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## **Deliverable D7.2: Communicaton Tools**

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**Deliverable D7.2: Short Description**

**This document describes the plan for the BaaS project outputs dissemination.**

**Keywords: dissemination, public awareness**

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## Abbreviations and Acronyms

<b>BaaS</b>	Building as a Service
<b>CMYK</b>	Cyan, Magenta, Yellow, Key
<b>EC</b>	European Commission
<b>EPBD</b>	Energy Performance of Buildings Directive
<b>EU</b>	European Union
<b>FP7</b>	Framework Programme 7 <sup>th</sup>
<b>ICT</b>	Information and Communication Technologies
<b>ICT4EE</b>	Information and Communication Technologies for Energy Efficiency
<b>RGB</b>	Red, Green, Blue
<b>WP</b>	Work Package

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## Executive Summary

This document details the mechanisms that will be used to exploit and disseminate achievements concerning BaaS research. Over the course of the BaaS project, this document was updated and submitted to the commission on a six monthly basis presenting an overview of the continued efforts, status and tools used for dissemination. This is a final version of this document.

The communication activities of the BaaS research aiming to update all project stakeholders and wider industry and academic based audiences. The highest care taken regarding information released into the public domain so that it does not impact negatively on BaaS research results.



## **1 Introduction**

### **1.1 Purpose**

This document is the result of task 7.2 whose objective is to create a “project identity” and produce a set of tools to give visibility to the project and support all activities described in the WP7 (Exploitation, dissemination, standardization), particularly in Task 7.1. Most of these communication tools were used throughout the project’ life cycle.

### **1.2 Contribution from partners**

The deliverable 7.2 has been developed with the following contributions from the BaaS partners:

- UCC-IRU is the task leader. They have worked on the development of the brochure and the newsletters.
- CARTIF has developed the BaaS public website and the SharePoint collaboration platform. They have developed the logo, the flyer, and the templates and have created a group in LinkedIn for the project, as well as newsletter contributions.
- HON, as work package leader, has accelerated the development of tasks in this work package

All the partners of this consortium have collaborated in the contents of the brochure.

### **1.3 Relationship with other WPs**

This version of deliverable 7.2 is relevant to all WPs as it documents final results with representation of our communication tools applied up to date so that scientific and technical objectives of BaaS research can be promoted in the best way possible.

## 2 Timeline structure of the document

Table 1 below outlines the key dissemination events that have occurred since the outset of the BaaS project.

The columns in Table 1 below providing only general information, which is presented much more in details within deliverable D7.1 (cf. D7.1 Tables 1-4). The main purpose of this table is to timely orient the reader with BaaS-related communication activities performed during the project.

Nº	Mile-stone	Event	Distribution channels & Targeted audience
1	June 2012	REHVA World Congress and 8 <sup>th</sup> International Conference on IAQVEC Prague	Three papers published in REHVA-2012 Conference Proceedings for wide audience
2	July 2012	Workshop organized by EEB Data Models Community on ECPPM-2012, Reykjavik	Paper published in ECPPM-2012 Conference Proceedings for wide audience
3		Department meeting Energy Systems, Fraunhofer IBP. Reinhardt Forest School, Fulda valley, Germany	Presentation of the concept of Baas to a group of researchers working in the areas of building physics.
4		BaaS Web-page, completely operative 23/07/2012, enabled SSL security layer connection 11/08/2012	Internet access for broad general public, industry representatives and research community
5	Sept 2012	EPSRC CommNet Smart Grid Workshop, Loughborough University, UK.	EPSRC Smart Grid Workshop (3 days) attended by of researchers working in the areas of EE in buildings.
6	Oct 2012	Issue 1 of BaaS Brochure - to create awareness about project and major areas of interest	BaaS Web-page, Mass-mail For Industry and research community contacts
7		International Symposium on Sustainable Energy in Buildings and Urban Areas; SEBUA-2012, Kusadasi, Turkey	Paper published in SEBUA-2012 Conference Proceedings for wide audience, two oral presentations.
8		International Conference for Enhanced Building Operations (ICEBO-2012), Manchester, UK	Paper published in ICEBO-2012 Conference Proceedings for wide audience
9		2012 IEEE Multi-Conference on Systems and Control, Control design for Energy-Efficient Buildings Workshop, Dubrovnik, Croatia.	Presentation for conference participants during the Special Sessions organized by "United Technologies"
10	Apr 2013	BaaS Newsletter, Issue Nº 1	Web-page, Mass-Mail for Industry and research community contacts, Open Day for PPP-projects (Feb/March 2013, Brussels)
11		SEMANCO Workshop Barcelona 11/12 April	Presentation of the concept of Baas to a group of researchers working in the Collaborative Project

			(STREP)
12		Greener Buildings workshop, TU Eindhoven	Oral presentation of the BaaS project and its progress to a group of academia and industry representatives
13	May 2013	Build-up, created on 18/05/2013	Internet access for broad general public, industry representatives and research community
14		Linked In group, created 17/05/2013 - Now with 122 members	Publicly available for potential members for CoI
15	June 2013	Issue 2 of BaaS Brochure - to create awareness about project achievements on date	For circulation at PPP-Info Day in Brussels and as input for Workshop in CESBP 2013 Conference in Vienna
16	Aug 2013	BS2013 by IBPSA Conference in Chambéry, France	Paper published in BS2013 Conference Proceedings for wide audience
17	Sept 2013	Integrated Building Performance Management Workshop during the CESBP-2013 conference in Vienna	Three conference papers was presented and published in proceedings from the CESBP-2013 conference for a wide audience.
18	Oct 2013	CIB W78 2013 30 <sup>th</sup> International Conference on Applications of IT-in-AEC Industry, China	Two conference papers was presented and published in proceedings from the CIB W78 2013 conference for a wide audience.
19		Fraunhofer IBP: Building I internal seminar. 21st October, 2013, Nurnberg, Germany.	Seminar where the potential of the BaaS platform were presented.
20	Nov 2013	“Advances in Distributed Computing and Artificial Intelligence” Journal paper publication	Publication in Open Access Journal for a broad range of audience
21	Jan 2014	TH-Nurnberg Department Seminar, January 15th, 2014, Nurnberg, Germany	Discussion with special emphasis placed on BaaS research outputs
22	Feb 2014	Design and simulation Seminar with KICT delegation, Stuttgart, Germany.	Seminar exploring collaboration opportunities with delegation of Korean academics and researchers
23	April 2014	BaaS Newsletter, Issue № 2	Web-page, Mass-Mail for Academics, Sister Projects, Industry, Public Authorities.
24	May 2014	SAUTER Group Meeting, Munich, Germany.	High level internal meeting that included SEO and all executives from European Countries. BaaS

			results presented.
25	June 2014	CIB W78 Conference, Florida 2014, USA	1 Paper published in CIB W78 Conference Proceedings for wide audience
26	July 2014	4th Internal Conference, Energy Campus Nurnberg, July 4th, 2014, Nurnberg, Germany	Scheduled oral presentation for diverse group of energy experts.
27		Intelligent Systems & Agents – ISA Conference, Portugal 2014	1 Paper published in ISA Conference Proceedings for wide audience
28	Sept 2014	ECPPM-2014 Conference, 17-19 <sup>th</sup> September 2014, Vienna	Seven conference papers presented and published in proceedings from the ECPPM-2014 conference for a wide audience.
31		Publication in Journal of Process Control	Publications in Scientific Journals for a broad range of audience e.g. industry representatives, research community etc.
29		Publication in International Journal of Energy for a Clean Environment	
30		Publication in Journal of Building Performance Simulation	
32		Publication in Computer-aided Civil and Infrastructure Engineering Journal	
33	March 2015	BIM-Workshop AK Bauinformatik	Discussion with special emphasis placed on BaaS research outputs
34	M36 Apr 2015	ICEIS 17 <sup>th</sup> International Conference on Enterprise Information Systems Barcelona, Spain	Paper published in the Conference Proceedings for wide audience
35	Apr 2015	PPP Impact Workshop Brussels	High level meeting for wider audience.
36	June 2015	E2BA General Assembly Brussels	High level internal meeting that included BaaS results presentation.
37		European Spatial Agency (ESA) Symposium	Oral presentation about BaaS
37	Sept 2015	Newsletter 3	Web-page, Mass-Mail for Industry and research community contacts.
38	Oct 2015	Journal Computer-aided Civil and Infrastructure Engineering Journal	Wider audience informed with ongoing achievements of the project
39	M42 Oct	CIB W78 Conference	Papers published in the Conferences Proceedings for wide

	2015		audience
40	Oct 2015	EeB PPP Info Project Idea	
41	Dec 2015	Journal Automation in Construction 2015	Publications in Scientific Journal for a broad range of audience e.g. industry representatives, research community etc.
42	Dec 2015	Building Simulation Conference IBPSA, India	Wider Audience
43	Dec 2015	2 <sup>nd</sup> World Forum on Internet of Things, Italy	Wider Audience
44	M 48 April 2016	Final Newsletter	Web-page, Mass-Mail for Academics, Sister Projects, Industry, Public Authorities.
45	Apr 2016	Impact of Energy Efficient Buildings PPP meeting.	Wider audience
46	June 2016	7 <sup>th</sup> ACM International conference on Future Energy Systems, Canada	
47	Sept 2016	11 European Conference on Product Process Modelling ECPPM 2016, Cyprus	Papers published in the Conferences Proceedings for wide audience.
48	Sept 2016	Third IBPSA Building Simulation & Optimization BSO 2016	

**Table 1: Dissemination events timeline structure**

All significant achievements related to the BaaS project were published in multiple conferences proceedings, journal papers as well as verbal presentations in conferences or workshop where BaaS concepts/results were presented. The timeline offered above in this document is done to highlight that our attempts to communicate with global community worldwide were successful to the best extend possible.

### 3 Communication Tools

The following section details and illustrates material produced for communication and dissemination activities during and after the BaaS project.

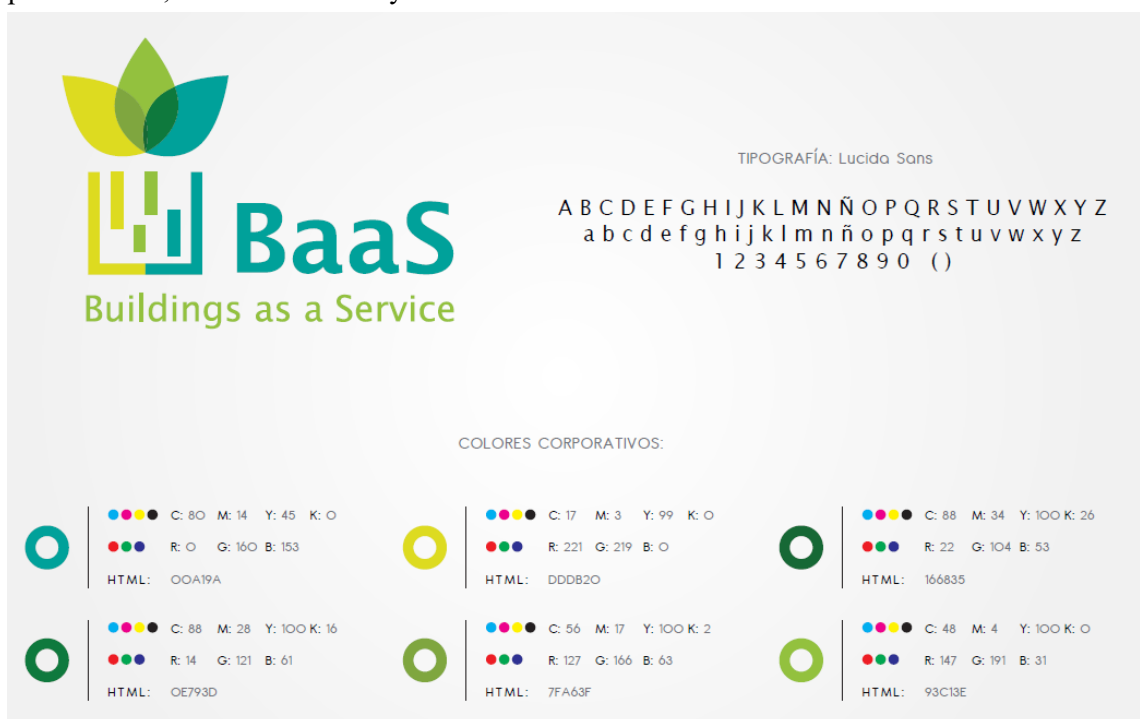
#### 3.1 BaaS Logo

The BaaS logo, illustrated in Figure 1, is used for all BaaS research communication medium.



**Figure 1: Different alternatives of the BaaS Logo**

In Figure 2 the CMYK and RGB colour codes shown illustrate their use in the project presentations, documents and any other communication material.



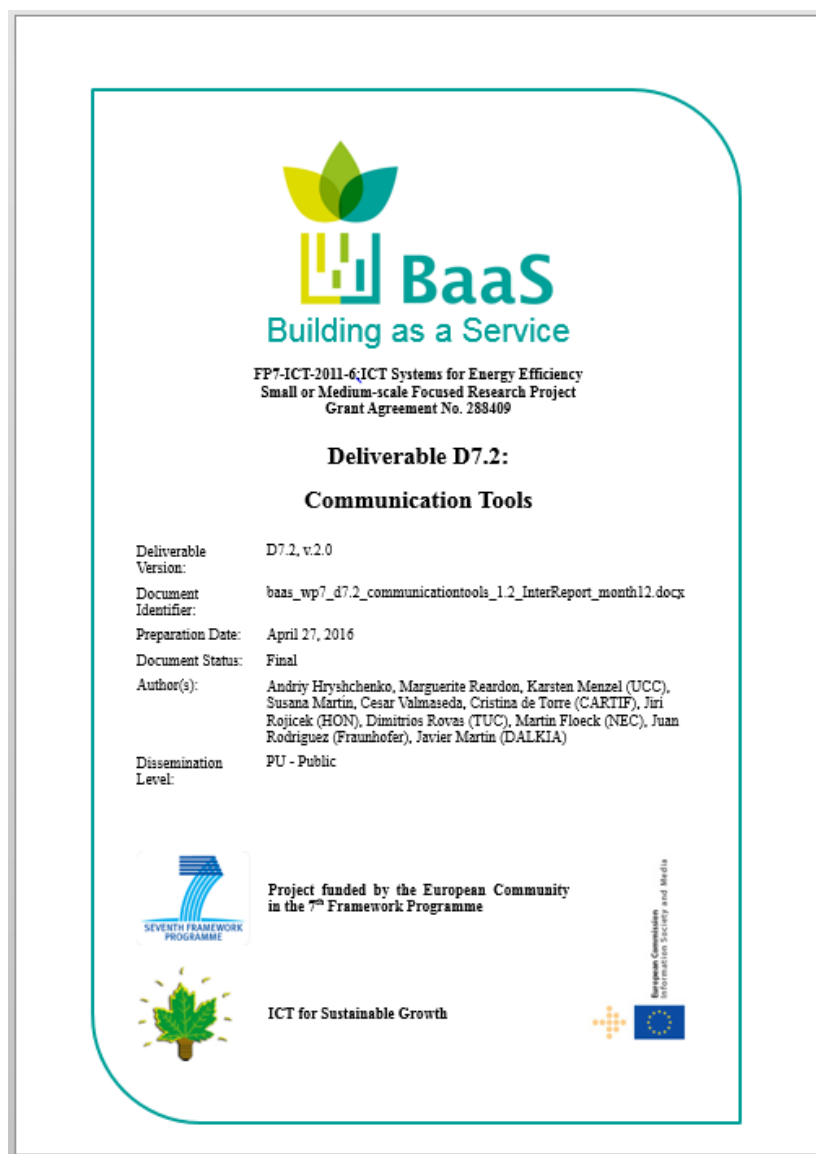
**Figure 2: Corporate CMYK and RGB colour codes for the BaaS Logo**

#### 3.2 Templates for international and local communication purposes

For the purposed of BaaS Project documentation, different templates have been generated for internal and external communication. Among others, templates for the generation of deliverables and presentations have been expanded upon.

Examples of relevant cover pages of both are showed in Figure 3 and Figure 4.





**Figure 3: Cover page of the deliverable template**



**Figure 4: First slide of the presentation template**

### 3.3 The BaaS project presentation

In order to communicate with widest possible range of related stakeholders, so the main results of the BaaS project will be positively acknowledged, a presentation<sup>1</sup> containing the main characteristics of the project has been generated. This presentation is currently being used in dissemination activities, such as participation in conferences and events organized by the European Commission.

In Appendix A: *Building as a Service identity presentation* is provided.

### 3.4 Flyer and Brochure

BaaS Partners use the flyer whose presentation is shown below on Figure 5 and Figure 6, also in Appendix A:, detailing what the project involves and what achievements were expected from each work package.

As can be seen in these figures, the flyer has five main sections: background, objectives, demonstration sites, expected impact and target.

This flyer was used for all BaaS research events including targeted conferences as detailed in BaaS deliverable 7.1.

The format of the flyer layout also supports the printing of relevant posters where poster exhibits relevant to BaaS research targeted events are hosted.

The flyer is available directly in the website link for the project (<https://www.baas-project.com/index.php/public/commtools>).

<sup>1</sup> This presentation is located in the BaaS Website (<https://www.baas-project.eu>) /Private Access/SharePoint/WP7/General BaaS Project Presentation.



Figure 5: Cover of the BaaS Project Flyer



Figure 6: Inside area of the BaaS Project Flyer

There are two iteration of the BaaS brochure has been released, so the third-one is complementing the end of this project. The brochure itself consists with 3 sections: (i) a project overview, (ii) project partners' definition and (iii) technical work packages description. Only third part is updated in order to highlight the WP's achievements at the end of the project. The goal of this update done by WP7 is to present the all WPs' final approaches and main outcomes. Each single WP/partner may implement minor changes in the future, if necessary for dissemination activities. Thus, this brochure will be displayed by partners in different forms even after the project' closure. It has been created in a format that allows printing in an isolated poster format (A0) per each individual work package or complete in a more classical format (A4) for dissemination and promotion of the whole project.

Both the flyer and the brochure are published in English to reach a wider international audience. A snapshot of this brochure is shown in Figure 7 but it can be seen in the Appendix B: (in order not to overload this document, only latest version of brochure is attached).



Figure 7: Snapshot of the BaaS Brochure

### 3.5 The BaaS Newsletter

The BaaS newsletter is used to update the wider community on the main achievements of the BaaS Project. The newsletter provides information about:

- Upcoming events
- The status of the BaaS demonstration sites
- Synopsis of work package achievements
- Useful contacts in BaaS, for example people who can answer specific questions relating to scientific objectives, co-ordination and management and events participation.

Four issues of the newsletter have been published to date, all issues of the BaaS newsletters are located in BaaS Website (cf. 3.6), SharePoint/WP7/Newsletter. Also, these newsletters of the BaaS project have been published in the publicly available Website and LinkedIn. The latest version of the Newsletter is available in Appendix C: of this document.

### 3.6 Website

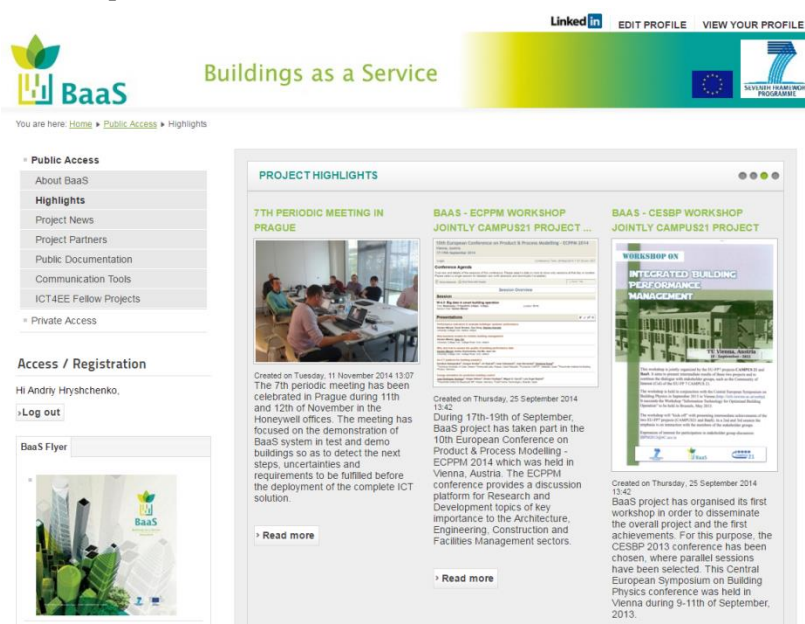
The use of online medium to disseminate BaaS achievements will be supported in a number of ways. Primarily, BaaS partners use:

- <https://www.baas-project.eu>,
- <https://www.baas-project.com> or
- <https://www.baas-project.org>

As a “shop-window” for the project where all stakeholders, be it industry or public communities, have access to information concerning the overall aim of the project and the latest news.

The Web page is divided into two parts, the public section where all information pertaining to the project is accessible for the general public, and also a private one. This second part is password protected and it is used by BaaS Partners in order to develop and share their work package documentation, meeting presentations and relevant material.

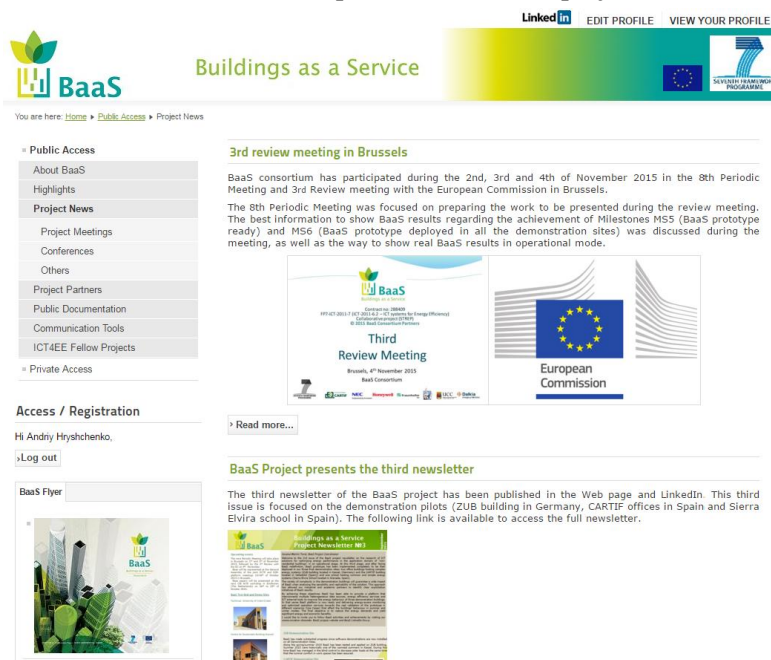
Figure 8 presents a snapshot of this website.



**Figure 8: BaaS project Web page snapshot**

With regard to with regard to the public information of the Web site, the “home” page provides some details about the project, such as the background and objectives. The “About BaaS” menu contains a sub-menu with a more detailed project description in all the languages of the

participants (English, Spanish, German, Czech and Greek), the project objectives, the description of technical work packages and the demo sites are outlined. A “highlights” page contains a slide with the joint news and a brief description of the BaaS events. “Project news” is the same, but the representation of the information differs from the highlights, as displayed in Figure 9. An in-depth description of each new item is also accessible from the “Read more” button, also through the sub-menu inside the project news. BaaS events shown are the project meetings and those conferences or workshops where the BaaS project has been represented.

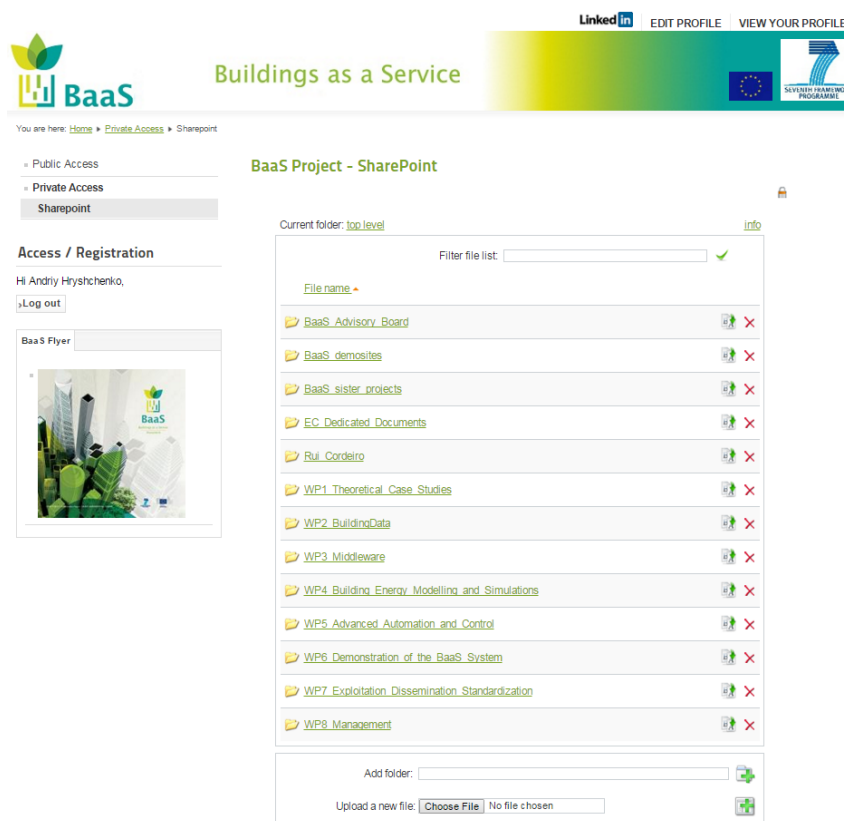


**Figure 9: Project news snapshot**

An important part is the menu of “Communication tools” which shows the community dissemination tools available in the current status. Presently the flyer, the brochure, LinkedIn group and build-up page are shown, but specific links to read and download the Newsletters are also included. It has to be noted that the flyer is always accessible from all the parts of the Web page though the image at the bottom of the main menu. Also, the LinkedIn group is linked at the top of the Web page. To conclude with the public section, the ICT4EE fellow projects are included in the Web page where the projects Pebble, Campus21, Direction, Adapt4ee and Semanco are catalogued.

The private section on the Web site is useful for sharing internal documentation among all the partners and the final deliverables which are not public. The SharePoint snapshot is shown in Figure 10. There is one folder for every work package, but also an additional one for the documentation appointed to the European Commission.





**Figure 10: SharePoint snapshot**

To access the private section each approved partner used to fill in the form, so the administrator of the Web page can allow permission to the user.

### 3.7 Commercial communication tools used for dissemination

Commercial dissemination is primarily done by industrial partners in the consortium (NEC, Honeywell) as a part of their internal marketing activities. The main objectives of this dissemination are to promote BaaS results to players in building management market (e.g. facility managers, building owners etc.)

Communication tools used for their internal dissemination are described in D7.1, Chapter 6.

### 3.8 General Public and Scientific communication

All significant achievements related to the BaaS project were published in multiple conferences proceedings, journal papers as well as verbal presentations during seminars or workshops, where BaaS concepts/results appeared for general auditorium. This is to assure the dissemination of research results, particularly the reporting of the scientifically new techniques and methods used in different work-packages. This information was discussed among communities involved in similar research and development on local and European level in form of peer-reviews and analysis of the related feedbacks received in verbal and written forms, e.g. e-mails. The full list of contacts used for BaaS-related communication is presented in D7.1 Appendix A and Appendix D: of this document.

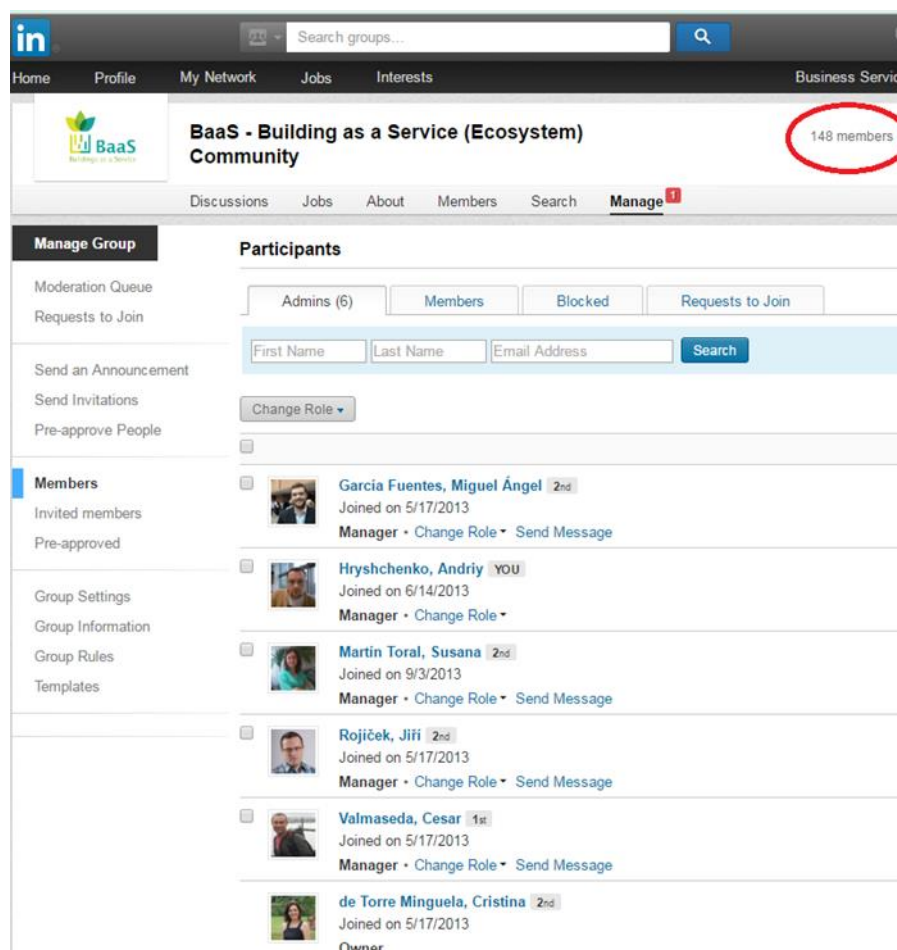
Journals and peer-reviewed publications are still the most widely used communication channels through which research is disseminated within the scientific community and to a broader audience. To maximise the dissemination of relevant information it is important to utilise social media outlets. However, social media-related dissemination activities (e.g. blogging in LinkedIn, Wiki, Build-Up platform posts) are increasingly challenging the supremacy of editors, reviewers and science communicators. For this reason it is important to mention the use of existing EC Dissemination Channels and Professional Community tools with responsible care and attention to detail.

### 3.9 Use of existing Professional Community tools

Different professional social networks were analysed. The defined tools that make use of these existing EC dissemination channels are available at month 48 of the BaaS project.

#### 3.9.1 BaaS LinkedIn Community

LinkedIn<sup>2</sup> is the most important social networking website for people in professional occupations. LinkedIn supports the formation of interest groups. The majority of the existing groups are employment related, although there already exists a wide range of topics dealing mainly with professional and career issues, even both academic and corporate alumni. This functionality fully supports the concept of the Community of Interest to be reached by the BaaS project.



**Figure 11: LinkedIn Group's Screenshot**

Groups support a limited form of discussion area, moderated by the group owners and managers. Since groups offer the ability to reach a wide audience, LinkedIn Groups (ref. Figure 12 overleaf) have become very popular as an easy tool for dissemination and discussion purposes. Groups can be private, accessible to members only or may be open to Internet users in general to read, though they must join in order to post messages.

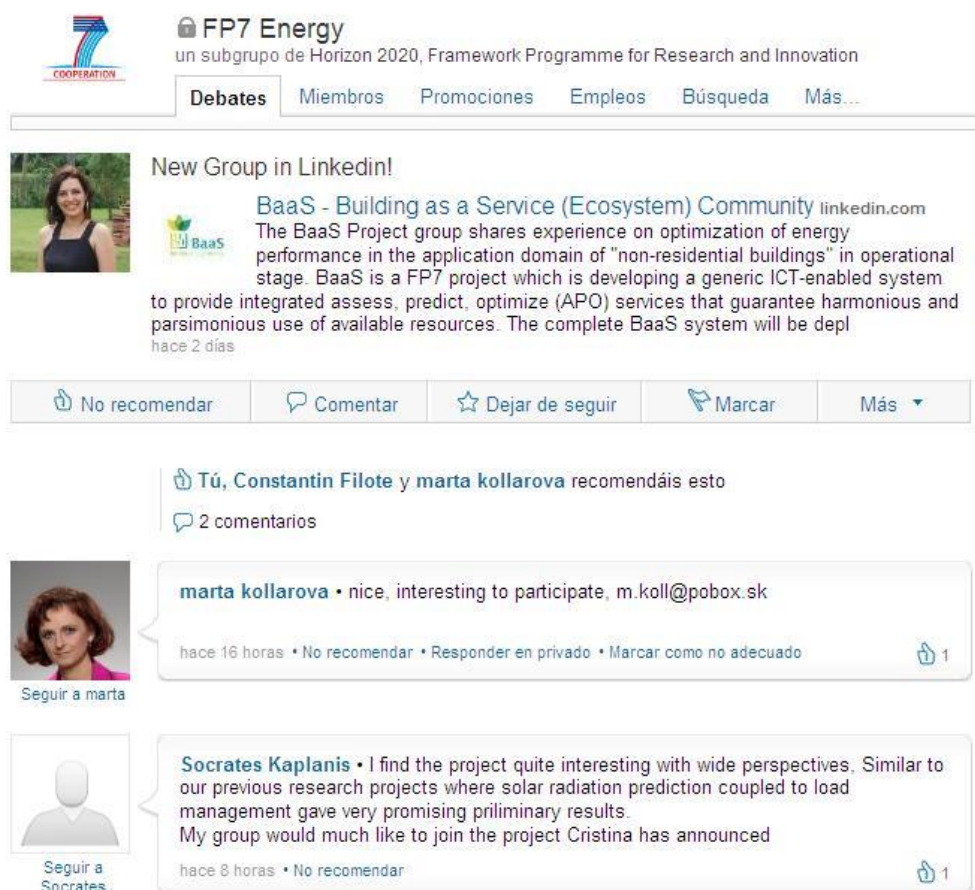
<sup>2</sup> [https://www.linkedin.com/groups/BaaS-Building-as-Service-Ecosystem-5017425?home=&gid=5017425&trk=anet\\_ug\\_hm](https://www.linkedin.com/groups/BaaS-Building-as-Service-Ecosystem-5017425?home=&gid=5017425&trk=anet_ug_hm)

Due to its nature, LinkedIn allows project partners to make contact with stakeholders and also eases the interaction among them. LinkedIn is an important tool to achieve a wide dissemination of the BaaS activities and achievements on a daily basis.

Thus, apart from the establishment of relationships with those stakeholders, our BaaS LinkedIn Group is intended to be used to promote activities that are also published in the other communication tools.

The name of the BaaS group is “**BaaS – Building as a Service (Ecosystem) Community**”, and it is possible to access to it from the website of BaaS Project (<https://www.baas-project.com/index.php/public/commtools>).

In order to advertise this group, it has been shared in other relevant groups like FP7 Energy or ICT Information and Communication Technologies (ICT), both are subgroups of Horizon 2020. Framework Programme for Research and innovation.



**Figure 12: Baas discussion group example**

The main target groups to be reached by this professional social networking tool are, highlighted in blue, they are:

- Other FP7 projects
- Activity Sectors: Construction, Energy, ICT
- General Public





**Figure 13: Main target groups of LinkedIn group**

### **3.9.2 Build-Up platform**

BUILD UP<sup>3</sup> is a European web portal for energy efficiency in buildings. This initiative was established by the European Commission in 2009 to support EU Member States in implementing the Energy Performance of Buildings Directive (EPBD). This web portal is intended to reap the benefits of Europe's collective intelligence on energy reduction in buildings for all relevant audiences. It will bring together new practitioners and professional associations while motivating them to exchange best working practices and knowledge and to transfer tools and resources.

BaaS project is promoted in Build Up platform<sup>4</sup> as described in details in Deliverable D7.1.

From the section of Communication Tools in the website of BaaS, it is possible to directly access this link (<https://www.baas-project.com/index.php/public/commtools>)

<sup>3</sup> <http://www.buildup.eu/>

<sup>4</sup> <http://www.buildup.eu/links/36463>

## 4 Conclusions

To handle and disseminate the information effectively, an efficient way of communication and information management is developed. The success of communication-related task is very much dependent not only on overcoming professional barriers between the BaaS participants and the group of interest, but also on sharing information with general public. The diffusion of knowledge will lead to well informed and committed wide-ranging stakeholders and to the improvement of energy efficient solutions and practices in general.

For this an Internet will play its increasingly important role. For example, the main intention of the LinkedIn and Build UP platforms use is to focus our dissemination on this virtual flexible learning and teaching environment, using effectively integrated infrastructure to announce the BaaS events and other related information. This supposed to be a powerful technology transfer mechanism of knowledge and experience, with learning and working process tools through these web-based platforms.

It is also important that our dissemination activities are enabling better BaaS-related knowledge distribution, understanding and spreading on “energy efficiency” commercial field. The challenge is to create a work environment that allows participants to learn, adapt, share and respond on the “energy efficiency” market demand, to motivate the integration of smart solution applied to buildings’ energy systems design and simulation, effective usage and maintenance.

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## Appendix A: Building as a Service identity presentation



Figure 14: Identity presentation, page 1

### BaaS Project – Overview

**Acronym:** BaaS

**Title:** Building as a Service

**Project Number:** 288409

**Call:** FP7-ICT-2011-7


**Topic:** ICT 2011.6.2 ICT systems for Energy Efficiency (a)

**Funding Scheme:** STREP

**Duration:** 48 months

**Maximum financial EC contribution:** 2,2 m€

Participant No.	Participant organization name	short name	Country
1	Fundación CARTIF	CARTIF	Spain
2	NEC	NEC	U.K.
3	Honeywell	HON	Czech Republic
4	Fraunhofer Institute for Building Physics	IBP	Germany
5	Technical University of Crete	TUC	Greece
6	University College of Cork - IRUSE	UCC	Ireland
7	Dalkia	Dalkia	Spain



**Participants:** CARTIF, NEC, Honeywell, Fraunhofer, UCC, Dalkia

Figure 15: Identity presentation, page 2

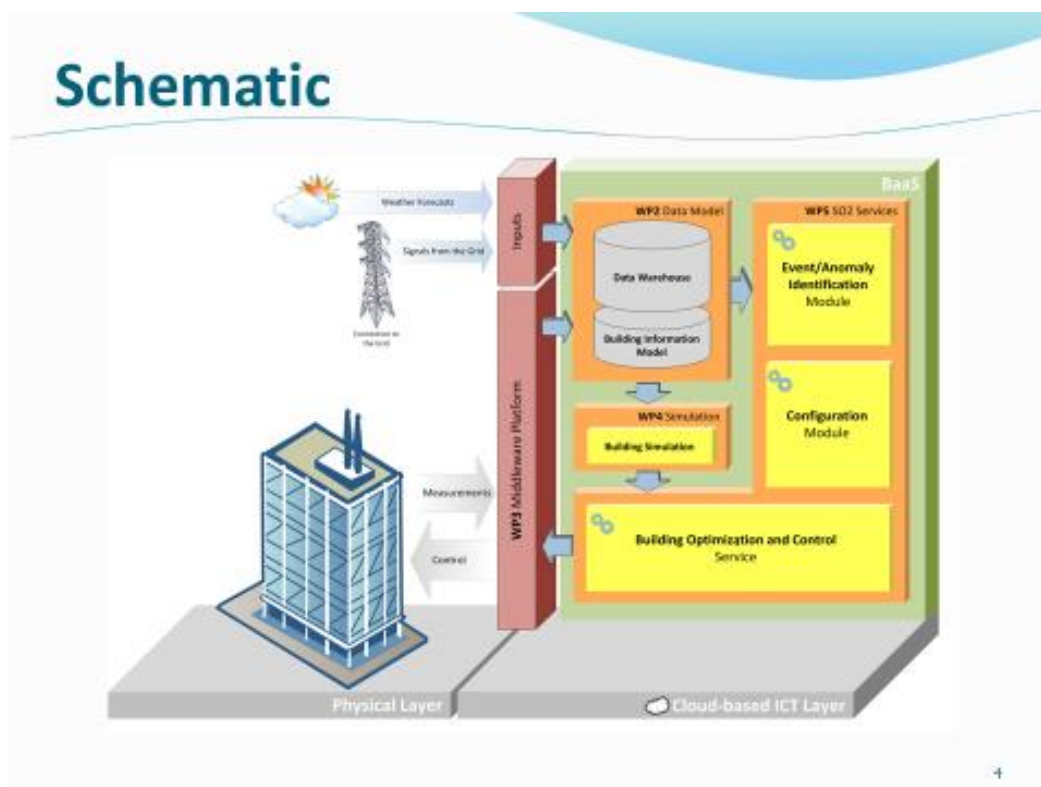


Figure 16: Identity presentation, page 3



Figure 17: Identity presentation, page 4

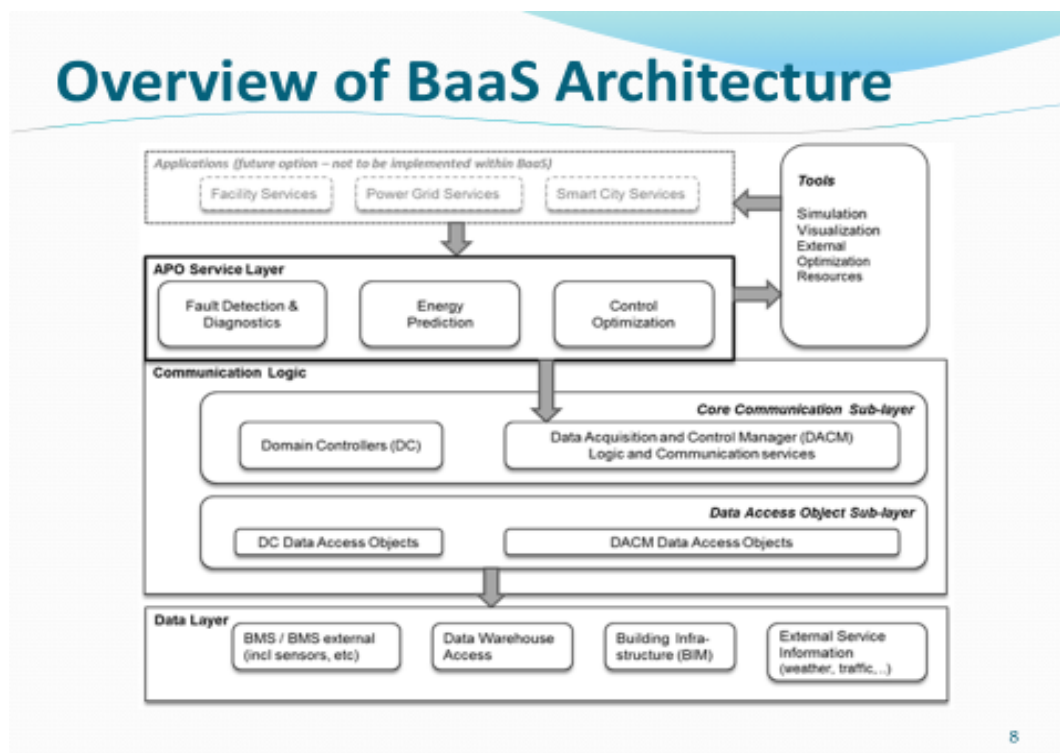


Figure 18: Identity presentation, page 8



Figure 19: Cover of the BaaS flyer





Figure 20: Back cover of the BaaS flyer

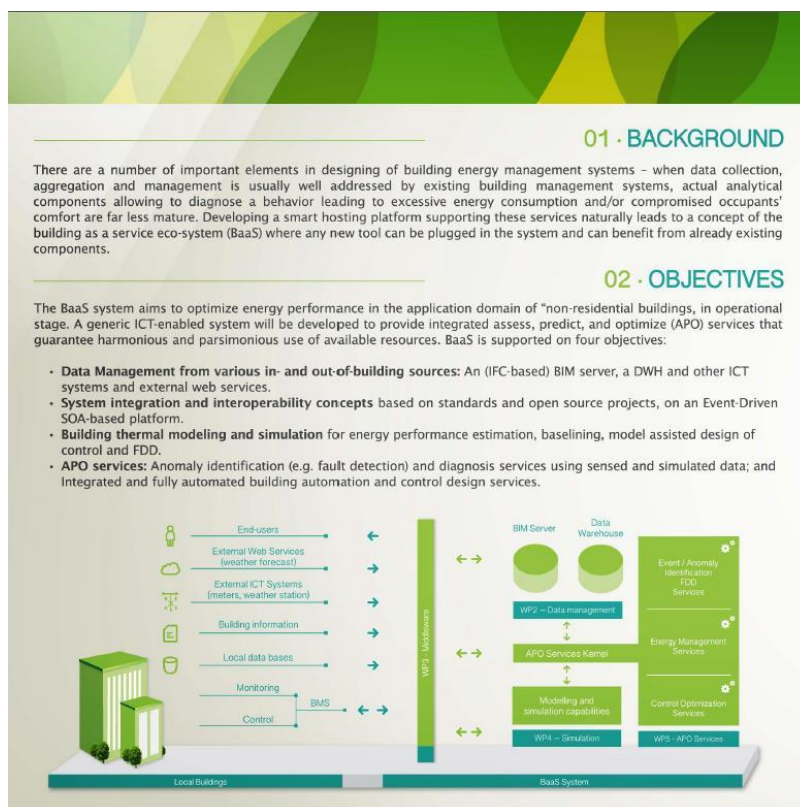


Figure 21: Sections 1 and 2 of the BaaS flyer

### 03 - DEMONSTRATION SITES

The complete BaaS system will be deployed and validated in real operating conditions in five demonstration sites.

Upon verification of component interoperability and implementation of an IPMVP-based measurement and verification plan in real buildings, the BaaS system behaviour will be analyzed as an Energy Conservation Measure and energy savings will be validated by an Energy Services Company.

End-user acceptance will be accomplished by analyzing the replication potential in tandem with the results of a sensibility study.

**Kassel (Germany) - Area: 1,348 m<sup>2</sup>**  
*Exhibition area, offices and experimental laboratory*

- Situated on an old urban neighborhood.
- Extensive utilization of passive and natural systems for heating, cooling and ventilation.
- District heating system.
- Central DDC for control with decentralized automation stations.

**Centre for Sustainability A - OFFICES**

**Madrid (Spain) - Area: 35,000 m<sup>2</sup>**  
*Hotel*

- Originally built to house the Spanish National Railway company offices, was transformed into a hotel (378 rooms).
- It is equipped with heating, cooling and DHW energy services, using individual terminal units on rooms.
- TREND-based energy management system for controlling energy systems.

**Husa Chamartín Hotel E - HOTEL**

**Chania (Greece) - Area: 450 m<sup>2</sup>**  
*Offices and meeting space*

- An atrium in the entrance is lit by a glazing area at the roof.
- Split-type air conditioning units.
- Central heating system.
- A BEMS from SAA Burgess with extensive sensing with wireless sensors.

**Technical University B - OFFICES**

**Valladolid (Spain) - Area: 7,500 m<sup>2</sup>**  
*Offices*

- Very low energy consumption building.
- Several renewable energy sources installed (PV and a closed-loop geothermal heat-exchanger system).
- Complete energy management system Lonworks-based.

**Carif 1 Offices building C - OFFICES**

**Granada (Spain) - Area: 7,670 m<sup>2</sup>**  
*School*

- Primary School for 650 students integrated by 3 separated buildings.
- Integration of renewable energy sources through the utilization of biomass boilers for thermal generation.
- TREND-based energy management system for controlling the heating generation and distribution.

**Sierra Elvira D - SCHOOL**



Figure 22: Section 3 of the BaaS flyer

### 04 - EXPECTED IMPACT

- Significant reduction of energy consumption and CO<sub>2</sub> emissions reaching or even surpassing the target of 15% reduction.
- Utilizing harmoniously and most effectively all installed systems in a building, taking into account human factors and adapting the decisions in real-time.
- Strengthen and consolidate European excellence in engineering at the intersection of control, thermal simulation, communication technologies, middleware platforms, energy, and building technologies.
- Contributing towards a unified European Methodology for a verifiable quantification of Energy Savings and CO<sub>2</sub> reduction in buildings.
- Contributing to European Energy Policy and to the analysis and further investigation and enhancement of European Standards.
- Impacting the evolution of standards for communication, interfaces, data models, methods of measuring energy performance, energy savings and CO<sub>2</sub> reduction in the standardization bodies for building standards.

### 05 - TARGET

- **Building** and construction companies
- **Process** and systems integration engineering at buildings
- **Building** Automation and Building Management Systems companies
- **Software** developers
- **IT Services** and networks providers
- **Energy** providers and utilities companies
- **Facility** managers
- **Energy** Services Companies
- **Public Authorities** and Regulatory Bodies
- **Building** Owners

Figure 23: Sections 4 and 5 of the BaaS flyer





Figure 24: BaaS flyer cover page



Figure 25: Inside area of the BaaS flyer

## Appendix B: BaaS brochure, final version 3



Figure 26: Brochure BaaS Cover page. Third version.





## Project Overview

**Objectives**

The BaaS system aims to optimize energy performance in the application domain of non-residential buildings in operational stage. In the building operational life-cycle three significant tasks have to be continuously performed: collect information and assess the buildings current state; predict the effect that various decisions will have to Key Performance Indicators (KPIs) optimization.

A generic ICT-enabled system will be developed to provide integrated assess, predict, optimize services that guarantee harmonious and parsimonious use of available resources.

This major objective is also pursued within BaaS via a number of multifaceted actions and Scientific & Technological Objectives:

**Scientific Objectives SO1**  
Development of building modelling and simulation for energy performance estimation and control design.

**Scientific Objectives SO2**  
Development of integrated Automation and Control Services.

**Technological Objective TO1**  
Development of data Management: Working on existing initiatives and ongoing projects results, integrating State of the Art of extended BIM, EEB Ontologies and Standards.

**Technological Objective TO2**  
Development of middleware Platform: System Integration, Interoperability And Standards

**Approach**

The **BaaS system** comprises four components:

A **data management** component to collect, organize, store and aggregate data from various in- and out-of-building sources. An (IFC-based) BIM will act as a central repository for all static building data, and a data warehouse will be used for dynamic data.

A **service middleware platform** to abstract the building physical devices, support high level services on the cloud and facilitate secure two-way communication between the physical and ICT layers (building) with high level services (cloud).

**Energy models** for performance estimation and for control services, looking for a trade-off between prediction accuracy (performance estimation) and computational complexity (fast-model for control design).

Assessment, Prediction and Optimization Service such as:

- **Assessment and prediction services:** simulation models, acting as surrogates of the real building, incorporating sensor dynamic data, will be used to assess performance and comprehensively estimate the values of relevant KPIs as well as help perform sensitivity analyses;
- **Optimization service,** automatically will generate holistic nearly-optimal control strategies with the goal of achieving operational efficiencies as measured through relevant KPIs and will be imbued with adaptive and re-configurability properties to respond to faults and atypical scenarios.

Upon verification of component interoperability, and development of a measurement and verification plan, the BaaS system will be demonstrated in two buildings and will be validated as an Energy Conservation Measure with Energy-Services Companies as the end-user.

End-user acceptance will be accomplished by analysing the replication potential in tandem with the results of a sensibility study.

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**Dalkia Energía y Servicios**  
Web: <http://www.dalkia.es/>






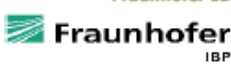








<http://www.baas-project.eu>

Figure 27: Brochure BaaS Project Overview. Second version




## Project Partners

<p style="text-align: center;"><b>Fundación Cartif</b></p> 	<p>Fundación CARTIF is a leading Spanish Applied Research Centre in terms of R&amp;D and technology transfer activities created in 1994. CARTIF is formed up by 9 technical divisions and 200 researchers specialised in several areas such as Energy, Environment, Food and Chemicals, Biomedical, Robotics, etc. In 2010 CARTIF carried out over 100 R&amp;D and Innovation projects, with a turnover of approximately 12M€.</p>	<p>Information and Communications Technologies (ICT) and Energy are two of the main research areas of CARTIF. Both together have created a multidisciplinary group focused on the application of ICT in the field of Energy, in particular Energy Efficiency, Energy Saving, Integration of Renewable Energy Systems, Electricity Market, Demand Response, Smart Grid, etc.</p>
<p style="text-align: center;"><b>NEC Laboratories Europe</b></p>  <p style="text-align: center;">Empowered by Innovation</p>	<p>NEC Corporation is a leader in the integration of IT and network technologies that benefit businesses and people around the world. By providing a combination of products and solutions that cross utilise the company's experience and global resources, NEC's advanced technologies meet the complex and ever-changing needs of its customers. NEC brings more than 100 years of expertise in technological innovation to empower people, businesses and society. NEC Europe is a subsidiary of NEC Corporation based in the UK that builds upon its heritage and reputation for innovation and quality by providing its expertise, solutions and services to a broad range of customers, from telecom</p>	<p>operators to enterprises and the public sector. NEC Laboratories Europe is a laboratory established by NEC Europe Ltd, and is located in Heidelberg, Germany. NEC Labs Europe conducts leading research and development across IT and communications, including Future Internet and OpenFlow, next generation fixed and mobile networks, M2M, context-aware platforms and services, the Internet-of-Things, multimedia, security, energy-saving services and green technology. Special emphasis is placed on solutions that meet the needs of NEC's European customers and as well as collaboration with industrial and academic partners within the European R&amp;D Framework Programme (FP7, etc.).</p>
<p style="text-align: center;"><b>Honeywell Prague Laboratory</b></p> 	<p>Honeywell is a diversified technology and manufacturing leader, serving customers worldwide with aerospace products and services, control technologies for buildings, homes and industry, automotive products, turbochargers, and specialty materials. Advanced control products and energy management services for homes and buildings represent an important part of Honeywell Automation and Control Solutions (ACS).</p>	<p>Honeywell customers range from individual homeowners to larger commercial and governmental buildings, health care facilities, airports, schools, and military bases. Honeywell Prague Laboratory – part of Honeywell spol. s r.o. – is an R&amp;D organization involved in development of new solutions for the process industries, homes and buildings, as well as in the fields of video surveillance and security.</p>
<p style="text-align: center;"><b>Fraunhofer IBP</b></p> 	<p>The Fraunhofer Institute for Building Physics (IBP) deals with research, development, testing, demonstration and consulting in the fields of building physics. This includes noise control, sound insulation measures in buildings, optimization of audibility conditions in audiences, energy saving measures, lighting technology, questions of indoor climate as well as aspects of moisture and weathering protection, the preservation of building structures and of historical monuments.</p>	<p>The fields of research that the Fraunhofer Institute cover include: research, development, testing, demonstration, and consultancy in the field of building physics: acoustics, sound insulation, lighting, energy conservation, indoor climate, durability, hygrothermics, building chemistry and building biology.</p>
<p style="text-align: center;"><b>Technical University of Crete</b></p> 	<p>The Technical University of Crete TUC is a research-oriented university with activities encompassing a number of engineering disciplines. The mission of TUC is to contribute to the advancement of the state-of-the-art in pertinent technological fields while establishing and maintaining close cooperation with the industrial and production sectors in Greece and abroad.</p>	<p>Integration technologies; development of building simulation software; development of algorithms to facilitate intelligent building operation. The TUC research group has significant experience in the area of ICT for Energy Efficiency and a computer cluster to support computational activities. In addition, a building on TUC campus has been fitted with an extensive sensing infrastructure and a web-based monitoring and control ICT system has been developed. This building will act as a test-bed for algorithm testing and ICT tool development in the BaaS Project.</p>
<p style="text-align: center;"><b>University College of Cork</b></p> 	<p>UCC is a state-owned University structured into four Colleges. UCC will be involved in the project through IRUSE (Informatics Research unit for Sustainable Engineering) as UCC-IRU. UCC-IRU is committed to the research and development of Sustainable Built Infrastructure, Systems and Technologies. Current research areas are Information Technology in Architecture, Engineering, and Construction as well as Building Energy Systems, Buildings Operation and Facilities Management. UCC-IRU is member of the European Construction Technology Platform (ECTP-FA7), CITA (Irish Construction Information Technology Alliance).</p>	<p>UCC-IRU has extensive experience in the area of ICT for Energy Efficiency. UCC-IRU research agenda addresses the need for integration concepts, holistic monitoring and analysis methodologies, lifecycle oriented decision support and sophisticated control strategies through the seamless integration of people, IT devices and computational resources. UCC-IRU have already developed a data warehouse system for its ongoing national projects that will be subsequently customised to match the requirements of various application domains and deployed in BaaS project. The motivation of UCC-IRU in BaaS is to collect, consolidate and analyse data and standardise data models.</p>
<p style="text-align: center;"><b>Veolia Environment</b></p> 	<p>Around the globe, Veolia helps cities and industries to manage, optimize and make the most of their resources. Improves the technical, financial and environmental performance of the facilities it manages on the behalf of local authorities and businesses. From design and engineering to energy procurement and facility operation and maintenance, all of Veolia's services are performed with a focus on sustainable</p>	<p>development. Its goal is to leverage local resources and minimize each facility's impact on the environment, while reducing both fossil fuel consumption and greenhouse gas emissions. Veolia provides cost-effective, eco-friendly energy efficiency services that include performance guarantees for the public and private-sector customers around the world.</p>

<http://www.baas-project.eu>

Figure 28: Brochure BaaS Project Partners Detail. Third version.



## Work Package WP1

### Theoretical Case Studies and End-user Acceptance

#### Objectives

WP1 is an end-user-driven work package. It continuously monitors the proper alignment of RTD outcomes with the application domain of "non-residential" buildings, in operational stage. The main objective of WP1 was to reach:

- A proper alignment with the application domain assuring replication of the BaaS solution on the whole typologies of buildings.
- A methodology of measurement and verification (M&V) of Energy Savings. BaaS aims on enhancing and using the results of on-going EC funded initiatives.
- A suitable end-user acceptance level by the end of the project.

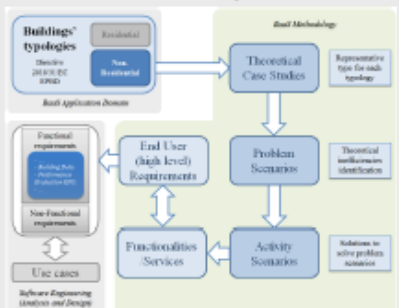
#### Approach

These objectives are being achieved through:

- Six theoretical case studies have been developed to analyse each of the six typologies of buildings which completely characterize the BaaS application domain.
- A set of key performance indicators (KPIs) have been identified and defined for each case study.
- These theoretical case studies were assigned as starting point for the remaining tasks in WP1 and also for the scientific and technological Work Packages 2, 3, 4, and 5.
- After the validation in demonstration buildings, selected in WP6 (belonging 3 typologies: offices, hotel and educational) in this WP1 the replication potentials of the BaaS Solution were analysed over the remaining buildings typologies (hospital, sports facilities and wholesale) which have not been selected as pilots.
- End-user acceptance was accomplished by analysing the replication potential in tandem with the results of a sensibility study.
- To achieve the savings evidence (through which potential benefits were calculated in the sensibility study), this work package, in conjunction with the demonstration WP6, defined (in WP1) and implemented (in WP6) a methodology to validate the expected savings associated to the project outcomes. Data obtained from WP6 was used to develop the sensibility study corroborated with real evidence of savings.

#### Task 1.1: Theoretical Case Studies Definition

In this task, six theoretical case studies have been developed to analyse each of the eight typologies of buildings which characterize the BaaS application domain (offices, hotel, educational, hospital, sport facilities and wholesale and retail). For each of the six theoretical case studies, analysis developed identifies problem scenarios and functional and non-functional requirements for which the BaaS system has been designed to address.



Scheme of the methodology for the development of the BaaS System

#### Task 1.2: Methodology of Measurement and Verification of Energy Savings

A methodology to record evidence, in an accurate way, of energy savings and CO2 emissions reduction and to measure and certify energy-savings attributed directly to the BaaS system (as an isolated retrofit-measure) has been identified. This methodology is the International Performance Measurement and Verification Protocol (IPMVP). In the project, the retrofits or (Energy Conservation Measures) ECMs to isolate will be the implementation of the BaaS Solution.

#### Task 1.3: End-User Acceptance Assessment

The goal of this task is ensuring proper implementation of Task 1.1 requirements in WP4 and WP5 and end-user acceptance. This task was in charge of the necessary functional requirements, partial-results monitoring and validation, at the end of the project, to ascertain end-user acceptance.

#### Achievements

As planned, the Theoretical Case Studies were analysed from the point of view of the problem scenarios affecting them, and solutions to solve these problems, i.e. the activity scenarios. Thus, the functionalities and services that will implement these activity scenarios, were used to define all the requirements that the BaaS System should fulfil from the end-user point of view) that were used by the technological WPs of the project.



#### Contact

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- Fraunhofer IBP
- Technical University of Crete
- University College of Cork-IRUSE
- Dalkia Energía y Servicios

<http://www.baas-project.eu>

Figure 29: Brochure Work Package 1. Third version.





## Work Package WP2

### Building Data: interoperability and standardization

Objectives

This work package aims on improving building data interoperability and standardization. Specifically, the work package objective was to collect, aggregate, integrate and use the existing buildings' product and process data and data models. It is concerned with interoperability and standardization of the data modeling (static and dynamic data). Therefore, in this work package we've specified and developed an extended data warehouse and a Building Information Model (BIM) based on standardized data model and functions.

The starting point was the current initiatives and on-going projects working on complementary topics and with aligned technological interests to exchange information and share experiences (BuildingSMART, HESMOS, CAMPUS-21) on developing and using an updated "Enhanced BIM with EE and FM extensions" (ISO/PAS 16739 and the newer version IFC2x4 which has a more comprehensive coverage in the data model of systems, sensors, controls).

These WP's activities were in charge of providing data (in the operation and maintenance building stage) supporting the requirements of energy models, simulations and algorithms addressed at the proposal (WP4 and WP5).

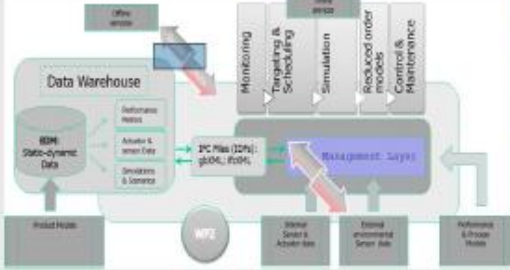
Approach

Information and data collected from multiple sources was consolidated, integrated, aggregated and pre-arranged for complex data-mining processes. The Extended Data Warehouse was the main consolidated data source of the BaaS network and contains all relevant product, process and performance data of the built artifacts being managed.

**Task 2.1: Data Warehouse Requirements and extended BIM Specification**  
This task was in charge of developing a Building Information Model (BIM) specification utilizing formal standard definitions (data & functions) of engineering building components (e.g. pumps, valves), systems (e.g. Air handling units, heat pumps, solar panels) and sensors (temperature, relative humidity, CO2, VOC's) as specified by professional engineering institutions CIBSE and ASHRAE.

**Task 2.2: Data Warehouse**  
In this task, using off-the shelf software tools, we've developed a data warehouse that aggregate the raw data from the BIM and monitoring system, including monitoring and targeting of environmental and energy resources for single and multiple building portfolios, to support facility management activities.

**Task 2.3: Standardized information exchange protocols**  
This task was in charge of designing and implementing the BIM specification from Task 2.1 using an ISO standard data model to facilitate seamless interoperability of the BIM with upstream activities that include data warehousing, ICT Building Blocks and downstream activities.



The diagram illustrates the data flow and components of the Data Warehouse. It shows a central 'Data Warehouse' box containing 'BIM Data-System Data', 'Reference Model', 'Active & Sensor Data', and 'Sensors & Services'. This box is connected to 'Input Data' on the left and 'Output Data' on the right. The 'Output Data' is further divided into 'Monitoring & Targeting & Scheduling', 'Simulation', and 'Reduced order models'. Below the 'Data Warehouse' box, there is a 'BIM Data-System Data' box, a 'BIM Data-System Data' box, and a 'BIM Data-System Data' box. The diagram also shows a 'BIM Data-System Data' box connected to a 'BIM Data-System Data' box, and a 'BIM Data-System Data' box connected to a 'BIM Data-System Data' box.

**Task 2.4: Data imputation, Uncertainty propagation and Data Integrity**  
In this task a methodology to address the identified inconsistencies in data was developed.

**Task 2.5: Prototype deployment and validation**  
This task was working on a DW connected to the Middleware Platform (WP3), using IFC and ifcXML files, with functional capacity to deal with uncertainty.

Achievements

We have designed a piece of software which could clean data for sensors and meters for any chosen building and for any type of sensor and meter data in that building. We have demonstrated that it is feasible to run the software over long time periods of up to one year. We have also demonstrated that there is a methodology for checking the data cleaned by the software. We have verified the hypothesis that we have a methodology to clean data over any time horizon, which acts directly on the database and cleans the data in automated way.

The choice of SQL to implement the software meant that we achieved our goal of cleaning the data automatically, whilst acting directly on the database, and without the need to involve other external tools.



Contact

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<http://www.baas-project.eu>

Figure 30: Brochure Work Package 2. Third version.



## Work Package WP3 Middleware Platform

### Objectives

In work package 3, the middleware platform (called communication logic layer CLL in BaaS) was specified, implemented, and evaluated. The middleware is an effective, holistic service and provides integrated communication among all entities of the BaaS system, e.g. the physical building, its Building Information Model, the data repositories, the APO (assess, predict, optimise) services, and the GUI. The CLL takes into account existing open standards frameworks, SOA architecture, and security and privacy needs.

While designing the CLL, essentials for data description (integrating the data modelling results from WP2) were taken into account. Moreover, the functional architecture and the integration components for control strategy and real-time building performance as well as the detailed interface specifications are defined. Additionally, WP3 builds a service platform prototype upon which the WP5 APO services is implemented. The aim was to provide a robust and flexible service middleware platform architecture that can be applied to the theoretical use cases defined in WP1.

### Approach

**Task 3.1: Data Modelling Harmonisation**  
Task 3.1 provided an overview of the BaaS data modelling harmonisation efforts. Moreover, in line with the overall emphasis of work package 3 on the BaaS middleware, task 3.1 yielded the following results which form the basis for the remaining work in WP3 but also the entire project in general:

- The BaaS High-Level Architecture
- Data Model Extensions with emphasis on Industry Foundation Classes as defined under BuildingSmart release IFC 2x4 Release 3
- Data Model Security and Privacy Classification

**Task 3.2: Functional Architecture**  
The BaaS system consists of three layers: the Data Layer DL, the Communication Logic Layer CLL, and the APO Service Layer APO-S. In Task 3.2, the functional architecture and their interconnections via interfaces were elaborated: The DL provides and stores data from various sources (BMS, data warehouse, BIM, etc.), the CLL reads and writes data from/to the DL and passes data on to the APO-SL, and the APO-SL provides intelligence for assessment, prediction, and optimisation as well as calculating KPIs and supporting decision-making. In order to achieve the system architecture, functional and non-functional requirements were collected. Together with the anticipated use cases, they were used to derive the functional components, functional blocks, and interfaces needed to design the functional architecture of the BaaS system and to deliver the desired functionality.

**Task 3.3: Overall System Design**  
Task 3.3 result in four deliverables, each of them giving an in-depth description of a particular part of the BaaS system:

- (1) Interfaces to external ICT systems
- (2) Containers for service logic on performance and control strategies
- (3) Detailed system design
- (4) Development guide

Work on these deliverables is finished at the moment. Class diagrams, sequence diagrams, and interface specifications have been created. Class diagrams represent the relationship among the objects for implementing the functionalities of a specific component and provide the basis for the final implementation of the components and the communication among them.

**APO Service Layer**

Fault Detection & Diagnostics

Energy Management

Control Optimisation

↓ External CL Interface

**Communication Logic**

Domain Controller (DC)

Data Acquisition & Control Manager (DACM)

↔ Internal CL Interface ↔

Data Layer Interface

**Data Layer**


BMS

Data Warehouse

BIM

External Data

**Task 3.4: Prototype implementation**  
In task 3.4, the BaaS system which has been developed and defined in the previous tasks during the project, is actually implemented. The prototype system was deployed to several demo sites and tested thoroughly in order to prove the feasibility of the chosen approach and to demonstrate its viability in real-world environments.



TUC

CMPT

ILB

SE

Left: Schematic representation of the overall BaaS system design.

### Achievements

During the BaaS project, WP3 made several fundamental decisions regarding the overall BaaS system design. Among others, a harmonised approach to the data models to be employed in the BaaS system has been presented, i.e. wherever possible an extended IFC model (based on 2x4 R3) and the BACnet protocol is used. Moreover, in order to allow the speedy and efficient implementation of a BaaS prototype to be deployed to several demo sites, the high-level system design has been introduced. This includes the description of use cases, scenarios, and functional requirements along with the distribution of data and functionality as well as the interfaces. Last, security and privacy considerations relating to the collection, storage, and processing of building data have been addressed.



### Contact

**Work Package Leader**

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**Participants**

- Fundación Cartif
- Honeywell Prague Laboratory
- University College of Cork-IRUSE


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Figure 31: Brochure Work Package 3. Third version.

BaaS, FP7-ICT-2011-6, #288409, Deliverable D7.2

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## Work Package WP4

### Building Energy Modelling and Simulations for Performance Estimation and Control

**Objectives**

**Approach**

**Achievements**

**Contact**

The objectives of WP4 were to provide building modeling and simulation tools for energy performance (EP) estimation and control design integrating needed simulation capabilities into the BaaS system. In particular within WP4 the objectives are:

- to develop thermal simulation models capable of estimating performance (using both models and sensor measurements) so that it can be comprehensively compared with actual measured performance;
- to create a simulation platform for testing and evaluating the control strategies developed in WP5 (advanced automation and control services for performance optimization of building operation);
- to develop simulation platforms for anomaly identification;
- to create simulation models amenable to control design;
- to integrate the simulation component in the BaaS framework.

**Task 4.1: Simulation for energy estimation, interconnection to the BaaS system**  
For energy performance estimation zonal-type software is selected to perform the simulations. There are several appropriate components developed to:

- Interface with the BIM and extract information about installed infrastructure in a building.
- Interface to the data warehouse to obtain dynamic data.
- Interface with external systems (e.g. weather service to obtain weather data).
- Interconnect the various components to permit the use of dynamic data.
- Experimental testing and verification of interoperability in the development test-bed (buildings).

**Task 4.2: Simulation models for the pilot buildings**  
This task activity was diverted on creating a simulation models of varying complexity and accuracy ("just enough accurate") for the BaaS pilot buildings.

**Subtask 4.2.1: Develop the thermal simulation models, for energy performance estimation.**

- Develop the simulation models for the zonal-type software selected in Task 4.1.
- Validate models under standard building operation.
- Verify that the components developed in T4.1 are of sufficient generality to interface with BIM & DW
- Evaluate KPIs defined in WP1. Suggest additional KPIs if deemed necessary.

**Subtask 4.2.2: Model-reduction for control and monitoring**

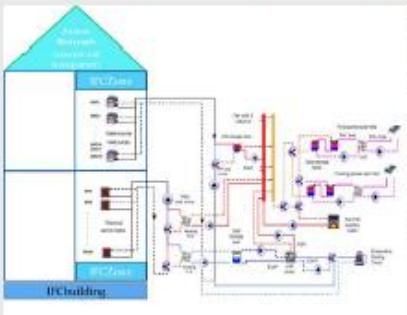
- Specify the computational complexity and accuracy requirements for each of the operations that the models will support (control design, monitoring and anomaly detection, etc.)
- Select a hierarchy of modeling and simulation approaches that could serve the requirements imposed
- Identify the structured model for pilots from available data, contextual information and EP models
- Verify against measurement data and compute deviations in KPI value predictions.

**Task 4.3: Evaluation of control strategies on the pilot buildings**

- To use EP models to assess control strategies developed in WP5 and compute relevant KPIs
- To evaluate the performance improvement and select KPIs to be optimized
- To test WP4 and WP5 algorithm integration before installing into real building, minimizing deployment impact.



BaaS will be applied firstly in non critical zones increasing the complexity until a complete implementation.

- To compute energy performance and energy-efficiency comparing the control with the "no-control" strategies.




The schematic on the left represents the interconnection between the systems installed inside buildings to generate, distribute and deliver energy into the conditioned zones with building and its occupants. Utilization of the IFC types included into BIM's in combination with the online measurements obtained from the buildings permits the creation of simulation environments that accurately reproduce the real environments.

The simulation structures created are used by the APO's to evaluate different cases as Fault detection or to estimate the behavior of the set Building/equipment operated under new evolved control strategies development in WP5.

<http://www.baas-project.eu>

Figure 32: Brochure Work Package 4. Third version.



## Work Package WP5

### Advanced Automation and Control Services for Performance Optimization of Building Operation

#### Objectives

The work in Work Package 5 concerned the design and development of advanced automation and control services for performance optimization during building operation. This includes development of proper analytics (Assess, Predict, and Optimize – APO services) and also a hosting platform (APO Kernel). The APO platform is an integration layer to support data access and communication needs of the APO Services. Together, the Kernel and the APOs comprise the business logic of BaaS; in general, there are three major types of inefficiencies were addressed by the APO services:

- Hardware faults detection and diagnostics. "You need a hammer to fix it."**  
Detect and possibly find a root cause (diagnose) of various equipment malfunctions and faults. Such faults may either prevent the system to operate and maintain required level of comfort or may lead to abnormal energy consumption caused by compensating a fault.
- Control faults and inefficiencies monitoring and optimization. "You need a keyboard to fix it."**  
Even properly working HVAC equipment may result in inefficient operation when not properly controlled. Control-related analytics monitor the applied control sequence to identify inefficiencies and, if needed, develop optimized strategies.
- Equipment performance degradation and monitoring. "Just looking what's going on"**  
Any equipment degrades over time and operating degraded equipment is more expensive. Various analytics can monitor equipment degradation and should a critical level for effective operation be reached, maintenance is scheduled.

#### Approach

Work was divided in four tasks:

**Task 5.1: APO Services Functional and Interoperability Requirements**  
Understanding the data and functional requirements along with the interoperability constraints is critical for developing and deploying the BaaS APO service layer components. Within this Task these requirements were collected to drive the development of the required software components. The APO services kernel was introduced, a middleware service, supporting the interoperability and data access requirements of the APO layer. Also the APO Services to be supported (Fault Detection and Diagnostics, Energy Management, Control Design and Optimization) were defined.

**Task 5.2: Anomaly and Event Identification and Diagnosis Services based on Energy Performance Estimation**  
Work within this task was focused on the development of the analytics components within BaaS. Starting from simple rule-based fault detection, to the more elaborate symptomatic treatment of anomalies, to model-based approaches, analytics components are being developed to form part of the BaaS business intelligence.

**Task 5.3: Building Automation and Control (BAC) Algorithms Development**  
Within this task Building Automation and Control analytics are being developed. The focus was on developing supervisory control strategies; special emphasis is given to the implementation and testing of model-based control design strategies that optimize and automatically tune the control system parameters so that good performance with respect to energetic and comfort parameters can be obtained.



**Task 5.4: Integration of BaaS APO Services**  
Integration of the APO Kernel with the middleware developed in WP3, so that the BaaS system can be realized. Deployment of the analytics modules developed in the previous tasks to the BaaS demonstration buildings.

#### Achievements

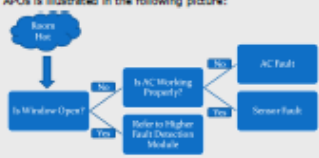
The activities undertaken during the BaaS project proceeded along two axes:

- Design and implementation of the platform (APO Kernel) to host APO analytics services and address data management, scheduling and simulation needs; and;
- Development of analytics components that provide the functional services outlined above.


**APO Services**  
Different types of analytics are supported by the APO Services Layer these are being developed by WP5 participants:

**Example of fault detection analytic**  
One fairly simple illustration of situations to be detected by APOs is illustrated in the following picture:




**APO Kernel:**



#### Contact

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**Participants**  
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– Fundación Cartif  
– NEC Laboratories Europe  
– University College of Cork-IRUSE  
– Fraunhofer IBP

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Figure 33: Brochure Work Package 5. Third version.





## Work Package WP6

### Demonstration of the Baas System

Objectives

The following activities were performed:

1. Using the theoretical case studies defined in WP1, in WP6 representative Demonstration Buildings have been selected as demonstration sites covering at least three of the six typologies of the Application Domain.
2. Implement in the Demonstration Buildings along with the measurement and verification methodology (developed in WP1).
3. Implement the measurement and verification methodology defined in WP1 for evaluating energy-savings.
4. A comprehensive validation procedure to ensure correct functionality, usability and interoperability of the Baas system, recording and calculation of savings will be performed.
5. The implementation of this WP is in charge of providing feedback to the RTD work packages (WP2, WP3, WP4, and WP5), identifying potential inconsistencies and/or providing real value.

Approach

**Task 6.1: Selection of pilot buildings**  
Five Demonstration Buildings have been initially selected for implementation of the Baas solution. Thus, three typologies are represented: offices, hotels and educational buildings. Therefore, due to various circumstances, there are three buildings only used as the test-bed to completely integrate the Baas results (<https://www.baas-project.eu/index.php/public/home/demosites>).

**Task 6.2: Preparation of Pilots for the implementation and evaluation of the Baas system**  
All planning, subcontracting and monitoring retrofitting actions are performed, necessary for adapting the pilots according to the Baas implementation requirements and for implementing the M&V methodology.

**Task 6.3: Implementation of measurement and verification M&V methodology in each Pilot: M&V Plan, Baseline and Reporting**  
Each Measurement and Verification Plan include: Energy Conservation Measures (ECM) intent, measurement boundary, Baseline (Period, energy and conditions), reporting period, basis of adjustment, analysis procedure, energy prices, meter specifications, monitoring responsibilities, expected accuracy, budget, quality assurance.

**Task 6.4: Deployment of the Baas ECM in the pilots**  
This task is developed the effective implementation of the complete Baas System on each pilot. This task Have been started after the monitoring systems were commissioned and after the baseline period required by the M&V plan (a year at most) has completed.

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.



Three of the demonstration buildings, are also used as test-bed, in order to validate on them each component of the Baas system separately.

As the validation of the whole system is based in a M&V Protocol implementation, the demonstration buildings selection is followed by the preparation of pilots to baseline period (MS3), the solution installation (MS5) and reporting of savings to final user validation (MS6).



Baas demonstrators

Scheme of Baas demonstration process

Achievements

During the Baas project, the demonstration buildings have been selected, defined (building general information, installed energy systems, existing monitoring and control systems) and analysed in order to adapt the buildings to implement the Baas solution and the M&V protocol selected (IPMVP) in WP1. Finally, the application potential of Baas and its feasibility in other case studies was proved as very useful and innovative. These Baas innovative solution could complement the existing methodologies and technical solutions, providing buildings with an added value in comparison with other utilities due to the improvements in energy efficiency and cost-effectiveness.

Contact

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- University College of Cork-IRUSE




<http://www.baas-project.eu>

Figure 34: Brochure Work Package 6. Third version.

## Appendix C: BaaS Project Newsletter, final Issue №4



**Buildings as a Service Project Newsletter №4**  
April 2016

The 3rd Review Meeting was held in the EC premises the 4th of November 2015, the main objective was to present the achievements obtained for the third Project Period of BaaS (from December 2014 to August 2015).  
Particularly presentations were focused on showing the achievements obtained per WP and the current situation of BaaS deployed in our three demonstration buildings: ZUB - Kassel (Germany), CARTIF - Valladolid (Spain), and Sierra Elvira School - Granada (Spain). In that sense, the consortium showed that BaaS is ready and delivering energy-aware monitoring and optimized operation services towards the real validation of the prototype in different scenarios (Use Cases) that affects the buildings' behaviour in summer and winter modes. Preliminary results related to the summer Use Cases were also presented.

**Upcoming events**  
The final project review will take place in Brussels June 9th 2016.

**Centre for Sustainable Building (Kassel)**

**CARTIF office building (Valladolid)**

**Sierra Elvira school (Granada)**

**César Valmaseda, BaaS Project Coordinator**  
Welcome to the 4th and final issue of the BaaS project newsletter on the research of ICT solutions for optimizing energy performance in the application domain of "non-residential buildings" in an operational stage. This final stage of the project has been remarked by the deployment of the winter mode in our three demonstration sites: two office buildings located in Kassel (Germany) and Valladolid (Spain) and one school placed in Granada (Spain). Additionally, the assessment of the results has been carried out both in summer and winter cases in order to provide specific numbers which help industrial and academic partners to identify potential exploitation initiatives.

Having in mind the objectives of energy efficiency and comfort improvements, the complete BaaS platform has been running during the experiments by gathering heterogeneous data from the buildings with the aim at supporting the model-based and data-driven decision-making services. These high-level services have provided better comfort conditions to the occupants, as well as energy savings for the owner. Finally, its replicability and sensibility analyses have been performed by which the replication potential and impact augur future developments under BaaS umbrella.

Finally, I would like to invite you to continue following BaaS project and its achievements by visiting our communication channels: BaaS project website and BaaS LinkedIn Group.

**Experiments and BaaS implementation results:**  
**CARTIF Demonstration Site**  
During the last stage of the BaaS project, the winter mode has been deployed in the CARTIF building which is model-based controller that treats the optimal control of the energy generation and distribution sources for heating. In particular, the inlet temperature water into the radiant floor has been the objective. Thanks to this new control, which overrides the old control strategies, in the CARTIF building 10% of energy savings have been achieved, while the comfort in the zones is ensured.

Additionally, the assessment of the summer mode has been obtained where 24% energy savings are got by means of controlling the set-points offset of the cooling systems.

**ZUB Demonstration Site**  
Two different experiments were implemented during the winter period 2015-2016 in ZUB building.


Period 1 (P1): New control was applied from Dec15 to Jan16 and it alters the previous baseline control strategy, modifying heating sending temperatures as a function of the forecasted ambient temperatures and solar radiation for the next 72 hours.

Period 2 (P2): It was applied from Feb16 to Mar16 when the building is preheated on Sunday afternoon and it is let "free floating" along the week. Some additional heating is provided if necessary until Friday morning, but the building is kept comfortable mostly with the available radiation and the internal loads. Both measurements lead to combined savings of 17% (13% in P1 and 30% in P2).

**Sierra Elvira School Demonstration Site**  
During the winter season 2015-2016, two different control strategies were implemented in SES building. For the first one, predictive models have been developed in order to implement control and optimization strategies that minimize the energy consumption while meeting the comfort requirements related to the indoor temperature. The second solution consisted on a holistic optimization of HVAC systems via distributed data-driven control and it is based on the principles of reinforcement learning. The overall energy savings achieved in SES are estimated on 18%, while the indoor temperatures reached very acceptable levels (19-20°C) compared to the reference ones.

**Logos:** 7th Framework Programme, European Union, Technology Centre, CARTIF, NEC, Fraunhofer, Honeywell, UCC, VEOLIA, and a building icon.

Figure 35: Baas Project Newsletter, Issue 4, page 1




### Publications

The BaaS project has presented in the following conferences this year  
**Further Information:**  
For most recent events, conferences, papers, you can find updated information on BaaS website:  
<https://www.baas-project.eu>


### Results summary

Pilot Building	Use Case	Energy consumed	Energy savings
CAR	Uc1 (Winter)	2,908 kWh <sub>y</sub>	284 kWh <sub>y</sub> 10%
	Uc2 (Summer)	1,962 kWh <sub>y</sub>	756 kWh <sub>y</sub> 34%
ZUB	Uc1 (Winter)	12,462 kWh <sub>y</sub>	2,566 kWh <sub>y</sub> 17%
SES	Uc1 (Winter)	31,360 kWh <sub>y</sub>	5,843 kWh <sub>y</sub> 18%

### BaaS useful contacts



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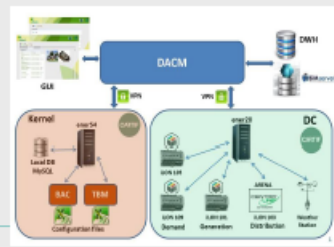
Follow updates and news and benefit from the exchanges among wide-ranging players in the energy efficient community by joining "BaaS - Building as a Service (Ecosystem) community" on LinkedIn.

If you would like to become a member of the BaaS Dissemination Network, please contact us at  
[baas\\_dissemination@cartif.es](mailto:baas_dissemination@cartif.es)

### Final Results and Future works

As it has been remarked before, a set of summer and winter use cases have been applied along the BaaS project lifecycle with unneglectable results. Having in mind them, the building owners will continue the application of the BaaS project during the next summer and winter seasons. In this way, BaaS has been completed through an holistic, interoperable and scalable platform to apply optimal control strategies so as to save energy at the same time than applying comfort constraints.

Under this concept, BaaS will not only continue its application in the pilot buildings, but also, its heterogeneity provides the possibility of replicating the solution, as ECM (Energy Conservation Measure) represented in the picture, in other contexts. Thus, ESCOs, such as Veolia may integrate the solution within its business models and exploitation plans. In low-performance buildings which require a significant energy retrofiting, the potential of the BaaS solution is very high in terms of energy efficiency and economic savings, justifying the projects feasibility.



As well, the individual pieces of software are subject of exploitation by other industrial partners.

BaaS has also largely contributed to dissemination activities. In summary, several papers have been published in peer-review journals. Regarding conferences, BaaS partners have carried out a wide activity, reaching more than 20 published papers in proceedings. Finally, BaaS project has organized two workshops where engineers, architects and end-user have participated.

Finally, during the last stage of the project, a set of final deliverables have been submitted, shown in the table below. The public documents are available on the Web site of the project.

No	Title	No	Title
D1.3	End-user acceptance assessment	D6.4	Deployment of BaaS ECM in pilot buildings
D2.5	Prototype deployment, evaluation, monitoring and support	D7.1	Dissemination Plan
D3.8	Prototype documentation deployment, evaluation, monitoring and support	D7.2	Communication Tools
D4.4	Evaluation of WP5 results under different KPIs	D7.3	Project Website
D5.4	Deployment, evaluation, monitoring and support of SO2 Integrated Services	D7.4	Plan for the Use and Dissemination of the Foreground (PUOF)
D6.3.3	Reporting Period in Pilot buildings	D7.5	Standardisation

### BaaS useful contacts:

- In respect to BaaS Project coordination and management you can contact the BaaS Project coordinator Susana from Fundación Cartif, Energy Division; email [cesval@cartif.es](mailto:cesval@cartif.es) or [baas@cartif.es](mailto:baas@cartif.es).
- In respect to BaaS events participation and related dissemination you can contact the BaaS Workshop Coordinator Professor Karsten Menzel from University College Cork, Ireland; email [k.menzel@ucc.ie](mailto:k.menzel@ucc.ie)
- If you have a question related to scientific objectives please contact WP leader
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Figure 36: Baas Project Newsletter, Issue 4, page 2



## Appendix D: Full list of contacts used for BaaS dissemination

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Adrain Downey	UCC	Ireland
Adrian Plüss	FH Aargau/Nordwest Switzerland	Switzerland
Adriana Bernardi	National Research Council Of Italy	Italy
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Agnieszka Lukaszewska	Przedsiębiorstwo Robot Elewacyjnych Fasada	Poland
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Ala-Juusela Mia	VTT	Finland
Alan Hore	DIT / CITA	UK
Alan Jacobs	Bentley Systems Incorporated	USA
Alan Lamont	Bentley Systems Germany GmbH	Germany
Alan Luke	Nottingham University	UK
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Andreas Meißner	Fraunhofer	Germany
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Andreas Rogge	BAM	Germany
Andreas Salzer	Wolff & Muller	Germany
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**Table 2: Full BaaS contact list**