NEWTREND

NEW INTEGRATED METHODOLOGY AND TOOLS FOR RETROFIT DESIGN TOWARDS A NEXT GENERATION OF ENERGY EFFICIENT AND SUSTAINABLE BUILDINGS AND DISTRICTS

GA NO. 680474

DELIVERABLE D6.1:

CHARACTERIZATION OF THE BUILDINGS INVOLVED IN THE PILOT (EVALUATION AND DATA COLLECTION)

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Deliverable D6.1: Short Description

The three demo buildings/districts in Finland, Spain and Hungary will be defined and evaluated in this task according to the methodology, developed in WP2. The responsible partners will set the boundaries and framework of the demo sites and describe their general condition and gather the initial parameters. Data collection is a major part of this task, which will be carried out by the methodology (T2.1). It will include the collection of energy bills, data based on surveys, statistics and measurements carried out on site

Keywords: pilot; data collection; evaluation; demonstration sites

Deliverable D6.1: Revision History

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0.2	08/30/2017	Draft	ABUD	Revised draft for review
1.0	09/22/2017	Final	ABUD	Final version

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Abbreviations and Acronyms

Acronym	Definition
BIM	Building Information Model
CDP	Collaborative Design Platform
DHW	Domestic Hot Water
DIM	District Information Model
EeB	Energy-efficient buildings
GA	Grant Agreement
GIS	Geographical Information System
GML	Geography Markup Language
HVAC	Heating, Ventilation, Air Conditioning
IA	Innovation Action
IAQ	Indoor Air Quality
IDM	Integrated Design Methodology
IDP	Integrated Design Process
IEQ	Indoor Environmental Quality
IFC	Industry Foundation Classes
KPI	Key Performance Indicator
LAT	Local Advisory Team
NewTREND	NEW integrated methodology and Tools for Retrofit design towards a next generation of ENergy efficient and sustainable buildings and Districts
PMV	Predicted Mean Vote
PV	Photovoltaic
SDH	Simulation and Design Hub
UC	Use Case
VPP	Virtual Power Plant
WP	Work Package

Executive Summary

This report presents the results of Task 6.1 "Characterisation of the buildings involved in the pilot" within WP6 of the NewTREND project. The objective of this task is to collect all relevant information on the existing buildings subject to renovation applying the new approach and support tool proposed. The data and information collected in this phase describes the five demonstration sites from three cities: Budapest (Hungary), Seinäjoki (Finland), Sant Cugat (Spain).

The deliverable considered work done for previous work packages, such as *WP2 – Development of the NewTREND design methodology* where a new approach for data collection process was elaborated (T2.1), Key Performance Indicators were defined (T2.2) and also the NewTREND Methodology was developed (D2.6 and D2.7). During the data collection process software tools developed in *WP3 – Life-cycle collaborative design platform* and *WP4 – Simulation & Design Hub* that were already available (e.g.: DIM server) were tested and feedback was provided to support later software refinement processes. This enabled continuous interaction in between the on-going tasks, whilst taking the previous findings further to inform and refine software development requirements.

These case studies provide a fundamental contribution for the validation of the Integrated Design Process (IDP) at a real scale and 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.

1. INTRODUCTION

This deliverable aims to characterize selected NewTREND demo sites in three cities: Budapest, Seinäjoki and Sant Cugat. It is essential to define the area precisely within the district, which will be involved in the retrofitting process. 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.

The work done in this task is presented in the following sections of this deliverable:

- Section 1 is an introduction of the work conducted within Task 6.1.
- Section 2 describes each of the five demo sites in a dedicated sub-chapter including their specific area, stakeholders involved, planned retrofit measures and barriers faced.
- Section 3 discusses the data collection methodology and requirements, including data crucial for KPI calculations; it also examines the monitoring activities, including a general description and validation and feedback contributed by each demo location; reviews the comfort assessment, starting with a description and followed by validation and feedback given by the demo sites; presents the scope of site specific surveys.
- Section 4 presents main results of this task, data availability for KPI calculations and simulations in case of all demonstration sites.
- Section 5 concludes the deliverable, summarizing the feedback to inform the methodology on data collection and also informing software development and provides valuable feedback for the DIM Server.

The main chapters are followed by annexes, which contain the detailed tables of simulation data availability in case of each demonstration site.

2. Description of Demo Sites

This section describes all demonstration sites where the newly developed NewTREND methodology and tool are going to be tested. Analyses on the district level are being carried out in case of three demonstration sites from the three countries:

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

As specified in D2.6 and 2.7 in NewTREND, district-level analyses are done in basic mode in case of the demo sites as well. Whereas, building level evaluations are conducted in advanced and/or premium mode in case of all five demonstration sites:

- Budapest site,
- Seinäjoki site,
- Pilot No. 1. 35 rented apartment 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 expected timeline of retrofitting design and construction phases can be seen on Figure 1 in case of each demo site.

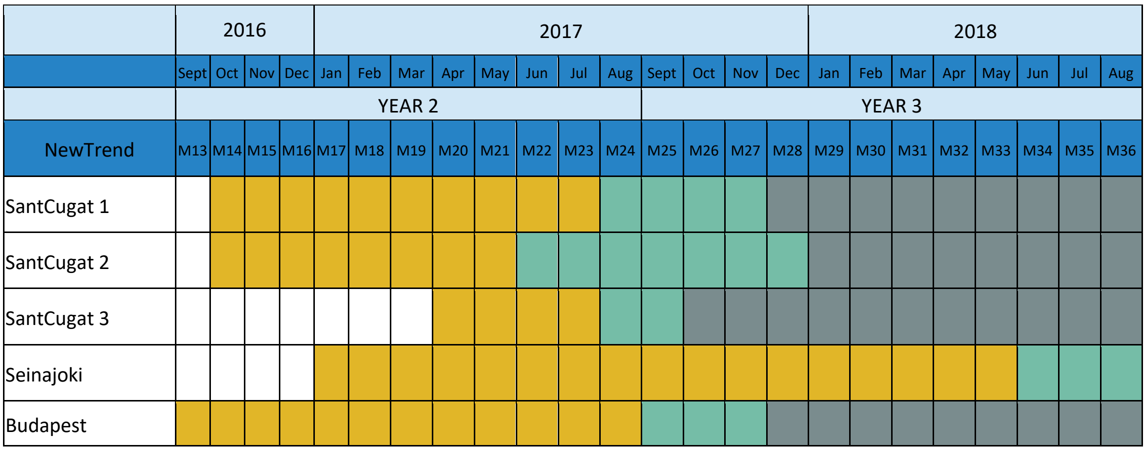

FIGURE 1: EXPECTED TIMELINE OF DEMO SITES DESIGN AND CONSTRUCTION

2.1. Budapest

2.1.1. Introduction

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.

FIGURE 2: LOCATION OF THE DEMO BUILDINGS AND DISTRICT
FIGURE 3: BÓKAY PRIMARY SCHOOL – VIEW FROM THE INNER COURTYARD
FIGURE 4: BÓKAY PRIMARY SCHOOL – VIEW FROM THE STREET

DISTRICT AREA DESCRIPTION

TABLE 1: GENERAL INFORMATION OF THE 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 m^2
NET BUILD AREA	5 137.08m^2
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 THE 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 m^2
Net Build Area	888 m^2
Maximum Height of Building	7 m

TABLE 3: GENERAL INFORMATION OF THE 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 m^2
Net Build Area	1 446 m^2
Maximum Height of Building	8.29 m

TABLE 4: GENERAL INFORMATION OF THE 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 m^2
Net Build Area	772 m^2
Maximum Height of Building	4.5 m

TABLE 5: GENERAL INFORMATION OF THE 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 m^2
Net Build Area	436 m^2
Maximum Height of Building	5 m

TABLE 6: GENERAL INFORMATION OF THE 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 m^2
Net Build Area	330 m^2
Maximum Height of Building	5 m

TABLE 7: GENERAL INFORMATION OF THE 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 m^2
Net Build Area	582 m^2
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.

Building description

TABLE 8: GENERAL INFORMATION OF THE 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 m^2
Net Build Area	1522 m^2
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 5: 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 6: AIR-WATER HEAT PUMP SYSTEM

2.1.2. STAKEHOLDERS INVOLVED

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.

BUILDING STAKEHOLDERS

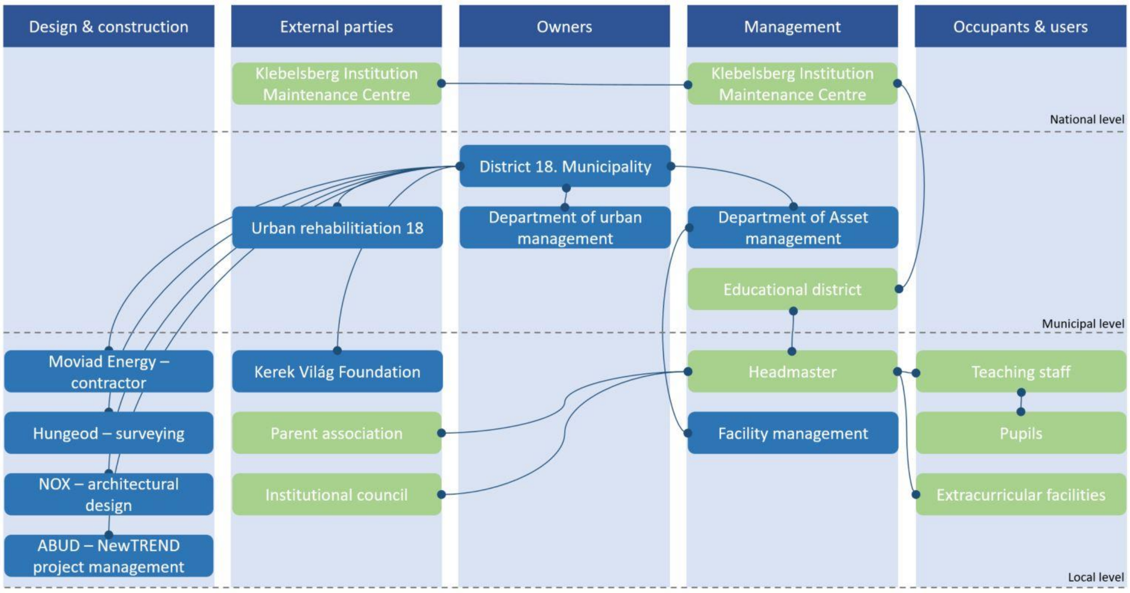

FIGURE 7: BÓKAY PRIMARY SCHOOL - STAKEHOLDER MATRIX

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.

2.1.3. Planned Measures

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.

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 is 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 is planned to further reduce the costs by the reduction of power consumption.

The planned solution for the inner side of the façade is 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 is recommended. The proposed solutions are: 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 is also advised from an energetic aspect. The thermal insulation of the attic floor is advised as well. The proposed solutions are: 15 cm Rockwool insulation for the attic floor.

2.1.4. Barriers

- Historic building;
- Delayed decision on the financing of the retrofit.
- The scope of retrofit was mainly determined by the type of calls which were available for the school to apply for. This is why façade structures are retrofitted and renewable systems are implemented whereas hot water and heating systems are left in a below-average condition.

2.2. SEINÄJOKI

2.2.1. INTRODUCTION

FIGURE 8: OLD HOSPITAL AREA IN SEINÄJOKI, FINLAND

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.

District area description

TABLE 9: GENERAL INFORMATION OF THE 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.

Building description

TABLE 10: GENERAL INFORMATION OF THE 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 11: GENERAL INFORMATION OF THE 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 m^2
Net Build Area	3 266 m^2
Maximum Height of Building	17 m

TABLE 12: GENERAL INFORMATION OF THE 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 13: GENERAL INFORMATION OF THE 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/m^{2}K), 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.

2.2.2. Stakeholders Involved

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);
- 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
- Engineering
  - MEP design: Granlund Pohjanmaa Oy
- Consultancy
  - Granlund Oy / Granlund Consulting Oy

2.2.3. Planned Measures

District area planned measures

For district area renewable energies addition will be analysed. Such as hybrid heating system (district heating + ground source heat pump) and solar PV panels.

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.

2.2.4. Barriers

Main barrier is that buildings are a part of cultural heritage (due to their age and architectural style), which limits the retrofitting scope. Another barrier is project timing, where retrofit construction phase will be finished after the NewTREND project ends, this means that post-retrofit analysis won't be made. This is going to be compensated by testing the post-occupancy methods for user data collection in phases before the retrofit happens.

2.3. Sant Cugat

2.3.1. Introduction

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.

PILOT NO. 1. 35 RENTED APARTMENT FOR YOUNG PEOPLE (7 MAR DE LA XINA STREET)

FIGURE 9: LOCATION OF THE DEMO BUILDING, SANT CUGAT, SPAIN

FIGURE 10 AND 11: 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 CO_2 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/m^{2}K

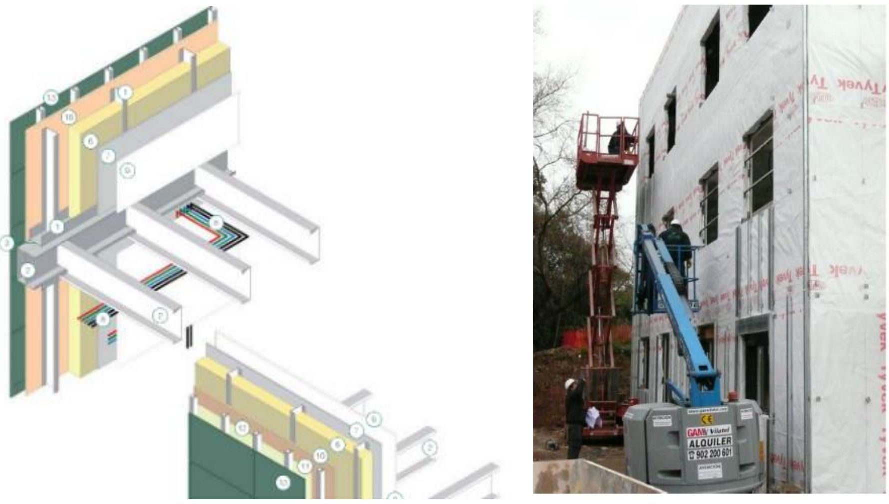

FIGURE 12: SANT CUGAT PILOT NO. 1. - WALL TYPE

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 13: SANT CUGAT PILOT NO. 1. - 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 14: GENERAL INFORMATION OF THE SANT CUGAT DEMO BUILDING NUMBER 1

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 m^2
Net Build Area	1 657.5 m^2
Maximum Height of Building	12 m

Pilot No. 2. Pins del Vallès School (51 Can Volpelleres Avenue)

FIGURE 14: PRIMARY SCHOOL BUIDING

FIGURE 15: SPORT PAVILION

FIGURE 16: ADMINISTRATIONS BUILDING

FIGURE 17: KINDERGARTEN BUILDING

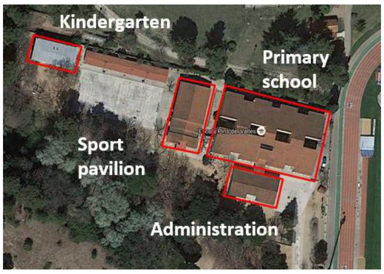

FIGURE 18: LOCATION OF THE DEMO BUILDING

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.

Pins del Vallès school consists of four buildings (Primary School Building, Administration Building, Sport Pavilion, Kindergarten Building).

In total, the school has 450 students.

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/m^{2}K
- Concrete block 25 cm in sport pavilion.
    - U value: 1,12 W/m^{2}K

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 (Aluminium window with double glazing and shutters PVC).

Windows in the Kindergarten building were replaced in 1999 (Aluminium 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.

District area description

TABLE 15: GENERAL INFORMATION OF THE 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 m^2
Net Build Area	3 396.05 m^2
Number of Buildings	4
District Morphology	Free-standing buildings

Building descriptions

TABLE 16: GENERAL INFORMATION OF THE 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 m^2
Net Build Area	2 335.95 m^2
Maximum Height of Building	7,5 m

TABLE 17: GENERAL INFORMATION OF THE 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 m^2
Net Build Area	396.1 m^2
Maximum Height of Building	6.5 m

TABLE 18: GENERAL INFORMATION OF THE 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 m^2
Net Build Area	250.25 m^2
Maximum Height of Building	3.5 m

TABLE 19: GENERAL INFORMATION OF THE 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 m^2
Net Build Area	413.75 m^2
Maximum Height of Building	7 m

Pilot No. 3. 2 private houses in Les Planes

FIGURE 19: GENERAL AND AERIAL VIEW OF LES PLANES NEIGHBORHOOD

The third demo site is 2 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 20: GENERAL INFORMATION OF THE SANT CUGAT DEMO BUILDING NUMBER 6

General Information of the Demo Building Number 6	
City / Country	Sant Cugat, Spain
Address/Location of the Building	6 Major del Rectoret Street
Building Function	Residential
Year of Construction	1970
Gross Build Area	69.25 m^2
Net Build Area	61.56 m^2
Maximum Height of Building	10 m

TABLE 21: GENERAL INFORMATION OF THE SANT CUGAT DEMO BUILDING NUMBER 7

General Information of the Demo Building Number 7	
City / Country	Sant Cugat, Spain
Address/Location of the Building	3 Carena Street
Building Function	Residential
Year of Construction	1965
Gross Build Area	80 m^2
Net Build Area	70 m^2
Maximum Height of Building	4 m

2.3.2. Stakeholders Involved

Pilot No. 1. 35 rented apartment for young people (7 Mar de la Xina Street)

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.santcugat.cat/

PILOT NO. 2. PINS DEL VALLÈS SCHOOL (51 CAN VOLPELLERES AVENUE)

Client

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

Building users

- Users (Teachers and students). http://pinsdelvalles.cat/green-school.php
    - "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.

- AMPA (Parents association). http://www.ampapins.cat/
    - 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.santcugat.cat/

Pilot No. 3. 2 private houses in Les Planes

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.santcugat.cat/

2.3.3. Planned Measures

Pilot No. 1. 35 rented apartment for young people (7 Mar de la Xina Street)

- Replacing thermal panels using Hybrid panels (PV + thermal) or both technologies. 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. In order to exclude from the mains consumption community proposes two options:
        - Option 1: The installation of solar hybrid Ecomesh production of heat and power;
        - Option 2: Two separate systems. PV panels system for electrical community spaces demands, and solar thermal panels system for Domestic Hot Water demands.
    - Using Hybrid panels the average coverage would be:
        - Solar hot water coverage: 58.94%;
        - Electricity coverage (consumption common spaces): 33.50%.
    - 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 or hybrid collectors;
    - PV or hybrids 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.

Pilot No 2. Pins del Vallès school (51 Can Volpelleres Avenue)

- 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 (partially done)
    - Installation of LED technology lamps will reduce the power demand in 5 kW.
    - This project will be implemented in Primary School Building.
- Replacement of the atmospheric boilers to condensing boilers.
- 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
- 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/m^2K
            - Concrete block 25 cm + ETICS system in sport pavilion.
                - New U value: 0,29 W/m^2K

Pilot No. 3. 2 private houses in Les Planes

- Monitoring the main data to detect a critical situation.
- Design cheap retrofit actions (€ 3 000) done by unemployed people from the neighbourhood.
- Replacement the current windows.
- Installation of two free PV kits supplied by manufacturers companies which are part of to the Catalan Energy Efficiency Cluster.
- Reduction of energy demand through the roof retrofitting. New insulation of envelope.

2.3.4. Barriers

Pilot No. 1. 35 rented apartment for young people (7 Mar de la Xina Street)

- Technical barriers
  - Excessive heat production in the summer.
  - Currently, the building has three electricity connections for community spaces consumptions.
- Non-technical barriers
  - The average occupants stay is 3.5 years.
  - Retrofitting process delayed.
  - Much of the financing depends on the public tender.

Pilot No. 2. Pins del Vallès School (51 Can Volpelleres Avenue)

- Technical barriers
  - Built in 1980. Not all information is available
- Non-technical barriers
  - Retrofitting process delayed.
  - Expensive actions to be implemented.
  - 100% of the financing depends on the public tender.
  - Funding to implement the proposed measures are subject to the total funds provided for works to all state schools in the municipality.

Pilot No. 3. 2 private houses in Les Planes

- Technical barriers
  - Built in 60s-70s. Not all information is available.
- Non-technical barriers
  - Low social and economic level neighbourhood.
  - Retrofitting process delayed.
  - Much of the financing depends on the public tender.

3. Data Collection

Chapter 3 describes the data collection activities already carried out on the demo sites and also describes the future data collection tasks.

The demo site data collection serves as an input for the testing of several NewTREND functionalities. The energy and comfort simulation, the comfort module validation, the stakeholder involvement functionalities all need input data about the current state of the building, district and occupants. Deliverable 2.6 describes the NewTREND IDM methodology, where the second phase (Preparation phase) includes the Collection of Neighbourhood Data, Collection of Building Data and Collection of occupant Data tasks. These tasks collect the data requirements for the different functionalities, these are also detailed in the following other deliverables:

- T3.4 – minimum data requirements for simulation
- T4.3 – data requirements for comfort assessment
- T5.2 – data requirements for cost / financial calculations

3.1. Data Requirements

3.1.1. Data Requirements for Simulation

This paragraph describes the software input data required to perform dynamic energy simulations for both building and neighbourhood scale, for all the three modes of operation of the Integrated Retrofit Design Methodology, as found in Deliverable *2.6 Integrated Design Methodology*.

In Deliverable *2.1 New approach for an advanced data collection process*, it is explained that although the planner of the district retrofitting concept will be supported by the use of software such as the NewTREND Platform and the data manager tool, the data collection is mainly a manual matter and can never be fully automatized. The reason for this is that the data in most cases is not available in a certain place or managed by a central institution. Instead, it has to be collected together from several data providers comparable with putting together a puzzle before it can be analysed.

Furthermore, in comparison with new building design, retrofitting existing buildings and neighbourhoods pose a bigger challenge in the data collection process, in terms of accuracy and reliability. As it is often the case that most of the required data are confined within the built structure or that available records do not accurately reflect the up to date state of the building due to the numerous changes that occur along the buildings years of operation.

To address this challenge, NewTREND proposes three modes of operation: Basic, Advanced and Premium mode as described in deliverabels 2.6 and 2.7. All three modes require a geometric model of the building and/or the neighbourhood that is enriched with semantic data as a starting point. However, the main difference between the three modes lies in the amount and the degree of accuracy of the geometric along with the semantic data of the building/neighbourhood which in turn have a direct impact on the number of outputs NewTREND will be able to offer to its users in each mode. More details can be seen on NewTREND modes on Figure 20.

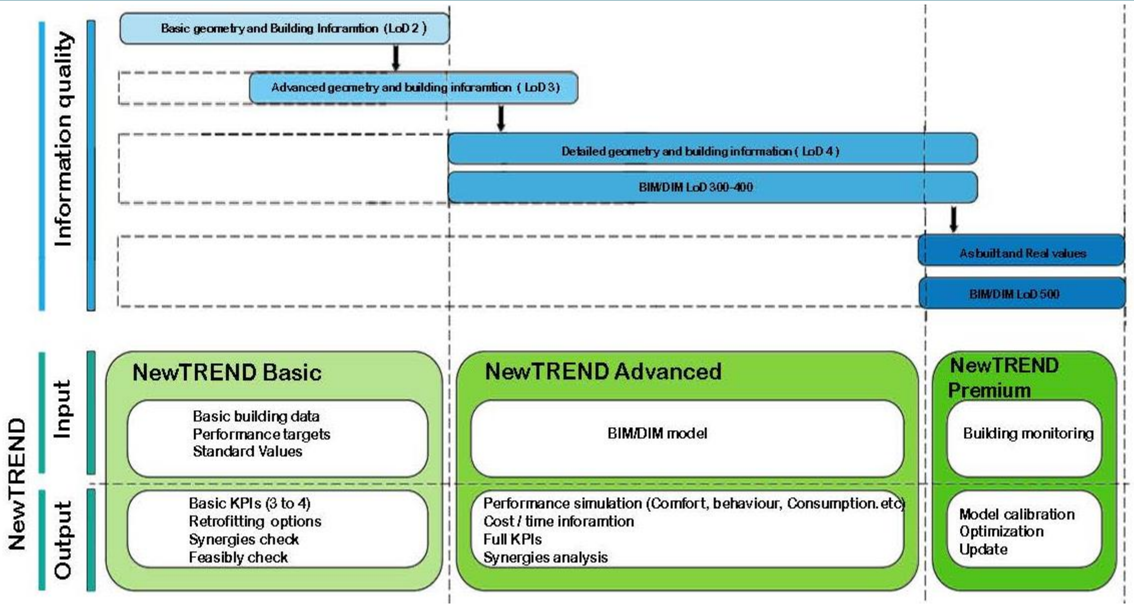

FIGURE 20 THE CONCEPT OF NEWTREND MODES

Choosing the mode of NewTREND that best suits the objectives of the project at this early stage would help guide the project team into collecting only the required information in the selected mode. Thus, reducing the redundancy of the information, as well as the time and effort required in collecting the data in the preparation phase.

As described in D2.1 in detail, the Basic mode is the mode of NewTREND with the lowest data requirements. Due to the limited availability of a BIM/DIM models for existing building stock and the fact that the creation of full BIM/DIM model of existing buildings is usually a very time and resources intensive process. Therefore, the Basic mode is introduced as a way to bridge the gap between a full BIM/DIM model and basic 2D drawing of a building.

In basic mode, the geo-located building footprint is enough information to create a basic geometry semi-automatically without using a desktop design tool. This is also populated with easy-to-obtain data collected early in the design phase at building storey level, such as building height, number of stories, wall to openings ratio etc. As a result, a concept 3D energy model can be semi-automatically created by the IES Virtual Environment (IESVE), the core of the NewTREND Simulation and Design Hub (SDH), suitable for early stage analyses of retrofit scenarios with good accuracy.

To enhance the accuracy and further populate the 3D geometry model with building thermal information that are easy and fast to collect, a template-based approach has been chosen, allowing the user to choose from lists of pre-populated data templates the ones that are the best match for their building. For example, if it is not possible for the data collector to obtain detailed information about the exterior wall U-values, the Basic mode can assign an appropriate construction template, auto-selected based on the user input of the location, the construction date and type of the building.

As described in D4.4 in detail, these templates are created manually based on accumulated knowledge obtained from previous research projects, historic information of the building typologies and regulations in the country of the site, and building templates suggested by well-known and acknowledged institutions such as CIBSE[1] and ASHRAE[2]. Before using these templates, the data collectors will be asked to verify them if they already exist from previous projects, or create them.

The Table 22: Data requirements for basic mode lists the data required to perform an analysis in the basic mode together with the appropriate format that is used as input in the simulation engine:

- String, for direct user input
- List, for selection among a list of available options
- Import from DIM server, for information required to be set up, stored and imported from the DIM server

TABLE 22: DATA REQUIREMENTS FOR BASIC MODE

Data Requirements	Format
Building name/ Number	String
Building heritage status	List
Construction date	String
Construction type	List
Building location	Import from DIM server
Building footprint	Import from DIM server
Building orientation	Import from DIM server
Building height (excluding roofs and basements)	String
Building number of storeys above ground level	String
Roof type	List
Surrounding buildings geometry	Import from DIM server
Building primary use	List
Window/ glazed area %	String
Building infiltration	List
Space Conditioning Type	List
Heating/Hot Water Fuel	List
Heating/Hot Water Fuel Cost	String
Cooling/Ventilation Mechanism	List
Electricity cost	String
Building Hours of Use	List
Existing improvements / potential improvements	List

As described above, the user is asked to collect in information about the building in various forms. As an example, the Table 23: Building Primary Use Listed Optionslists the options available for the building primary use selection. The user can choose which type of building primary use best describes their building and each of them corresponds to the appropriate building information template, that later gets assigned to the 3D energy model of the building. For the support of the data collection process, the Data Manager tool will be used, which is described in D3.4.

1 http://www.cibse.org/

2 https://www.ashrae.org/

TABLE 23: BUILDING PRIMARY USE LISTED OPTIONS

Apartment	Post Office
Bank	Primary School
Bar	Prison
Cafe	Public Administration Building
Car Park	Restaurant
Childcare	Retail Store
Church	Secondary School
Cinema	Single family attached
Community Center	Single family detached
Data Center	Single family terraced
Department Store	Sports Activities Indoors
Health Care	Sports activities Outdoors
Hospital	Supermarket
Hotel	Swimming Pool
Industrial	Theatre
Kiosk	Underground garage
Library	University
Museum	Unknown
Office	Warehouse
Pharmacy	

The advanced mode requires a higher demand on data. More specifically, the information about the building must include a 3D BIM model in good detail (i.e. a geometric model including detailed building properties). Thus, the NewTREND in Advanced mode can perform comprehensive, detailed and accurate analysis on room level. Additionally, the user can acquire vast array of analysis results that cover energy, life cycle and user comfort subjects. Therefore, and in contrast to Basic mode, NewTREND in Advanced mode rely heavily on user input data to operate.

The Premium is a mode of NewTREND with the highest demand on data. This mode requires that the building have a very detailed 3D BIM model that reflects the actual building as built. The NewTREND in Premium mode can perform the same operations as in Advanced mode, however, conducts these operations with greater accuracy as it relies heavily on actual metered data to operate.

The 3D BIM models used in the NewTREND advanced and premium modes for the case study districts will be created based on the data collected for the demo sites. For this purpose, a checklist has been created to facilitate the data collection process. A screenshot of the checklist is shown (Figure 19), while the completed one with data for all the demo sites is found in ANNEX 1 and 2.

B	C	D	E	H	I	J	K
NewTREND Hungary site: Real data checklist for demo site energy modelling in IES-VE (Constantly Updated)							
Building name:				**FOR DATA COLLECTORS TO COMPLETE**			
	Item/Data Required	**Sub category**	**Specific values**	**File name or value (please complete this serction)**	**Comments (please complete in case of any issues in data collection)**	**Preferable Data Format**	**Level of detail (Site/Building/ Room)**
				Post-retrofit Status (leave blank if not known or item not retrofitted)			
Building Envelope	CAD Floor plan (Basement)			"-1. Basement.dxf" & "-1. Basement.pdf"		CAD drawing & PDF drawings	Building
	CAD Floor plan (Ground level)			"0. Ground Floor.dxf" & "0. Ground Floor.pdf"		CAD drawing & PDF drawings	Building
	CAD Floor plan (First floor to all the above floors)			"1. 1st Floor.dxf","2. 2nd Floor.dxf" & "1. 1st Floor.pdf","2. 2nd Floor.pdf"		CAD drawing & PDF drawings	Building
	CAD Roof plan			"3. Roof Top View.dxf" & "3. Roof Top View.pdf"		CAD drawing & PDF drawings	Building
	CAD False ceiling/void plan			N/A	The building has no false ceilings/voids.	CAD drawing	Building
	CAD Site plan Showing all the buildings			"Site plan.dxf" & "Site plan.pdf"	Uploaded to Zoho	CAD drawing	Site
	CAD site plan showing North arrow			"0. Ground Floor.dxf" & "0. Ground Floor.pdf"		CAD drawing	Site
	CAD Elevation of all the sides of building			"North-East Facade.dxf","North-West Facade.dxf","South-East Facade.dxf","South-West Facade.dxf" & "North-East Facade.pdf","North-West Facade.pdf","South-East Facade.pdf","South-West Facade.pdf"		CAD drawing & PDF drawings	Building
	CAD Sections of buildings explaining building at different levels			"S-01 Section.dxf", "S-02 Section.dxf" & "S-01 Section.pdf", "S-02 Section.pdf"		CAD drawing & PDF drawings	Building
	CAD façade sections, part sections, sctional elevations explaining building			"S-01 Section.dxf", "S-02 Section.dxf" & "S-01 Section.pdf", "S-02 Section.pdf"	Relevant facade sections are on S-01 Section, S-02 Section. Are further details required?	CAD drawing	Building
	CAD drawing/detail of shading geometry, like pergola, canopy, balcony, refuge area etc			N/A	The building has no shading structures.	CAD drawing	Building
	Adjacent buildings dimensions like outer profile in plan and total ht for shading calculation			"Site plan.dxf" & "Site plan.pdf"	Uploaded to Zoho	CAD drawing	Site
	3D Building model			"3D Model - IFC General.ifc" and "3D Model - IFC to IES.ifc"		IFC drawings	Site
	Internal photos of buildings at different locations			"bokay_int_01.jpg", "bokay_int_02.jpg", "bokay_int_03.jpg", "bokay_int_04.jpg", "bokay_int_05.jpg", "bokay_int_06.jpg", "bokay_int_07.jpg",	Uploaded to Zoho	Images	Building
	Photos of internal atrium or double ht. spaces if not clearly mentioned in drawings for accurate thermal modelling			N/A	The building has no internal atrium or double height spaces.	Images	Room

FIGURE 21: SCREENSHOT OF THE CHECKLIST FOR DEMO SITE ENERGY MODELING IN IES-VE

The Table 24: guidance to the data collectorsdescribes the guidance given to the data collectors to complete each of the section in the checklist, and help them collect the appropriate information in each occasion.

TABLE 24: GUIDANCE TO THE DATA COLLECTORS

COLUMN 1	This column represents the main categories with respect to its relevance in building construction & operation.
COLUMN ITEM/DATA REQUIRED	This column is sub-category of column 1. In order to collect all the thermal data required for completion of model this category addresses all the items which falls under this class and systematically collect all the data.
COLUMN SUB-CATEGORY	This column further guide data collector in case any particular item under column "Item/Data Required" is not clear and help to collect exact data which is expected for building thermal model.
COLUMN SUB-CATEGORY	This Column is for more detailed subcategory. This exactly addresses the micro level details like properties, thickness, conductivity etc. related with its main category. This helps to build and replicate exact conditions as per existing building in thermal model.
COLUMN FILE NAME OR VALUE - CURRENT STATUS	This column is for Data collector. Basically, all the information collected in previous columns under its respective categories needs to be properly documented here. Data collector needs to mention file name or give reference to find that information in the respective document. This will guide model maker which information needs to be referred and from where it can be obtained from entire list of input data files. Data collector needs to sort this properly in order to minimize assumptions made during thermal model making process. Mostly all the information will be preferred to make detail model with exact conditions. Data in this column reflect the current state of the building, before the retrofit
COLUMN FILE NAME OR VALUE - WHAT IF /POST-RETROFIT STATUS	Same as above but for the post retrofit status of the building, if known
COLUMN COMMENTS	This column helps data collector to add their comments on points, which have issues in order to collect data. For all the sub categories where data is not found or any assumptions needs to be considered, data collector should provide some comments, which will help thermal modeller for best assumptions.
COLUMN PREFERABLE DATA FORMAT	This column guides what kind of format will be preferable for the particular category in order to create model more efficiently and with less assumptions.
COLUMN LEVEL OF DETAIL	This column generalise how the type of particular data is related with the building at large scale

Additional to the information collected for the demo building, district level data is required to simulate the as-is and what-if states of the electricity and heating/cooling networks of the whole neighbourhood. For this purpose, as described in T4.4, the IES' Virtual Power Plant (VPP) tool will be used within the NewTREND Simulation and Design Hub. VPP is a high-level district modelling tool for performing simulations of city-infrastructure distribution networks using a combination of accounting and physics concepts. The VPP tracks Electricity and/or Heat flows between providers and their end uses at the city or district level by aggregating demand and calculating how that demand should be met by the available providers. Specifically, it can inform users of the current performance of various utilities and quantitatively predict the impact of changes/improvements to district infrastructure.

The data requirements to set up an electricity and heat distribution networks for a district in VPP are summarised in the checklist found in the ANNEX, while a screenshot is shown in Figure 22.

Network Typology	**Network Schematic of district electricity network**	Schematic & drawing i.e. autocad or sketchup, technical document etc.
	Network Schematic of district cooling network	Schematic & drawing i.e. autocad or sketchup, technical document etc.
	Site Data	Latitude & Longitude of pilot site
Transformers & Substations	**Conversion loss factor**	
	Downstream transmission loss factor	
Power Station	**Available Provision Profile**	Plant's schedule
	Efficiency Curve	Constant Efficency/COP or Variable Efficiency COP
	Fuel	Gas, Oil, Coal, etc
	Maximum Output (kW)	kW output
Heat Generator	**Available Provision Profile**	Plant's schedule
	Efficiency Curve	Constant Efficency/COP or Variable Efficiency COP
	Fuel	Gas, Oil, Coal, etc
	Maximum Output (kW)	KW output
Cooling Generator	**Available Provision Profile**	Plant's schedule
	Efficiency Curve	Constant Efficency/COP or Variable Efficiency COP
	Fuel	Gas, Oil, Coal, etc
	Maximum Output (kW)	KW output
CHP Plant	**Available Provision Profile**	Plant's schedule
	Electrical Efficiency at min. electrical output	0.2-1
	Electrical Efficiency at rated electricity output	0.2-1
	Heat output at rated electricity output (kW)	KW output

FIGURE 22: SCREENSHOT OF THE CHECKLIST FOR DEMO SITE ELECTRICITY AND HEAT DISTRIBUTION NETWORKS

Simple schematic diagrams of the electricity and heat distribution networks are required, that include both supply and demand units, such as power stations, heat generators, PVs, Wind Turbines, Prosumers (e.g. buildings), electricity/heat storage units, street lights etc. Additionally, information for each unit is required.

For example, to calculate the KPIs related to a district heating network, the characteristics of the heat source are required, together with the losses introduced during the transmission of the heat to the buildings through pipes and the energy demand of the connected buildings.

The majority of the data for the demo sites will be prepopulated and stored on the DIM server, while the user will be able to create and assess the 'as-is' and 'what-if' scenarios through NewTREND tools by changing design parameters, and make analyses using the NewTREND KPIs.

3.1.2. Data Requirements for Comfort Assessment

The NewTREND methodology for the Comfort assessment will follow the EN15251 approach, focusing on thermal and acoustic comfort aspects.

The proposed methodology in based on the evaluation of KPIs and benchmarks according to *D2.2 – Definition of sustainable Key Performance Indicators.*

In general, the monitoring campaign has to be performed according to the following procedure/options:

TABLE 25: PROCEDURE TO PERFORM THERMAL AND ACOUSTIC COMFORT ASSESSMENT

CODE	TYPE	DESCRIPTION	INSTRUMENT	WHEN/DURATION	WHERE/WHO
M1	Measurement	Monitoring of all the variables required to assess the indoor climate according to ISO7726 and ISO 15251	Monitoring of all the variables required to assess the indoor climate according to ISO7726 and ISO 15251	During periods probably more critical: 2-3 weeks in winter and 2-3 weeks in summer. Frequency: 10-20 min (if possible max, min, average and standard deviation values for each time step).	Installation and removal days: point measurements in large part of the building and outdoor CO_2 Other days: continuous measurements in one or more representative rooms.
M2	Measurement	Acoustic monitoring	Sound Level Meter	Spot measurements according to EN ISO 16283–3: one weekday during occupied hours. Duration 5 hours during the day (covering different peak hours).	Daily measurements performed by the technician in each room under investigation. Measurement of outdoor (2 meters in front of each room façade) and indoor noise should be done at the same time. The season does not impact the measurement.
Q1	Interview	Indirect (paper form) interview. Simplified questions about sensations, preferences, clothing, activity, individual building control, acoustic comfort and air quality.	Questionnaire	During the days of installation and removal of MMS. 2-3 interviews for each measurement point	To the larger number of occupants: at least the 50% of total occupants, better if more than 20.

The monitoring systems to be used should allow the measurement of the following variables:

TABLE 26: MEASUREMENT PROTOCOLS FOR THERMAL AND ACOUSTIC COMFORT ASSESSMENT

Variable	Accuracy		Comments
	Required	Desirable	
Air temperature (TA)	± 0.5°C	± 0.2°C	The air temperature sensor shall be effectively protected from any effects of the thermal radiation.
Mean Radiant Temperature (TR)	± 2°C	± 0.2°C	This shall be measured with globe-thermometer or view factor methodology (requires surfaces temperatures)
Absolute humidity expressed as partial pressure of water vapour	± 0.15 kPa	± 0.15 kPa	This variable can be measured also as relative humidity with required accuracy of ± 5% and desirable accuracy of ± 3%
Air velocity (VA)	± (0.05 + 0.05 va) m/s	± (0.02 + 0.07 va) m/s	This variable becomes significant for values higher than 0.2 m/s. An indication of the mean value and standard deviation for a period of 3 min is also desirable
CO_2	± 50 ppm	± 30 ppm	
Noise	± 1 dB	± 0.7 dB	Required accuracy can be achieved with Class 2 instruments, Desirable accuracy with Class 1 instruments.

Section 3.2.3 of this document describes the methodology for comfort assessment, which is applied to the demo sites.

3.1.3. Financial Data Requirements

This paragraph describes the financial input data required to analyse the economic Key Performance Indicators for both building and neighbourhood scale. The Key Performance Indicators have been described in detail in D2.2. One core and 2 optional indicators are available to measure the economic sustainability of buildings and districts. The Table 27: FINANCIAL DATA REQUIREMENTS shows the financial data requirements for calculating KPIs in basic, advanced and premium mode as well.

TABLE 27: FINANCIAL DATA REQUIREMENTS

KPI	Data Requirement
Operational energy cost	Energy prices by fuel type (EUR)
Investment cost (Optional KPI)	Total investment cost in year 0
Return of investment (Optional KPI)	Discount rate
Return of investment (Optional KPI)	Escalation rate of energy costs

For projects applying for funding from external parties financial planning spreadsheets have also been developed in D5.2. These spreadsheets provide a financial plan for the investment case and the acquisition of funds for developing a new one. The data requirements are shown in. The various items in the spreadsheets are prompts for things to consider, not necessarily relevant in every case.

TABLE 28: FINANCIAL DATA REQUIREMENTS FOR SPREADSHEETS DEVELOPED IN T5.2

Financial Data Requirements for Spreadsheets Developed in T5.2	
General	Preconstruction phase (yrs)
	Construction phase
	Facility Lifetime Modelled
	Residual value (as % of total capital cost)
	Decommissioning cost
Capital costs	Pre-licensing, technical, design
	Regulatory, licensing, public enquiry
	EPC
	Total
Operating costs	Maintenance contracts/ pa
	Rent
	Local Taxes and Fees
	Management, Accountancy, Legal
	Insurance costs / MW/pa
	Other annual costs
Debt financing	% total capital cost in Debt Tranche
	Loan term in years
	Cost of debt (%)
Cost of equity	Equity discount rate
Taxation	Corporation tax
	Capital Allowances and Fiscal Benefits
	Depreciation: Linear 15 yrs
	Value Added Tax
	VAT Benefit for Renewable Energy
Financial sources and benefits	
Capital	Debt
	Grant
	Equity
Operating	Corporate Tax
	VAT
	On-bill
	Opportunity Cost of Energy (£/MWh)
Inflation	General
	Item Specific
	Technical – energy production

3.2. Data Collection Methods

Data is being gathered on district, building, and in some cases room level.

Data will be gathered through qualitative (e.g.: survey, questionnaire, focus groups) and/or quantitative (e.g.: datasets, survey, document) means. The Preparation phase recommends the usage of different data collection methods for each type of data. This is also detailed in D2.1 where the data collection methods are described along with possible data sources. For the demo site data collection methods described in the above-mentioned documents are evaluated and the best fittings have been chosen.

Data gathering is coordinated by the NewTREND partner associated with the demo site. Most of the cases the project stakeholders hand the available data to the NewTREND partners. In some instances, the NewTREND demo partners collect the data themselves.

The process of the data collection for each site is the following:

1. Determination of the needed data types
2. Consideration of data sources (likely cost, time, validity, quality, accessibility, reliability and accuracy of data)
3. Collection of already available data from stakeholders
4. Scheduling the data collection for missing items
5. Collection of available data
6. Consideration must be given in determining the hierarchy to the likely cost, time, validity, quality, accessibility, reliability and accuracy of the data collection.
7. Data will be uploaded to the DIM server through the CDP and Data Manager.

The main data types and associated collection methods for the demo sites are summarized in the Table 29: main data types and associated collection methods for the demo sites and detailed in the next subchapters.

TABLE 29: MAIN DATA TYPES AND ASSOCIATED COLLECTION METHODS FOR THE DEMO SITES

Data Type	Data Collection Method (Based on D2.1 7.2.1 List of Methods	Use of Collected Data	Data Collection Frequency
Geometric and technical data	electronic documentation physical documentation data gathered on-site human knowledge	energy and comfort simulation	once
Monitoring data	live electronic system	energy, comfort calculations	continuous
Comfort assessment	live electronic system human knowledge	comfort assessment	continuous
Site specific survey	human knowledge	stakeholder analysis	once / regularly
Financial	human knowledge, interviews	economic KPI calculations	once

3.2.1. Geometric and Technical Data Collection for Simulation

Geometric and technical data collection methods used in Budapest

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.

FIGURE 23: RESULT OF THE LASER SCANNING: POINT CLOUD OF THE BÓKAY SCHOOL

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. (See D6.3 for more details and report of results.)

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. (See 39 for more detail.)

Geometric and technical data collection methods used in Seinäjoki

District level

Within the district of old hospital, which is consisted of four buildings, all the available design drawings and specifications have been collected. Owner of the building (city of Seinäjoki) has hired a specialized company to undertake complete building survey and condition assessment.

On the district level energy consumption is monitored in following way: heating energy is manually read every month for all four buildings, while electricity is collected every hour per building.

Building level

Additional to data collected for district level, for the main building additional walk through has been made and additional drawings have been collected (HVAC systems, lighting and equipment). Owner has as well ordered a 3D laser scanning of exterior and interior (for some spaces) of the building. For the end users of main building (mostly students of musical school and college), questionnaire was made to get additional information on the issues of the building.

Geometric and technical data collection methods used in Sant Cugat

Pilot No. 1. 35 rented apartment for young people (7 Mar de la Xina Street)

- Central heating system monitored. Heating consumption data is available.
- 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.
- Collection of energy bills.
- Users questionnaire.
- Drawings of HVAC systems, lighting and equipment.

Pilot No. 2. Pins del Vallès School (51 Can Volpelleres Avenue)

- Central heating system monitored. Heating consumption data is available.
- Collection of energy bills.
- Users questionnaire.
- Drawings of HVAC systems, lighting and equipment.

Pilot No. 3. 2 private houses in Les Planes

- Collection of energy bills.
- Users questionnaire.

3.2.2. Monitoring Activities

Monitoring scope in NewTREND project extends to these three categories:

1. Building indoor conditions
2. Building/neighbourhood energy consumption
3. Building/neighbourhood outside conditions

Indoor conditions are from the given categories probably the least known and therefore require more effort than the other two. Energy is usually monitored (at least through utility meters), while outside conditions can be acquired from local meteorological service. Under indoor conditions we classify following parameters: Indoor Air Quality (IAQ), noise and light. IAQ can be then further divided into air temperature, humidity, CO_2 concentration, etc.

When planning monitoring activities, it is important to select a period of the year in which occupancy & weather is at wanted conditions. For example, if we have a school building and want to check the heating conditions at full occupancy, we will choose a period during the winter, but not during the winter holidays. Further effort is needed to select locations in the building which are going to be monitored. Deciding the location should be tied to building purpose, so that in example of school, one of the monitoring locations is a classroom. But also, the decision on measurement equipment placement can be assisted with user questionnaire and building survey which could discover places with worst conditions.

Monitoring activities in Budapest

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 (see full list of measurement points below) in February 2017. Retrofitting works are going to be conducted in the school building during the summer of 2017. Therefore, data from the system is going to be available for 5-6 months before retrofit and around one year after the retrofit.

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, CO_2 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 CO_2 measurements;
- Lux levels;
- U-value measurements of existing walls.

FIGURE 24: MONITORING SYSTEM, LOGGING THE ENERGY CONSUMPTION

Monitoring activities in Seinäjoki

In Seinäjoki based on user questionnaire we have found out that different occupants have slightly different issues with the building. This means that when selecting the monitoring location, at least one should be on the vocational college part of the building and another in musical school part. Especially in musical school where there is humidifier installed (to preserve wooden instruments), there is problem with moisture (it was mentioned in survey) and should be monitored.

Indoor conditions will be measured during autumn/winter 2017/2018 and they will include air temperature, relative humidity and CO_2 concentration. Radiant temperature will be checked using thermal camera.

Monitoring activities in Sant Cugat

Pilot No. 1. 35 rented apartment for young people (7 Mar de la Xina Street)

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.

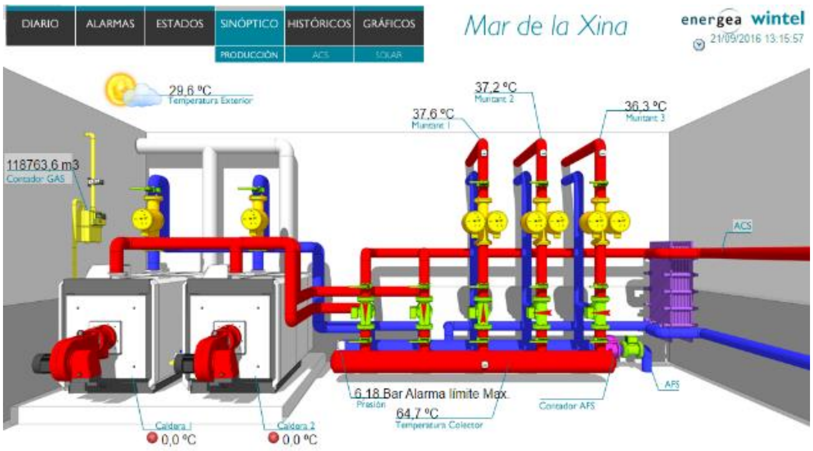

FIGURE 25: CENTRAL HEATING SYSTEM

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 or hybrid collectors
    - PV or hybrids 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, CO_2 concertation and noise in three apartments of this building. Indoor conditions will be measured during winter 2018.

Pilot No. 2. Pins del Vallès School (51 Can Volpelleres Avenue)

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.

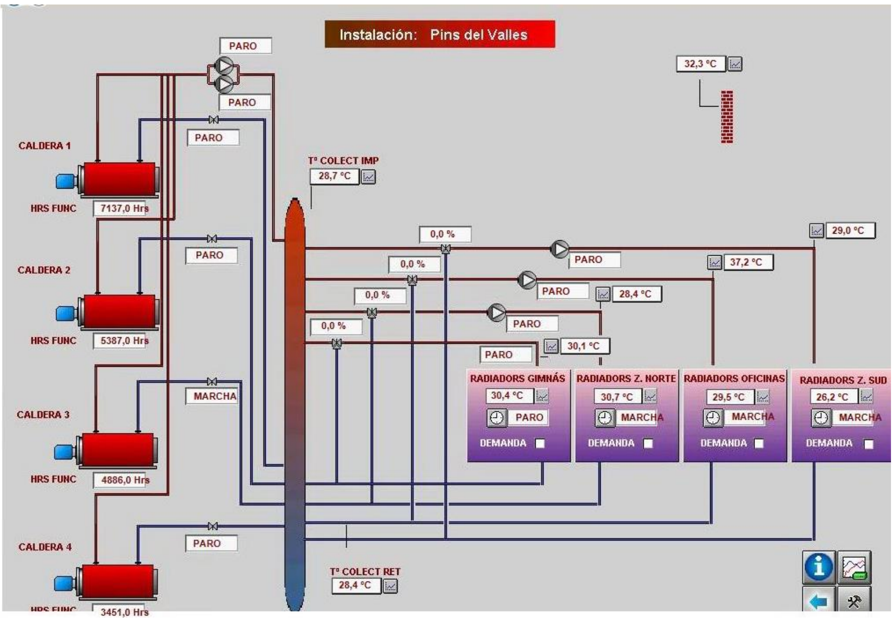

FIGURE 26: HEATING SYSTEM IN PINS DEL VALLES SCHOOL

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, CO_2 concentration and noise in the different buildings of school, after the sectioning of the school heating system.
- 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

Pilot No. 3. 2 private houses in Les Planes

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, CO_2 concentration and noise.
- One sensor will be installed at each house.

3.2.3. Comfort Assessment

Comfort assessment means the evaluation of thermal/acoustic comfort and indoor air quality on demo sites, based on the typology of data collection process applied to them.

The **Error! Reference source not found.** reported in section 3.1.2 describes the measurements protocol needed to perform a complete comfort assessment for a building. This section presents the methodology applied to demo cases to perform thermal, acoustic and IAQ assessment using the set of measured data available from each pilot.

The proposed thermal comfort models are fully described on D4.3, section 2.2.2. They can be divided into predictive and adaptive.

Practically, before starting with the data collection phase, a questionnaire model for socio-thermal comfort survey should be delivered to the occupants, following standard UNI EN ISO 10551, to obtain a subjective evaluation of thermal comfort inside living environments and to assess the main critical rooms, which should be analysed.

In particular, according to ISO 7730, suggests a procedure to evaluate or measure the parameters required by the predictive model. Some data are dynamic others static.

Dynamic data are related to environmental parameter, they need to be measured; while static data are related to metabolic rate and clothing insulation, they are defined by the typology of activity and users of the building.

Measurement of the thermal environment parameters: thermal comfort is evaluated throughout the occupied zone, 0.6 m for a seated person and 1.1 for a standing person. In this zone air velocity and air temperature should be recorded for a period of 3 minutes with a sampling rate of 5 Hz, air humidity with a sampling rate of 30 s. At the same level the mean radiant temperature has to be evaluated. It can be directly measured using a globe thermometer, or evaluated with indirect method.

Evaluation of the thermal insulation and clothing area factor of man's clothing: standard provides a procedure to evaluate clothing insulation with exhaustive tables of Icl values for several clothing types. On its basis the clothing area surface factor fcl is calculated. Evaluation of man's metabolic rate (Met) and external work (W) performed: standard provides necessary data for calculation of M and W with tables for different physical activities.

Measurements shall be made in occupied zones of the building at locations where the occupants are known to or are expected to spend their time. Such locations might be workstation or seating areas, depending on the function of the space. In occupied rooms, measurements should be taken at a representative sample of occupant locations spread throughout the occupied zone. In unoccupied rooms, the evaluator should make a good faith estimate of the most significant future occupant locations within the room and make appropriate measurements. In the case of exterior walls with windows, the measurement location should be 1.0 m inward from the centre of the largest window. In either case, measurements should be taken in locations where the most extreme values of the thermal parameters are estimated or observed to occur. Typical examples might be near windows, diffuser outlets, corners, and entries. Measurements are to be made sufficiently away from the boundaries of the occupied zone and from any surfaces to allow for proper circulation around measurement sensors with positions as described below. Absolute humidity need only be determined at one location within the occupied zone in each occupied room or HVAC controlled zone provided it can be demonstrated that there is no reason to expect large humidity variations within that space. Otherwise, absolute humidity shall be measured at all locations defined above. Air temperature and air speed shall be measured at the

0.1, 0.6 and 1.1 m levels for sedentary occupants at the locations specified. Standing activity measurements shall be made at the 0.1, 1.1 and 1.7 m levels.

Then the PMV value is evaluated and additional information are required as start/end of the monitoring period, heating/cooling systems operational hours, room floor area. Once the data are collected and processed, according to EN 15251, the room is identified as one of the four proposed categories, according to D4.3 and D2.2. The analysis is reported on a psychrometric chart with comfort zones calculated using the PMV model, as in Figure 23.

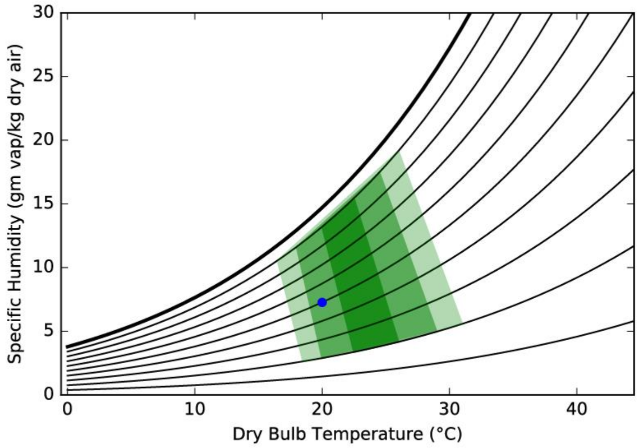

FIGURE 27: PSICHROMETRIC CHART WITH COMFORT ZONES CALCULATED USING PREDICTIVE MODEL

The described procedure for thermal comfort assessment, if extended to the entire building, allows the calculation of a building thermal comfort KPI, according to D2.2.

The proposed adaptive comfort models are included on the comfort standards EN 15251 and ASHRAE 55 and fully described on D4.3, section 2.2.2. The needed measurements are indoor air temperature, mean radiant temperature, outdoor temperature. These variables can be measured following the predictive model approach, described previously. The indoor operative temperature and the running mean temperature are calculated and additional information are required as start/end of the monitoring period, occupied hours and room floor area. The indoor operative temperature and the running mean temperature are reported on the following graph **Error! Reference source not found.**(Figure 28) as result of the room analysis.

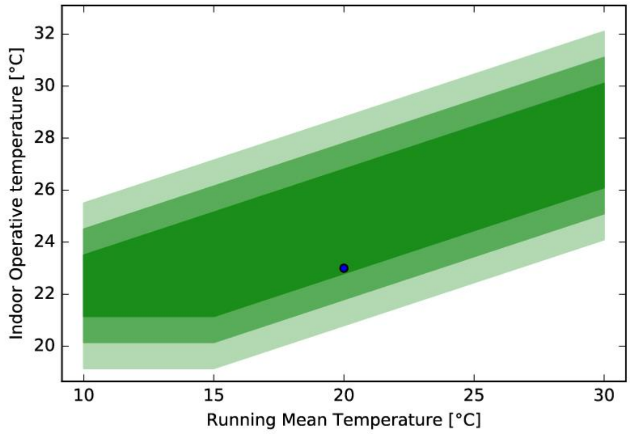

FIGURE 28: COMFORT ZONES CALCULATED WITH ADAPTIVE MODEL

Also in this case, each analysed room is included on a comfort category (D4.3 and D2.2), the extension of the analysis will define a building thermal comfort KPI according to D2.2.

In the case that the parameters for applying predictive or adaptive model are not available in a demo site, a simplified method to perform anyway the comfort assessment is proposed. The methodology requires measuring the indoor air temperature and comparing it with the indoor temperature boundaries, which the room should be kept between and usually defined by national guidance (Figure 29).

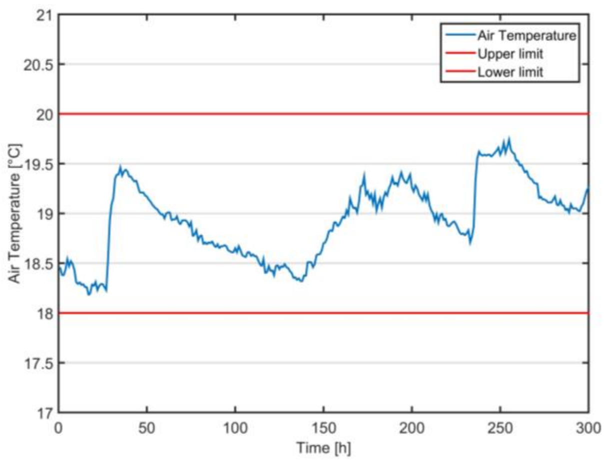

FIGURE 29: COMFORT ZONES CALCULATED USING SEMPLIFIED NATIONAL GUIDE LINES

The indoor air quality assessment requires the measurements of the indoor/outdoor CO_2 concentrations. In the case that the second one is missing, the data can be retrieved from an online database filled with data available from an air monitoring station located near to the building. Other data as start/end of the monitoring period, occupied hours, room floor area are required for the assessment. The collected variables allow the calculus of the Indoor air quality KPI, following the procedure described on D2.2.

The acoustic comfort assessment should be performed following the measurement protocol described in D4.3 section 4.2.4. Practically, before starting with the data collection phase, a questionnaire model for socio-acoustic surveys inside building, based upon the international technical specification ISO/TS 15666 should be delivered to the occupants to obtain a subjective evaluation of acoustic comfort inside living environments and to assess the main critical rooms, which should be analysed.

Then, the measurement procedure for sound insulation of building façades should be carried on according to EN ISO 16283 part 3, which describes the method to measure the airborne sound insulation of a room façade using the actual traffic noise conditions as source.

The determination of sound insulation of building façades requires the measurement of both outdoor and indoor sound pressure levels. The standard requires at least 1 microphone for measuring the sound pressure level at 2 m distance of the exposed façade, and at least 5 microphones inside the room (or other equipment following the guidelines defined on **Error! Reference source not found.**).

Since the indoor and outdoor noise due to traffic noise is time fluctuating, it has to measure the standardized level difference during the pick hour of the day. Other data have to be collected as the volume of the receiving room, the total area of the façade as seen from inside. Then, the sound level difference of the façade is determined through the calculation model proposed by the standard EN 12354 part 3. Finally, an acoustic class for the room can be defined following the procedure described on D2.2 and D4.3. This analysis can be extended to the entire building, defining a general acoustic class for it.

SITE SPECIFIC COMFORT ASSESSMENTS IN THE DEMO SITES

The following Table 30: demo sites comfort assessment schema summarizes the comfort assessment studies planned to be conducted on the demo sites.

TABLE 30: DEMO SITES COMFORT ASSESSMENT SCHEMA

	THERMAL COMFORT PREDICTED	THERMAL COMFORT ADAPTIVE	THERMAL COMFORT SIMPLIFIED	ACOUSTIC COMFORT	IAQ
BOKAY SCHOOL	X	X		X	X
SEINÄJOKI			X		X
SANT CUGAT P.1			X		
SANT CUGAT P.2			X		
SANT CUGAT P.3			X		

In particular, taking into account the planned measures for each pilot, the Bókay school measurements allow a complete comfort assessment. While in the Seinäjoki pilot, measurement of indoor temperature and CO_2 level allow just simplified thermal comfort model and indoor air quality. The tree pilots in Sant Cugat are planned to be tested only using the simplified thermal comfort model as well, due to the data availability of indoor air temperature, relative humidity and CO_2 concentration measurements.

3.2.4. SITE SPECIFIC SURVEYS

Site specific surveys are additional surveys which don't belong into monitoring (indoor conditions, energy), nor into comfort assessment. Such examples could be advanced or standard methods for user data collection as previously described in NewTREND task *2.4 – Progressive strategies and practices for a comprehensive post-retrofitting controlling and continuous commissioning.*

Surveys pre-retrofit, during the retrofit and post-retrofit (planned). Explained in detail in the D6.2

Site specific surveys in Budapest

We will do pre- and post-retrofit interviews with different groups of users in the school demonstration project about their needs and aspects for the planning, how and which phase they can contribute to the planning and to what extent they are satisfied with the results. Since the district retrofit project is only in the initial phase (there are not even official plans available yet for the retrofitting) we will do only a pre-retrofit survey with stakeholders from the municipality about their visions.

Methodology: semi-structured in-depth interviews with different groups of users (teachers, school director/administration, students, other type of users if any).

Pre-retrofit – what are the main aspects and requirements that the users of the building find the most important to be addressed during the retrofitting (what influences the decisions – the Hungarian case is a special case in this regard, because of its tangled stakeholder network where the maintainer, the owner, the user and the project financier are different, which unusual situation has also an impact on the planning and decision-making process. In addition, the dependence on the funding/subsidies and their requirements have also a great influence on the project).

The same questions will be asked about the district retrofit plans as well, but in this case only stakeholders from the local municipality will be interviewed.

Questions:

- What are their main aspects and requirements that they wish to be considered for the retrofit project? How would they prioritize them?
- To what extent/at which phase are they involved into the planning? Are they involved into the decision making?

Post-retrofit – evaluate to what extent could the retrofit plan address all the requirements of different stakeholders and to what extent are the users of the building feel comfortable with their new environment.

Questions:

- Do they see their previous expectations met by the retrofit project? Were their aspects considered during the project development? If not, can they list these aspects. Did they have the chance to mention them to the project designers?
- Are they satisfied now with the results of the retrofit project? Does the retrofitted building provide comfort in all aspects they would need? If not, mention the shortcomings or functions/conditions that they miss?

Site specific surveys in Seinäjoki

In pilot site in Seinäjoki, using Granlund Pulse tool real-time user satisfaction monitoring will be performed during autumn/winter 2017/2018. Through Pulse users can leave real-time feedback and additionally give comments on current indoor conditions. User feedback is then complemented with CO_2 and temperature measurements and end result is then presented as a score (from 0 to 100). This advanced method for user satisfaction collection will allow to see which parameter has highest effect on users and at what time. This can help with directing building retrofit design focus. Furthermore through this pilot, we will learn how to approach users and how to “nudge” them to use real-time feedback tool.

Standard user questionnaire was already done with students and staff of both schools located in main building, which gave us insight how different users can have different issues (even though both are educational institutions), but also that main issues with the building are shared between them. For example users from musical school have more complained about high temperatures in summer and low in winter, problems with humidity (too low or too high), mould smell, bad smell from sewers and ventilation. Also sound issues were more raised by musical school users, such as need for better insulation between classrooms and a bouncy sound. There has been as well feedback that emphasizes user opinion which should be taken into consideration, this supports NewTREND approach.

SITE SPECIFIC SURVEYS IN SANT CUGAT

Inhabitants/users surveys

Currently, we are waiting the first users/occupants responses.

There are two types of surveys: one for tenants (35 person) of the 7 Mar de la Xina building and another for school users (students, teachers, etc.).

We hope that in September we will have the results of the surveys. Surveys sent last July.

K0. Personal questions. Identification.

K1. Building general condition is good (Agree/Partly Agree/Disagree/ DK-NA)

K2. In spaces, in which you spend most of your time, general condition is good. (Agree/Partly Agree/Disagree/ DK-NA)

K3. Building façade condition is good. (Agree/Partly Agree/Disagree/ DK-NA)

K4. Building roof condition is good. (Agree/Partly Agree/Disagree/ DK-NA)

K5. Building doors and windows condition is good (Agree/Partly Agree/Disagree/ DK-NA)

K6. In spaces, in which you spend most of your time, indoor air quality is good. (Agree/Partly Agree/Disagree/ DK-NA)

K7. In spaces, in which you spend most of your time, temperature quality is adequate. (Agree/Partly Agree/Disagree/ DK-NA)

K.8 In spaces, in which you spend most of your time, humidity is adequate. (Agree/Partly Agree/Disagree/ DK-NA)

K.9 In spaces, in which you spend most of your time, ventilation is good. (Agree/Partly Agree/Disagree/ DK-NA)

K.10 In building there is disturbing noise. (Agree/Partly Agree/Disagree/ DK-NA)

K.11 Work space is comfortable / Your apartment is comfortable. (Agree/Partly Agree/Disagree/ DK-NA)

K.12 Building/s are energy-efficient. (Agree/Partly Agree/Disagree/ DK-NA)

K.13 HVAC system is energy-efficient. (Agree/Partly Agree/Disagree/ DK-NA) *k.14 The cost of energy is adequate for the service provided. (Agree/Partly Agree/Disagree/ DK-NA)*

The cost of energy corresponds to the service provided.

K.15 Main problem of the building (temperature/humidity/illumination/ ventilation)

K.16 Do you know what you consume? (Yes/No)

k.17 Can you regulate the level of temperature, humidity and lighting of the building? (Yes/No)

K.18 How many people live in the house?

K.19 How many hours are you in the building?

K.20 Do you think that the response time to achieve the desired slogan is adequate?

K.21 Usually in what time zone are you in the building? (morning/afternoon/night)

3.2.5. Financial Data Collection

The demo site specific financial data collection is based on the data requirements described in chapter 3.1.3 Financial Data Requirements.

Financial data collection in Budapest

The Budapest demo project received funding from a regional energy efficiency operative program of the EU (KEHOP). The application procedure started with a project proposal which contained design documentation for the retrofitting, a detailed cost calculation and it named the project stakeholders including the future contractor. The disadvantage of this kind of application process is the very short design planning time as most of the applicants use predetermined solutions optimized to achieve the highest possible scores in the application evaluation. The municipality submitted its proposal for the retrofitting in the summer of 2016 and due to serious delays during the evaluation only received funding a year later (July, 2017).

For the Operational Energy Cost indicators the demo site input data of energy prices by fuel type is available. The electricity and gas prices are determined from national data and available from services providers. The investment cost data is determined from the project proposal for the energy efficiency operative program. The input data for the Return of Investment indicator has an expert recommended national values.

Table 31: FINANCIAL DATA OF THE BUDAPEST DEMO SITE

KPI	Data Requirement	Demo Site Data
Operational Energy Cost	Energy prices by fuel type (EUR)	Electricity: • daytime: 37.56 HUF/kWh • daytime (reduced): 36.24 HUF/kWh • night-time: 23.18 HUF/kWh Gas: • 10.64 HUF/kWh
Investment Cost (Optional KPI)	Total investment cost in year 0	99 439 146 HUF (initial calculation, could change with retrofit scope changes)
Return of Investment (Optional KPI)	Discount rate	10%
Return of Investment (Optional KPI)	Escalation rate of energy costs	Different scenarios: 1.5%, 3%, 5%

Financial data collection in Seinäjoki

TABLE 32: FINANCIAL DATA OF THE SEINÄJOKI DEMO SITE

KPI	Data Requirement	Demo Site Data
Operational Energy Cost	Energy prices by fuel type (EUR)	Electricity price: 0.10 €/kWh District heat price: 0.06254 €/kWh
Investment Cost (Optional KPI)	Total investment cost in year 0	Depends on a chosen retrofit, project is not yet on that stage
Return of Investment (Optional KPI)	Discount rate	~3%
Return of Investment (Optional KPI)	Escalation rate of energy costs	District heat price escalation 1.5 – 3% Electricity price escalation -3 – 3%

Financial data collection in Sant Cugat

TABLE 33: FINANCIAL DATA OF THE SANT CUGAT DEMO SITES

KPI	Data Requirement	Demo Site Data
Operational Energy Cost	Energy prices by fuel type (EUR)	7 Mar de la Xina Street (apartments for young people): • Electricity price: 0.10884 €/kWh Pins del Vallès School: • Electricity price: 0.07965 €/kWh • Natural gas price: 0.084 €/kWh 2 private houses in Les Planes: no data
Investment Cost (Optional KPI)	Total investment cost in year 0	7 Mar de la Xina Street (apartments for young people) planned measures cost: 93.829,73 € Pins del Vallès School planned measures cost: • Installation of PV panels: 59 523.37 € (possible subsidy of 20 000 € by Deputation of Barcelona) • Façade retrofitting: ~250 000 € • Replacement of the atmospheric boilers to condensing boilers and sectioning of the heating system: no data. 2 privates houses in Les Planes: no data
Return of Investment (Optional KPI)	Discount rate	7 Mar de la Xina Street (apartments for young people): no data Pins del Vallès School: • Installation of PV panels – IRR: 8.3% 2 private houses in Les Planes: no data
Return of Investment (Optional KPI)	Escalation rate of energy costs	Electricity price escalation: ~5 – 10% Natural gas price escalation: ~15 – 20%

3.3. Constraints Faced During Data Collection

3.3.1. Constraints Faced in Budapest

Technical barriers

- GIS base map: The national cadastre in Hungary is not a publicly available data, and the base maps are sold for a rather high fee. Only municipalities have free access to the GIS base data with the restriction of not letting them to third parties. While there is an ongoing filed survey for the full 3D mapping of the city, the official cadastral GIS map contains data only on the roads, pavings and buildings geometry.
- Data collection: Hungary Demo sites – data collection was highlighted as an issue, and this is likely to be an ongoing issue across all sites, document detailing the issues and resolution of data collection at the Hungary site is to be made available so that other demo sites may learn from it.
- HVAC and electrical system: there is no documentation available for now
- Appointment of actual metering points: Based on architectural design documents and an initial walk-through, a comprehensive monitoring plan was elaborated to the building with many submetering points. In the process of the plan-implementation and bidding process, many problems arose and the scope of the monitoring system had to be reduced due to practical or technological reasons. For example, it was not possible to install heat-flow sensors into the heating system (before and after radiators) during heating season as the system was considered too old and leaking to drain off the whole system. This way any valuable heating energy submetering points had to be excluded from the scope.

Non-technical barriers

- Bureaucratic system (municipality, owners, clients, etc.): The number of institutes and stakeholders concerned in the operation of the Bókay primary school and Bókay Garden, can be stated as a biggest constraint in data collection. In general, it can be stated that most of the required information is accessible, but not digitized, moreover the stakeholders involved often have partial and unclear information. It makes the data collection process circumstantial and several site visits is required to check reliability of the data.
- Third-party operation of the building: The operator of the school is a third party-company (GESZ) who was appointed by the municipality of district 18th. Personnel of operators are not present in the school building itself. Therefore, it was challenging to get information about the existing operational parameters of systems, bill-payment, utility invoicing and meter-reading procedures. Also, it must be mentioned that the school building's staff is not encouraged and not benefitted by any energy saving gained at this building as the administrative system implemented an automation process of bill-payments at this third-party company mentioned above.

  Main meters are utility-owned: The sum gas and electricity consumption of the building are monitored at the main meters that are owned by natural gas and electricity providers. Our system needed an impulse-type of signal from these meters, therefore the process of replacing and adjusting these meters had to be administered by the operator (third-party company) and the utility providers. These providers are large, mainly state-owned companies where the administration burden is vast in case of a meter-change project for example. This process caused significant delays in the monitoring system's installation campaign

3.3.2. Constraints Faced in Seinäjoki

Technical barriers

- Technical details have mostly come from old design drawings and specifications which are most likely not the current situation
- Heat meter is installed in a way that it measures total heating energy consumption of 4 buildings in district. Another issue is that it is read manually once a month.
  Electricity meters are newer and are automatically sending hourly consumption for each of 4 buildings, issue is that further sub-metering per consumption type isn't available. It is only possible to guess what part of electric energy is used for lighting, equipment or ventilation.

3.3.3. Constraints Faced in Sant Cugat

Pilot No. 1. 35 rented apartment for young people (7 Mar de la Xina Street)

Technical barriers

- Electricity: no data from private use.
- Not available and needs to be:
  - User electrical energy bills (till agreement)
  - User behaviour (by surveys)
- The building is not model in BIM. BIM model discarded but real-time data available.

Non-technical barriers

- The energy consumption data is private so it is not easy to collect it. Users should be involved and give their data.

Pilot No. 2. Pins del Vallès School (51 Can Volpelleres Avenue)

Technical barriers

- BIM model in process.
- Currently, not available energy consumption data of each building separately.

Non-technical barriers

- Non.

Pilot No. 3. 2 private houses in Les Planes

Technical barriers

- Electricity: no data from private use.
- Not available and needs to be:
  - User electrical energy bills (till agreement)
  - User behaviour (by surveys)
- The building is not model in BIM. BIM model discarded but real time data available.

Non-technical barriers

- The energy consumption data is private so it is not easy to collect it. Users should be involved and give their data.

4. Results

4.1. Data Availability for KPI Level Calculations

KPIs were developed in WP2, find more detail on the development and short-listing process in the comprehensive NewTREND methodology documents (D2.6 and D2.7). In this section, a real-life check was carried out whether the KPIs developed in NewTREND can be calculated and if so on what level (basic/advanced/premium) in case of each demonstration site.

The Table 34: data availability levels of each demo site for each NewTREND KPIcontains information on the data availability levels of each demo site for each NewTREND KPI:

TABLE 34: DATA AVAILABILITY LEVELS OF EACH DEMO SITE FOR EACH NEWTREND KPI

	BUDAPEST		SEINÄJOKI		SANT CUGAT	
	BUILDING LEVEL	NEIGHBOURHOOD LEVEL	BUILDING LEVEL	NEIGHBOURHOOD LEVEL	BUILDING LEVEL (PILOTS 1-3)	NEIGHBOURHOOD LEVEL (PILOT 2)
BIM MODEL	advanced	basic			advanced	
KPI CALCULATION	advanced/premium	basic			advanced/premium	
B1.1 OPERATIONAL PRIMARY ENERGY DEMAND	advanced	n/a	advanced	n/a	advanced	n/a
B1.2 DELIVERED ENERGY DEMAND	advanced	n/a	advanced	n/a	advanced	n/a
B1.3 RENEWABLE ENERGY ON SITE	advanced	n/a	advanced	n/a	advanced	n/a
B2.1 GLOBAL WARMING POTENTIAL	advanced	n/a	advanced	n/a	advanced	n/a
B5.1 INDOOR AIR QUALITY	advanced/at room level premium	n/a	advanced/at room level premium	n/a	advanced/at room level premium	n/a
B6.1 SUMMER COMFORT WITHOUT COOLING	advanced/at room level premium	n/a	advanced/at room level premium	n/a	advanced/at room level premium	n/a
B6.3 THERMAL COMFORT IN THE COOLING	advanced/at room level premium	n/a	advanced/at room level premium	n/a	advanced/at room level premium	n/a

SEASON						
B6.2 THERMAL COMFORT IN THE HEATING SEASON	advanced/at room level premium	n/a	advanced/at room level premium	n/a	advanced/at room level premium	n/a
B8.1 ACOUSTIC COMFORT	advanced	n/a	advanced	n/a	advanced	n/a
B10.1 OPERATIONAL ENERGY COSTS	advanced/premium	n/a	advanced/premium	n/a	advanced/premium	n/a
D1.1 OPERATIONAL PRIMARY ENERGY DEMAND	n/a	basic	n/a	basic	n/a	
D1.2 DELIVERED ENERGY DEMAND	n/a	basic	n/a	basic	n/a	
D1.3 RENEWABLE ENERGY ON SITE	n/a	basic	n/a	basic	n/a	
D2.1 GLOBAL WARMING POTENTIAL	na	basic	na	basic	na	
D8.1 ACOUSTIC ENVIRONMENT	na	-	na	-	na	
D10.1 OPERATIONAL ENERGY COSTS	na	basic	na	basic	na	

4.2. Data Availability for Simulations

In this section, it is investigated which data types needed for simulation in NewTREND (identified in section 3.1.1) are available in case of each demo site. This information is summarized in ANNEX 1 and 2. It can be seen that demo site owners could collect majority of building-level information needed. If a type of data was not available, partners attempted to estimate their values for the simulations. On the other hand, the collection of district level data was a major challenge for each demo site as in most cases the management of district-level buildings is not in one hand. Therefore, many stakeholders had to be contacted for information.

Major constraints faced during the data collection process are summarized here below: (section 3.3)

4.2.1. Technical Barriers

- Limited access to building plans and documentation.
- GIS maps are not accessible to inform design.
- Monitoring system installation constraints influencing the final monitoring scopes.
- BIM resources are not available.

4.2.2. Non-technical Barriers

- Almost inextricable interconnections and responsibility overlaps between stakeholders of retrofit projects.
- Some buildings were not operated by owners or users but a third party. Difficult to cooperate as a team.
- Monitoring and sensor data – data privacy issue.

These barriers were hindering the data collection process for demo sites but in the end all demo owners managed to collect all relevant information. Their feedback on the challenges faced during the data collection process can be used as an important feedback to the NewTREND tool development.

5. Feedback to Other Tasks

The activities carried out in the demo sites in project NewTREND are to provide information and important feedback on usability and real-world applicability of the methodology and software tools developed in the early project phases. In the following sections, findings of demo site data collection process conducted in Task 6.1 are summarized.

5.1. Feedback to NewTREND Methodology and Software Development

In the framework of Task 6.1, two phases of the NewTREND project methodology (for more information see D2.6 and D2.7) were tested on the demonstration sites of the project: Preparation and Initiation phases. The stakeholder identification and analysis were a key part of the preparation phase which meant a challenge for most of the demo site owners. This work continues as part of Task 6.2, therefore a comprehensive set of feedback can be reported at the end of the project, in D6.3.

Majority of the work needed to complete these phases in NewTREND was data collection, data organization and storing. This effort consumed most of the resources used in this task and points to the direction of future efficient use of the Data Manager developed in NewTREND.

Main goal of the first two project phases in NewTREND is to collect data identified as necessary to complete retrofit solution assessments using the newly developed NewTREND set of KPIs. Data availability and expected mode (basic, advanced or premium) of KPI calculations are summarized in section 4.1. in case of each demo site. Main feedback: list of core constraints faced during data collection, limited availability of data for KPIs. It can be seen that most KPIs can be calculated on either advanced or premium modes which shows that the level of information available are going to be sufficient to make KPI calculations supporting the retrofit decision making process in case of each demo site.

Regarding district level data collection, it was found that stakeholders of demo projects were not handling energy supply of buildings on a neighbourhood level but were interested in potential post-retrofit solutions that enhance synergy between their buildings. This implies that district-level investigations carried out in NewTREND are of big interest for retrofit project managers and interested parties.

It was found on the two Local Advisory Team (LAT) meetings conducted so far and also in case of demonstration sites that BIM modelling is not an integrated part of retrofit projects yet. Most of the stakeholders interviewed reported that it is a challenge to find resources to build a BIM model in case of an average retrofitting project. On the neighbourhood level, it was a challenge to build up cityGML files required for NewTREND for the demo sites as they were not readily available for most of the projects. In the future, these issues should be considered during the NewTREND methodology and software tool refinement process.

On the other hand, energy consumption and indoor thermal comfort monitoring activities (required for NewTREND working in premium mode) were of great interest in case of all demonstration sites of the project. Stakeholders reported the need for monitoring and data analysis to be able to get to know the operation of the building and to support retrofit decision making. Demonstration owners were committed to use resources to achieve this goal which was a reassuring sign that monitoring systems are an essential part of retrofitting projects. There is a need for appropriate data storage and analysis framework, therefore, it is proposed to refine the Data Manager tool of NewTREND from this aspect as well.

5.2. Test and Feedback for DIM server

The DIM Server consumes a variety of files and form generated information. The server acts as a data store for many of these types of information, and as such doesn't have a specific contents requirements in these cases. However, since this information will be consumed by other functional areas, and because the DIM server will also prepare information for these, there is an implicit set of requirements that are defined by these components.

The DIM server, which structures data access around the semantic relationships between district and building models, has two explicit data requirements [1][2]; the district model must be expressed to the server using the CityGML format and buildings must be described using the Industry Foundation Class (IFC) format.

Testing was conducted to assess the suitability of information collected to-date. This testing focused on:

- System testing – this was conducted to confirm that collected data was compatible with the DIM server. The ability to support upload/download and requirements for data access in support of DIM functions was tested; other compatibility requirements exist, but are addressed by the originating components, for example, simulation.
- Performance testing – this testing is conducted examine the temporal and system execution cost of processing the data to enable proper provisioning of hardware resources to support running of the DIM server software.

TABLE 35: HARDWARE SPECIFICATION FOR TEST SERVER

Operating System	Ubuntu 14.04 x86 64-bit
Memory	4.096 MB
Hard Drive	10 GB

To support testing, a DIM server was provisioned according to the standard DIM setup documentation on a virtual machine which ran on Oracle's VirtualBox VM manager. This machines' specification is shown in Table 35: Hardware specification for test server. A sanity test was conducted on the provisioned machine to confirm that it was functioning correctly.

As described in D3.4, the server requires a site/district model in a CityGML formatted file, and each building to be described in the Industry Foundation Class (IFC) format. As the district model was still being developed, a surrogate model was used in lieu. An initial IFC file 12.5 MB was made available for testing purposes.

TABLE 36: SERVER TEST SET

Test #	Test	Result
1	Upload a building model and semantically link to a district level entity	Pass
2	Download the model uploaded in 1 (test round trip)	Pass
3	Access summary information contained in the building model	Pass
4	Create and download a CSV file and associate with an IFC entity	Fail
5	Upload measured file and associate with an IFC entity	Pass
6	Upload measured result file and associate with IFC entity	Pass
7	View measured results for an IFC entity	Pass
8	Upload/download general file associated with an IFC entity	Pass

The file was uploaded in 11 seconds. It is probable that this time would be reduced by a second on a cloud based instance (e.g. Amazon Web Service medium instance with direct internet access). Downloads were achieved in just under 2 seconds for both zipped and unzipped forms of the file.

System testing resulted in 7/8 (87%) tests passing. The test file was uploaded, processed and inspected. No processing errors occurred. The file was downloaded and it was confirmed that no changes were introduced during the upload/parse/download process. This confirms that the server maintains the file's fidelity. Various functionality was tested, including the ability to upload and associate measured and other files with IFC entities.

One test failed. This was the current version of acoustic data manager. Errors occurred at two points for the same reason. Rooms required in the model to provide a room identity for the acoustic simulation input file and mining information, such as room volume. The server is currently dependent on the use of IFCSpace entities to model room spaces. The IFC model provided does not model spaces in this way. This indicates a need to standardise the set of IFC (and CityGML) components that will be used in DIM, Data Manager and Simulation modules.

ANNEXES

ANNEX 1: NEW TREND SIMULATION DATA AVAILABILITY FOR DEMO SITES - TABLE BUILDING LEVEL

ANNEX 2: NEW TREND SIMULATION DATA AVAILABILITY FOR DEMO SITES - TABLE DISTRICT LEVEL

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Annex 1: NewTREND Simulation Data Availability for Demo Sites - Table Building Level

				ABUD - BUDAPEST			GRANLUND - SEINÄJOKI			SANT CUGAT - 7 MAR DE LA XINA STREET			SANT CUGAT - PINS DEL VALLES SCHOOL			SANT CUGAT - TWO PRIVATE HOUSES IN LES PLANES					FOR IES TO COMPLETE	
	Item/Data Required	Sub category	Specific values	File name or value (please complete this serction)		Comments (please complete in case of any issues in data collection)	File name or value (please complete this serction)		Comments (please complete in case of any issues in data collection)	File name or value (please complete this serction)		Comments (please complete in case of any issues in data collection)	File name or value (please complete this serction)		Comments (please complete in case of any issues in data collection)	File name or value (please complete this serction)		Comments (please complete in case of any issues in data collection)	Preferable Data Format	Level of detail (Site/Building/Room)	STATUS (for IES)	Data Reviewers comments (for IES)
				Current Status	What-if/post retrofit status (leave blank if not known or item not retrofitted)		Current Status	What-if/post retrofit status (leave blank if not known or item not retrofitted)		Current Status	What-if/post retrofit status (leave blank if not known or item not retrofitted)		Current Status	What-if/post retrofit status (leave blank if not known or item not retrofitted)		Current Status	What-if/post retrofit status (leave blank if not known or item not retrofitted)					
Building Envelope	CAD Floor plan (Basement)			"-1. Basement.dxf" & "-1. Basement.pdf"			"/Main building drawings/Vanh.kesk. sairaala. kellarikerros 1_100.dwg"			"7 Mar de la Xina Street/Buildings drawings/02nivell139_10_e200 Model (1).pdf"			N/A		The buildings have no basement	N/A		The buildings have no basement	CAD drawing & PDF drawings	Building	Adequate	Adequate information available to work on VE model geometry
	CAD Floor plan (Ground level)			"0. Ground Floor.dxf" & "0. Ground Floor.pdf"			"/Main building/ Vanh.kesk. sairaala. pohja 1krs. 1_100.dwg"			"7 Mar de la Xina Street/Buildings drawings/03nivell142.pdf"			"Pins del Vallès School/Buildings drawings/CEIP Pins_P00-edifici principal.dwg" , "Pins del Vallès School/Buildings drawings/CEIP		Kindergarten: N/A	"2 private houses in Les Planes/Buildings drawings/Annex_Carena, 3.pdf" , "2 private houses in Les			CAD drawing & PDF drawings	Building	Adequate	Adequate information available to work on VE model geometry
	CAD Floor plan (First floor to all the above floors)			"1. 1st Floor.dxf","2. 2nd Floor.dxf" & "1. 1st Floor.pdf","2. 2nd Floor.pdf"			"/Main building/Vanh.kesk. sairaala. pohja 2krs. 1_100.dwg, Vanh.kesk. sairaala. pohja 3krs. 1_100.dwg, Vanh.kesk. sairaala. pohja 4krs. 1_100.dwg"			"7 Mar de la Xina Street/Buildings drawings/04nivell144_90_e200 Model (1).pdf" , "7 Mar de la Xina Street/Buildings drawings/05nivell147_80_e200 Model (1).pdf" , "7 Mar de la Xina Street/Buildings drawings/06nivell150_70_e200 Model (1).pdf"			"Pins del Vallès School/Buildings drawings/CEIP Pins_P01-edifici principal.dwg" "Pins del Vallès School/Buildings drawings/CEIP Pins_P01-edifici principal.pdf"			"2 private houses in Les Planes/Buildings drawings/Annex_Carena, 3.pdf" , "2 private houses in Les Planes/Buildings drawings/Annex Rectoret 6.pdf"			CAD drawing & PDF drawings	Building	Adequate	Adequate information available to work on VE model geometry
	CAD Roof plan			"3. Roof Top View.dxf" & "3. Roof Top View.pdf"			N/A		Roof can be seen from the other drawings such as sections	"7 Mar de la Xina Street/Buildings drawings/08 coberta.pdf"			"Pins del Vallès School/Buildings drawings/COBERTA EDIFICI PRINCIPAL.dwg" "Pins del Vallès School/Buildings drawings/COBERTA PARVULARI.dwg" "Pins del Vallès School/Buildings drawings/Sport pavilion/coberta gimnas.dwg"			"2 private houses in Les Planes/Buildings drawings/Annex_Carena, 3.pdf" , "2 private houses in Les Planes/Buildings drawings/Annex Rectoret 6.pdf"			CAD drawing & PDF drawings	Building	Adequate	Adequate information available to work on VE model geometry
	CAD False ceiling/void plan			N/A		The building has no false ceilings/voids.	N/A			N/A		The building has no false	N/A		The building has no false	N/A		The building has no false	CAD drawing	Building	Cannot be obtained	Not Applicable
	CAD Site plan Showing all the buildings			"Site plan.dxf" & "Site plan.pdf"		Uploaded to Zoho	Asemapiirustus 1_500.dwg			"7 Mar de la Xina Street/Buildings drawings/01 planol1.pdf"			"Pins del Vallès School/Buildings drawings/CEIP Pins_emplaçament.dwg"			N/A			CAD drawing	Site	Adequate	Adequate information available to work on VE model geometry
	CAD site plan showing North arrow			"0. Ground Floor.dxf" & "0. Ground Floor.pdf"			Asemapiirustus 1_500.dwg		North is up, or 0°	"7 Mar de la Xina Street/Buildings drawings/01 planol1.pdf"			"Pins del Vallès School/Buildings drawings/CEIP Pins_emplaçament.dwg"			N/A			CAD drawing	Site	Adequate	Adequate information available to work on VE model geometry
	CAD Elevation of all the sides of building			"North-East Facade.dxf","North-West Facade.dxf","South-East Facade.dxf","South-West Facade.dxf" & "North-East Facade.pdf","North-West Facade.pdf","South-East Facade.pdf","South-West Facade.pdf"			"/Main building/Vanh.kesk. sairaala. julkisivu east1_100.dwg, Vanh.kesk. sairaala. julkisivu north1_100.dwg, Vanh.kesk. sairaala. julkisivu south1_100.dwg, Vanh.kesk. sairaala. julkisivu west1_100.dwg"			"7 Mar de la Xina Street/Buildings drawings/11 alçats.pdf"			Pins del Vallès School/Buildings drawings/Sport pavilion/façanes gimnas.dwg "Pins del Vallès School/Buildings drawings/Sport pavilion/façanes gimnas.pdf"		Only available for sport pavilion building	N/A			CAD drawing & PDF drawings	Building	Adequate	Adequate information available to work on VE model geometry
	CAD Sections of buildings explaining building at different levels			"S-01 Section.dxf", "S-02 Section.dxf" & "S-01 Section.pdf", "S-02 Section.pdf"			"/Main building/Vanh.kesk. sairaala. leikkaus B - B 1_100.dwg"			"7 Mar de la Xina Street/Buildings drawings/09 seccio alçat.pdf" , "7 Mar de la Xina Street/Buildings drawings/10 seccio alçat.pdf"			Pins del Vallès School/Buildings drawings/Sport pavilion/façanes gimnas.dwg "Pins del Vallès School/Buildings drawings/Sport pavilion/façanes gimnas.pdf"		Only available for sport pavilion building	"2 private houses in Les Planes/Buildings drawings/Annex_Carena, 3.pdf"			CAD drawing & PDF drawings	Building	Adequate	Adequate information available to work on VE model geometry
	CAD façade sections, part sections, sctional elevations explaining building			"S-01 Section.dxf", "S-02 Section.dxf" & "S-01 Section.pdf", "S-02 Section.pdf"		Relevant facade sections are on S-01 Section, S-02 Section. Are further details required?	N/A			N/A			N/A			N/A			CAD drawing	Building	Adequate	Adequate information available to work on VE model geometry
	CAD drawing/detail of shading geometry, like pergola, canopy, balcony, refuge area etc			N/A		The building has no shading structures.	N/A			N/A			N/A			N/A			CAD drawing	Building	Cannot be obtained	Not Applicable
	Adjacent buildings dimensions like outer profile in plan and total ht for shading calculation			"Site plan.dxf" & "Site plan.pdf"		Uploaded to Zoho	Asemapiirustus 1_500.dwg			"7 Mar de la Xina Street/Buildings drawings/01 planol1.pdf"			"Pins del Vallès School/Buildings drawings/CEIP Pins_emplaçament.dwg"			N/A			CAD drawing	Site	Adequate	Adequate information available to work on VE model geometry
	3D Building model			"3D Model - IFC General.ifc" and "3D Model - IFC to IES.ifc"			"/Main building/Seinäjoki_main_building_detailed.ifc"			N/A			"Pins del Vallès School/Building drawings/01417_ANT_ARQ_CNT_170711.nwd"			N/A			IFC drawings	Site	Adequate	Adequate information available to work on VE model geometry
	Internal photos of buildings at different locations			"bokay_int_01.jpg", "bokay_int_02.jpg", "bokay_int_03.jpg", "bokay_int_04.jpg", "bokay_int_05.jpg", "bokay_int_06.jpg", "bokay_int_07.jpg",		Uploaded to Zoho	"/Interior images"			"/Interior images"			"/Interior images"			N/A			Images	Building	Adequate	Adequate information available to work on VE model geometry
	Photos of internal atrium or double ht. spaces if not clearly mentioned in drawings for accurate thermal modelling			N/A		The building has no internal atrium or double height spaces.	N/A			N/A		The building has no internal atrium or double height spaces.	N/A		The building has no internal atrium or double height spaces.	N/A		The building has no internal atrium or double height spaces.	Images	Room	Cannot be obtained	Not Applicable
	Exterior photos of building from all sides			"bokay_ext_NW_01.jpg", "bokay_ext_NW_02.jpg",		Uploaded to Zoho	"/Exterior images"			"/Exterior images"			"/Exterior images"			N/A			Images	Building	Adequate	Adequate information available to work on VE model geometry
	Google street views images of building, photos of building from any surrounding higher building if available			"bokay_google_streetview_01.jpg", "bokay_google_streetview_02.jpg", "bokay_google_streetview_03.jpg", "bokay_google_streetview_04.jpg", "bokay_google_streetview_05.jpg", "bokay_google_streetview_06.jpg", "bokay_google_streetview_07.jpg", "bokay_google_streetview_08.jpg", "bokay_google_streetview_09.jpg", "bokay_google_streetview_10.jpg", "bokay_google_streetview_11.jpg", "bokay_google_streetview_12.jpg",		Uploaded to Zoho - the school is the highest building in its surroundings	"/Streetview images"			"/Streetview images"			"/Streetview images"			"/Streetview images"			Images	Site	Adequate	Adequate information available to work on VE model geometry
	KMZ file of building location or Exact location of building to locate on google maps with Lat. Long. coordinates			"bokay_school_bp_demo.kmz"		Uploaded to Zoho	62°47'20.6"N 22°49'40.9"E			41°27'29.0"N 2°04'38.1"E			41°28'57.2"N 2°04'33.5"E			41°26'03.9"N 2°05'23.6"E ; 41°25'59.7"N 2°05'41.1"E			*.kmz file	Site	Adequate	Adequate information available to work on VE model geometry
	Weather file or exact location of the site on map			"bokay_school_bp_demo.kmz"		The kmz file attached to the previous point is acceptable here too?	62°47'20.6"N 22°49'40.9"E			41°27'29.0"N 2°04'38.1"E			41°28'57.2"N 2°04'33.5"E			41°26'03.9"N 2°05'23.6"E ; 41°25'59.7"N 2°05'41.1"E			Address, Coordinates etc.	Site	Adequate	location, based on that nearest weather file can be selected.
Construction details	External wall	Drawings showing construction layers with material types from outside to inside	Thickness of each layer	"layer_U_values.xlsx "		updated excel, layers marked on the sections uploaded to Zoho	U-values Seinäjoki.xlsx			U values - 7 Mar de la Xina Street.xlsx		Uploaded to Zoho	U-values Pins del Vallès School.xlsx		Uploaded to Zoho	no data available		Uploaded to Zoho	milimeter	Building/Room	Received	Thickness available for all types of walls as per excel sheet provided, adequate information available
			Type of material of each layer, or the below	"layer_U_values.xlsx "			U-values Seinäjoki.xlsx			U values - 7 Mar de la Xina Street.xlsx			U-values Pins del Vallès School.xlsx			no data available				Building/Room	Received	Type of materials information is available for all different types of assembly. Adequate information available.
			Conductivity of each layer																W/(m.K)	Building/Room	Not Received Yet	Total U value of assembly is available, but this particular parameter is not provided in excel sheet. Assembly can be created based on assumptions and data available for this type if information cannot be estimated by data collector.
			Density of each layer																kg/m³	Building/Room	Not Received Yet	Assembly can be created based on assumptions if data cannot be estimated
			Specific heat capacity of each layer																J/(kg.K)	Building/Room	Not Received Yet	This data is missing in excel sheet. Assembly can be created based on assumptions if data cannot be estimated by data collector.
			Outside surface Emissivity																	Building/Room	Not Received Yet	This data is missing in excel sheet. Assembly can be created based on assumptions if data cannot be estimated by data collector.
			Outside surface Resistance																m²K/W	Building/Room	Not Received Yet	This data is missing in excel sheet. Assembly can be created based on assumptions if data cannot be estimated by data collector.
			Outside surface Solar Absorptance																	Building/Room	Not Received Yet	This data is missing in excel sheet. Assembly can be created based on assumptions if data cannot be estimated by data collector.
			Inside surface Emissivity																	Building/Room	Not Received Yet	This data is missing in excel sheet. Assembly can be created based on assumptions if data cannot be estimated by data collector.
			Inside surface Resistance																m²K/W	Building/Room	Not Received Yet	This data is missing in excel sheet. Assembly can be created based on assumptions if data cannot be estimated by data collector.
			Inside surface Solar Absorptance																	Building/Room	Not Received Yet	This data is missing in excel sheet. Assembly can be created based on assumptions if data cannot be estimated by data collector.
	Internal Wall/Partition	Same properties as above (like external wall) will be required		"layer_U_values.xlsx "		updated excel, layers marked on the sections	U-values Seinäjoki.xlsx			U values - 7 Mar de la Xina Street.xlsx			U-values Pins del Vallès School.xlsx			no data available				Building/Room	Inadequate - Assumption needed	Layer type and thickness available for internal walls. U value of total wall assembly is not provided for W5, W6, W7 on Ground, First and Second floor. Assumptions will be required to make this constructions in VE in absence of this data.
	Ground/Exposed floor	Same properties as above will be required		"layer_U_values.xlsx "		updated excel, layers marked on the sections	U-values Seinäjoki.xlsx			U values - 7 Mar de la Xina Street.xlsx			U-values Pins del Vallès School.xlsx			no data available				Building/Room	Received	Thickness, type of materials & total U value is available. Adequate information available, lower priority data is missing in excel sheet so for that assumptions will be considered.
	Roof	Same properties as above will be required		"layer_U_values.xlsx "		updated excel, layers marked on the sections	U-values Seinäjoki.xlsx			U values - 7 Mar de la Xina Street.xlsx			U-values Pins del Vallès School.xlsx			no data available				Building/Room	Inadequate - Assumption needed	Layer type and thickness available for roof assembly. Total U value of assembly is not available, lower priority data is missing in excel sheet so for that assumptions will be considered.
	Internal Ceiling/Floor	Same properties as above will be required		" layer_U_values.xlsx "		updated excel, layers marked on the sections	U-values Seinäjoki.xlsx			U values - 7 Mar de la Xina Street.xlsx			U-values Pins del Vallès School.xlsx			no data available				Building/Room	Received	Layer type and thickness available for internal floor with U value of total assembly. Adequate information available for creating this construction, lower priority data is missing in excel sheet so for that assumptions will be considered.
	Door	Same properties as above will be required		"layer_U_values.xlsx "			U-values Seinäjoki.xlsx			U values - 7 Mar de la Xina Street.xlsx			U-values Pins del Vallès School.xlsx			no data available				Building/Room	Received	Type of material and U value is available, Construction can be created with missing data as assumption.
	Windows	Drawings showing construction layers with material types from outside to inside	Thickness of all layers	no data available		can be estimated if needed	no data available			no data available			no data available			no data available			milimeter	Building/Room	Received	Type of material and U value is available, Construction can be created with missing
			Conductivity of all layers	no data available		can be estimated if needed	no data available			no data available			no data available			no data available			W/(m.K)	Building/Room	Not Received Yet	if estimated then good or else we can use
			Gas Type (if doubled/tripled glazed)	no data available		can be estimated if needed	no data available			no data available			no data available			no data available				Building/Room	Not Received Yet	if estimated then good or else we can use assumptions for this
			Convection Coefficient (if doubled/tripled glazed)	"layer_U_values.xlsx "		updated excel, layers marked on the sections	U-values Seinäjoki.xlsx			U values - 7 Mar de la Xina Street.xlsx			U-values Pins del Vallès School.xlsx			no data available			W/m²K	Building/Room	Received	Adequate information available
			Resistance																m²K/W	Building/Room	Not Received Yet	Adequate information available for
			Transmittance																	Building/Room	Not Received Yet	Adequate information available for
			Outside Reflectance																	Building/Room	Not Received Yet	Adequate information available for
			Inside Reflectance																	Building/Room	Not Received Yet	Adequate information available for
			Refractive Index																	Building/Room	Not Received Yet	Adequate information available for
			Net U value (including																W/m²K	Building/Room	Not Received Yet	Adequate information available for
			g-value																	Building/Room	Not Received Yet	Adequate information available for
			Visible light normal																	Building/Room	Not Received Yet	Adequate information available for
			Outside surface Emissivity																	Building/Room	Not Received Yet	Adequate information available for creating construction. Missing lower priority data if not available then assumptions needed.
			Outside surface Resistance																m²K/W	Building/Room	Not Received Yet	Adequate information available for
			Inside surface Emissivity																	Building/Room	Not Received Yet	Adequate information available for
			Inside surface Resistance																m²K/W	Building/Room	Not Received Yet	Adequate information available for
			Frame type																	Building/Room	Received	Adequate information available
			Frame Percentage																%	Building/Room	Not Received Yet	Adequate information available for
			Frame Absorptance																	Building/Room	Not Received Yet	Adequate information available for
			Frame U value																W/m²K	Building/Room	Not Received Yet	Adequate information available for
			Frame Resistance																m²K/W	Building/Room	Not Received Yet	Adequate information available for
			Shading devices with																		Not Received Yet	Adequate information available for
	Hard landscape	Constructions layers from outside to inside	Thickness of all layers																milimeter	Site	Not Received Yet	No information available, assumptions needed
			Conductivity																W/(m.K)	Site	Not Received Yet	No information available, assumptions
			Density																kg/m³	Site	Not Received Yet	No information available, assumptions
			Specific heat capacity																J/(kg.K)	Site	Not Received Yet	No information available, assumptions
			Outside surface Emissivity																	Site	Not Received Yet	No information available, assumptions
			Outside surface Resistance																m²K/W	Site	Not Received Yet	No information available, assumptions
	Parking	Same properties as above (like Hard landscape) will be required																		Site	Not Received Yet	No information available, assumptions needed
	Pavement/sidewalk	Same properties as above (like Hard landscape) will be required																		Site	Not Received Yet	No information available, assumptions needed
	Pervious hard landscape	Same properties as above (like Hard landscape) will be required																		Site	Not Received Yet	No information available, assumptions needed
	Road	Same properties as above (like Hard landscape) will be required																		Site	Not Received Yet	No information available, assumptions needed
Individual Room data	Internal gains	Lighting gains	Maximum sensible gain	no data available		can be estimated if needed	Average ~10 W/m2			no data available			no data available			no data available			W/m² or W	Room	Not Received Yet	Need to be estimated by data collector. In case of missing data, UK NCM School standards will be applied to rooms for simulations
			Maximum power consumption	no data available		can be estimated if needed	Average ~10 W/m2			no data available			no data available			no data available			W/m² or W	Room	Not Received Yet	Need to be estimated by data collector. In case of missing data, UK NCM School standards will be applied to rooms for simulations
			Radiant fraction	no data available		can be estimated if needed	0.45	assumed		no data available			no data available			no data available				Room	Not Received Yet	Need to be estimated by data collector. In case of missing data, UK NCM School standards will be applied to rooms for simulations
			Ballast/driver fraction	no data available		can be estimated if needed	N/A			no data available			no data available			no data available				Room	Not Received Yet	Need to be estimated by data collector. In case of missing data, UK NCM School standards will be applied to rooms for simulations
			Variation profile	no data available		can be estimated if needed	07:00 - 20:00, load 0.5	From regulations/estimation		no data available			no data available			no data available			Yearly	Room	Not Received Yet	Need to be estimated by data collector. In case of missing data, UK NCM School standards will be applied to rooms for simulations
			Dimming profile	no data available		can be estimated if needed	On continuously			no data available			no data available			no data available			Yearly	Room	Not Received Yet	Need to be estimated by data collector. In case of missing data, UK NCM School standards will be applied to rooms for simulations
		People gains	Occupancy			class schedule procurement is in progress from the headmistress (with afternoon activities)	10 m2/person	Estimated		52 persons; 1,5 person/apartment; 37,5 m2/person			7,5 m2/person; 25 persons/class			no data available			number of people	Room	Not Received Yet	Need to be estimated by data collector. In case of missing data, UK NCM School standards will be applied to rooms for simulations
			Occupancy pattern/variation	school times		class schedule procurement is in progress from the headmistress (with afternoon activities)	07:00 - 20:00, load 0.65	Estimated		not available			not available	The class schedule is from 3:00 to 4:30 PM. From 12:30 to 3:00 PM some classrooms are open the majority of the students are in the dining room or outside the building. There is also extra activities out the class schedule. Inthe morning (from 7:30 to 8:45 AM) and in the afternoon (from 4:30 to 6:00 PM).		not available			Yearly	Room	Not Received Yet	Need to be estimated by data collector. In case of missing data, UK NCM School standards will be applied to rooms for simulations
		Misc. gains, including cooking, equipment etc	Maximum sensible gain	no data available		No cooking, no server room, what else would be relevant here? Could be estimated if needed	Music school buildign half - 6 W/m2, SeAMK half - 10 W/m2	Estimated		no data available			no data available			no data available			W/m² or W	Room	Cannot be obtained	No cooking and servers, ok. Other relevant parameters comes under this is machinaries, task lights, display lights, process lighting or equipment. Need to be estimated by data collector. In case of missing data, UK NCM School standards will be applied to rooms for simulations
			Maximum power consumption	no data available		can be estimated if needed	Music school buildign half - 6 W/m2, SeAMK half - 10 W/m2	Estimated		no data available			no data available			no data available			W/m² or W	Room	Not Received Yet	Need to be estimated by data collector. In case of missing data, UK NCM School standards will be applied to rooms for simulations
			Maximum latent gain	no data available		can be estimated if needed	no data available			no data available			no data available			no data available			W/m² or W	Room	Not Received Yet	Need to be estimated by data collector. In case of missing data, UK NCM School standards will be applied to rooms for simulations
			Variation profiles	no data available		can be estimated if needed	07:00 - 20:00, load 0.5			no data available			no data available			no data available			Yearly	Room	Not Received Yet	Need to be estimated by data collector. In case of missing data, UK NCM School standards will be applied to rooms for simulations
	Air exchanges	Infiltration	Maximum flow	no data available		can be estimated if needed	0.333 ac/hr	Estimated		no data available			1 ac/hr	Estimated		no data available			Air changes per hour	Room	Not Received Yet	Need to be estimated by data collector. In case of missing data, UK NCM School standards will be applied to rooms for simulations
		Auxiliary Ventilation	Maximum flow	no data available		can be estimated if needed	no data available			no data available			no data available			no data available			Air changes per hour	Room	Not Received Yet	Need to be estimated by data collector. In case of missing data, UK NCM School standards will be applied to rooms for simulations
			Variation profile	no data available		can be estimated if needed	no data available			no data available			no data available			no data available			Yearly	Room	Not Received Yet	Need to be estimated by data collector. In case of missing data, UK NCM School standards will be applied to rooms for simulations
	Space conditions	Heating	Operating profile	Heating season is from 15th October to 15th April		daily profile can be gained from monitoring data, if needed	On continuously	Estimated		Heating season is from 1st October to 31st May		daily profile can be gained from monitoring data, if needed	Heating season is from 1st October to 31st May		daily profile can be gained from monitoring data, if needed	no data available			Yearly	Room	Not Received Yet	Need to be estimated by data collector. In case of missing data, UK NCM School standards will be applied to rooms for simulations
			Setpoint	no data available		can be estimated if needed	21C	Standard		21C	Standard		21C	Standard		no data available			°C	Room	Not Received Yet	Need to be estimated by data collector. In case of missing data, UK NCM School standards will be applied to rooms for simulations
		Cooling	Operating profile	no data available		Cooling only in the IT class room, can be estimated if needed	Not present		In few PC rooms	no data available			no data available		Cooling only in the IT class room, can be estimated if needed	no data available			Yearly	Room	Not Received Yet	Need to be estimated for IT room by data collector. In case of missing data, UK NCM School standards will be applied to rooms for simulations
			Setpoint	no data available		can be estimated if needed	Not present		can be estimated if needed	no data available		can be estimated if needed	no data available		can be estimated if needed	no data available			°C	Room	Not Received Yet	Need to be estimated by data collector. In case of missing data, UK NCM School standards will be applied to rooms for simulations
		DHW	Consumption	no data available		There is neihter kitchen, nor shower in the building. DHW is used only for handwashing. Can be estimated if needed	0.2 l/h/person	From regulations/estimation		no data available			no data available			no data available				Room	Not Received Yet	Need to be estimated for Handwashing by data collector. In case of missing data, UK NCM School standards will be applied to rooms for simulations
			Pattern of use	only handwashing		can be estimated if needed	no data available			no data available			no data available			no data available				Room	Not Received Yet	Need to be estimated by data collector. In case of missing data, UK NCM School standards will be applied to rooms for simulations
		Plant(Auxiliary Energy)	Plant operation	N/A		There is no local energy production.	N/A			N/A			N/A			N/A				Room	Cannot be obtained	Not Applicable
		Humidity Control	Min & Max % saturation	N/A		there is no humidity control	Music school building half has humidifier - 50 - 80%	Estimated		N/A			N/A			N/A				Room	Cannot be obtained	Not Applicable
Building System Data	Types of HVAC system		Mechanical drawings if available	no data available		Mechanical drawings are not available. Need to discuss what drawings are must have	"/Mechanical drawings"		Old drawings from 1970s	no data available			"/Mechanical drawings"		Old drawings from 80s and 90s	no data available			CAD or PDF drawing	Building/Plant system	Not Received Yet	Detail drawings required of mechanical system and other related plants for better understanding and creating network in thermal model
	Heating	Generators	Heating Type	Gas-fired heat pumps, condenser boiler, radiators			radiators / pre-heating supply air			central heating			radiators			Wood and electric stoves			e.g. radiators?	Building/Plant system	Not Received Yet	Related information will be required to model the same
			Seasonal efficiency	no data available		can be estimated if needed	no data available			no data available			no data available			no data available				Building/Plant system	Not Received Yet	Related information will be required to model the same
			Fuel used	natural gas, electricity			District heating			natural gas			natural gas			Electricity				Building/Plant system	Received	Related information will be required to model the same
			SCoP	no data available		can be estimated if needed	no data available			no data available			no data available			no data available			kW/kW	Building/Plant system	Not Received Yet	Related information will be required to model the same
		Heat Recovery	Vent. Heat recovery effectiveness	N/A		There is no heat recovery system in the building	Assumed 70 %			N/A			N/A			N/A				Building/Plant system	Cannot be obtained	Not Applicable
			Vent. Heat recovery return air temp	N/A			N/A			N/A			N/A			N/A			°C	Building/Plant system	Cannot be obtained	Not Applicable
	Cooling	Generator	Air Conditioning?	YES		Split Cooling only in the IT class room.	No		Few PC rooms	No			yes		Split Cooling only in the IT class room.	No			YES/NO	Building/Plant system	Not Received Yet	Split cooling related all information will be required to model the same
			Nominal EER	no data available		can be estimated if needed	no data available			no data available			no data available			no data available			kW/kW	Building/Plant system	Not Received Yet	Related information will be required to model the same
			Seasonal EER	no data available		can be estimated if needed	no data available			no data available			no data available			no data available			kW/kW	Building/Plant system	Not Received Yet	Related information will be required to model the same
			SSEER	no data available		can be estimated if needed	no data available			no data available			no data available			no data available			kW/kW	Building/Plant system	Not Received Yet	Related information will be required to model the same
			Fuel used	no data available		can be estimated if needed	no data available			no data available			no data available			no data available				Building/Plant system	Not Received Yet	Related information will be required to model the same
			Absorption chiller?	NO			NO			NO			NO			NO			YES/NO	Building/Plant system	Cannot be obtained	Not Applicable
	Auxiliary Energy		Auxiliary Energy Method	N/A		There is no local energy production.	N/A			N/A			N/A			N/A				Building/Plant system	Cannot be obtained	Not Applicable
			Auxiliary Energy Value	N/A			N/A			N/A			N/A			N/A			W/m2	Building/Plant system	Cannot be obtained	Not Applicable
			Off-schedule heating/cooling AEV	N/A			N/A			N/A			N/A			N/A			W/m2	Building/Plant system	Cannot be obtained	Not Applicable
			Auxiliary energy fan fraction	N/A			N/A			N/A			N/A			N/A				Building/Plant system	Cannot be obtained	Not Applicable
	Auxiliary Ventilation System	Ventilation & Extract	Type	N/A		There is no ventilation system in the building.	Mechanical supply air ventilation			N/A			N/A			N/A				Building/Plant system	Cannot be obtained	No Ventilation system, so entire building is naturally ventilated? Information required to design natural ventilation for building in its respective tab.
			Local mechanical exhaust in room?	NO			NO			NO			NO			NO			YES/NO	Building/Plant system	Cannot be obtained	Not Applicable
			Specific fan power (if yes above)	N/A			N/A			N/A			N/A			N/A			W/(l/s)	Building/Plant system	Cannot be obtained	Not Applicable
			Extract fan is remote from room?	N/A			N/A			N/A			N/A			N/A			YES/NO	Building/Plant system	Cannot be obtained	Not Applicable
			Extract flow rate (if yes above)	N/A			N/A			N/A			N/A			N/A			l/(s*m2)	Building/Plant system	Cannot be obtained	Not Applicable
	Hot water	Generator	DHW delivery efficiency	no data available		electric water heater can be estimated if needed	no data available		electric water heater can be estimated if needed	no data available		solar DHW system can be estimated if needed	no data available		electric water heater can be estimated if needed	no data available		electric water heater can be estimated if needed		Building/Plant system	Not Received Yet	Need to be estimated by data collector to model the same in VE
		Set point	Mean cold water inlet temp	no data available		can be estimated if needed	no data available		can be estimated if needed	no data available		can be estimated if needed	no data available		can be estimated if needed	no data available		can be estimated if needed	°C	Building/Plant system	Not Received Yet	Need to be estimated by data collector to model the same in VE
			Hot water supply temp	no data available		can be estimated if needed	no data available		can be estimated if needed	no data available		can be estimated if needed	no data available		can be estimated if needed	no data available		can be estimated if needed	°C	Building/Plant system	Not Received Yet	Need to be estimated by data collector to model the same in VE
		Hot Water Storage	Is there a storage system?	NO			NO			NO			NO			NO			YES/NO	Building/Plant system	Cannot be obtained	Not Applicable
			Storage volume	N/A			N/A			N/A			N/A			N/A			l	Building/Plant system	Cannot be obtained	Not Applicable
			Insulation type & thickness	N/A			N/A			N/A			N/A			N/A			milimeter	Building/Plant system	Cannot be obtained	Not Applicable
			Storage losses	N/A			N/A			N/A			N/A			N/A			kWh/(l.day)	Building/Plant system	Cannot be obtained	Not Applicable
		Secondary circulation	Does system have secondary circulation?	NO			NO			NO			NO			NO			YES/NO	Building/Plant system	Cannot be obtained	Not Applicable
			Circulation Losses	N/A			N/A			N/A			N/A			N/A			W/m	Building/Plant system	Cannot be obtained	Not Applicable
			Pump power	N/A			N/A			N/A			N/A			N/A			kW	Building/Plant system	Cannot be obtained	Not Applicable
			Loop length	N/A			N/A			N/A			N/A			N/A			milimeter	Building/Plant system	Cannot be obtained	Not Applicable
			Is there a time switch?	NO			NO			NO			NO			NO			YES/NO	Building/Plant system	Cannot be obtained	Not Applicable
		Solar hot water	Area	N/A			N/A			N/A			N/A			N/A			m²	Building/Plant system	Cannot be obtained	Not Applicable
			Azimuth	N/A			N/A			N/A			N/A			N/A			° clockwise from north	Building/Plant system	Cannot be obtained	Not Applicable
			Tilt	N/A			N/A			N/A			N/A			N/A			° from horizontal	Building/Plant system	Cannot be obtained	Not Applicable
			Shading factor	N/A			N/A			N/A			N/A			N/A				Building/Plant system	Cannot be obtained	Not Applicable
			Storage tank	N/A			N/A			N/A			N/A			N/A			l	Building/Plant system	Cannot be obtained	Not Applicable
			Storage loss at max temperature	N/A			N/A			N/A			N/A			N/A			kWh/(l.day)	Building/Plant system	Cannot be obtained	Not Applicable
			Degradation factor	N/A			N/A			N/A			N/A			N/A				Building/Plant system	Cannot be obtained	Not Applicable
		Aux Energy	Auxiliary energy method	N/A			N/A			N/A			N/A			N/A				Building/Plant system	Cannot be obtained	Not Applicable
			Auxiliary energy	N/A			N/A			N/A			N/A			N/A			W/m²	Building/Plant system	Cannot be obtained	Not Applicable
		Air supply	Outside air supply	N/A			N/A			N/A			N/A			N/A			l/s	Building/Plant system	Cannot be obtained	Not Applicable
			Cooling air supply sizing	N/A			N/A			N/A			N/A			N/A			K	Building/Plant system	Cannot be obtained	Not Applicable
Natural Ventilation	Types of openings for all types of windows in entire building		Openable/fixed window	openable windows			no data available			openable windows			openable windows			no data available				Room/Building	Not Received Yet	Information need to be estimated by data collector. Since there is no mechanical
			Opening Type	no data available			no data available			no data available			no data available			no data available				Room/Building	Not Received Yet	Mention the opening type like top hung, side hung, bottom hung etc for all the respective windows.
			Openable area	no data available			no data available			no data available			no data available			no data available			%	Room/Building	Not Received Yet	Mention openable area % of the perticular window as compared to total area of that window.
			Crack flow coefficient	no data available			no data available			no data available			no data available			no data available			l/(s*m*Pa^0.6)	Room/Building	Not Received Yet	Infiltration % of air from crack around the window in l/(s*m*Pa^0.6)
			Crack length	no data available			no data available			no data available			no data available			no data available			%of opening perimeter	Room/Building	Not Received Yet	% of crack length as compared to entire window area need to be estimated
			Opening threshold	no data available			no data available			no data available			no data available			no data available			°C	Room/Building	Not Received Yet	In case of automated window threshold inside temperature at which windows will be opened in staging
			Opening profile	no data available			no data available			no data available			no data available			no data available				Room/Building	Not Received Yet	Opening profile of the window for entire day
Renewable energy	PV		Type	N/A		The building does not use any renewable	N/A		The building does not use any renewable	N/A		Solar thermal collectors system	N/A		The building does not use any renewable	N/A		The building does not use any renewable		Site/Building	Cannot be obtainec	Not Applicable
			Area	N/A			N/A			N/A			N/A			N/A			m²	Site/Building	Cannot be obtainec	Not Applicable
			Azimuth	N/A			N/A			N/A			N/A			N/A			degrees clockwise from north	Site/Building	Cannot be obtainec	Not Applicable
			Inclination	N/A			N/A			N/A			N/A			N/A			degrees from horizontal	Site/Building	Cannot be obtainec	Not Applicable
			Shading Factor	N/A			N/A			N/A			N/A			N/A				Site/Building	Cannot be obtainec	Not Applicable
	CHP	Performance at rated output	Heat Output	N/A			N/A			N/A			N/A			N/A			kW	Site/Building	Cannot be obtainec	Not Applicable
			Thermal Efficiency	N/A			N/A			N/A			N/A			N/A				Site/Building	Cannot be obtainec	Not Applicable
			Power Efficiency	N/A			N/A			N/A			N/A			N/A				Site/Building	Cannot be obtainec	Not Applicable
		Performance at minimum	Fraction of rated heat	N/A			N/A			N/A			N/A			N/A				Site/Building	Cannot be obtainec	Not Applicable
			Thermal Efficiency	N/A			N/A			N/A			N/A			N/A				Site/Building	Cannot be obtainec	Not Applicable
			Power Efficiency	N/A			N/A			N/A			N/A			N/A				Site/Building	Cannot be obtainec	Not Applicable
	Wind		Hub Height	N/A			N/A			N/A			N/A			N/A			m	Site/Building	Cannot be obtainec	Not Applicable
			Rated Power	N/A			N/A			N/A			N/A			N/A			kW	Site/Building	Cannot be obtainec	Not Applicable
Metered data (for calibration)	Utility bills	Electricity	One per month for a full	"electricity_consumption.xlsx"		Uploaded to Zoho (DHW consumption included	"/Metered data/Electric		For the main building monthly consumption i	"/Metered data"			"/Metered data/Electricity"			no data available			kWh	Site/Building	Received	Received and adequate as preliminary
		Fuel used for heating	One per month for a full year	"natural_gas_consumption.xlsx"		Uploaded to Zoho	"/Metered data/District heating energy 15-16 monthly.xlsx"		Metered monthly energy from district heating network for the whole site of 4 buildings is given for years 2015 and 2016	no data available			"/Metered data/Natural Gas"			no data available			kWh	Site/Building	Received	Received and adequate as preliminary data. Detailed information can be estimated ir required in future
		Fuel used for hot water	One per month for a full year	no data available		Included in Total Electricity consumption	no data available		District heating energy is used for this	no data available		Included in Total Natural Gas consumption	no data available		Included in Total Natural Gas consumption	no data available			kWh	Site/Building	Received	Received and adequate as preliminary data. Detailed information can be estimated ir required in future
		Fuel used for cooling	One per month for a full year	no data available		Included in Total Electricity consumption	N/A			no data available		Included in Total Electricity consumption	no data available		Included in Total Electricity consumption	no data available			kWh	Site/Building	Received	Received and adequate as preliminary data. Detailed information can be estimated ir required in future
	BMS data	Breakdown of electricity use	Hourly intervals or less	"monitoring.xlsx"		available only from February 2017 monitored: every 4hrs to be uploaded to Zoho	"/Metered data/Electric consumption hourly-site 15-16.xlsx" "/Metered data/Seinäjoki electricity cons per building- typical weeks/"		Hourly electricity consumption is given as a sum for site area (4 buildings). In more details hourly consumption for each building is given for typical weeks	no data available			no data available			no data available			kWh	Site/Building	Not Received Yet	Need to be estimated by data collector
		Breakdown of electricity use	Hourly intervals or less	no data available		Only building level data is available.	no data available		Only building level data is available.	no data available			no data available			no data available			kWh	Room	Cannot be obtained	Not Applicable
		Air Temperature	Hourly intervals or less	"monitoring.xlsx"		available only from February 2017 monitored: every 30 sec. to be uploaded to Zoho	no data available			no data available			no data available			no data available			oC	Room	Not Received Yet	Need to be estimated by data collector

LOWER PRIORITY

LOWER PRIORITY

Annex 2: NewTREND Simulation Data Availability for Demo Sites - Table District Level

			ABUD - BUDAPEST			GRANLUND - SEINÄJOKI			SANT CUGAT - PINS DEL VALLES SCHOOL				
	Property Input	Data	File name or value (please complete this serction)		Comments (please complete in case of any issues in data collection)	File name or value (please complete this serction)		Comments (please complete in case of any issues in data collection)	File name or value (please complete this serction)		Comments (please complete in case of any issues in data collection)	Preferable Data Format	Level of detail (Site/Building/Room)
			Current Status	What-if/post retrofit status (leave blank if not known or item not retrofitted)		Current Status	What-if/post retrofit status (leave blank if not known or item not retrofitted)		Current Status	What-if/post retrofit status (leave blank if not known or item not retrofitted)			
Network Typology	**Network Schematic of district heating network**	Schematic & drawing i.e. autocad or sketchup, technical document etc.	"bokay_garden.gml"			N/A		Heating energy comes from city district heating network to heating distribution building and from there it goes to each of the buildings in site. Meter is also located there	N/A				
	Network Schematic of district electricity network	Schematic & drawing i.e. autocad or sketchup, technical document etc.				N/A			N/A				
	Network Schematic of district cooling network	Schematic & drawing i.e. autocad or sketchup, technical document etc.	N/A			N/A			N/A				
	Site Data	Latitude & Longitude of pilot site	"47.436656 N, 19.177591 E"			62°47'20.6"N 22°49'40.9"E			41°28'57.2"N 2°04'33.5"E				
Transformers & Substations	**Conversion loss factor**		N/A			N/A			N/A				
	Downstream transmission loss factor		N/A			N/A			N/A				
Power Station	**Available Provision Profile**	Plant's schedule	N/A			N/A			N/A				
	Efficiency Curve	Constant Efficency/COP or Variable Efficiency COP	N/A			N/A			N/A				
	Fuel	Gas, Oil, Coal, etc	N/A			N/A			N/A				
	Maximum Output (kW)	kW output	N/A			N/A			N/A				
Heat Generator	**Available Provision Profile**	Plant's schedule	N/A			N/A			N/A				
	Efficiency Curve	Constant Efficency/COP or Variable Efficiency COP	N/A			N/A			N/A				
	Fuel	Gas, Oil, Coal, etc	N/A			N/A			N/A				
	Maximum Output (kW)	KW output	N/A			N/A			N/A				
Cooling Generator	**Available Provision Profile**	Plant's schedule	N/A			N/A			N/A				
	Efficiency Curve	Constant Efficency/COP or Variable Efficiency COP	N/A			N/A			N/A				
	Fuel	Gas, Oil, Coal, etc	N/A			N/A			N/A				
	Maximum Output (kW)	KW output	N/A			N/A			N/A				
CHP Plant	**Available Provision Profile**	Plant's schedule	N/A			N/A			N/A				
	Electrical Efficiency at min. electrical output	0.2-1	N/A			N/A			N/A				
	Electrical Efficiency at rated electricity output	0.2-1	N/A			N/A			N/A				
	Heat output at rated electricity output (kW)	KW output	N/A			N/A			N/A				
	Thermal efficiency at min. electricity output	0.2-1	N/A			N/A			N/A				
	Thermal efficiency at rated electricity output	0.2-1	N/A			N/A			N/A				
Photovoltaic Panel	**Available Provision Profile**	Plant's schedule	N/A			N/A			N/A				
	Area (m2)	The total surface area of **all PV panels**	N/A			N/A			N/A				
	Azimuth (deg.)	This is the azimuthal orientation of all PV panels (in degrees clockwise from North)	N/A			N/A			N/A				
	Degradation factor		N/A			N/A			N/A				
	Electrical conversion rate (kW/kW)	Parameter associated with the efficiency of the conversion of light energy to electrical	N/A			N/A			N/A				
	Inclination (deg.)		N/A			N/A			N/A				
	Nominal cell temperature (deg.celsius)		N/A			N/A			N/A				
	PV moduel nominal efficiency	Parameter associated with the efficiency of the PV Array Installation as a whole. Not to be confused with the electricalConversion.	N/A			N/A			N/A				
	Reference irradiance for NOCT (W/m2)	800-1000	N/A			N/A			N/A				
	Shading factor	This is the amount of shading affecting the whole PV Array Installation	N/A			N/A			N/A				
	Temperature coefficient for module efficiency		N/A			N/A			N/A				
Wind Turbine	**Available Provision Profile**		N/A			N/A			N/A				
	Hub height (m)	This is the (average) height above ground of the hub of the wind turbine(s).	N/A			N/A			N/A				
	Power curve	installation. The list of values represents x-y coordinate pairs where thre x-axis	N/A			N/A			N/A				
	Rated Power	The maximum power that the wind turbine installation can output.	N/A			N/A			N/A				
Electricity Stores	**Available charging flux profile**	Storage schedule	N/A			N/A			N/A				
	Available discharging flux profile	Storage schedule	N/A			N/A			N/A				
	Charge Loss Factor	The fraction of energy lost when charging the storage device	N/A			N/A			N/A				
	Discharge Loss Factor	The fraction of energy lost when discharging the storage device	N/A			N/A			N/A				
	Initial stored energy (kWh)	Amount of energy in storage at the beginning of the simulation.	N/A			N/A			N/A				
	Leakage Loss Factor (/30 days)	The fraction of energy lost every 30 days due to leaks or background discharge.	N/A			N/A			N/A				
	Maximum Flux (kW)	The maximum power that can be used to charge or can be discharged from storage	N/A			N/A			N/A				
	Storage capacity (kWh)	Maximum amount of energy that can be in storage at any given point in time.	N/A			N/A			N/A				
	Stored energy indirect CO2 emissionf actor	This is the CO2 emission factor associated with the energy initially in storage.	N/A			N/A			N/A				
Heating Storage	**Available charging flux profile**	Storage schedule	N/A			N/A			N/A				
	Available discharging flux profile	Storage schedule	N/A			N/A			N/A				
	Charge Loss Factor	The fraction of energy lost when charging the storage device	N/A			N/A			N/A				
	Discharge Loss Factor	The fraction of energy lost when discharging the storage device	N/A			N/A			N/A				
	Initial stored energy (kWh)	Amount of energy in storage at the beginning of the simulation.	N/A			N/A			N/A				
	Leakage Loss Factor (/30 days)	The fraction of energy lost every 30 days due to leaks or background discharge.	N/A			N/A			N/A				
	Maximum Flux (kW)	The maximum power that can be used to charge or can be discharged from storage	N/A			N/A			N/A				
	Storage capacity (kWh)	Maximum amount of energy that can be in storage at any given point in time.	N/A			N/A			N/A				
	Stored energy indirect CO2 emissionf actor	This is the CO2 emission factor associated with the energy initially in storage.	N/A			N/A			N/A				
Cooling Storage	**Available charging flux profile**	Storage schedule	N/A			N/A			N/A				
	Available discharging flux profile	Storage schedule	N/A			N/A			N/A				
	Charge Loss Factor	The fraction of energy lost when charging the storage device	N/A			N/A			N/A				
	Discharge Loss Factor	The fraction of energy lost when discharging the storage device	N/A			N/A			N/A				
	Initial stored energy (kWh)	Amount of energy in storage at the beginning of the simulation.	N/A			N/A			N/A				
	Leakage Loss Factor (/30 days)	The fraction of energy lost every 30 days due to leaks or background discharge.	N/A			N/A			N/A				
	Maximum Flux (kW)	The maximum power that can be used to charge or can be discharged from storage	N/A			N/A			N/A				
	Storage capacity (kWh)	Maximum amount of energy that can be in storage at any given point in time.	N/A			N/A			N/A				
	Stored energy indirect CO2 emissionf actor	This is the CO2 emission factor associated with the energy initially in storage.	N/A			N/A			N/A				
Solar Water Heaters	**Available Provision Profile**	Schedule	N/A			N/A			N/A				
	Area (m2)	The total surface area of all PV panels.	N/A			N/A			N/A				
	Azimuth (deg.)	This is the azimuthal orientation of all PV panels (in degrees clockwise from North).	N/A			N/A			N/A				
	Conversion efficiency at ambient temperature	Parameter associated with the efficiency of the conversion of light energy to electrical	N/A			N/A			N/A				
	Degradation factor	Parameter associated with the slight degradation in performance due to an aged or	N/A			N/A			N/A				
	First order heat loss coefficient	One of the two heat loss coefficients used to calculate the heat losses of the sensible	N/A			N/A			N/A				
	Flow rate (l/h/m2)	Flow rate of water through entering and exiting the sensible water tank.	N/A			N/A			N/A				
	Heat exchange effectives	Effectiveness of the air-water heat exchanger.	N/A			N/A			N/A				
	Pump Power (kW)	Parameter associated with the power of the pump responsible for the flow rate.	N/A			N/A			N/A				
	Secord order heat loss coefficient	One of the two heat loss coefficients used to calculate the heat losses of the sensible	N/A			N/A			N/A				
	Shading factor	This is the amount of shading affecting the whole PV Array Installation.	N/A			N/A			N/A				
	Storage tank losses at maximum temperature (kWh/l/	Parameter associated with losses from the sensible storage tank over time.	N/A			N/A			N/A				
	Storage tank volume (l)		N/A			N/A			N/A				
	Tank inlet temperature (deg.Celsius)	The temperature of cold water entering the water tank	N/A			N/A			N/A				
	Tank supply temp (deg.Celsisu)	The required temperature of the water tank.	N/A			N/A			N/A				
	Tilt (deg.)	Parameter associated with the tilt of the panel.	N/A			N/A			N/A				
Prosumer Units	At least Basic mode information or metered data for all the buildings in the neighbourhood		N/A			"/Metered data/Electric consumption hourly-site 15-16.xlsx" "/Metered data/Seinäjoki electricity cons per building- typical weeks/"		Hourly electricity consumption is given as a sum for site area (4 buildings). In more details hourly consumption for each building is given for typical weeks	/Metered data/Electricity , /Metered data/Natural Gas				
Lighting installations	Ballast or LED driver fraction		N/A			N/A			N/A				
	Dimming Profile		N/A			N/A			N/A				
	Electricity Consumption Profile		N/A			N/A			N/A				
	Maximum output (kW)		N/A			N/A			N/A				
	Variation profile		N/A			N/A			N/A				