*Budapest, Hungary*
Address/Location of the Building	*Szélmalom Street 33, 1181*
Building Function	*Administrative building*
Year of Construction	*~1980*
Gross Build Area	*592 m2*
Net Build Area	*436 m2*
Maximum Height of Building	*5 m*

Table 6: General information of Budapest demo building number 5

General Information of the Demo Building Number 5	
City / Country	*Budapest, Hungary*
Address/Location of the Building	*Szélmalom Street 33, 1181*
Building Function	*Restaurant*
Year of Construction	*~1990*
Gross Build Area	*400 m2*
Net Build Area	*330 m2*
Maximum Height of Building	*5 m*

Table 7: General information of Budapest demo building number 6

General Information of the Demo Building Number 6	
City / Country	*Budapest, Hungary*
Address/Location of the Building	*Margó Tivadar Street 116-118, 1181*
Building Function	*Herrich-Kiss Villa - protected monument*
Year of Construction	*~1870*
Gross Build Area	*698 m2*
Net Build Area	*582 m2*
Maximum Height of Building	*9 m*

- Currently, the Bókay Garden can be divided into the following parts / functions:
- Városháza Street area: establishments / areas hosting the paid and organized activities (ski slope, fitness room, open air stage, parking lot);
- In the "heart" of the area is the Park Centre (main building and its surroundings: tennis bar, playground, info pavilion, building(s) of park maintenance, adventure park, park-like, well-groomed green area, small lake);
- North of the main building is the area of the swimming Pool and the beach (its area extends up to Szélmalom Street, accessible from the 1st (west) entrance of Szélmalom Street);
- In the area south of the 1st entrance of Szélmalom Street, the Kindergarten operates;
- In the vicinity of the 3rd entrance (east) of Szélmalom Street are the school building and its courtyard, the central parking lot, a large meadow and the VIP wooden house;
- From Makói Street to the line of the tennis bar, there is a wooded area with a runway the adventure park and the former large, vaulted cellar;
- The Herrich-Kiss Villa, which is under local protection, is accessible from Margó Tivadar Street;
- Along the Margó Tivadar Street, south of the Herrich-Kiss villa, there are private houses enclosed in the garden;
- In the area south / south-east of the main building, until the Kiss István Street, various sports fields (tennis courts, grass football field, BMX track) can be found;
- The "corner" of Cziffra György Street and Margó Tivadar Street is an unused, almost 3-hectare barren area.

3.1.2 Building description

Table 8: General information of Budapest demo building number 7

General Information of the Demo Building Number 7	
City / Country	*Budapest, Hungary*
Address/Location of the Building	*Wlassics Gyula street 69, 1181*
Building Function	*Primary school*
Year of Construction	*1903*
Gross Build Area	*1623 m2*
Net Build Area	*1522 m2*
Maximum Height of Building	*18,36 m*

Originally the building of the primary school building was a two-story building, in the 1980s a 3rd floor was built upon it with a steeper pitched roof structure. The building has brick walls. The original exterior wall structure (ground floor + 1st floor walls) is a 70 cm thick traditional solid wall structure with small-sized brick wall. The extension (2nd floor) has narrower exterior walls: 30 cm (towards inner courtyard), 45 cm thick (street facade).

Figure 8: Classroom in Bókay School

HVAC and electric system

- There is no mechanical ventilation in the building.
- Heating:

Primary system: Air-water heat pump system installed a couple of years ago (in fairly good condition now) connected to old (1981 – 134 kW) gas-fired boiler system. Most of the time the heat pump can supply hot water for heating. During the winter when it's cold outside, the gas boiler is switched on automatically to support the heat pump system. (no smart optimal efficiency controls, only when the max capacity of the heat pump is not enough, the boiler switches on.)

Secondary system: hot temperature radiator system. One inlet to the building, 5-6 vertical rising pipes to the 2nd and 3rd floor using one single pipe to supply and 1 to return many-many radiators. Some rooms have one inlet with 2 radiators, some have 2 inlets with 3-4 radiators. (See attached pics for better understanding.)

Control: there is no temperature control in the rooms. Some radiators, where they are not broken yet, have valves but they lock them so the kids cannot mess up with them. If the supply is too big, they simply open the windows, sadly.

- Domestic hot water: There are 3 electric heaters (one per floor) to supply the bathroom taps.
- Cooling: 2 decentralized split units.
- Electric system: There is no sub-metering currently within the building. We know only the overall electricity consumption. However, there are 2 switch-boards per floor (see pics attached also.) where we could install some sub-metering maybe. This way maybe we could separate heat pump, lighting, split units and DHW heaters. (there is not much plug-load in the building, only a couple of computers in the ground-floor teaching rooms.)

Figure 9: air-water heat pump system

3.2 Main stakeholder involved

3.2.1 District area stakeholders

- District area users
- Residents of the 18th district and the surrounding districts;
- Operators, tenants of the buildings.
- Client
- Municipality of District 18, Department of urban management: owner of the buildings and park;
- Klebelsberg Institution Maintenance Centre, Educational District, Department of Asset Management: maintenance of the school building.
- Designers
- Urban planning
  - Aczél Urban Planning Ltd.
- Transport
  - Mobil City Ltd.
- Utilities
  - Dima Engineering Ltd.
- Green areas, environmental protection
  - Solitaire Ltd.

3.2.2 Building stakeholders

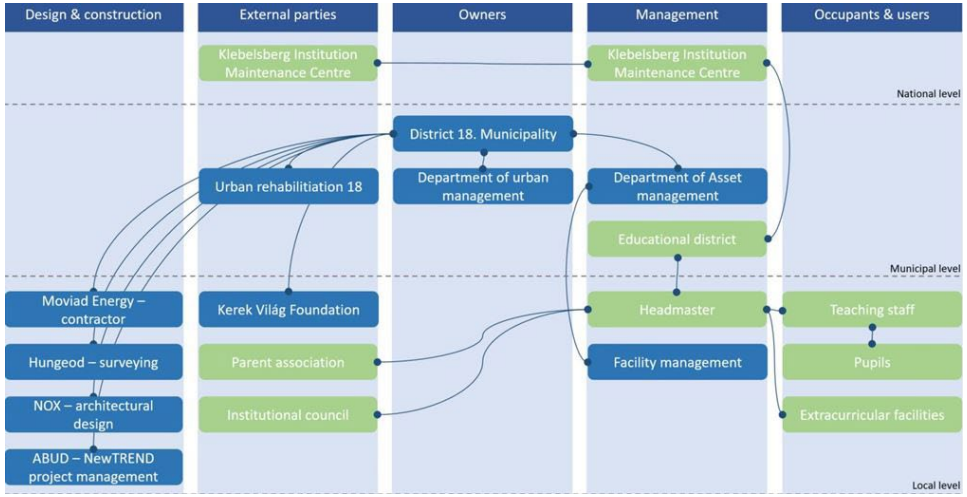


Figure 10: Bókay Primary School - stakeholder matrix

Building users

- Bókay Árpád Primary School: teachers and pupils (age: 6-14). The school is an eco-school, which differs from an ordinary school, that it places great emphasis on the followings: environmental education and sustainability, not just in teaching, but also in all areas of school life; In school management, as well as in catering for children or the organization of camps.

- Kerek Világ Foundation: The aim of the public benefit foundation is to assist the pedagogical activity of the school in all areas, such as pedagogical initiatives within the school, supporting talented but disadvantaged students, creating more favourable conditions for language teaching, complex, art-oriented development, and strengthening environmental education.

Client:

- Municipality of District 18, Department of urban management: owner of the building;
- Klebelsberg Institution Maintenance Centre, Educational District, Department of Asset Management: maintenance of the building.

Designers:

- Architectural
  - NOX Ltd
- Surveying (laser-scan):
  - Hungeod Ltd.
- Contractor:
  - Moviad Energy Ltd.

3.3 Retrofit measures

3.3.1 District area planned measures

The Bókay Garden is one of the most important recreational area of the 18th district. The Bókay Garden plays a significant role in the district's sports and recreational life, it is a venue for numerous camps, district and school events. During the development of the last decades, the facilities of the Bókay Garden were arranged on a random basis, so it is necessary to create a new development concept. This new development concept takes into account the following main principles:

- Maintaining the park's youth and recreational functions;
- Arranging the environment of existing functions;
- Creating new development opportunities in currently under-utilized (barren) areas;
- Creating a unified architectural image of the garden;
- Preserving the existing vegetation (replacing where needed), creating new green spaces, maintaining and increasing the green space ratio;
- Reunification of the historical area: reattach the Herrich-Kiss villa to the park, the functional involvement of the Grassalkovich chapel and its surroundings (public park);
- Increasing the number of parking lots (outside the park).

The synergies and the potential for energy efficiency improvements of the Bókay Garden are unexplored, suggestions resulting from the simulation of the NewTREND tool can help to determine them later.

3.3.2 Building planned measures

The building has high operational costs and mostly the high heating energy demand is responsible for it. Therefore, the reduction of heating energy demand is required to reduce the operational costs. This was planned to be achieved with the insulation of facades and the replacement of current, outdated doors and windows. In addition, the implementation of solar panels was planned to further reduce the costs by the reduction of power consumption.

The planned solution for the inner side of the façade was a 16 cm thick EPS insulation with dryvit rendering. The street facades would get a 3-layer thermal insulation coating (Nansulate). There is a basement under some part of the building. Based on the current condition: ceiling insulation was recommended. The proposed solutions were: 20 cm Rockwool insulation for the ceiling.

At the NE and NW street facades and at facade of the interior courtyard the windows were replaced partially a few years ago. Double-glazing plastic windows replaced the old ones. In the inner side facades there are still outdated wooden windows (traditional wooden window with coupled sash, single glazing or wooden with single glazing), replacing them are essential as they are not only in poor condition but they are dangerous. It was also advised from an energetic aspect. The thermal insulation of the attic floor was advised as well. The proposed solutions were: 15 cm Rockwool insulation for the attic floor.

3.3.3 Implemented measures during the project lifetime

At the start of the NewTREND project the design phase has already been conducted for the main demonstration building. (The district is in early design phase during the whole NewTREND project lifetime.) The tendering and implementation of the planned measures and a year of operation for the school were scheduled during the NewTREND project lifetime. The original plans has been changed due to the following:

- The retrofitting project that this case study investigated was supported from national development funds that the Hungarian government receives from the EU regional and cohesion funds. The pre-condition of the call was an already proceeded public procurement and a pre-contract with a constructor. However, the project funding approval process has been delayed for nearly a year due to a dispute between the national government and the EU regional and cohesion funds. During that time there was a big boom in the building sector and the material prices and work fees have nearly doubled. Therefore, the contractor is unable to deliver the project for the same price / on the same level as was promised in the precontract. The municipality and the contractor are in the process of renegotiating the precontract which means that the remaining construction works are not expected to be finished during the NewTREND project lifetime.
- During the time of the funding approval process, the status of the historical protection of the building has been disputed. At the end, the envelope insulation have been cancelled for the building.

In summary, from the original planned measures, the envelope insulation has been cancelled. Up until the present time only the insulation of the basement and roof has been finished and some preparatory works, but neither the solar PVs or the windows haven't been installed yet. Their installation is depending on the negotiations between the contractor and the municipality.

3.4 Interconnection with NewTREND

During the NewTREND project the following actions were taken in connection with the school building refurbishment:

- Geometric and technical data collection
- Building energy consumption and occupant behaviour monitoring
- Stakeholder involvement investigations
- NewTREND IDM methodology testing through the NewTREND tool
- These actions are detailed in the following.

3.4.1 Geometric and technical data collection methods used in the Budapest demo site

District level

In Budapest within Bókay garden, onsite walk-through method was used to collect data on the usage patterns, occupancy ratio and building condition categorisation. Also interviews were conducted with the municipality of district 18th and their department of urban and asset management to investigate future plans and organisational structure within the area.

Building level

The main building of the Hungarian demo site, Bókay School, was investigated in more detail. As a first step, onsite walk-throughs were conducted where the overall condition and use of the building was mapped. Interviews with local personnel and other stakeholders helped in obtaining the original architectural plans of the building, and also in getting to know in more detail the organisational structure and occupancy of the building. The building's HVAC and electrical systems were identified through interviews with the local maintenance crew and by local walk-throughs with experts.

Geometrical parameters and dimensions of the building were measured by a new technology called laser scanning. This technology is not widely used in Hungary yet, therefore it was also a test of technology for applicability in such cases.

Energy consumption order of magnitudes and patterns were analysed by obtaining the utility bills from the municipality from the last 3-5 years. The outcome of this analysis was later on double-checked with the newly installed electricity and comfort monitoring system data.

3.4.2 Building energy consumption and occupant behaviour monitoring

Monitoring activities in Budapest are carried out in the main building of the demo site, in Bókay school building. Based on the complaints of teachers, two classrooms were identified where there are thermal comfort issues perceived during winter season. IAQ and window opening monitoring devices were installed in these classrooms to investigate the problem before retrofitting and also the thermal comfort improvements due to retrofitting works. Along with the indoor condition monitoring sensors, energy consumption and outside condition monitoring devices were installed in February 2017.

Continuous monitoring in the elementary school building:

- Weather station on site;
- SUM electricity consumption (PV gain to be added once the panels are installed next year);
- SUM natural gas consumption (all used by heating system);
- Electricity submeter for heating consumption;
- Air temperature, and window opening sensors in two classrooms, CO2 sensor in one of them.
- Additional one-point-in-time measurements planned in several classrooms:
- Acoustic measurements both in classrooms and outside at the street;
- Complete IEQ assessment: black ball radiant temperature, air temperature, relative humidity and CO2 measurements;
- Lux levels;
- U-value measurements of existing walls.

3.4.3 Stakeholder involvement investigations

After the identification of stakeholders on the demo site several engagement activities were organized for them:

- Local Advisory Team meetings
- During the NewTREND project lifetime 4 LATs were planned. Up until April 2018 2 of the LATs have been realized. The first LAT was organized to meet the stakeholders and explain the fundamentals and goals of the project. The second LAT was dedicated to getting feedback about the NewTREND IDM methodology and the presentation of planned monitoring measures. The third and last LATs will be dedicated to software presentation and testing.
- The LAT members were able to express their opinion on the presented NewTREND developments in person and also through a feedback sheet provided for them.
- Personal meetings to set up the demo testing activities and data collection
- Semi-structured in-depth interviews

The stakeholders were grouped into 3 main categories: users, decision makers and project developers. After chosing the main stakeholders from each stakeholder groups, semi-structured in-depth interviews were conducted with them.

Stakeholder group, recording 11 interviews in all. We contacted the stakeholders through some preliminary key respondents who also participated in the LAT workshops before. The interviews took place in the form of personal meetings and they were recorded for the sake of the research. The interviews served different purposes:

- they helped gain insight on how the decision making on the planning and design of the retrofitting took place and to what level of authority were each stakeholder involved
- they aimed at identifying the value-chain of planning and decision making
- regarding the user preferences the interviews also aimed to reveal their preliminary expectations and wishes
- they also contained questions on the current user experiences, how they like and feel in the building

3.4.4 NewTREND IDM methodology testing through the NewTREND tool

The NewTREND software tools are being tested by demo site managers from the early versions of the separate tools. The usability and functionality testing of each software part ensures that developers get feedback about the aesthetics, comprehensibility and usefulness of the tools. The recommendations are being collected and incorporated into the tools when they deemed viable.

Pilot Project in Spain

4. Spanish Pilot Projects: Sant Cugat del Vallès, Spain - Apartment for young people

Sant Cugat del Vallès is a medium size city located in the outskirts of Barcelona, in the region of Vallès Occidental. Its monumental heritage, led by an ancient Benedictine monastery, is surrounded by natural areas of great beauty.

Sant Cugat (population 90 100) has seen its population increase in recent years, with more births than bigger cities like Barcelona. It has also practically merged with the nearby Rubí (population 75 167) and Cerdanyola del Vallès (population 57 543).

The town has several train stations with a direct metro connection to Barcelona city centre and the nearby industrial cities of Terrassa and Sabadell. Sant Cugat del Vallès is a city well connected through several highways.

The climate is mild, and generally warm and temperate. This climate is considered Cfa according to the climatic classification of Köppen-Geiger. In Sant Cugat, the annual average temperature is 16.1°C.

Sant Cugat is within the domain Mediterranean coast climate, characterized by the following aspects:

- Moderate annual thermal oscillation (13°C to 30°C on average);
- Mild winters (average minimum temperature of 6-8°C), with no cold periods, although there may be occasional freezing (-16°C in February 1956, -12°C in January 1985);
- Hot, dry summers, lack of rain and high temperatures (average temperature of 24°C);
- Average rainfall of about 650 mm per year. Irregular seasonal rainfall, concentrated in equinoctial periods. Rainfall is characterized by its irregularity month and year, and a strong torrential. The months of September, October and November are the ones who collect a greater volume rain fall. The average number of days of precipitation per year in Sant Cugat is 58.4.
- As for the wind, there is a predominance of the component SW (13.2%), followed by addresses W (10.6%), S (7.7%) and SE (6.9%).
- Collserola exerts an effect slightly dimmer influence coast, the extent and causes Thermal is greater than in Barcelona. Another differential is stagnant humid air masses, especially in situations of thermal inversion.

- Within the municipality there are considerable variations microclimatic, favoured the extension of the territory and environmental factors (altitudinal variation, location or orientation). This gives rise to different microclimates conditional variations in temperature, humidity, sunshine and wind. For example, between the ridge and the valley have been temperature differences of 7-8°C.

4.1 General information about pilot project

4.1.1 Building area description

Figure 11: LOCATION OF THE DEMO BUILDING, Sant cugat, Spain

Figure 12 and 13: 7 MAR DE LA XINA STREET, Sant cugat, Spain

The first demo building that will be retrofitted is 35 rented apartments for young people. This demo site is located in Can Trabal neighbourhood, nearby the Golf Club and Collserola Natural Park.

This demo consists of three connected buildings by two stairways. Each block has a ground floor and two floors. Parking is located in the basement of one of the volumes. To save unevenness of the street, every block has a ground gradient respect each other.

The building is divided by levels. The main entrance is at level B. The building, with two vertical cores of stairs and an elevator, consists of five levels with 35 apartments with 1 bedroom, nine private parking places and one local with commercial use.

The structure of the building has been built with the system Teccon (light metallic structure with insulation) and wrought plate working.

The building incorporates water recycling systems and solar thermal energy. It also incorporates centralized production energy for heating and hot water (DHW) with individual metering.

The purpose of the implementation of this system is to improve TGEM energy efficiency and increase comfort and safety of each home and minimize operating and maintenance costs thanks to a centralized and individual control of energy in each home.

Energy installations for heat and domestic hot water are centralized and designed to achieve greater energy savings and reduce costs maintenance and energy consumption, which will lead to significant reduction in CO2 emissions and a lower invoice to be paid by final users.

Each house has an individual meter to measure their individual consumption of heat energy for radiators and another to measure the heat energy of domestic hot water. All meters are electronic allowing user to connect and know their consumption in real time.

Wall type

- Isolated envelope
  - U external wall: 0,65 W/m2K

Figure 14: Sant Cugat pilot area - wall type

1 Framework of 105mm cold-rolled galvanized steel beams
2 Framework of 250mm cold-rolled galvanized steel beams
3 Fixings: self-tapping bolt for joining metal components
4 Layer of neoprene
5 Cold-rolled galvanized steel beam. Lightweight-panel envelope
6 100mm mineral wool sheet in light gauge steel framework
7 Internal sheet of standard 13mm laminated plasterboard
8 Electrical installations (with 36mm cladding coming from the suspended ceiling)
9 Standard 15mm laminated plasterboard
10 10mm OSB/3
11 Impermeable HDPE sheet. Water vapor-resistant
12 40mm airway in ventilated exterior wall
13 Exterior lining

Figure 15: Sant Cugat pilot area. - wall layers

HVAC and electric system

- Heating system type
  - Central heating system monitored (Natural Gas): 2x115 kW condensing boiler;
  - Boiler room and distribution. Solar thermal system with auxiliary boiler;
  - Installation provides hot water and heating to 35 homes in the building. Includes boilers, hydraulic room, storage and pumping systems;
  - Solar panels system: supports the supply of hot water;
  - Thermal panels integrated into the architecture;
  - Metering and control system: control of boiler and solar system. System counters for hot water and heating for each apartment with electronic data transmission to an external server to check each individual apartment.
- There is no cooling or mechanical ventilation in the building.
- Electric system
  - There're not sub-metering currently within the buildings. We know only the overall electricity consumption of community spaces;
  - The building currently has three electricity connections for community spaces consumptions.

Table 1: General information of Sant Cugat demo building

General Information of the Demo Building Number 1	
City / Country	*Sant Cugat, Spain*
Address/Location of the Building	*7 Mar de la Xina Street*
Building Function	*Residential: 35 rented apartments*
Year of Construction	*2008*
Gross Build Area	*1 950 m2*
Net Build Area	*1 657.5 m2*
Maximum Height of Building	*12 m*

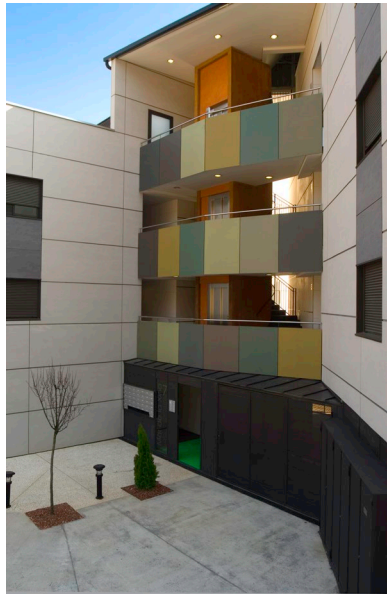


Figure 16, 17, 18, 19 and 20: 7 MAR DE LA XINA STREET, Sant cugat, Spain

4.2 Main stakeholder involved

4.2.1 Building area stakeholders

Client

- Promusa (public company, the Local Housing Office manager). http://www.promusa.cat/
  - The City council of Sant Cugat del Vallès, founded the municipal company Promusa in 1988 municipal. The main objective of the company is to facilitate access to housing for the citizens of Sant Cugat.
  - Promusa over the years, has also carried out other activities parallel to the housing development: it has built offices, shops and parking. He has also worked in urban management and development.
  - Currently, Promusa manages 235 rental apartments for young people, 272 rental housing for families, and 38 rental apartments for the elderly.
- City of Sant Cugat del Vallès (Owner). https://www.santcugat.cat/

Building users

- Users/Tenants (50 occupants in 35 dwelling)
  - The users/tenants are young, that means that they're supposed to be aware of the environmental issues.

- The duration of the lease is at most 5 years.
- The average occupants stay is 3.5 years.
- The type of housing is designed for one or two occupants.
- Designers

- Energea (Energy management company). http://www.3e-energea.com/ca/
  - Energea is a company that offers comprehensive services, specializing in the energy sector and the design, implementation and maintenance of projects with criteria of efficiency, innovation and excellence.
  - They offer customized solutions to suit the needs of customers with the aim of reducing energy consumption, operating costs and environmental impact. Their mission is to help customers reducing their environmental impact, providing value the organization and increase its competitiveness by reducing operating costs.
  - Currently, Energea manages the central heating and domestic hot water systems of 505 social housing owned by de city council of Sant Cugat.
- Technics of Sant Cugat del Vallès City Council. https://www.sant-cugat.cat/

4.3 Retrofit measures

4.3.1 Building planned measures

- Replacing thermal panels using PV + thermal panels. PV for electrical common services needs and thermal for Domestic Hot Water needs.
  - The aim is to improve the performance of solar current, replacing other existing panels with higher performance. PV panels system for electrical community spaces demands, and solar thermal panels system for Domestic Hot Water demands.
  - Using two separate systems the average coverage would be:
- Solar hot water coverage: 66%;
- Electricity coverage (consumption common spaces): 50%.

- Installation of individual electrical meters for each apartment: Installation of 35 single-phase electric meters to measure the consumption of each apartment. The data collected will be sent to a platform on which users can monitor their consumption and compare them with the rest of the consumption of the building.
- Change of locations of light sensors in community spaces: Currently, occupancy sensors to turn the lighting community are located at about 1.5 meters high. This fact cause that the sensors are often manipulated and spoil. It is proposed to replace the existing sensors for others that are located in the ceilings and combine motion detection and brightness.
- Replacement of collectors of hot water and heating system
  - The current collectors for hot water and heating have no insulation and in some places leak, causing losses in the system.
  - We propose their replacement with other collectors with better thermal insulation.
  - Modification of the boiler room pipes to use of renewable energy.
  - In order to integrate the various thermal systems proposed, changes will be necessary to optimize the hydraulic functioning of the system.
- Improvement of the control system to integrate new elements of renewable energy: In order to control the overall system for ensuring proper operation and maintenance, the current control system will be updated integrating the new elements of the installation:
  - Solar thermal collectors;
  - PV and new thermal panels;
  - Inverter.
- Unification of electric meters and legalization of self-consumption: In order to optimize the costs of electricity consumption and reduce energy consumption proposes the following:
  - Unifying the three existing connections into one, reducing the term of power and letting us to choose a cheaper energy price;
  - Install energy meters in order to pass on the costs according to the currently existing connections;
  - Legalize 5 kW photovoltaic production as a direct self-consumption type 1.

4.3.2 Implemented measures during the project lifetime

- New PV system for electrical common services needs.
  - Will be completed by the end of July 2018.
- Installation of individual electrical meters for each apartment:
  - Will be completed by the end of July 2018.
- Change of locations of light sensors in community spaces:
  - Completed by the end of autumn 2017.
- Replacement of collectors of hot water and heating system
  - Completed by the end of autumn 2017.
- Improvement of the control system to integrate new elements of renewable energy:
  - Will be completed by the end of July 2018.
- Unification of electric meters and legalization of self-consumption:
  - Will be completed by the end of July 2018.

4.4 Interconnection with NewTREND

Stakeholder engagement activities for the task 6.2

- Building diary exercise: Users and occupants might document their experiences with the building on a daily basis. They were not to be confined to the topic of energy, and some participants sent photographs. We provided them with an e-mail address where they might send photos. They wrote about how they felt, the lighting, the view, the smell, the atmosphere, the noise - anything at all. (This part of the engagement was only for users / occupants).
- Interviews: At the end of the diary process, we met each participant face to face in a private un-structured interview to discuss the diary process, what they thought of the process, and what they wrote about. All interviews to be recorded, and transcribed word for word, translated to English, and sent to UCC for coding and analysis.

The users and residents of buildings interviewed who participated and previous stages of NewTREND, feel they didn't get enough feedback about the "results", "conclusions" or "reflections" of the design process and the study itself.

As a result of interviews phase, there was a new measure in the school: replacement of current windows in administrational building and sport pavilion.

In total, 6 occupants / users of the pilot buildings of Sant Cugat engaged in interviews and building diary exercise activity.

In case of the building of 7 Mar de la Xina Street, two inhabitants engaged.

- Focus Group: Based on the emerging themes from the diary process, it was expected to organize a focus group & a workshop. The NewTREND Focus Group of Sant Cugat was on Saturday 14th of April in the morning.

The participants for the Focus group and Workshop are not limited to the users / occupants. It is preferable to have as many different types of stakeholders possible at these activities; designers, builders, owners etc. The required numbers for a focus group are minimum 4 maximum 12, and for a workshop are minimum 5, maximum 15. Each event should also be attended by a moderator / facilitator (member of the Sant Cugat team), and a recorder / transcriber / translator.

Ten persons were involved in the NewTREND Focus Group (2 inhabitants, 6 users, 1 designer, 1 owner)

- Workshop: TBD

Local Advisory Team (LAT)

Setting up a Local Advisory Team with the stakeholders of the demo sites and independent consultants, whose feedback will be an important input for the development of the NewTREND methodology and tool.

There will be several activities – workshops, interviews, testing of the tool – organized with the Local Advisory Team (LAT) at various stages of the project on a regular basis, in order to have the possibility for incorporating their feedback at an early stage. Occupants' involvement in the Integrated Design Process (IDP) will be supported by activities focusing specifically on their habit, user preferences.

- 1st LAT : October 2016
- 2nd LAT: July 2017
- 3rd LAT: June 2018
- 4th LAT: July-August 2018

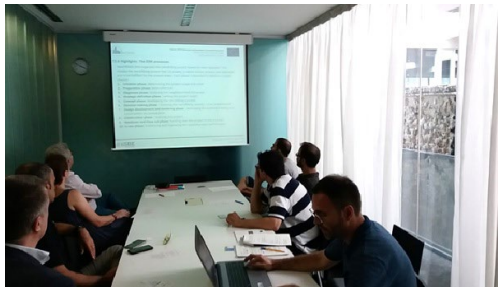


Figure 21 and 22: Local Advisory Team in Spain

Data collection activities (task 6.1)

Each house has an individual meter to measure their Individual consumption of heat energy for radiators and another to measure the heat energy of domestic hot water. All meters are electronic allowing user to connect and know on time their consumption.

Heating system: Central heating system monitored (Natural Gas): 2x115 kW condensing boiler.

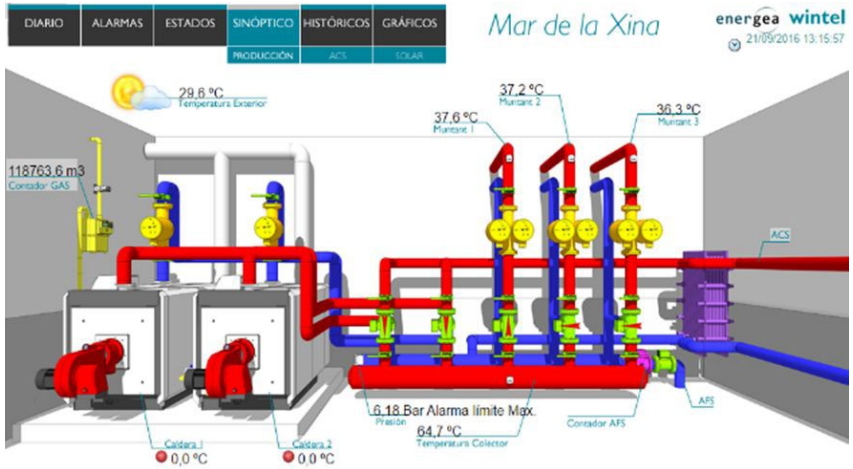


Figure 23: Central heating system

Metering and control system: control of boiler and solar system. System counters for hot water and heating for each apartment with electronic data transmission to an external server to check each individual apartment.

Electric system: there're not sub-metering currently within the buildings. We know only the overall electricity consumption of community spaces.

Currently, Energea (Energy management company) manages the central heating and domestic hot water system of this building.

Planned monitoring measures

- Installation of individual electrical meters for each apartment: Installation of 35 single-phase electric meters to measure the consumption of each apartment. The data collected will be sent to a platform on which users can monitor their consumption and compare them with the rest of the consumption of the building.
- Improvement of the control system to integrate new elements of renewable energy: In order to control the overall system for ensuring proper operation and maintenance, the current control system will be updated integrating the new elements of the installation:
  - Solar thermal collectors
  - PV and new thermal panels.
  - Inverter
- Install energy meters in order to pass on the costs according to the currently existing connections.
- Measurements of the indoor air temperature, relative humidity and CO2 concentration in three apartaments of this Building. Indoor conditions will be measured during Autumn 2018.

NewTREND tool testing on each demo sites (task 6.3)

- Data Manager Testing. Data Manager Testing Feedback Templates (DM-TFT)
- CDP Testing. Testing Feedback Template oh the Collaborative Platform (CDP-TFT)

Pilot Project in Spain

5. Spanish Pilot Projects: Sant Cugat del Vallès, Spain - Pins del Vallès School

Sant Cugat del Vallès is a medium size city located in the outskirts of Barcelona, in the region of Vallès Occidental. Its monumental heritage, led by an ancient Benedictine monastery, is surrounded by natural areas of great beauty.

Sant Cugat (population 90 100) has seen its population increase in recent years, with more births than bigger cities like Barcelona. It has also practically merged with the nearby Rubí (population 75 167) and Cerdanyola del Vallès (population 57 543).

The town has several train stations with a direct metro connection to Barcelona city center and the nearby industrial cities of Terrassa and Sabadell. Sant Cugat del Vallès is a city well connected through several highways.

The climate is mild, and generally warm and temperate. This climate is considered Cfa according to the climatic classification of Köppen-Geiger. In Sant Cugat, the annual average temperature is 16.1°C.

- Sant Cugat is within the domain Mediterranean coast climate, characterized by the following aspects:
- Moderate annual thermal oscillation (13°C to 30°C on average);
- Mild winters (average minimum temperature of 6-8°C), with no cold periods, although there may be occasional freezing (-16°C in February 1956, -12°C in January 1985);
- Hot, dry summers, lack of rain and high temperatures (average temperature of 24°C);
- Average rainfall of about 650 mm per year. Irregular seasonal rainfall, concentrated in equinoctial periods. Rainfall is characterized by its irregularity month and year, and a strong torrential. The months of September, October and November are the ones who collect a greater volume rain fall. The average number of days of precipitation per year in Sant Cugat is 58.4.
- As for the wind, there is a predominance of the component SW (13.2%), followed by addresses W (10.6%), S (7.7%) and SE (6.9%).
- Collserola exerts an effect slightly dimmer influence coast, the extent and causes Thermal is greater than in Barcelona. Another differential is stagnant humid air masses, especially in situations of thermal inversion.

- Within the municipality there are considerable variations microclimatic, favored the extension of the territory and environmental factors (altitudinal variation, location or orientation). This gives rise to different microclimates conditional variations in temperature, humidity, sunshine and wind. For example, between the ridge and the valley have been temperature differences of 7-8°C.

5.1 General information about pilot project

5.1.1 District area description

The second demo site is Pins del Vallès School (State School). This school is located in the north of the centre of Sant Cugat. It's close to the RENFE railway (line R8) and near Volpelleres forest.

The school is in an isolated and opened area of the city. The school's buildings are in a secluded sector, surrounded by green areas and sports facilities. The area where the school is located is very airy and sunny.

Table 1: General information of Sant Cugat demo district area

General Information of the Demo District Area	
City / Country	*Sant Cugat, Spain*
Address/Location of the District	*51 Can Volpelleres Avenue*
District Function	*School buildings*
Year of Construction	*1980*
Gross Build Area	*3 894 m²*
Net Build Area	*3 396.05 m²*
Number of Buildings	*4*
District Morphology	*Free-standing buildings*

5.1.2 Building area description

Table 2: General information of Sant Cugat demo building number 2

General Information of the Demo Building Number 2	
City / Country	*Sant Cugat, Spain*
Address/Location of the Building	*51 Can Volpelleres Avenue*
Building Function	*Primary school building*
Year of Construction	*1980*
Gross Build Area	*2 685 m2*
Net Build Area	*2 335.95 m2*
Maximum Height of Building	*7,5 m*

Table 3: General information of Sant Cugat demo building number 3

General Information of the Demo Building Number 3	
City / Country	*Sant Cugat, Spain*
Address/Location of the Building	*51 Can Volpelleres Avenue*
Building Function	*Kindergarten building*
Year of Construction	*1980*
Gross Build Area	*466 m2*
Net Build Area	*396.1 m2*
Maximum Height of Building	*6.5 m*

Table 4: General information of Sant Cugat demo building number 4

General Information of the Demo Building Number 4	
City / Country	*Sant Cugat, Spain*
Address/Location of the Building	*51 Can Volpelleres Avenue*
Building Function	*Administrational building*
Year of Construction	*1980*
Gross Build Area	*289 m2*
Net Build Area	*250.25 m2*
Maximum Height of Building	*3.5 m*

Table 5: General information of Sant Cugat demo building number 5

General Information of the Demo Building Number 5	
City / Country	*Sant Cugat, Spain*
Address/Location of the Building	*51 Can Volpelleres Avenue*
Building Function	*Sport pavilion*
Year of Construction	*1980*
Gross Build Area	*454 m2*
Net Build Area	*413.75 m2*
Maximum Height of Building	*7 m*

Pins del Vallès school consists of four buildings (Primary School Building, Administration Building, Sport Pavilion, Kindergarten Building). In total, the school has 450 students.

Figure 24, 25, 26, 27, 28, 29 and 30: External area of the Pins del Vallès school

School's schedule

- The class Schedule is from 9:00 to 12:30 AM and from 3:00 to 4:30 PM
- From 12:30 PM to 3:00 PM some classrooms are open but the majority of the students are in the dining room or outside the building.
- There is also extra activities out the class schedule. In the morning (from 7:30 to 8:45 AM) and in the afternoon (from 4:30 to 6:00 PM)
- Wall types
- Ceramic wall 30 cm wide with chamber (15+10+5) in Primary school building, kindergarten building and administration building.
  - U value: 0,83 W/m2K
- Concrete block 25 cm in sport pavilion.
  - U value: 1,12 W/m2K

Energy consumption

The total energy consumption per year is 414 862 kWh of which 31% is electricity and 69% is natural gas.

HVAC and electric system

- Heating system type
  - Central heating system monitored (Natural Gas)
- 3x126 kW standard boiler (Central heating (3 atmospheric gas boilers (3x100 kW)) for Primary school, school administration and Sport pavilion. Cast iron radiators;
- 1x101 kW standard boiler (Central heating (atmospheric gas boiler (50 kW)) for kindergarten building. Cast iron radiators.
- Cooling system type
  - 4 split (4x3 kW) in computer classrooms (Primary Scholl Building). The rest of classrooms and spaces of Primary School building have natural ventilation;
  - No cooling system in Sport pavilion, kindergarten building and administration building. Natural ventilation;
  - It is forbidden by law to install cooling systems in school buildings. Therefore, no actions are planned in this sense.
- Electric system
  - There're not sub-metering currently within the buildings.
- Currently, no renewable production.

Windows in the primary school building were replaced in 2009 (Aluminum window with double glazing and shutters PVC).

Windows in the Kindergarten building were replaced in 1999 (Aluminum window with double glazing and shutters PVC).

Administration building: Steel window with single glazing and shutters PVC (originals windows). Sport pavilion: Steel window with single glazing.

5.2 Main stakeholder involved

5.2.1 District area stakeholders

Client

- City of Sant Cugat del Vallès (Owner). https://www.santcugat.cat/
- Building users
- Users (Teachers and students). http://pinsdelvalles.cat/
  - "Green school": Project based in conservation awareness and environmental education for sustainability.
  - The school adheres to the Network of Green Schools of Catalonia and School 21 Agenda of Sant Cugat through which receives training in a school meetings and environmental workshops organized by the City Council and receive a badge that must go renewed every four years presenting the project done.
  - The main objectives are:
- Promote healthy and respectful attitudes towards the environment in order to foster sustainable behavior and solidarity in the management of environmental resources.
- Consolidate activities that encourage involvement towards respect for the environment and involve the entire school community (teachers, students, parents, instructors ...) to ensure dynamic participation and training.
- Strengthen and work from practice and experience some of the learning objectives in the area of Environmental Knowledge of each cycle related to the environment, the use and operation of the orchard and farm.
- AFA (Families association). http://agora.xtec.cat/ceip-pins/categoria/afa/
  - Parents Association is very aware and interested in environmental themes. The association has an environmental committee.
  - This organization, among its activities, subsidize improvements to school buildings and facilities.

Designers

- Veolia (Energy management company). http://www.veolia.es/es
  - Veolia provides innovative solutions for the sustainable development of cities and companies, through the control and maintenance of urban networks of heat and cold, industrial utilities and energy services in buildings and facilities.
  - Veolia manages HVAC systems in municipal buildings of Sant Cugat.
- Technics of Sant Cugat del Vallès City Council. https://www.sant-cugat.cat/

5.2.2 Building area stakeholders

Client

- City of Sant Cugat del Vallès (Owner). https://www.santcugat.cat/

Building users

- Users (Teachers and students). http://pinsdelvalles.cat/
  - "Green school": Project based in conservation awareness and environmental education for sustainability.
  - The school adheres to the Network of Green Schools of Catalonia and School 21 Agenda of Sant Cugat through which receives training in a school meetings and environmental workshops organized by the City Council and receive a badge that must go renewed every four years presenting the project done.
  - The main objectives are:
- Promote healthy and respectful attitudes towards the environment in order to foster sustainable behavior and solidarity in the management of environmental resources.
- Consolidate activities that encourage involvement towards respect for the environment and involve the entire school community (teachers, students, parents, instructors ...) to ensure dynamic participation and training.
- Strengthen and work from practice and experience some of the learning objectives in the area of Environmental Knowledge of each cycle related to the environment, the use and operation of the orchard and farm.
- AFA (Families association). http://agora.xtec.cat/ceip-pins/categoria/afa/
  - Parents Association is very aware and interested in environmental themes. The association has an environmental committee.
  - This organization, among its activities, subsidize improvements to school buildings and facilities.

Designers

- eolia (Energy management company). http://www.veolia.es/es
  - Veolia provides innovative solutions for the sustainable development of cities and companies, through the control and maintenance of urban networks of heat and cold, industrial utilities and energy services in buildings and facilities.
  - Veolia manages HVAC systems in municipal buildings of Sant Cugat.
- Technics of Sant Cugat del Vallès City Council. https://www.sant-cugat.cat/

5.3 Retrofit measures

5.3.1 District area planned measures

- Replacement of the atmospheric boilers to condensing boilers.
- Sectioning / segregation of the heating system
  - To obtain energy consumption data of each building separately.
  - Segregation of the heating system according to the different orientations of each building.
- Improvement of the control system to integrate new elements of renewable energy

5.3.2 Building planned measures

- Installation of PV panels
  - 27.03 kWp photovoltaic installation for self-consumption located on the roof of Primary School building of Pins del Vallès.
  - Photovoltaic solar energy is the capture of solar radiation in order to transform it into electricity.
  - The aim of this installation is the instantaneous consumption.
  - It is a type of installation that support network where the energy generated will be self- consumed instantly. Whenever possible and, if it occurs, the surplus will be uploaded into the electricity distribution network.
  - The purpose of the photovoltaic installation is environmental. It aims to reduce the carbon footprint resulting from daily activities developed at the School Pins del Vallès and also to reduce the cost of it.
  - The installation will consist of 102 photovoltaic modules BenQ Green triplex PM060P00 of 256 Wp or similar totaling 27,03 kWp of installed power.
  - The photovoltaic system will have a monitoring system of production and consumption like of 2.0 ITR manufacturer LACECAL, who control both the generation of the inverter and the consumption and disposal of surplus production solar self-consumed not instantly to the electric distribution network.
  - To follow the specifications established in RD900 / 2015 regulating consumption installations, must have a new measuring equipment that follow the specifications of the electric distribution company.
  - A set of actions must be placed to measure the net generation of photovoltaic installation of Pins del Vallès School.
  - It is considered essential to a real-time monitoring system that allows displays publicly the operation of the photovoltaic installation.
- Installation of LED technology lamps
  - Installation of LED technology lamps will reduce the power demand in 5 kW.
  - This project will be implemented in Primary School Building, kindergarten, administration building and sport pavilion.

- Reduction of energy demand through the façade retrofitting
  - External Thermal Insulation Composite System (ETICS / EIFS):
- Constructive solution: Overlay of insulating panel + protection mesh + waterproof and water-repellent finishing plastering mortar.

1. Adhesive mortar
2. EPS panel (insulation)
3. Mechanical anchoring
4. Reinforcement mesh
5. Adhesive mortar for reinforcement-mesh embedding
6. Topcoat coating of waterproof and water-repellent plastering mortar.
7. Foundation lath

Advantages of this system:

- No lost floor space inside the rooms;
- Reduction of thermal bridges, particularly at points of contact with the facades of the slabs;
- Significant improvement of the energy efficiency of the facades.
- Very high energy efficiency system;
- Low thermal conductivity;
- Contribution to the environmental sustainability;
- Aesthetic improvement of the building;
- Significant reduction of energy demand and energy consumption;
- Heating demand reduction is estimated between 20% and 40%;
- Ceramic wall 30 cm with chamber (15+10+5) + ETICS system in Primary school building, kindergarten building and administration building.
  - New U value: 0,27 W/m2K
- Concrete block 25 cm + ETICS system in sport pavilion.
  - New U value: 0,29 W/m2K
- Replacement of current windows in administrational building and sport pavilion

5.3.3 Implemented measures during the project lifetime

- Installation of PV panels
  - Will be completed by the end of august 2018.
- Installation of LED technology lamps
  - Completed by the end of Winter 2018.
- Improvement of the control system to integrate new elements of renewable energy
  - Will be completed by the end of august 2018.
- Reduction of energy demand through the façade retrofitting
  - Will be completed by the end of Summer 2018
- Replacement of current windows in administartional building and sport pavilion
  - Will be completed by the end of August 2018

5.4 Interconnection with NewTREND

Stakeholder engagement activities for the task 6.2

- Building diary exercise: Users and occupants might document their experiences with the building on a daily basis. They were not to be confined to the topic of energy, and some participants sent photographs. We provided them with an e-mail address where they might send photos. They wrote about how they felt, the lighting, the view, the smell, the atmosphere, the noise - anything at all. (This part of the engagement was only for users / occupants).
- Interviews: At the end of the diary process, we met each participant face to face in a private un-structured interview to discuss the diary process, what they thought of the process, and what they wrote about. All interviews to be recorded, and transcribed word for word, translated to English, and sent to UCC for coding and analysis. The users and residents of buildings interviewed who participated and previous stages of NewTREND, feel they didn't get enough feedback about the "results", "conclusions" or "reflections" of the design process and the study itself. As a result of interviews phase, there was a new measure in the school: replacement of current windows in administrational building and sport pavilion.

In total, 6 occupants / users of the pilot buildings of Sant Cugat engaged in interviews and building diary exercise activity.

In case of the buildings of Pins del Vallès School, three users engaged.

- Focus Group: Based on the emerging themes from the diary process, it was expected to organize a focus group & a workshop. The NewTREND Focus Group of Sant Cugat was on Saturday 14th of April in the morning.. The participants for the Focus group and Workshop are not limited to the users / occupants. It is preferable to have as many different types of stakeholders possible at these activities; designers, builders, owners etc. The required numbers for a focus group are minimum 4 maximum 12, and for a workshop are minimum 5, maximum 15. Each event should also be attended by a moderator / facilitator (member of the Sant Cugat team), and a recorder / transcriber / translator. Ten persons were involved in the NewTREND Focus Group (2 inhabitants, 6 users, 1 designer, 1 owner)

Figure 31, 32, 33 and 34: Focus Group

- Workshop: TBD

Local Advisory Team (LAT)

Setting up a Local Advisory Team with the stakeholders of the demo sites and independent consultants, whose feedback will be an important input for the development of the NewTREND methodology and tool.

There will be several activities – workshops, interviews, testing of the tool – organized with the Local Advisory Team (LAT) at various stages of the project on a regular basis, in order to have the possibility for incorporating their feedback at an early stage. Occupants' involvement in the

Integrated Design Process (IDP) will be supported by activities focusing specifically on their habit, user preferences.

- 1st LAT : October 2016
- 2nd LAT: July 2017
- 3rd LAT: June 2018
- 4th LAT: July-August 2018

Data collection activities (task 6.1)

Heating system type

- Central heating system monitored (Natural Gas):
  - 3x126 kW standard boiler (Central heating (3 atmospheric gas boilers (3x100 kW)) for Primary school, school administration and Sport pavilion. Cast iron radiators.
  - 1x101 kW standard boiler (Central heating (atmospheric gas boiler (50 kW)) for kindergarten building. Cast iron radiators.

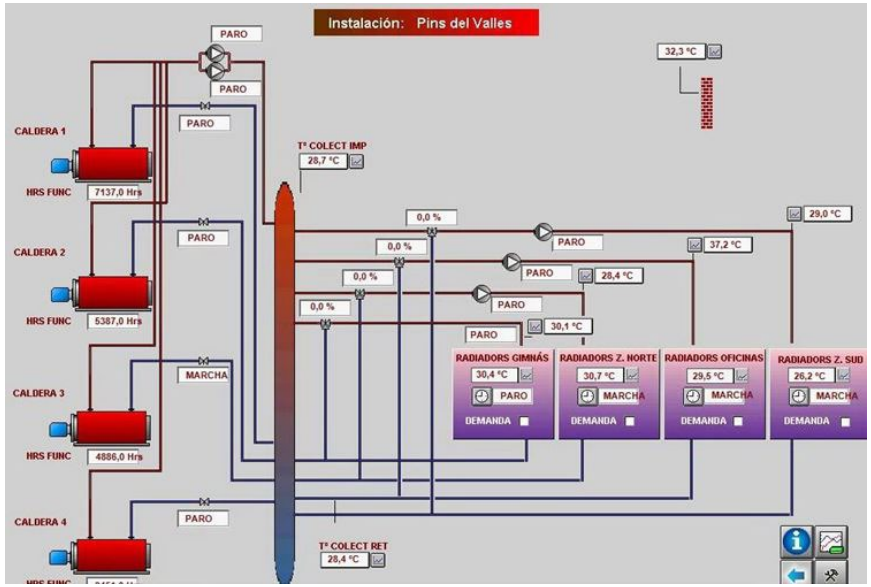


Figure 35: heating system in pins del valles school
http://telegestio.cat.veolia.es/View/lan/menu_sant_cugat.shtml

Electric system

- There're not sub-metering currently within the buildings.
- Currently, Veolia (Energy management company) manages HVAC of Pins del Vallès school and the monitoring of the heating system.
- Between August 2016 and January 2017, electricity consumption was analysed using a monitoring system installed by AMB (Metropolitan Area of Barcelona).

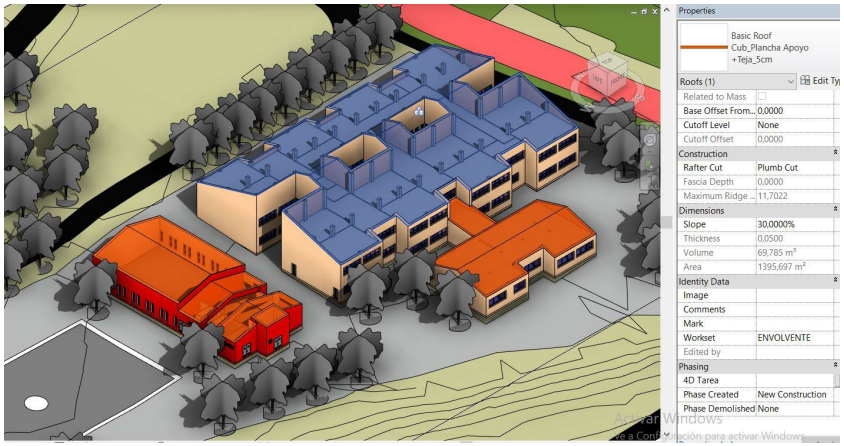
Planned monitoring measures

- Installation of PV panels – monitoring
  - The photovoltaic system will have a monitoring system of production and consumption like of 2.0 ITR manufacturer LACECAL, who control both the generation of the inverter and the consumption and disposal of surplus production solar self-consumed not instantly to the electric distribution network.
  - It is considered essential to a real-time monitoring system that allows displays publicly the operation of the photovoltaic installation.
  - If it was necessary, the ITR 2.0 system could regulate the photovoltaic production to approach the instantaneous consumption but without exceeding it. Therefore, the injection of surplus in the electrical network could be avoided.
  - The ITR 2.0 system will do monitoring tasks of general consumption, photovoltaic production, self-consumption, surplus, and energy quality control. Thanks to its Input / Output Interface, it could also control certain loads of the installation based on the production, providing remote management capability.
  - The ITR 2.0 device includes three-phase power meters that will analyse the overall consumption of loads throughout the Pins del Vallès School. Communication with inverters will be done through an Ethernet network, and communication with the local or remote server may be for Ethernet, WIFI or 3G. The distribution cabling of the photovoltaic installation includes all the conductors that transport electrical energy from the photovoltaic modules to the general panel of distribution of the consumptions in low voltage.
- Sectioning (zoning) of the heating system
  - To obtain energy consumption data of each building separately.
  - Zoning of the heating system according to the different orientations of each building.
- Improvement of the control system to integrate new elements of renewable energy
- Measurements of indoor air temperature, relative humidity and CO2 concentration in the different buildings of school, after the sectioning of the school heating system. Indoor conditions will be measured during Autumn 2018 (one month).

- Number of rooms where the sensors will be installed at each building:
  - Primary School Building: 4
  - Administration Building: 2
  - Kindergarten Building: 2
  - Sport Pavilion: 1

NewTREND tool testing on each demo sites (task 6.3)

- Creating BIM with Revit
- BIM – IFC export
- Creating Citygml
- Data Manager Testing. Data Manager Testing Feedback Templates (DM-TFT)
- CDP Testing. Testing Feedback Template oh the Collaborative Platform (CDP-TFT)



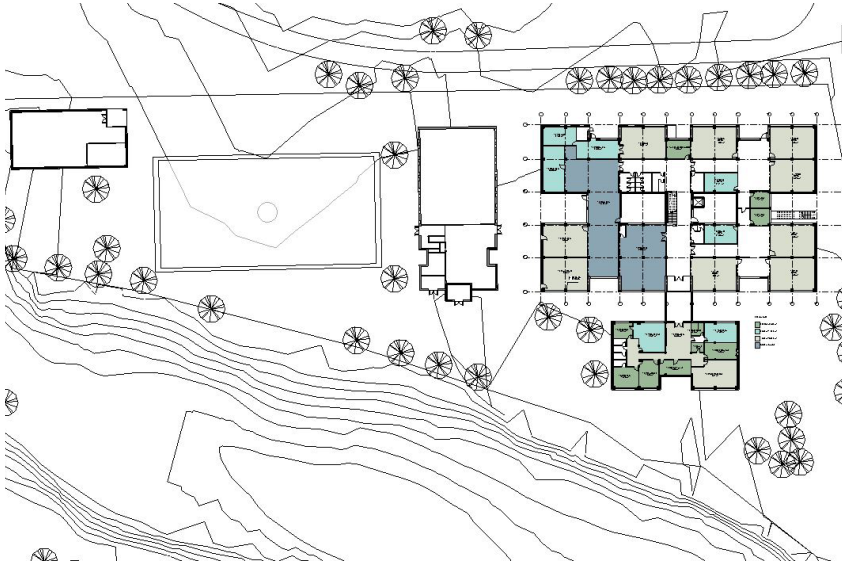


Figure 36, 37 and 38: BIM Pins del Vallès school

Pilot Project in Spain

6. Spanish Pilot Projects: Sant Cugat del Vallès, Spain - Private houses in Les Planes

Sant Cugat del Vallès is a medium size city located in the outskirts of Barcelona, in the region of Vallès Occidental. Its monumental heritage, lead by an ancient Benedictine monastery, is surrounded by natural areas of great beauty.

Sant Cugat (population 90 100) has seen its population increase in recent years, with more births than bigger cities like Barcelona. It has also practically merged with the nearby Rubí (population 75 167) and Cerdanyola del Vallès (population 57 543).

The town has several train stations with a direct metro connection to Barcelona city centre and the nearby industrial cities of Terrassa and Sabadell. Sant Cugat del Vallès is a city well connected through several highways.

The climate is mild, and generally warm and temperate. This climate is considered Cfa according to the climatic classification of Köppen-Geiger. In Sant Cugat, the annual average temperature is 16.1°C.

Sant Cugat is within the domain Mediterranean coast climate, characterized by the following aspects:

- Moderate annual thermal oscillation (13°C to 30°C on average);
- Mild winters (average minimum temperature of 6-8°C), with no cold periods, although there may be occasional freezing (-16°C in February 1956, -12°C in January 1985);
- Hot, dry summers, lack of rain and high temperatures (average temperature of 24°C);
- Average rainfall of about 650 mm per year. Irregular seasonal rainfall, concentrated in equinoctial periods. Rainfall is characterized by its irregularity month and year, and a strong torrential. The months of September, October and November are the ones who collect a greater volume rain fall. The average number of days of precipitation per year in Sant Cugat is 58.4.
- As for the wind, there is a predominance of the component SW (13.2%), followed by addresses W (10.6%), S (7.7%) and SE (6.9%).
- Collserola exerts an effect slightly dimmer influence coast, the extent and causes Thermal is greater than in Barcelona. Another differential is stagnant humid air masses, especially in situations of thermal inversion.

- Within the municipality there are considerable variations microclimatic, favoured the extension of the territory and environmental factors (altitudinal variation, location or orientation). This gives rise to different microclimates conditional variations in temperature, humidity, sunshine and wind. For example, between the ridge and the valley have been temperature differences of 7-8°C.

6.1 General information about pilot project

Figure 39 and 40: general and aerial view of les planes neighborhood

6.1.1 Building area description

The third demo site is two private houses in Les Planes neighbourhood.

This neighbourhood is located in the south of Sant Cugat municipality, surrounded by Collserola Natural Park, in a forest area. Les Planes has 1 228 inhabitants (1% of Sant Cugat population). Most of the housing are single-family houses. The neighbourhood has a low social and economic level.

HVAC system

- Heating and DHW system type
  - Electric boiler for Domestic Hot Water.
  - Heating System: wood and electric stoves.
- There is no cooling nor mechanical ventilation in the building.

Table 1: General information of Sant Cugat demo building number 6

General Information of the Demo Building Number 6	
City / Country	*Sant Cugat, Spain*
Address/Location of the Building	*28 Nostra Senyora de l'Estrada Street*
Building Function	*Residential*
Year of Construction	*1960*
Gross Build Area	*61 m²*
Net Build Area	*54 m²*
Maximum Height of Building	*6 m*

Figure 41, 42 and 43: Nostra Senyora de l'Estrada street

Table 2: General information of Sant Cugat demo building number 7

General Information of the Demo Building Number 7	
City / Country	*Sant Cugat, Spain*
Address/Location of the Building	*9 Passatge del Pi Street*
Building Function	*Residential*
Year of Construction	*1965*
Gross Build Area	*95 m2*
Net Build Area	*83.6 m2*
Maximum Height of Building	*4 m*

6.2 Main stakeholder involved

6.2.1 Building area stakeholders

Client

- City of Sant Cugat del Vallès (Owner). https://www.santcugat.cat/
- Building users
- Users (occupants)
  - Low social and economic level neighborhood.

Designers

- ETSAV – UPC (Faculty of architecture – Polytechnic University of Catalonia) http://etsav.upc.edu/ca
- Arqbag (Architecture Office) https://www.arqbag.coop/
- Technics of Sant Cugat del Vallès City Council. https://www.sant-cugat.cat/

6.3 Retrofit measures

6.3.1 Building planned measures

- Monitoring the main data to detect a critical situation (done).
- Design cheap retrofit actions done by unemployed people from the neighbourhood (€ 10.000 per house).
- Replacement of current windows.
- New mechanical ventilation system in bathroom and kitchen
- Reduction of energy demand through the roof and walls retrofitting. New insulation of envelope.

6.3.2 Implemented measures during the project lifetime

- Monitoring the main data to detect a critical situation (March 2018).
- Design cheap retrofit actions done by unemployed people from the neighborhood (€ 10 000 per house).
- Replacement of current windows.
- New mechanical ventilation system in bathroom and kitchen
- Reduction of energy demand through the roof and walls retrofitting. New insulation of envelope.
- These measures will be executed during summer 2018.

6.4 Interconnection with NewTREND

Stakeholder engagement activities for the task 6.2

- Building diary exercise: Users and occupants might document their experiences with the building on a daily basis. They were not to be confined to the topic of energy, and some participants sent photographs. We provided them with an e-mail address where they might send photos. They wrote about how they felt, the lighting, the view, the smell, the atmosphere, the noise - anything at all. (This part of the engagement was only for users / occupants).
- Interviews: At the end of the diary process, we met each participant face to face in a private un-structured interview to discuss the diary process, what they thought of the process, and what they wrote about. All interviews to be recorded, and transcribed word for word, translated to English, and sent to UCC for coding and analysis.

The users and residents of buildings interviewed who participated and previous stages of NewTREND, feel they didn't get enough feedback about the "results", "conclusions" or "reflections" of the design process and the study itself.

As a result of interviews phase, there was a new measure in the school: replacement of current windows in administrational building and sport pavilion.

In total, 6 occupants / users of the pilot buildings of Sant Cugat engaged in interviews and building diary exercise activity.

In case of the two private houses of Les Planes, one inhabitant engaged.

- Focus Group: Based on the emerging themes from the diary process, it was expected to organize a focus group & a workshop. The NewTREND Focus Group of Sant Cugat was on Saturday 14th of April in the morning.

The participants for the Focus group and Workshop are not limited to the users / occupants. It is preferable to have as many different types of stakeholders possible at these activities; designers, builders, owners etc. The required numbers for a focus group are minimum 4 maximum 12, and for a workshop are minimum 5, maximum 15. Each event should also be attended by a moderator / facilitator (member of the Sant Cugat team), and a recorder / transcriber / translator.

Ten persons were involved in the NewTREND Focus Group (2 inhabitants, 6 users, 1 designer, 1 owner)

- Workshop: TBD

Local Advisory Team (LAT)

Setting up a Local Advisory Team with the stakeholders of the demo sites and independent consultants, whose feedback will be an important input for the development of the NewTREND methodology and tool.

There will be several activities – workshops, interviews, testing of the tool – organized with the Local Advisory Team (LAT) at various stages of the project on a regular basis, in order to have the possibility for incorporating their feedback at an early stage. Occupants' involvement in the Integrated Design Process (IDP) will be supported by activities focusing specifically on their habit, user preferences.

- 1st LAT : October 2016
- 2nd LAT: July 2017
- 3rd LAT: June 2018
- 4th LAT: July-August 2018

Data collection activities (task 6.1)

Monitoring activities

In 2014, sensors of temperature and humidity were installed in some homes.

Planned monitoring measures

- Monitoring the main data to detect critical situation.

- Measurements of indoor air temperature, relative humidity, CO2 concentration and noise. Indoor conditions were measured during winter 2018 (one week).
- One sensor were installed at each house.

REC Project

The REC project (energy retrofit of communities) addresses the problems of Energy Poverty from an energetic, social, economic and health perspective.

- Diagnosis phase.
  - Monitoring case studies (RELS)
  - Modeling (3D), computer simulation and calibration of selected cases (RELS)
- Suggestions for improvement.
  - Proposals for intervention actions (RELS)
  - Study and validation of retrofit proposals (RELS)
  - Implementation of the executive retrofit project
- Validation phase.
  - Monitoring and validation of the retrofit actions executed
  - Validation of the social and medical improvement of families after the retrofit
  - Drafting of the conclusions report
  - Evaluation of the project

RELS Methodology

EU / RELS project. The RELS project (Rénovation Energétique des LogementS

- Energy Renovation of Housing) is an energy rehabilitation methodology that helps to know the behavior of its users and not only the technical conditions of buildings.

The RELS project is a cross-border cooperation project funded 90% by the ENPI CBC MED Program for the promotion of renewable energies and the improvement of the thermal and energy efficiency of buildings for residential and social use located in the Mediterranean Region.

NewTREND tool testing on each demo sites (task 6.3)

- Data Manager Testing. Data Manager Testing Feedback Templates (DM-TFT)
- CDP Testing. Testing Feedback Template oh the Collaborative Platform (CDP-TFT)

Project Partners

ABUD Mernokiroda KFT
Hungary
www.abud.hu

Ajuntament de Sant Cugat
Spain
www.santcugat.cat

Granlund Oy
Finland http://www.granlund.fi/
www.granlund.fi

Integrated Environmental Solutions LtD
United Kingdom
www.iesve.com

iiSBE Italia R&D srl
Italy
www.iisbe-rd.it

dr. jakob energy research GmbH & Co. KG
Germany
www.drjakobenergyresearch.de

London Business School
United Kingdom
www.london.edu

Universita Politecnica delle Marche
Italy
www.univpm.it

Munich University of Applied Sciences
Germany
www.hm.edu

REGENERA energia&mediambiente
Spain
www.regeneralevante.com

Stam industrial research
Italy
www.stamtech.com

University College Cork
Ireland
www.ucd.ie http://www.ucd.ie/

University College Dublin
Ireland
www.ucd.ie

The research leading to these results has received funding from the European Union's Seventh Programme for research, technological development and demonstration under grant agreement 609222.

New TREND EU H2020

+NewtrendprojectEuH2020

NewTREND_EU

www.newtrend-project.eu