BaaS

Building as a Service

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Deliverable 6.1:
Identification and definition of BaaS demonstration buildings

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Deliverable Summary Sheet

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Deliverable 6.1: Short Description

This document selects and describes the Demonstration Buildings in which BaaS System will be implemented and validated. The five selected buildings cover three different typologies: offices, hotel and educational building. The description of each of these buildings is included as one appendix at the end of this document.

Keywords: Pilots; Demonstration buildings; Selection; Definition

Deliverable 6.1: Revision History

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0.3	12/04/2013	Draft	CARTIF: add building data
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0.5	02/05/2013	Draft	CARTIF: new structure for circulation
0.6	09/05/2013	Draft	DALKIA: add HUSA and Sierra Elvira buildings information
0.7	14/05/2013	Draft	Fraunhofer: add ZUB building information; TUC: add TUC building information; DALKIA: add Sierra Elvira school information
1.0	31/05/2013	Final	CARTIF: final version

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Abbreviations and Acronyms

BaaS	Building as a Service
ESCO	Energy Services Company
DWH	Data Warehouse
BIM	Building Information Model
RTD	Research and Technological Development
MS	Milestone
M&V	Measurement and Verification
ECM	Energy Conservation Measure
EPBD	Energy Performance Building Directive
TCS	Theoretical Case Study
HVAC	Heating Ventilation and Air Conditioning
ICT	Information and Communication Technologies
GPL	General Public Licenses
BMS	Building Management System
BACN	Building Automation and Control Network
KPI	Key Performance Indicator
DHW	Domestic Hot Water
ZUB	Centre for Sustainable Building
TUC	Technical University of Crete

Executive Summary

As BaaS solution has to be validated and demonstrated on real buildings, this document sets the first stage of this work, analysing and selecting the demonstration buildings to be used for the whole system verification.

Selected buildings must fulfil the conditions and requirements that have been set in the project framework, regarding the scope of its activities and objectives. In this sense, considering the portfolio provided by the ESCO, all buildings have been analysed from these requirements point of view, selecting the most suitable for the BaaS solution verification in order to move from the research and technological development to the demonstration and validation process. This selection is closely related to the theoretical case studies and the analysis of the end-user acceptance, activities carried out in WP1.

Thus, once selected the demonstration buildings for implementing the BaaS system, they are described considering its current state, giving the necessary information for this implementation and validation process: geometrical definition, information about materials, thermal zones, installed energy systems and installed building energy management systems.

This information is the basis for the adaptation of the demonstration buildings for implementing the BaaS system (task 6.2) and the M&V protocol for the validation (tasks 6.3 and 6.4).

In this sense, this document only includes the existing information and the way in which it can be provided, that is, no adaptations are considered. Thus, the information to be provided for creating the BaaS components, as the Building Information Model (BIM), or the Data Warehouse (DWH) is included, while these components are not included in this document.

The document is structured in two main parts. The first one includes the selection of the significant pilots considering the buildings provided by the ESCO and taking as basis the theoretical case studies defined in WP1. The second part of this document includes the definition of the buildings in the way of tables containing this description of its relevant characteristics.

The selected buildings cover different climate zones of Europe (arid, warm temperature and snow climates), located in Spain (north, centre and south), Central Germany and Crete. Regarding the typologies, the considered buildings are three buildings of offices, a hotel and a school, thus being five demonstration buildings.

1 Introduction

1.1 Purpose and target group

This document aims to pilot buildings selection considering all the requirements defined in the framework of the BaaS project (as described in D1.1) to use them as demonstration buildings for the BaaS solution.

Buildings will be selected among the portfolio that the ESCO involved in the project has provided, organized following the typologies and theoretical case studies that have been defined in D1.1. In this sense, the document D6.1 fills the gap between RTD and demonstration activities in the project.

So, this document is the first stage of the BaaS solution components integrated (which have been verified in the test-bed separately) implementation for its validation and standardization, as part of an ESCO Business (as it is shown in Figure 1: BaaS Process).

As the validation of the whole system will be based in a Measurement & Verification Protocol implementation, this first stage of demonstration buildings selection will be followed by the preparation of pilots to baseline period (MS3), the solution installation (MS5) and reporting of savings to final user validation (MS6).

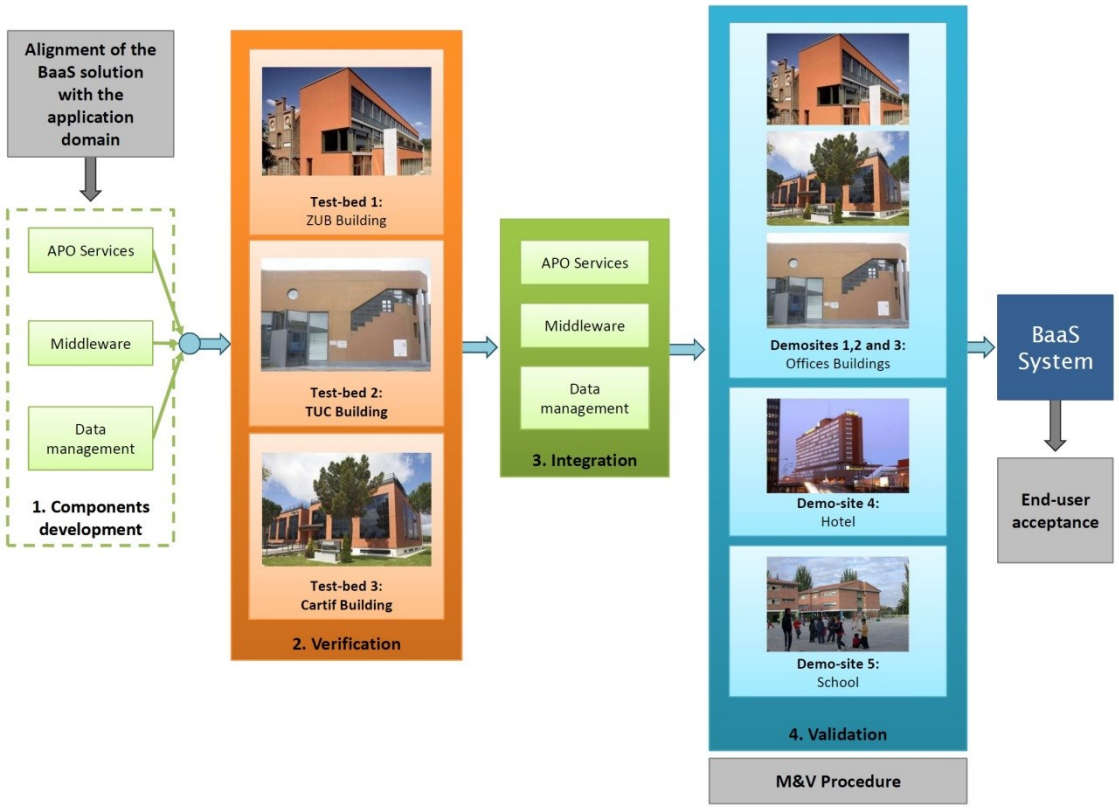

Figure 1: BaaS Process

Figure 2: Distribution of WP6 tasks

1.2 Contribution of partners

This deliverable is led by CARTIF with major contribution from DALKIA, as members of the Local Team. All partners (scientific, technological and industrial) will assist with their knowledge and bring complementary points of view to assure that all the stakeholder visions are addressed and all potential issues are identified.

Table 1: Summary of Contributions of Partners

Partner	Deliverable Focus
CARTIF	Deliverable Lead, pilots' selection Required data acquisition of Cartif offices building
DALKIA	Portfolio provide, pilots selection Required buildings data acquisition of the school and the hotel
TUC	Required data acquisition of TUC offices building
FHG	Required data acquisition of Fraunhofer offices building
Other partners	Requirements on pilots verification

1.3 Relation to other activities in the project

This deliverable lays the foundations for the work in the demonstration activities in the project, and also the Research and Technological Development activities, which aims to the BaaS solution validation and standardization.

Table 2: D6.1 tasks relationship with other BaaS activities

Deliverable	Relationship
D1.1	Characterization of the theoretical case studies and definition of the constraints to be verified by the pilots List the information to be provided by the buildings
D4.1	D6.1 will provide the information for creating the thermal models with the software tool selected in D4.1
D6.2	D6.1 will select and define the pilots including the existing information as it is, while D6.2 will adapt this information in order to prepare the pilots to implement BaaS
D6.3	D6.3 will analyse the inefficiencies of the pilots in order to implement the appropriate ECMs taking the description of the pilots included in this deliverable

2 From theoretical case studies to demonstration buildings

The starting point of this section is the list of Theoretical Case Studies defined in the deliverable 1.1. In that document, one Theoretical Case Study was chosen for each typology of buildings extracted from the Directive 2010/31/EU on energy performance of buildings (EPBD) but only taking into account non-residential buildings.

To choose these theoretical case studies were taken into account the availability of buildings for BaaS Project. This selection is shown in the following table:

Table 3: Theoretical case studies selected

Typologies from EPBD	Theoretical Cases Studies
Offices	Building of offices
Educational buildings	School
Hospitals	Hospital
Hotels and restaurants	Hotel
Sport Facilities	Swimming pool
Wholesale and retail	Shopping mall

After this selection, the goal of this document is to choose the most suitable real buildings for the installation of BaaS System in order to ensure a high replication of our system.

As a first stage, it is necessary to analyse how each TCS behave from several points of view. In D1.1, a characterization of these buildings is presented from the point of view of occupancy profiles and installed energy and control systems. Also, the building stock among Europe is shown. In order to ensure the replicability of the BaaS system, also the average energy consumption for each of them, and the location and climate conditions should be taken into account.

2.1 Energy consumption for theoretical case studies

Since BaaS system will be in charge of reducing the energy consumption of the buildings, it is necessary to analyse the energy profiles of each type of building for choosing those of them with a greater potential for reducing their consumption.

It is widely recognized that the operating energy consumption of the buildings (residential and non-residential) is one of the key consumers of energy in Europe. Buildings represent the largest sector of all the end-use sectors, so this high level of energy consumption in buildings in Europe makes this an obvious sector to target in order to determine the savings potential and improve energy performance.

Taking into account the typologies of buildings defined in the EPBD, the non-residential building stock (m^2) in Europe is represented in the Figure 4 and the share of total energy use per each typology is represented in Figure 3.

As can be seen in the Figure 4, the typology with more surfaces in Europe is “wholesale and retail trade” followed by “offices”. Only with this information, we could say that “wholesale and retail” would be a good representative of non-residential buildings for the application of BaaS System from the point of view occupied surface but we have to take into account that this type of buildings are in the first place in that graph because these buildings have a large surface,

although the number of this kind of buildings in the city are usually lower than offices or educational buildings.

Thus, if we consider the number of buildings of each type instead of the surface occupied for these buildings, the order of these categories could vary.

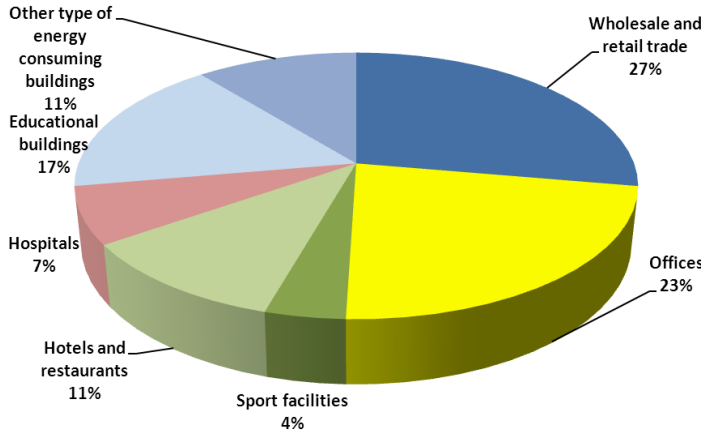

Figure 3: Non-Residential building stock in Europe (m2). Source: BPIE survey

The following figure shows the total energy use per building type. In this case, the largest energy consumer is again the "Wholesale and retail trade" followed by "offices", but as in the previous case, the order of these categories could vary if we took into account the energy consumption per m2 instead of the total consumption per typology.

In any case, this classification is also relevant due the goal of the project is to reduce the energy consumption and we should choose buildings with high energy consumption.

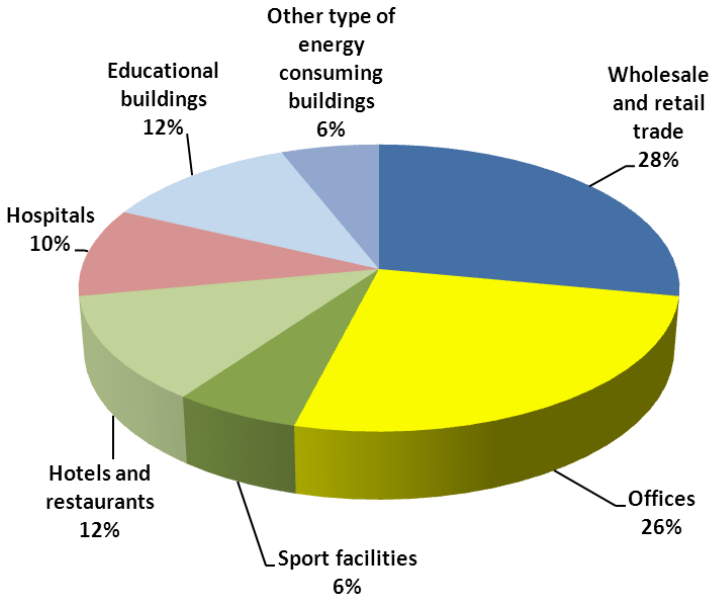

Figure 4: Share of total energy use per building type. Source: BPIE survey

If we consider the information from the Figure 3 the most representative buildings from the point of view of the surface occupied by them are:

1. Wholesale and Retail
2. Offices
3. Educational buildings and Hotels & Restaurants

If we consider the largest energy consumers in order to obtain the greater reduction of energy consumption with the application of BaaS System, we could choose the following typologies of buildings taking into account the Figure 4:

1. Wholesale and Retail
2. Offices
3. Educational buildings

Thus, the choice of buildings according to any of these criteria would give a very similar result.

In the section 2.6, these and other relevant criterions that will be defined bellow, will be jointly used in order to find the most representative theoretical case studies and to choose the real buildings that will be used as demo sites.

2.2 Location and climate conditions

In order to ensure the replication potential of BaaS system, also climate conditions have to be considered. In this sense, different climate conditions for BaaS demonstrators, and climates with high presence in European countries will considered. Thus, the replication potential of BaaS will be analysed from the point of view of climate conditions.

Figure 5 shows the Köppen climate classification. This is one of the most widely used climate classification systems and it divides climate into five main groups, each having several types and subtypes. These main groups are: Equatorial climates (A), Arid climates (B), Warm temperature climates (C), Snow climates (D) and Polar climates (E).

To ensure the replication potential of the obtained results after the application of BaaS System in the chosen buildings, buildings located in extreme climate conditions: equatorial and polar climates (A and E) will not be considered. It must be noted that these climate groups have a very low presence in the European countries.

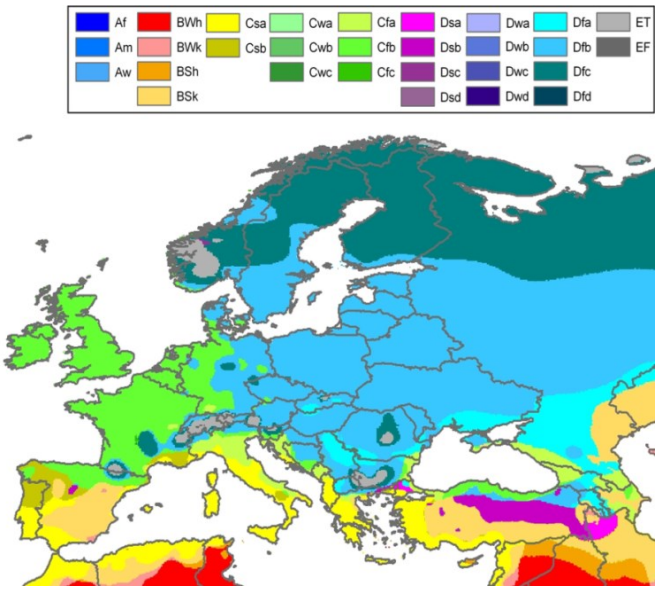

Figure 5: European Map of Koppen climate classification

The BaaS system will be tested in three buildings before being implemented in the final demonstrator buildings. These three research buildings, located in Germany, Greece and Spain, will be also used as demonstrator buildings.

Besides these three buildings, two other buildings belonging to the portfolio of the ESCO will be selected. As the portfolio of the ESCO contains only buildings located in Spain, regarding the climate conditions, BaaS system will be applied to three buildings located in different areas of Spain, to one building in Germany and to other located in Greece. With these five demonstrators, it can be considered BaaS Project has a great scope and most buildings in Europe are represented from the point of view of the climate.

2.3 Theoretical case studies and problem scenarios identification

As this WP6 activities are focused on the system demonstration, the basis of it is in the Theoretical Case Studies definition and end-user acceptance developed in WP1, which collects all requirements defined in the framework of the whole system development and defines the typologies and buildings to be considered in order to ensure the replication potential of the BaaS solution and demonstration activities fulfilment.

As it was conclude in D1.1, all Theoretical Case Studies are affected by all the problem scenarios. In the following table, a summary of the Problem and Activity Scenarios related to the Theoretical Case Studies is shown:

Table 4: Theoretical Case Studies and Problem and Activity Scenarios

Problem Scenarios		Activity Scenarios			School	Hotel	Offices	Swimming pool	Hospital	Shopping mall
1	Inefficient control strategies for thermal comfort and energy efficiency	1.1	Temperature control		X	X				
		1.2	Temperature & humidity control				X	X	X	
		1.3	Temperature, humidity & others, control							X
2	Control Strategies not considering known future circumstances.	2.1	Advanced control system	Data gathering	X	X	X	X	X	X
				Weather Prediction Tool	X	X	X	X	X	X
				Demand Prediction Tool	X	X	X	X	X	X
				Control system	X	X	X	X	X	X

3	Optimize energy performance of the facility to increase the profit margin of the end user: ESCO	3.1	Rates to estimate consumption and others variables (Energy, Economy)	X	X	X	X	X	X
4	Different Building Management System in each building and across buildings	4.1	Management integration system and adjusted optimization logic	X	X	X	X	X	X
5	Lack of a fault detection and diagnosis system	5.1	Implementation of a fault detection and diagnosis system	X	X	X	X	X	X

In the following table, theoretical case studies are characterized regarding occupancy profiles and energy and control systems, in order to show how the different types of buildings can be more suitable or not for the implementation of the BaaS system and the evaluation of the energy savings. In this sense, all these considerations are included in the justification of the buildings selected as demonstrators.

Table 5: Theoretical Case Studies characterization

		School	Hotel	Office Buildings	Swimm. pool	Hospital	Shopping mall
Context	**Occupancy profile**	Scheduled	Scheduled	Scheduled	Variable	Variable	Variable
	Non-residential building stock	17%	11%	23%	4%	7%	28%
HVAC	**Thermal services to be given**	Heat	Heat and cool	Heat and cool	Heat and cool	Heat and cool	Heat and cool
	Technologies available for the services	Boiler, district heating	Boiler, district heating and cooling, chiller	HVAC system	HVAC system	HVAC system	HVAC system
	Final elements	Radiators, radiant floor	Combined quick/slow systems	Combined quick/slow systems	Quick systems	Combined quick/slow systems	Quick systems
	Problem boundaries		Stand-by when there are no clients		Need of simult. heating and cooling (air drying)	Need of simult. heating and cooling	

					Specific problems due to the high humidity		
Control	**Physical variables that affect the control**	Temperature	Temperature	Temperature and humidity	Temp., humidity, air quality, stratific.	Temp., humidity and air quality	Temp., humidity, air quality, stratific.
	BMS	No	Yes	Yes	Yes	Yes	Yes

2.4 Constraints to be verified by the demonstration buildings

In order to guarantee the concept of replicability and the possibility of installing the BaaS system and evaluate its performance through the measurement and verification protocol, some constraints must be fixed for the selected buildings.

2.4.1 Building existing information

Although the BaaS system is going to be replicable to all the buildings belonging to the "non-residential" domain, regardless of the quantity of information available, for its development and first implementation, the selected buildings as pilots must meet the conditions presented in this document, including the amount of information and their characteristics. Thus, the available information from each building will be an important point to choose between two buildings belonging the same theoretical case study and with similar characteristics.

2.4.2 Energy and control installed systems in buildings

In the theoretical case studies' characterization are defined the thermal services to be given by the buildings considered. Thus, the buildings selected as demonstrators for implementing the BaaS system should provide at least the thermal and ventilation systems defined for each case, that are represented in the following table.

Table 6: BaaS HVAC systems borders

School	Heat system
Hotel	Heat and cool system
Office Buildings	Heat, ventilation and air conditioning systems
Swimming Pool	Heat, ventilation and air conditioning systems
Hospital	Heat, ventilation and air conditioning systems
Shopping Mall	Heat, ventilation and air conditioning systems

On the other side, and as BaaS system is an ICT platform for optimized control, buildings should have a previous management and monitoring system in order to implement the improvements. In the next section, some requirements regarding this building management and monitoring systems are described.

2.4.3 Requirements to be fulfilled by buildings for BaaS implementation

From the requirements defined in D1.1 (*see appendix C*) those directly related with the demonstration activities has been extracted, in order to establish an objective way to select the buildings. These requirements are the following [2]:

1) As far as possible open-sources with General Public Licenses (GPL) and GNU solutions should be used. Use of open/open-source components should be encouraged and promoted (e.g. OpenBIM Server; LON or BACNET based BMSs; open and relational based DWH; M-BUS based meters)
2) The BaaS system should be able to read/write data from/to the BMS/BACN working on the BaaS demonstration buildings:
   a) Live data from devices
   b) Temporary storage structures (data logs)
   c) Other information (schedules, lists of devices)
3) The BaaS system should be able to retrieve data of external services. Some examples of data served by external services could be:
   a) Weather forecasting
   b) Historical weather data
   c) Products catalogue, info, properties
   d) Properties of materials
4) The BaaS system should be able to retrieve and write data of external ICT system as:
   a) In-building weather station
   b) Access control system
   c) Meters (gas, water, electricity)
5) BIM and DWH should integrate the concept of extended BIM, so one unique-coherent-complementary data model should be implemented.
6) The BaaS system should detect abrupt changes in the monitored system where the changes relate to difference from expected behaviour.
7) The BaaS system should design and calculate KPIs describing monitored system in terms of its energy performance and user comfort.
8) The system should be able to simulate the behaviour of the building and interface with the control algorithms. Also, simulation using sensed (past) data and forecasts should be possible.

2.5 ESCO's portfolio and buildings characteristics

In the sense, and taking into account the aforementioned aspects, the ESCO involved in the project is in charge of providing a list of buildings and its main characteristics in order to select among them the most suitable for the BaaS solution validation and its objectives accomplishment.

In the following table are represented the buildings provided by the ESCO and the main characteristics of each of them related to location and energy consumptions. The buildings are organized by typology, responding to the Theoretical Case Studies defined in D1.1 (for further information see: *D1.1 Definition of Theoretical Case Studies including Key Performance Indicators*).

Table 7: ESCO's buildings portfolio and characteristics

	Location	Thermal facilities	Electrical energy consumption	Fossil fuel consumption historical	Renewable energy	Consumption/year
Schools						
Federico García Lorca	Granada (Spain)	Heat and DHW	no data	(2011)	Biomass	100 MWh
Nuestra Señora de Moratalaz	Madrid (Spain)	Heat	no data	(2010)	n.a.	62 MWh
Sierra Elvira	Granada (Spain)	Heat and DHW	no data	(2010)	Biomass	
Hotels						
Husa Chamartín	Madrid (Spain)	Heat, cool and DHW	(2001)	(2001)	n.a.	2800 MWh heat 800 MWh cool
Sand Beach Resort	Canary Island (Spain)	Heat and DHW	no data	(2011)	Biomass	1500 MWh
Sanyres Córdoba	Córdoba (Spain)	Heat, cool and DHW	(2011)	(2011)	n.a.	580 MWh heat 270 MWh cool
Mensajeros de la Paz Illescas	Toledo (Spain)	Heat and DHW	no data	(2012)	Biomass	450 MWh
Offices buildings[1]						
Center for Sustainable Building	Kassel (Germany)	HVAC	(2001)	(2001)	District heating	-
Cartif offices	Valladolid (Spain)	HVAC	(1999)	(1999)	Solar thermal / PV	140 MWh heat 70 MWh cool
Technical University of Crete	Chania (Greece)	HVAC	(2001)	(2001)	-	-
Swimming pools						

[1] Offices buildings are not from the ESCO's portfolio but they are the buildings used as test-beds and owned by the partners of the BaaS project.

San Andrés Sport Center	Soria (Spain)	Heat and DHW	no data	no data	Solar	900 MWh
Ángel Tejedor Sport Center	Soria (Spain)	Heat and DHW	no data	no data	n.a.	800 MWh
Hospitals						
San Telmo	Palencia (Spain)	Heat and DHW	no data	no data	n.a.	1950 MWh
Reina Sofía	Córdoba (Spain)	Heat, cool and DHW	(2006)	no data	Solar	12600 MWh heat 17600 MWh cool
Shopping Malls						
Gran Vía Hortaleza	Madrid (Spain)	Heat, cool and DHW	no data	no data	n.a.	no data
El Ferial	Madrid (Spain)	Heat, cool and DHW	no data	no data	n.a.	no data

2.6 Demonstration buildings selection and justification

Following with this process, all buildings will be compared with the statements, requirements and limits aforementioned in order to select the most suitable for the demonstration activities.

In this sense, and assuming the most important aspects are the replicability issues (as has been defined in the objectives of the project), all buildings of the ESCO's portfolio has been evaluated, selecting the most suitable for the demonstration activities of the project. Also, a very important point is that the BMS of buildings can be standard-protocol compatible (directly or by disposing a gateway).

For portfolio's buildings evaluation (requirements and constraints detailed before) and in order to establish an objective way for pilot's selection, this requirements have been related to a system of rating, developed as following:

Table 8: Requirements defined for ESCO's buildings portfolio classification

Requirement	Rating	Explanation
HVAC system	**0**	Requirement about required HVAC system for theoretical case study **not fulfilled**
	1	Requirement about required HVAC system for theoretical case study **fulfilled**
Building information data existence	**0**	Not available or existent data about the building and its systems
	1	Building and systems partially defined or unavailable
	2	Building and systems completely defined and available
BMS open communication protocol	**0**	Not existing BMS in the building

(BACnet/Lonworks) or gateway existence	**1**	BMS with proprietary protocol and not connectable with a standard one by using a gateway (i.e. Siemens)
	2	BMS with not standard but compatible by using a gateway (i.e. TREND)
	3	BMS with a standard communication protocol (BACnet/Lonworks)
Historical consumptions data existence and accessibility	**0**	Not existing data about historical consumptions
	1	Partially existing or accessible data about historical consumptions (i.e. existing data about thermal consumption but not about electricity)
	2	Existing and available data about historical consumptions
User's behaviour and occupancy schedules existence and accessibility	**0**	Not existing data about occupancy patters or data not accessible
	1	Existing and accessible data about occupancy patterns
Weather station existence in the building or its proximities (≤1000m)	**0**	Weather station not installed in the building or its proximities (farther than 1000m)
	1	Weather station existing in the building or its surroundings (aprox. 1000m)
Replicability (m^2 building stock in Europe)	**0**	0-5% of the non-residential stock
	1	5-10% of the non-residential stock
	2	10-15% of the non-residential stock
	3	15-25% of the non-residential stock
	4	>25% of the non-residential stock
Replicability (energy consumption per use in Europe)	**0**	0-10% of the non-residential energy cons.
	1	11-24% of the non-residential energy cons.
	2	>25% of the non-residential energy cons.

Thus, in the following table, each building provided by the ESCO has been evaluated under eleven relevant points taking into account the topics aforementioned.

In this sense, after analysing each building under these requirements and rating them following them, the last column of the table shows the final rate, in order to establish the most suitable buildings for be selected as BaaS demonstration buildings.

Table 9: Requirements verification for each building of the ESCO's portfolio

	HVAC system (0-1)	Building information data existence (0-2)	BMS open communication protocol (BACnet/Lonworks) or gateway existence (0-3)	Historical consumptions data existence and accessibility (0-2)	User's behaviour and occupancy schedules existence and accessibility (0-1)	Weather station existence in the building or its proximities (≤1000m) (0-1)	Replicability (building stock in Europe) (0-4)	Replicability (energy consumption percentage) (0-2)	Final evaluation (0-16)
Schools	**Heat**						**17%**	**12%**	
Federico García Lorca	1	1	1	1	1	0	3	1	**9**
Nuestra Señora de Moratalaz	1	1	1	1	1	0	3	1	**9**
Sierra Elvira	1	2	2 (TREND)	1	1	0	3	1	**11**
Hotels	**HVAC**						**11%**	**12%**	
Husa Chamartín	1	2	2 (TREND)	2	0	0	2	1	**10**
Sand Beach Resort	0	1	1	1	0	0	2	1	**6**
Sanyres Córdoba	1	0	0	2	1	0	2	1	**7**
Mensajeros de la Paz Illescas	0	1	1	1	1	0	2	1	**7**
Offices buildings	**HVAC**						**23%**	**26%**	
Center for Sustainable Building	1	2	3	2	1	1	3	2	**15**
Cartif offices building	1	2	3	2	1	1	3	2	**15**

Technical University of Crete	1	2	3	2	1	1	3	2	**15**
Swimming pools	**HVAC**						**4%**	**6%**	
San Andrés Sport Center	1	1	1	0	0	0	0	0	**3**
Ángel Tejedor Sport Center	1	1	1	0	0	0	0	0	**3**
Hospitals	**HVAC**						**7%**	**10%**	
San Telmo	0	1	1	0	0	0	1	0	**3**
Reina Sofía	1	1	1	1	0	0	1	0	**5**
Shopping Malls	**HVAC**						**28%**	**28%**	
Gran Vía Hortaleza	1	1	1	0	0	0	4	2	**9**
El Ferial	1	1	1	0	0	0	4	2	**9**

As can be seen, there are six buildings with higher requirements fulfilment:

- **School**: Santa Elvira, Granada (Spain)
- **Hotel**: Husa Chamartín, Madrid (Spain)
- **Offices buildings**: test-beds used during the BaaS components validation process:
  - Centre for Sustainable Building, Kassel (Germany)
  - Cartif Offices Building, Valladolid (Spain)
  - Technical University of Crete, Chania (Greece)

So, the demonstrators to be used by BaaS for system implementation and evaluation are represented in the following figure:

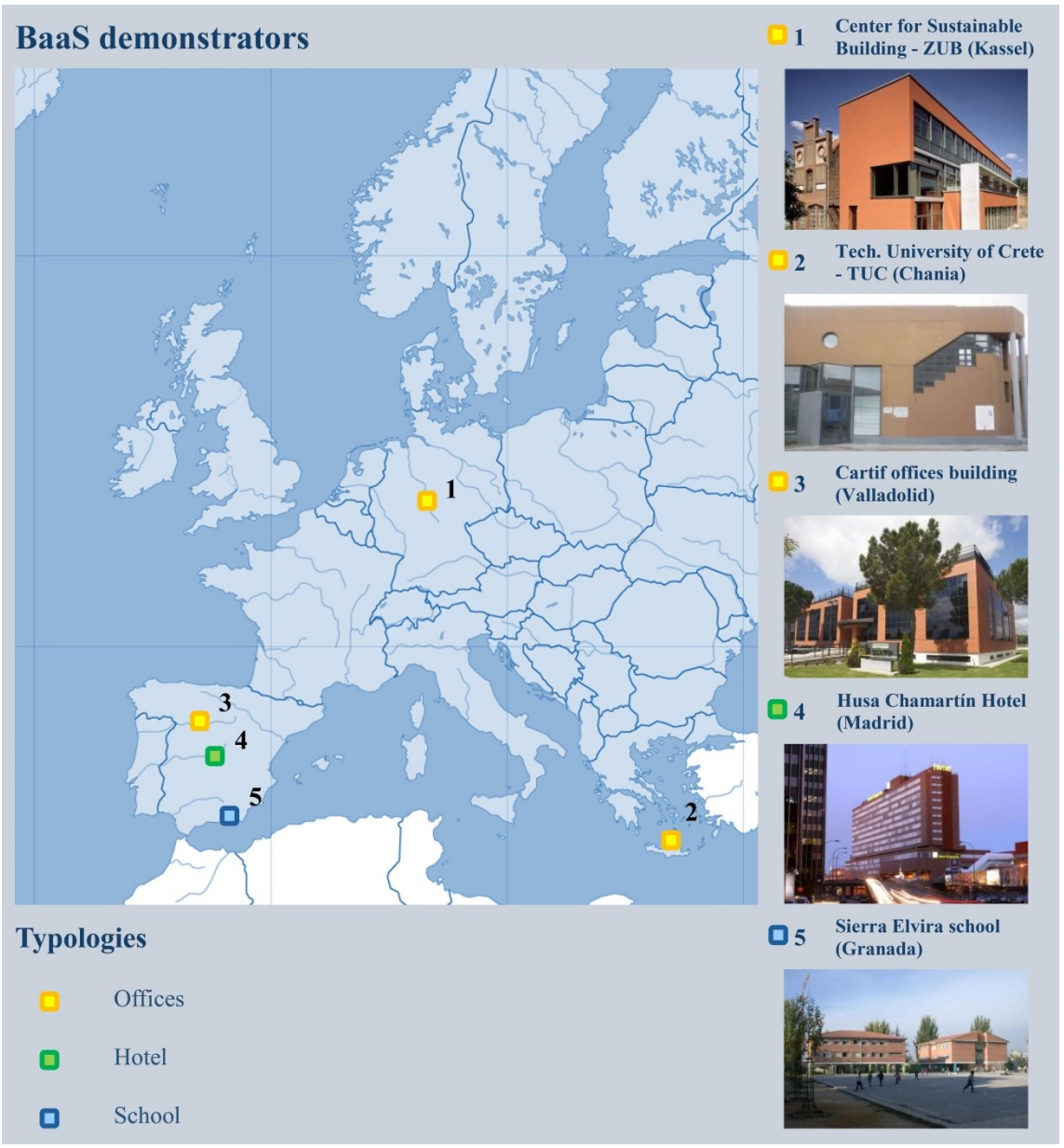

Figure 6: BaaS demonstrators

Table 10: Summary of BaaS demonstrators

	Demonstrator 1	Demonstrator 2	Demonstrator 3	Demonstrator 4	Demonstrator 5
Name	Centre for Sustainable Building	Technical University of Crete	Cartif offices building	HUSA Chamartín Hotel	Sierra Elvira school
Typology of building	Offices	Offices	Offices	Hotel	School
Location	Kassel (Germany)	Chania (Greece)	Valladolid (Spain)	Madrid (Spain)	Granada (Spain)
Orientation	340º (-20ºSouth)	North-North-West	N S W E	N S W E	N S W E
Year of construction	2001	2003	1995	1982	1975
Floors	3	2	3	16	3-4
Built area	2129 m^2	-	2615.7 m^2	34,834 m^2	7670 m^2
Net usable area	1732 m^2	-	2650.4 m^2	28,935 m^2	5839 m^2
Heated area	596 m^2	-	2592.9 m^2	15,875 m^2	4253 m^2
Cooled area	596 m^2	-	1870.1 m^2	15,875 m^2	0 m^2
Heating degree days (15.5ºC)	2435	510	2025	1471	1167
Cooling degree days (15.5ºC)	139	1680	868	1443	1660
Average power consumption (kWh/m^2a)	7	-	128.06	-	-
Average thermal consumption (kWh/m^2a)	24.7	31.37	55.75	119.95	136.84

3 Description of demonstration buildings

In the following sections, demonstration buildings are described including the existing information related to the building and its systems (energy and building management). Thus, all the geometrical information and data about constructive characteristics, energy elements (generation, distribution and delivery), energy consumption and building management systems is included.

As far as this information is necessary for the creation of the thermal models and for the adaptation of the buildings in order to implement them the BaaS system (task 6.2) and the procedure for verifying the energy savings due to the Energy Conservation Measures (ECM) (task 6.3), the compilation of the existing information is essential in this process.

As stated in previous sections, this document only includes the existing information and the way in which it can be provided, that is, no adaptations are considered. In this sense, the information to be provided for creating the BaaS components, as the Building Information Model (BIM), or the Data Warehouse (DWH) is included, while these components are not included in this document. In the case of the BIM, all geometrical and related to materials data is provided to be included in the model, and this model will be deployed in task 6.2 (adaptation of the pilots). Regarding the DWH, this document only offers the historical data and the way to access the existing historical data bases or files, and the population of the DWH will be deployed in the corresponding task of WP2.

All this data is included as appendix, where each appendix belongs to one demonstration site:

- Appendix A: Centre for sustainable building, Kassel (Germany)
- Appendix B: Technical University of Crete, Crete (Greece)
- Appendix C: Cartif offices building, Valladolid (Spain)
- Appendix D: HUSA Chamartín hotel, Madrid (Spain)
- Appendix E: Sierra Elvira School, Granada (Spain)

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