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Big data for buildings

Building Information aGGregation, harmonization and analytics platform

Project Nº 957047

D8.4
Final report on dissemination, communication and clustering activities and results

Responsible:	Nerea Gómez (ECTP)
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Executive Summary

The purpose of this deliverable is to describe all the communication and dissemination activities, as well as the marketing material, that were carried out throughout the project, especially during the second half of the project, aiming at guaranteeing a broad visibility and promotion of the project's activities.

This document includes a description of the project website and the social media activity, the printed and digital material, along with the main tools used to spread the word of BIGG among the stakeholders, such as press releases, newsletters, publications in professional magazines, scientific publications and participation to conferences. In addition, the section *Synergies and liaisons* presents the different activities carried out with identified similar projects and initiatives.

Furthermore, an overview of the current status of the communication and dissemination KPIs, a description of the completed achievements and of the encountered difficulties is provided. It is followed by a section dedicated to the long-term availability of the BIGG resources.

This is the fourth and final deliverable of Work Package 8, an updated version of the *D8.3 - 1st report on dissemination, communication and clustering activities and results*, which presents all the communication and dissemination activities performed during the second reporting period.

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ACRONYM	DEFINITION
BC	Business Case
C-KPI	Communication Key Performance Indicator
D-KPI	Dissemination Key Performance Indicator
EC	European Commission
M	Month
TA	Target Audience
WP	Work Package

I. INTRODUCTION

I.1. Purpose and organization of the document

The deliverable describes the communication and dissemination activities carried out throughout the second part of the project (M18-M36).

The document is divided in 6 sections: starting with an *Introduction*, followed by *Section II* presenting the communication and dissemination timeline from the point of view of the public deliverables and milestones. *Section III* includes all the communication and dissemination channels that are fundamental in the widespread of the project and the activities performed in the second period. *Section IV* gives an overview on the synergies and liaisons created with other projects and international initiatives, including the projects under the same call.

In *Section V*, the status of the communication and dissemination key performance indicators (C-KPIs and D-KPIs) are presented, while *Section VI* aims at presenting the strategy to ensure a long-term availability of the main outputs of the project.

I.2. Scope and audience

The communication and dissemination activities of WP8 support the activities of *WP7 - Project impact* to realize a maximal exploitation and valorisation of the solutions developed within BIGG. This deliverable is thus intended for WP7 partners as well as for the EC Project Officer and External Reviewers to follow-up on the project's dissemination and communication activities.

II. PUBLICATION OF DELIVERABLES AND MILESTONES

To maximize the widespread adoption of the results of the project, BIGG focuses on the specification and implementation of standardized and open solutions:

- An open source Data Reference Architecture
- An open and interoperable Buildings Data Specification
- An extensible, open and cloud-based Data Analytics Toolbox

Consequently, most deliverables have been publicly released. A section on the project website (https://www.bigg-project.eu/deliverables/) was created, where all the public and accepted deliverables can be found. The release of a deliverable is always followed by appropriate communication and dissemination actions to inform the intended target audiences.

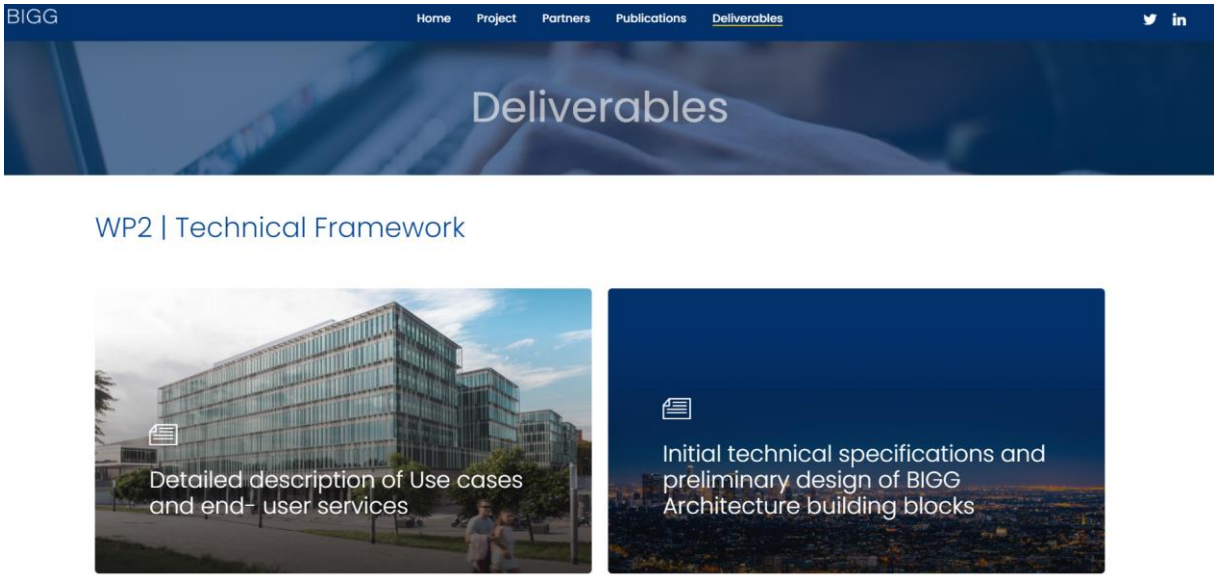

Figure 1. Dedicated BIGG website page for deliverables

In addition, a community has been created in Zenodo.org: *H2020 project BIGG: Building Information aGGregation, harmonization and analytics platform* (https://zenodo.org/communities/bigg_h2020). Zenodo is a general-purpose open access repository developed under the European OpenAIRE program and operated by CERN. Zenodo complies with the FAIR principles: to be findable, accessible, interoperable and reusable. All the public deliverables have been also published on Zenodo. In total, the published deliverables have 200 views and more than 270 downloads.

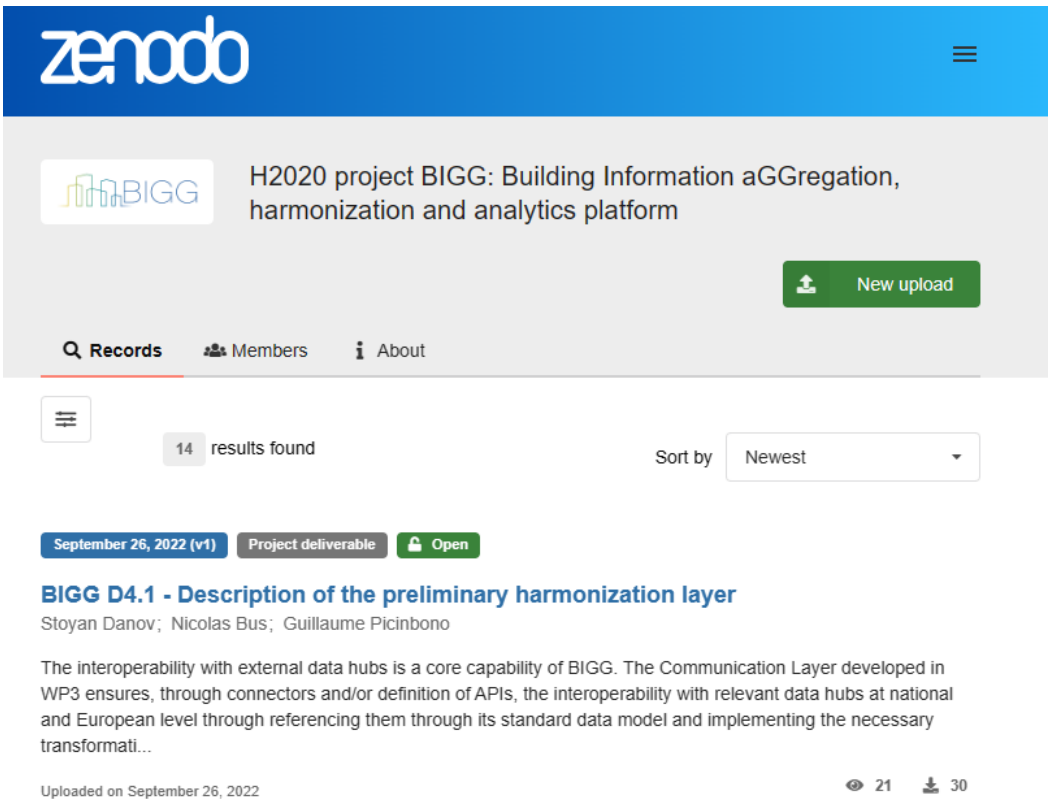

Figure 2. BIGG community on Zenodo

The table below gives an overview of the BIGG public deliverables with due dates.

Table 1. BIGG public deliverables (sorted by due dates) published on the website

Nº	Deliverable title	Due date
D8.1	Marketing material and website	M3
D8.2	Dissemination and communication actions plans and target KPIs	M3
D2.1	Detailed description of Use cases and end-user services	M6
D2.2	Initial technical specifications and preliminary design of BIGG Architecture building blocks and APIs	M12
D7.1	Initial contributions to standardization actions and market analysis	M12
D3.1	Description of the preliminary end-user, communication and security layers	M15
D4.1	Description of the preliminary harmonization layer	M15
D5.1	Description of the preliminary AI toolbox	M15
D6.2	First evaluation of the BIGG pilots results on use cases	M18
D8.3	1st report on dissemination, communication and clustering activities and results	M18
D7.2	Update of contributions to standardization actions and preliminary Market2Go strategy including BIGG impact	M24
D5.2	Description of the final AI toolbox	M30

D3.2	Description of the final end-user, communication and security layers	M30
D4.2	Description of the final harmonization layer	M30
D4.3	Public BIGG Data	M34
D2.3	Final technical specifications and description of the integrated BIGG solution	M36
D6.3	Final evaluation of the BIGG pilots results on use cases	M36
D7.3	Final contributions to standardization actions and final Market2Go strategy including BIGG impact	M36
D8.4	2nd report on dissemination, communication and clustering activities and results	M36

Concerning the public deliverables submitted from M30 to M36, they have been published on the website with the following message: "*This deliverable has not yet been approved by the EC*".

Within BIGG there are also a number of milestones defined, that typically coincide with the release of multiple or major deliverables, see the table below. When a milestone is achieved, communication is further intensified, especially for milestone MS5 (first round of pilot evaluations). With milestones MS8, MS9 and MS10 at the end of the project (final version of integrated BIGG solution, final round of pilot evaluations and final Go2Market strategy), the same strategy has been followed.

Table 2. BIGG Milestones

Nº	Description	Due date	Relevant Deliverables
MS1	Project Kick-off.	M1	Minutes
MS2	Release of the description of BIGG use cases and end-user services definition.	M6	D2.1
MS3	Release of the 1st version of the BIGG architecture.	M12	D2.2
MS4	Release of the 1st version of BIGG solution individual components.	M15	D3.1, D4.1, D5.1
MS5	Achievement of the end of the 1st round of pilots evaluations.	M18	D6.2
MS6	Initial Go2Market strategy.	M24	D7.2
MS7	Release of the final version of BIGG solution individual components.	M30	D3.2, D4.2, D5.2
MS8	Release of the final version of the integrated BIGG solution.	M36	D2.3
MS9	Achievement of the end of the final round of pilots evaluations.	M36	D6.3
MS10	Final Go2Market strategy.	M36	D7.3

III. COMMUNICATION AND DISSEMINATION CHANNELS

III.1. BIGG website

The BIGG website (https://www.bigg-project.eu/) was created in M3 and all the relevant information about the project can be found on it: objectives, scope, expected impacts and business cases. There is a section dedicated to the publications, which is fed with at least one publication per month: https://www.bigg-project.eu/publications/. 62 news publications can be found about diverse topics, from communication material (poster, video, press releases, newsletters) to the last updates on the project and relevant events within the sector.

In order to ensure the diversity of topics and perspectives, a calendar was created. Each month a different partner was responsible for publishing a piece of news about an interesting topic related to the project.

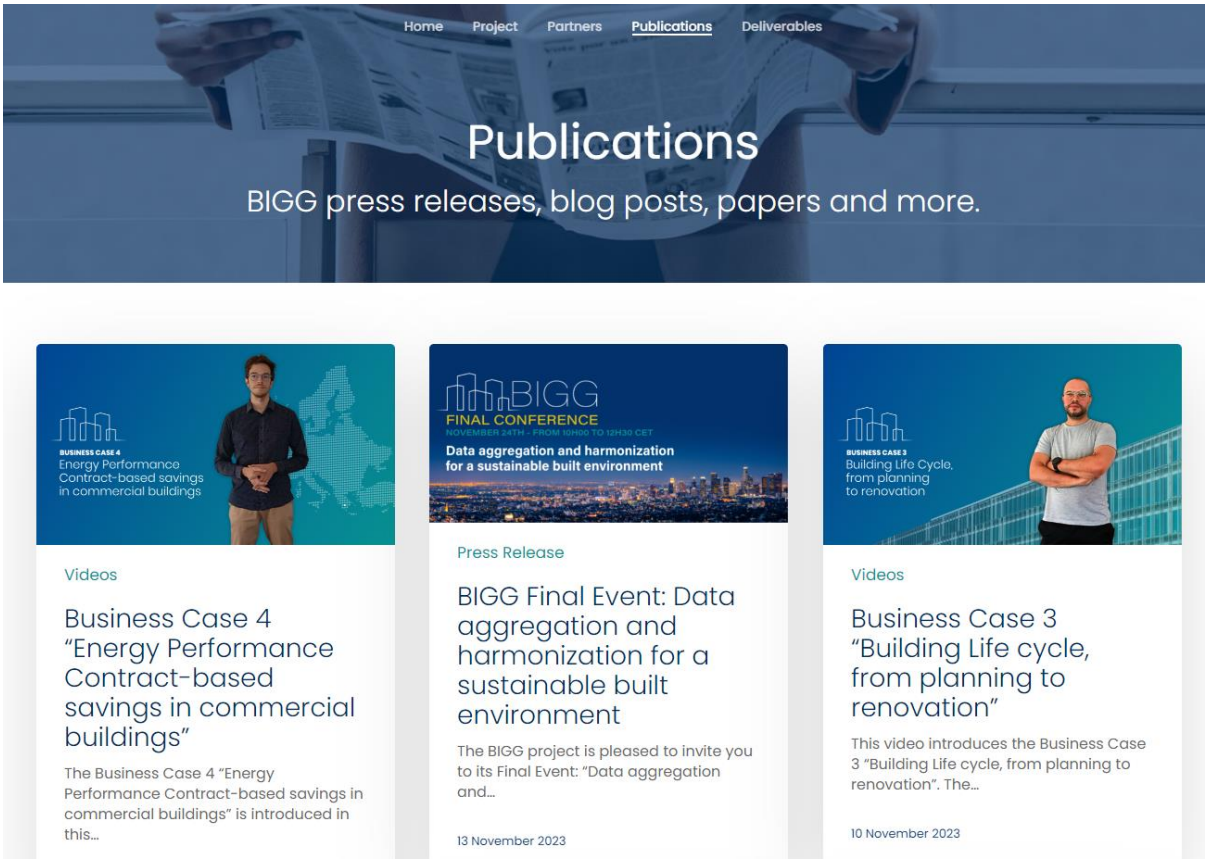

Figure 3. BIGG website – Publications

III.2. Social Media channels

The social media channels were created in M3 and have been actively managed aiming to increase the visibility of the project. The Twitter account (https://twitter.com/BiggProject), which gathered already more than 1260 followers as of November 30th, has been updated with at least 2 posts per month. The LinkedIn account (https://www.linkedin.com/showcase/bigg-project) had an increasing community of more than 310 followers and has also been fed with at least 2 posts per month. Both social media were fed with posts based on different elements, work and research provided by all the consortium partners.

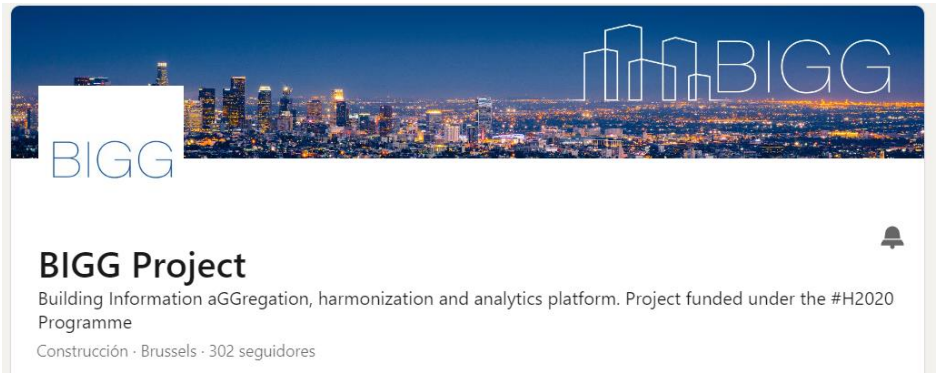

Figure 4. BIGG LinkedIn profile

Figure 5. BIGG Twitter profile

During the 2nd Reporting Period, it was decided to create a YouTube channel (https://www.youtube.com/@BIGGProject), to publish and store all the videos created throughout the project. Please refer to *Section III.3.2.* to find more details about the videos.

III.3. Printed and digital material

III.3.1. Printed material: flyer and poster

Printed and digital material for communication and dissemination was created and published through the BIGG channels during the 1st Reporting Period.

The flyer (https://www.bigg-project.eu/flyer-bigg-project/) was distributed on 12 events, including the following: Sustainable Places 2021 Conference (Rome, September 2021), ECTP Conference (Madrid, December 2021), Climatherm – Energy 2022 (Athens, February 2022), EnerGreen Deal Conference (Brussels, May 2022), CIB W78 (Melbourne, June 2022), Sustainable Places 2022 (Nice, September 2022), ECPPM (Trondheim, September 2022), EUSEW Networking Village (Brussels, September 2022), Beyond Expo (Thessaloniki, May 2023), Sustainable Places 2023 (Madrid, June 2023), TIF-HELEXPO (Thessaloniki, September 2023) and ENLIT 2023 (París, November 2023).

Figure 6. BIGG Flyer

Two different posters (https://www.bigg-project.eu/poster-bigg-project/) were designed in order to choose the most suitable one depending on the focus and the audience of the event. Version A was designed mainly for communication purposes and the objective was to use it on events with a general and varied audience, including general public and civil society. On the other hand, version B of the poster contains more details about the project, aiming to reach a more specialized and technical audience.

The poster was shown on 2 events: EUSEW Networking Village (Brussels, September 2022), and Sustainable Places 2023 (Madrid, June 2023).

Figure 7. BIGG Posters (version A and B)

III.3.2. Digital material: videos

The first video of the project (https://www.bigg-project.eu/watch-the-first-project-video-of-bigg/) was published on BIGG's website. This video introduced the project, the main objectives, the scope and the Consortium. Once the YouTube channel was created, the video was also published there.

This video was followed by another one (https://www.bigg-project.eu/watch-our-video-of-bigg-pilot-tests-and-business-cases/) briefly presenting the three case study areas: Catalunya (Spain), Athens (Greece), and Volos and Thessaloniki (Greece).

The BIGG project is a revolution of the way data and analytics are harnessed in building management, fostering efficiency, sustainability, and innovation for the benefit of all stakeholders involved. Therefore, during the 2nd Reporting Period, the BIGG Consortium decided to explain in detail each of the large-scale pilots in Spain and Greece: the final official video would be substituted by a series of 7 videos.

All the videos can be found on the project website (https://www.bigg-project.eu/category/videos/) as well as on the YouTube channel (https://www.youtube.com/@BIGGProject). It is worth mentioning that the videos reached more than 460 views in total on the YouTube channel, where the Business Case 6 video reached 90 views in the first day of publication.

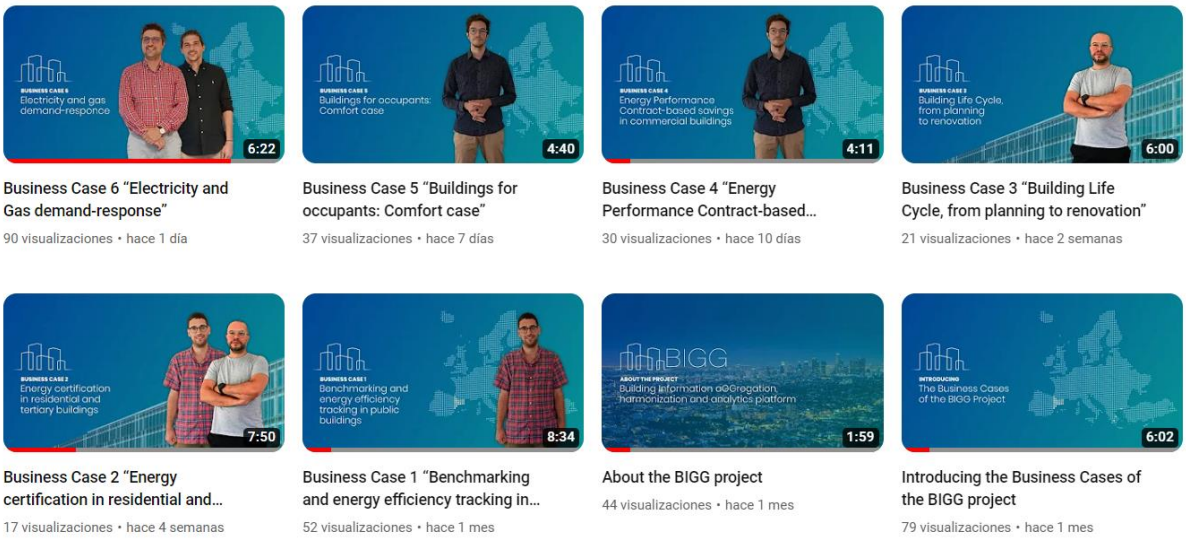

Figure 8. Example of some of the videos published on the YouTube channel

III.4. Newsletters

The 6 newsletters published throughout the project can be found on the corresponding section of the website: https://www.bigg-project.eu/category/newsletter/

During the second part of the project, three newsletters were released:

- 07/11/2022 Fourth newsletter "*November Newsletter*" (https://www.bigg-project.eu/newsletter-november-2022/). Throughout the November Newsletter, BIGG presented the recent progress of the project and the most remarkable activities carried out: including the joint participation to the Networking Village EUSEW 2022 with the sister projects BuiltHub, MATRYCS and BEYOND; the publication of a research paper "Dynamic horizon selection methodology for model predictive control in buildings", and the organization of the first standardization workshop with the sister project; among other news. The newsletter was distributed via the ECTP network and published on its website.

- 02/05/2023 Fifth newsletter "*May Newsletter*" (https://www.bigg-project.eu/newsletter-may-2023/). This newsletter focused on the completion of the second year of the project, presenting some of its significant progress such as of the Standard Data Model for Buildings, the Reference Architecture Framework, and some major improvements in how the information is gathered, stored and processed. In addition, the newsletter introduced the later called #SmartEnergyCluster, to which BIGG was invited together with some other projects to join forces and work together in the framework of the dissemination, communication and exploitation of the projects activities and results, aiming at engaging interested and common target groups. The newsletter was published on the ECTP website.
- 22/10/2023 Final newsletter "*October Newsletter*" (https://www.bigg-project.eu/newsletter-october-2023/). The final newsletter introduced the series of videos that would be published during the following weeks presenting in detail each of the large-scale pilots, as well as the 2nd White Paper "The need for harmonizing input data and AI Toolbox revolution in context of smart building management". It was also announced that the BIGG project was invited to pitch during the session "Data and information aggregation for a sustainable Built Environment" at the Annual Built4People Stakeholders Forum, which was held online on October 3rd. Among other news, this newsletter also officially introduced the #SmartEnergyCluster, in which BIGG and other 18 projects pool resources and expertise to accelerate the smart energy transition. The newsletter was also published on the ECTP website.

III.5. Press Releases

The six press releases published throughout the project can be found on the corresponding section of the website: https://www.bigg-project.eu/category/press-release/

Four press releases were published during the 2nd Reporting Period:

- 30/06/2022 Third press release "*BIGG architecture as purposed standard at Catalan Public Procurement Innovation Program*" (https://www.bigg-project.eu/bigg-architecture-as-purposed-standard-at-catalan-public-procurement-innovation-program/). The article introduced that The Catalan Government would purchase innovative technological solutions to address several challenges whose aim is to improve civil services and processes and as far as possible, must have an impact on society.The press release was published on BuildUp and Construction 21 International.
- 10/12/2022 Fourth press release "*BIGG events: from the standardization workshop to the first and upcoming BIGG training sessions*" (https://www.bigg-project.eu/bigg-events-from-the-standardization-workshop-to-the-first-and-upcoming-bigg-training-sessions/). This press release gave an overview of the recent events, including the standardization workshop "Leveraging on standardisation for building data aggregation and analytics" that BIGG co-organized with BuildUp and to which the project MATRYCS and BuiltHub were invited. The press release was published on BuildUp and Construction 21 International.
- 02/06/2023 Fifth press release "*Join BIGG in the next webinar of the Zero-Emission Buildings Academy #3 organized jointly with Leonardo Energy (European Copper Institute), ECTP and BPIE*" (https://www.bigg-project.eu/join-bigg-in-the-next-webinar-of-the-zero-emission-buildings-academy-3/). This press release served as an invitation to the webinar, and it was distributed through the Leonardo Energy community, which counts more than 10k subscribers.

- 13/11/2023 Final press release “BIGG Final Event: Data aggregation and harmonization for a sustainable built environment” (https://www.bigg-project.eu/bigg-final-event-data-aggregation-and-harmonization-for-a-sustainable-built-environment/). The last press release served as an official invitation to the Final Event “Data aggregation and harmonization for a sustainable built environment”. The press release was published on BuildUp and Construction 21 International.

III.6. Publications in and Collaboration with Professional Magazines

As mentioned above, the professional magazines BuildUp and Construction 21 International were an important dissemination tool to increase the visibility of the project. Due to the success in the first Reporting Period, the publication on these two platforms continued for the rest of press releases as well as for other articles. The three press releases were published on both platforms reaching more than 3000 readers.

Figure 9. Third press release published on Construction 21 International

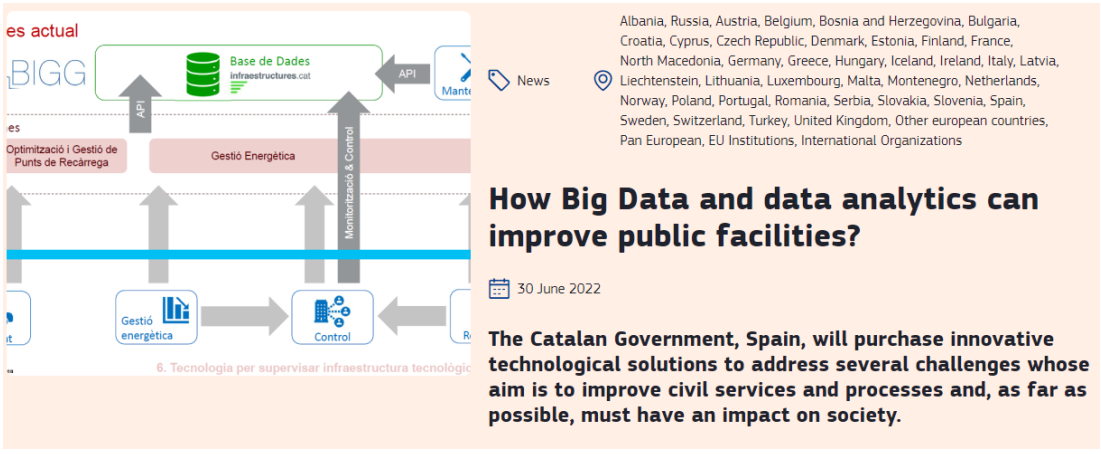

Figure 10. Third press release published on BuildUp

III.7. Scientific Publications

In the context of the national and international scientific and professional journals and conferences which were identified within this task, the following scientific papers were published during the second Reporting Period:

- *A novel system for providing explicit demand response from domestic natural gas boilers*, ELSEVIER. Applied Energy Vol. 317 (2022) 119038: published by DOMX in July 2022 https://www.sciencedirect.com/science/article/abs/pii/S0306261922004421
- *Dynamic horizon selection methodology for model predictive control in buildings*, ELSEVIER. Energy Reports 8 (2022) 10193-10202: published by CIMNE in November 2022 https://www.sciencedirect.com/science/article/pii/S2352484722014585?via%3Dihub
- *Real-World Implementation of Reinforcement Learning Based Energy Coordination for a Cluster of Households*, In Proc. 4th ACM SIGEnergy Workshop on Reinforcement Learning for Energy Management (RLEM 2023), at ACM BuildSys 2023, Istanbul, Turkey, 12 Nov. 2023: published by IMEC in November 2023 https://doi.org/10.1145/3600100.3625681

In addition, another scientific paper has been written. Its abstract has been submitted to the 2024 EC3 Conference (https://ec-3.org/conference2024/) and it has been approved, thus, the full paper will be submitted in December 2023.

- *Harmonizing input data for Digital Building Twin: Energy Efficiency Use Case*. CSTB and CIMNE have written this paper introducing the objectives of the BIGG project and mentioning the National Energy Efficiency Action Plans of EU countries.

Another scientific paper has also been written, however it will be submitted after the end of the project:

- *Linked Data framework for Geospatial Cross-sectional buildings energy benchmarking*. CIMNE has written this paper about the process of creating the ontology and the linked data. In addition, it is shown in practice in Use case 3 “Integration of INSPIRE spatial data with Energy Performance Certification (EPC)".

III.8. Participation to events and conferences

During the 2nd project period, BIGG participated in the following events:

- **CIB W78 – World Building Congress 2022** (https://cibworld.org/world-building-congress/) that took place in Melbourne, Australia, from 27 to 30 June 2022. Alain Zarli (ECTP) presented the BIGG project as part of a general keynote presenting IT in Construction developments in projects at European level.
- **3rd Energy Engineering Congress** (https://www.aeespain.org/iener22-el-iii-congreso-internacional-sobre-ingenieria-energetica-se-pone-en-marcha/) held in Barcelona, Spain on the 6th and 7th July 2022. ICAT addressed an academic presentation to the 3rd Energy Engineering Congress promoted by the Spanish Chapter of the Association of Energy Engineers (AEE). The aim was to highlight how the results achieved by means of BIGG’s developments were fundamental to succeed as a data driven organisation in the energy management.
- **EUSEW 2022 – Networking Village** (https://cinea.ec.europa.eu/news-events/events/european-sustainable-energy-week-2022-2022-09-26_en) which took place from 26 to 29 September 2022 in Brussels. BuiltHub, MATRYCS, BEYOND and BIGG shared the joint stand “*Big Data: big breakthroughs for buildings*”. The stand was part of the Energy Fair and drew on the examples and expertise of these projects to identify major barriers and potential solutions and to increase collaboration with an audience of key stakeholders in the EU building data space, in a fun and engaging way.

Figure 11. Colleagues from IMEC, Energis, Inetum, ECTP and Inetum-Realdolmen at the EUSEW 2022 – Networking Village

- **Webinar "Data-driven innovations for monitoring the performance of buildings"** (https://build-up.ec.europa.eu/en/resources-and-tools/audio-visual-resources/webinar-data-driven-innovations-monitoring-performance) organized by the project DigiBUILD and MODERATE and hosted by BUILDUP on 16 March 2023. BIGG, represented by Stoyan Danov (CIMNE), took part in the roundtable discussion, together with the projects MATRYCS and BEYOND, who shared their experiences and perspectives in the field of big data tools for the buildings sector.

Figure 12. Banner of the webinar "Data-driven innovations for monitoring the performance of buildings"

- **Imec ITF Flanders 2023** (https://www.imecitf.com/2023/flanders) was held in Flanders, Belgium, on 17 May 2023. During ITF Flanders, IMEC and several key partners look into the role of technology in the future: which challenges can we tackle leveraging an ingenious combination of hardware and software? In specific domains, this combination is clearly very promising, notably in preventive health care, sustainable industries, safe mobility, and a resilient energy system. How can different stakeholders in Flanders today start preparing for tomorrow's technology and its vast possibilities? In this context, Matthias Strobbe (IMEC) and Polychronis Symeonidis (DOMX) presented the BIGG pilot on demand response for natural gas "Flexibility potential of residential consumers on natural gas" during the session "*Impact on digitization on the built environment*".
- **Beyond Expo** (https://www.beyond-expo.gr/) in Thessaloniki on 24-26 May 2023. BEYOND is an international stage for Industry in South Eastern Europe, the Mediterranean and the MENA region. Beyond offered a dedicated stage for all those who thrive in the business of consumer technologies, a hybrid "exhibition meets summit" platform. DOMX had the opportunity to take part in the event and showcase their smart energy management products and services and the work done within the BIGG project.

Figure 13. Colleagues from DOMX at the Beyond Expo

- **InEExS Cluster Collaboration Workshop** (https://cinea.ec.europa.eu/news-events/news/unlocking-power-collaboration-smartenergycluster-driving-smart-energy-transition-2023-07-07_en) that was held online on 12 June 2023. María Pérez (Inetum) and Nerea Gómez (ECTP) represented BIGG during the first Cluster Collaboration Workshop organized by the InEExS project with 18 other projects. The aim of the session was to join forces and work together in the framework of the dissemination, communication and exploitation of the projects activities and results, aiming at engaging interested and common target groups. The objective was to define a common strategy building on cross-promotion, joint events and other collaboration activities.
- **International Fair of Thessaloniki TIF-HELEXPO** (https://www.helexpo.gr/) took place in Thessaloniki on 16 september 2023. DOMX participated at the International Fair of Thessaloniki TIF-HELEXPO. They showcased their smart energy management products and services in front of numerous interested visitors of the booth. They were also invited to pitch in front of an audience of potential investors and to introduce BIGG.

Figure 14. DOMX at the TIF-HELEXPO

- **Technical workshop "Innovation & Usability – Designing tomorrow's energy efficiency services for building users"** (https://digibuild-project.eu/events/digibuild-technical-workshop/) that was organized by the DigiBUILD project on 25 October 2023, online. BIGG was invited to the workshop organized by DigiBUILD and took part in the discussion. This interactive session aimed to gather valuable feedback on the concept and usability of DigiBUILD services for energy efficiency.
- **Built4People Stakeholders Forum** (https://www.ectp.org/news-events-newsletters/events/event-detail/built4people-b4p-stakeholder-forum-3-october-2023-online). The BIGG project was invited to pitch during the session "*Data and information aggregation for a sustainable Built Environment*" during the Annual Built4People Stakeholders Forum, that was held on 3 October 2023. Oriol Escursell (ICAEN) (Catalan Institute of energy) presented the BIGG project and its outcomes and participated in an open discussion about the transformation of the construction industry thanks to data. ECTP was involved in the organization and moderation of the session.
- **Buildsys** (https://buildsys.acm.org/2023/). IMEC participated in the 10th ACM International Conference on Systems for Energy-Efficient Buildings, Cities, and Transportation (BuildSys 2023) , which took place on 15 and 16 November 2023 in Istanbul. IMEC presented its paper "*Real-World Implementation of Reinforcement Learning Based Energy Coordination for a Cluster of Households*".

IV. SYNERGIES AND LIAISONS

At the beginning of the project, different initiatives and projects were identified, with which a liaison could be created in order to spread the BIGG message to a larger audience.

- Identified relevant projects and other initiatives in which the project partners participate:
  - H2020 InterConnect (InetumBE/InetumFR, IMEC, HERON)
  - DOS4Buildings (Intuicy via mother company Energis)
  - UIA Circular South (IMEC), ROLECS (IMEC),
  - H2020 RENergetic (InetumBE, IMEC)
  - H2020 BRIGHT (IMEC, domX)
  - H2020 BD4NRG (IMEC)
  - Programme PROFEEL (CSTB)
  - SHERPA (CIMNE)
  - MEDNICE (CIMNE)
  - EDI-Net (CIMNE)
  - SmartBuilt4EU and its community of EU Smart Buildings projects & stakeholders (ECTP). In this context, BIGG and SmartBuilt4EU have reached a co-communication agreement, in terms of disseminating the projects' news on their respective websites (https://smartbuilt4eu.eu/bigg-building-information-aggregation-harmonization-and-analytics-platform/) and social media channels, and the possibility of co-participation in events, among others.
  - Built4People Partnership (ECTP)
- Identification of other international initiatives related to BIGG, including other projects funded under the same call (BEYOND, MATRYCS, BUILTHUB) in order to optimise and coordinate dissemination and communication synergies across projects.
- Other identified initiatives, especially relevant for the data modeling and harmonization tasks in WP4, include: Smart Appliances REFerence (SAREF) ontology, Building Energy Data Exchange Specification (BEDES), INSPIRE Directive, EU Building Stock Observatory (EUBSO) or EEFIG De-Risking Energy Efficiency Platform (DEEP), among others.

IV.1. Synergies with sister projects

The projects BIGG, BEYOND and MATRYCS, that belong to the same call (LC-SC3-B4E-6-2020 - Big data for buildings) and also the related CSA project BUILTHUB, shared the interest of creating a homogeneous approach on stakeholder engagement, exploitation, dissemination and communication.

The projects established a community in order to communicate and disseminate information about the other projects, with the aim in reaching a major and diverse audience and helping to promote project's events.

Furthermore, the liaisons among the projects encouraged them to participate together to different workshops and events: the workshop organized by BEYOND "*Data and Intelligence sharing for transforming buildings into active nodes in the future energy system*" at Sustainable Places 2021; or the webinar organized by DigiBUILD and MODERATE "*Data-driven innovations for monitoring the performance of buildings*" where the sister projects participated jointly in the round table. In addition, they sent an application for a joint policy session at the EUSEW 2021 and EUSEW 2022, that unfortunately weren't accepted. Due to the declination, the projects shared the joint stand "*Big Data: big breakthroughs for buildings*" at the EUSEW Networking Village 2022, as part of the Energy Fair.

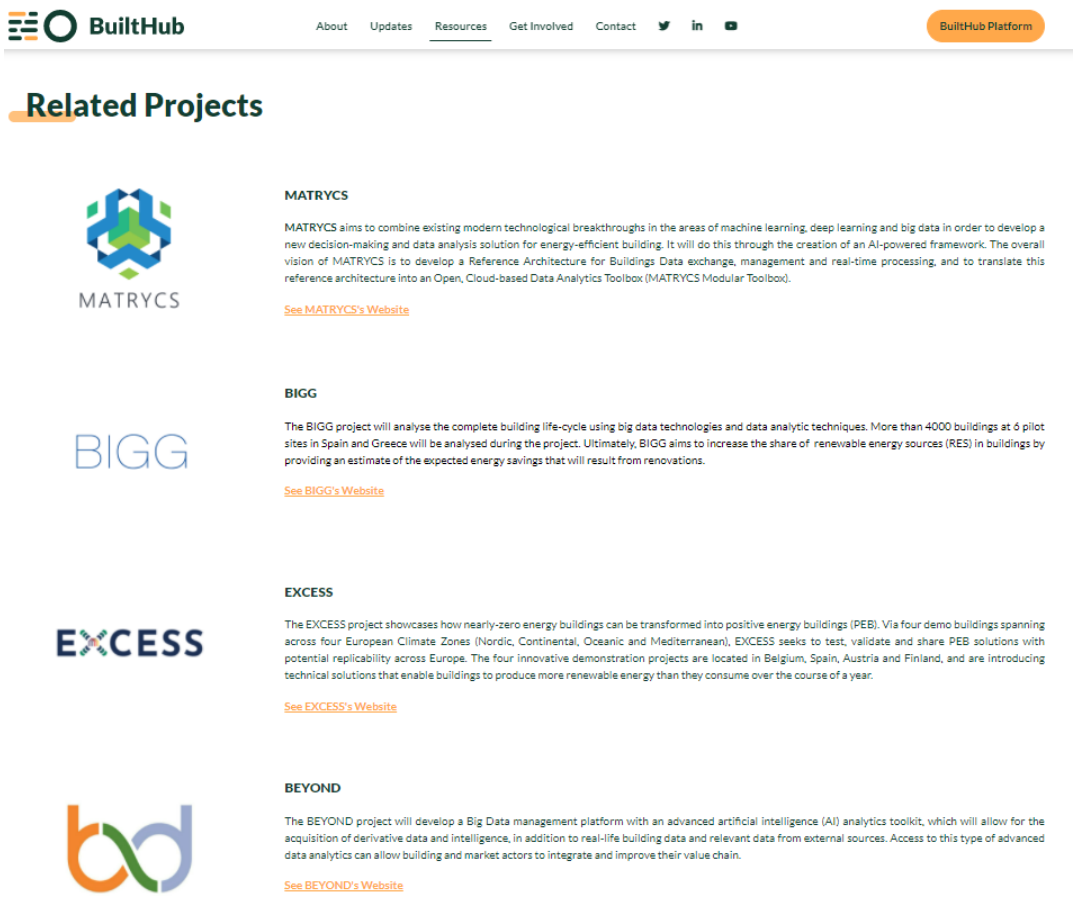

Figure 15. Screenshot of "Related Projects" on [BuiltHub](#) website

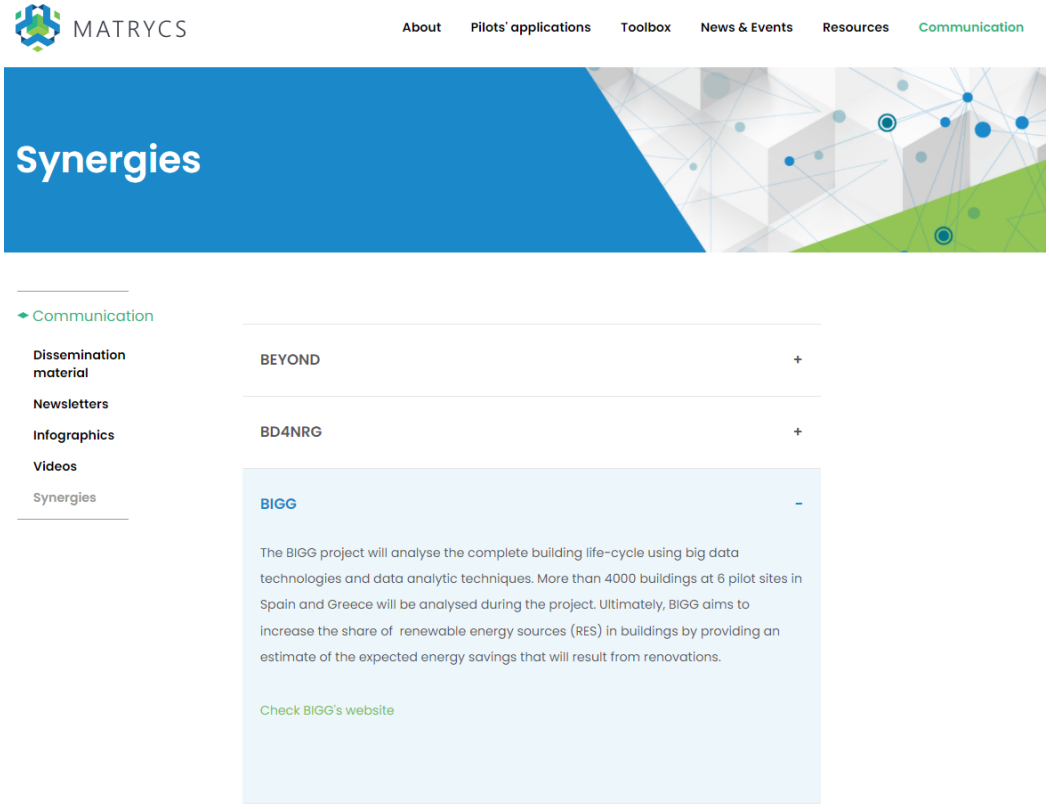

Figure 16. Screenshot of "Synergies" on [MATRYCS](#) website

IV.2. Synergies with other projects

In addition to the 3 sister projects, other projects were identified due to their similarities with the BIGG project:

- Interconnect (https://interconnectproject.eu/): Inetum, HERON and IMEC have kept an active communication with InterConnect. In addition, CIMNE has interacted several times with InterConnect and one of its partners, TNO, as they are in charge of the development of SAREF. Their communications were focused on smart buildings, connecting ontology and standardized communication.
- DigiBUILD (https://digibuild-project.eu/) and MODERATE (https://moderate-project.eu/):
  - Joint webinar organized by DigiBUILD and MODERATE: "*Data-driven innovations for monitoring the performance of buildings*" March 16, 2023. BIGG, represented by CIMNE, was invited together with other related projects (BEYOND, BuiltHub and MATRYCS) to participate in the roundtable discussion, which was mainly focused on the opportunities and barriers related to data sharing and interoperability
  - Technical workshop organized by DigiBUILD: "*Innovation & Usability – Designing tomorrow's energy efficiency services for building users*" October 25, 2023. BIGG, represented by CIMNE, was invited to the workshop and took part in the discussion. This interactive session aimed to gather valuable feedback on the concept and usability of DigiBUILD services for energy efficiency.
  - DigiBUILD, together with MODERATE and ENERGATE projects, were invited to take part in the BIGG Final Event (November 24, 2023). As part of the event, the session "*Ontology and AI Toolbox*" was dedicated to explore the aim, advantages and key components of the harmonization layer of BIGG, based on the White Paper II "*The need for harmonizing input data and AI Toolbox revolution in context of smart building management*". The three projects participated in an open discussion focused on the different ontologies developed within the projects.
- ENERGATE (https://www.energate-project.eu/):
  - ENERGATE could exploit the services and business models of BIGG with the aim to facilitate the incorporation of big data in the platform. In terms of promoting Energy Efficiency investments, the BIGG project is dealing with investment data collection and tracking, investment de-risking services and traceable, data-driven approaches for savings' evaluation and risk indicators' calculation. In the meanwhile, the BIGG use case for evaluating the real impact of the energy improvement actions could assist ENERGATE in extracting valuable information at the statistical level from the set of EEMs applied and registered in buildings.
  - As both projects share target countries (Spain and Greece), they disseminated one another's objectives to their target audiences.
  - As mentioned above, ENERGATE was also invited to the "*Ontology and AI Toolbox*" session during the BIGG Final Event (November 24, 2023).

IV.3. #SmartEnergyCluster

BIGG was invited to become part of the #SmartEnergyCluster together with other sister projects, to join forces and work together in the framework of the dissemination, communication and exploitation of the projects' activities and results, aiming at engaging interested and common target groups.

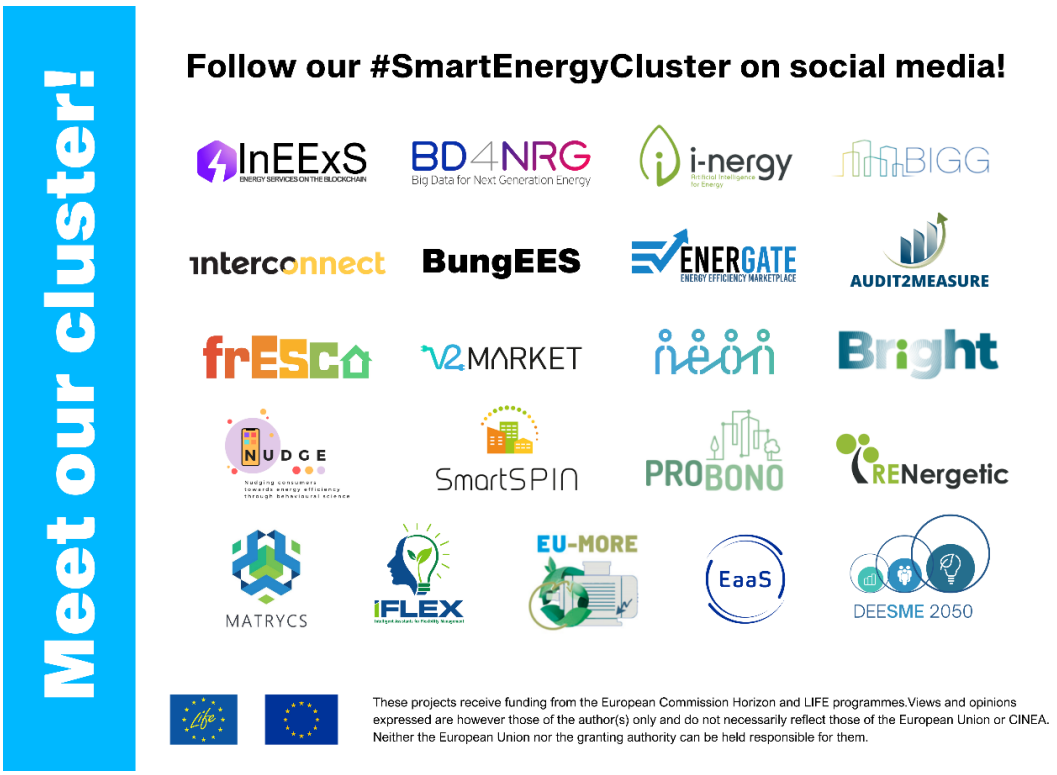

Figure 17. Banner of the #SmartEnergyCluster with the project logos

Recognising that collaboration and innovation are key, 21 projects pool resources and expertise to accelerate the smart energy transition. The projects share a common objective to develop and deploy new business models and concepts which add value by leveraging integrated energy services. These combine different energy services, such as energy efficiency, distributed generation and flexibility, and/or which integrate energy services with non-energy benefits. Moreover, they aim to overcome the fragmentation of markets and segments and to enhance the cooperation and trust among different services providers and market actors, also across segments that so far do not have common business cases.

The cluster works together in the framework of dissemination, communication and exploitation of the projects' activities and results, aiming at engaging interested and common target groups. These collaborative actions also aim to multiply the impacts of the benefits of each project, including for example, the integration of new and smart service offers, reduced energy costs for end-users and payback times of investments into sustainable energy.

The #SmartEnergyCluster is an initiative led by the InEExS project, a LIFE project whose main objectives are the deployment of integrated energy services across sectors and carriers, and the tokenization of energy saving data in a public blockchain to facilitate cooperation among market segments and actors. Within the cluster, there are also other 3 LIFE projects (AUDIT-TO-MEASURE, EU-MORE and BungEES) and other H2020 and Horizon Europe projects (BD4NRG, MATRYCS, I-NERGY, iFLEX, InterConnect, ENERGATE, NUDGE, FrESCO, SmartSPIN, V2Market, RENergetic, Neon, Bright, EaaS, PROBONO and DEESME 2050).

More information about the 21 projects that shape the #SmartEnergyCluster can be found here.

IV.4. Establishment of the standardization community

Beyond the community established for communication and dissemination purposes, BIGG decided to create a Community of Standardisation. One of the project's objectives was to create a long-term collaboration framework with standardization bodies to which BIGG, the sister projects and potentially other related initiatives could technically contribute and influence.

Therefore, BIGG started contacting the projects under the same call (BEYOND, MATRYCS, BUILTHUB) in order to invite them to take part to this community. The project organized on November 8 the standardization workshop “Leveraging on standardisation for building data aggregation and analytics” in collaboration with the sister projects MATRYCS and BuiltHub and hosted by BuildUp.

The aim of the discussion was to:

- Share each project’s vision of contribution to standardisation;
- Identify the common subjects and ideas that could be pushed to standardisation;
- Identify similar structures among the projects that could help to influence the standards;
- Co-define together the founding principles and operational mechanisms of the Community of Standardisation.

The workshop set the basis of the “sister projects community” and exposed: the intention of taking part together in actions organised by standardisation bodies and regulators; and how the projects could approach, participate in them and actively contribute to standardisation.

IV.5. Synergies between buildings data projects and EU Buildings Stock Observatory

The EU Buildings Stock Observatory (EU BSO) aims to provide a better understanding of the energy performance of the building sector through reliable, consistent and comparable data. It includes a database, a data mapper and factsheets for monitoring the energy performance of buildings across Europe. The EU BSO is currently in the 3rd phase of development which includes the definition of indicators, data collection and a revamping of the user interface.

A consortium has recently started working to these objectives and they wanted to create synergies with other projects, thus they could contribute on the definition of data architectures, data governance, data security, use cases, data analytics services etc.

Five projects have been invited to initiate the conversations: 3 projects funded under the Horizon 2020 call Big data for buildings (BIGG, BEYOND and MATRYCS), since they develop a reference architecture for buildings data and data analytics services; and 2 projects funded under the Horizon Europe call Advanced data-driven monitoring of building stock energy performance (DigiBUILD and MODERATE), due to their work on data collection practices and data-driven monitoring of buildings performance.

During a first discussion that took place on September 14, it emerged that:

- All projects can provide valuable contributions to a document that lists the suitable solutions to EU BSO priorities
- Providing small datasets to EU BSO is possible, but the main purpose of the action is to showcase methods, use cases, analytics, data models etc… from the different projects as a reference
- It was agreed that the BuiltHub project will lead the action, supported by all the projects.
- It was agreed that the objective is to share a mapping between project results (with TRL, description, references, suitability, licensing) and EU BSO priority needs.
- Any additional effort about transferring results from projects to EU BSO is out of scope.

After that, BuiltHub initiated collecting feedback on EU BSO needs, from the consortium as well as from their offices; where it was highlighted their interest in data including governance and analytics on various aggregation levels.

V. MONITORING AND KPIS

V.1. Communication Key Performance Indicators

Table 3. Communication Key Performance Indicators

Communication Key Performance Indicators		Status
C-KPI#1	Number of events where BIGG will show a **poster**; All; At least in 10.	2/10
C-KPI#2	Number of events in which **brochures and/or leaflets** will be distributed; All TAs; At least 20.	12/20
C-KPI#3	Number of **press releases** published, translated into local language and distributed among local media; All; At least 6 (two per year).	Achieved: 6/6
C-KPI#4	Number of produced **videos** introducing the project and its results; All; At least 2, one as an introduction and one presenting final results. Intermediate videos will be also considered.	Achieved: 9/2 (2 project info videos, 7 BC videos)
C-KPI#5	Social media channels for community building; All TAs; **LinkedIn** for TA1, TA2, TA3 and TA4; **Twitter** more oriented for TA5; To reach at least 500 followers in each SN, To post at least 2 posts per month in each social network.	Achieved: Twitter > 1260, LinkedIn > 310
C-KPI#6	Frequency of **blog posts and short news** feed on BIGG website on topics treated during the project; All; 1 post per month.	Achieved
C-KPI#7	Website - Number of **returning website visitors** per year; All; 400; Number of **unique website visitors** per year; 800.	Achieved

The five principal target audiences (TA) were identified in *D8.2. Dissemination and Communication Action Plans and Target KPIs*:

- TA1 - Users: Building professionals, mainly building managers and operators, and other technical experts involved in the whole building life-cycle such as designers, builders, energy services and maintenance companies.
- TA2 - Enablers: Those who bring the regulatory and standardization conditions, policy markers at all levels.
- TA3 - Suppliers: Those who bring the technical context to integrate BIGG in the market
- TA4 - Researchers: Big data processing and AI related expertise including AI experts and data scientists both from academic and industry.
- TA5 - Beneficiaries: Building occupants that will profit of the advantages of applied ICT in the building sector to improve its life-cycle and to provide a more optimal use of building resources.

C-KPI#1 Number of events where BIGG will show a poster

Unfortunately, due to the sanitary situation during the first half of the project, the participation to events and conferences was fully online, without the possibility of showing a poster. During the second reporting period, the participation was mainly online, but the poster was shown in

2 events: EUSEW Networking Village 2022 (Brussels, 28-09-22) and Sustainable Places 2023 (Madrid, 14/16-06-23).

This has been compensated with a strong online presence, where the poster was distributed through the website and social networks.

C-KPI#2 Number of events in which brochures and/or leaflets will be distributed

As mentioned above, the major presence of the BIGG at different events and conferences was online, which hindered the distribution of communication printed material. Throughout the project, the project flyer was distributed at 12 conferences/events:

- Sustainable Places 2021: 29th September – 1st October 2021, Rome (Italy)
- ECTP Conference: 2nd – 3rd December 2021, Madrid (Spain)
- Climatherm – Energy 2022: 25th – 27th February 2022 (Greece)
- EnerGreen Deal Conference: 31st May 2022 (Belgium)
- CIB W78 – Information Technology for Construction: 27th June 2022, Melbourne (Australia)
- Sustainable Places 2022: 6th September 2022, Nice (France)
- ECPPM - European Conference of Product and Process Modeling: 14th – 16th September 2022, Trondheim (Norway)
- EUSEW Networking Village 2022: 28th September 2022, Brussels (Belgium)
- Beyond Expo: 24th – 26th May 2023, Thessaloniki (Greece)
- Sustainable Places 2023: 14th – 16th June 2023, Madrid (Spain)
- TIF-HELEXPO: 16th September 2023, Thessaloniki (Greece)
- ENLIT 2023: 28th – 30th November 2023

C-KPI#3 Number of press releases published, translated into local language and distributed among local media

According to the Grant Agreement, 6 press releases had to be published, 2 per year, which was accomplished for the three years of the project. They can be found in the project website as well as on other platforms, such as BuildUp and Construction21.

- 23/02/2021 1st press release: Launch of the Building Information aGGregation, harmonization and analytics platform, the H2020 project BIGG
- 28/10/2021 2nd press release: BIGG in September 2021: from the 1st PMB meeting in Thessaloniki to Sustainable Places Conference
- 30/06/2022 3rd press release: BIGG architecture as purposed standard at Catalan Public Procurement Innovation Program
- 10/12/2022 4th press release: BIGG events: from the standardization workshop to the first and upcoming BIGG training sessions
- 02/06/2023 5th press release: Join BIGG in the next webinar of the Zero-Emission Buildings Academy #3 organized jointly with Leonardo Energy (European Copper Institute), ECTP and BPI
- 13/11/2023 6th press release: BIGG Final Event: Data aggregation and harmonization for a sustainable built environment

C-KPI#4 Number of produced videos introducing the project and its results

As mentioned above, at least 2 videos presenting the project and its objectives had to be released. However, 9 videos were published in total, 2 general introductory videos, and 7 deep diving in the business cases. All the videos can be found on the project website (https://www.bigg-project.eu/category/videos/).

The first video of the project introduced the project, the main objectives, the scope and the Consortium. This video was followed by another one (https://www.bigg-project.eu/watch-our-video-of-bigg-pilot-tests-and-business-cases/) which briefly presented the three case study areas: Catalunya (Spain), Athens (Greece), and Volos and Thessaloniki (Greece).

During the last year of the project, it was decided to explain in detail each of the large-scale pilots in Spain and Greece. Thus 7 videos were published:

- Introducing the Business Cases of the BIGG project
- Business Case 1 “Benchmarking and energy efficiency tracking in public buildings”
- Business Case 2 “Energy certification in residential and tertiary buildings”
- Business Case 3 “Building Life cycle, from planning to renovation”
- Business Case 4 “Energy Performance Contract-based savings in commercial buildings”
- Business Case 5 “Buildings for occupants: Comfort case”
- Business Case 6 “Electricity and Gas demand-response”

C-KPI#5 Social media channels for community building

Social media channels were created with the aim of building a community and increase the visibility of the project through a large and diverse audience. Both, Twitter and LinkedIn have been managed and updated frequently, ensuring that at least 2 posts were published per month in each channel. Throughout the project, more than 100 posts were published in each social network.

Regarding the audience, BIGG built a community of more than 1100 followers on Twitter in the first year of the project, and it continued growing surpassing 1260 followers. Twitter has been a very helpful tool in order to spread the project among the general public and to create a community with the sister projects.

LinkedIn was focused on a different target audience. BIGG reached more than 140 followers in the first year of the project, and at the end of the project, it had more than 310 followers. The LinkedIn community included other EU-funded projects, researchers, industry, among others.

C-KPI#6 Frequency of blog posts and short news feed on BIGG website on topics treated during the project

The project website has been frequently updated by publishing at least one short news item per month: https://www.bigg-project.eu/publications/ A calendar was created in order to assign a partner responsible of publishing a news item each month. Therefore, the variety of topics and perspective was ensured. At the end of the project, 62 news items were posted, including press releases, newsletters, videos, general news and communication material, focusing on the project or on related events.

C-KPI#7 Website - Number of returning and unique website visitors per year

To get better insights in the usage of our website, we decided to integrate Google Analytics into the CMS system of the site. This way, we could gather information on the number of visits, where users come from (geo location), how they reach the site and on which type of device they visit bigg-project.eu. Google Analytics also provides speed tests and solutions to ensure a good user experience. Below are some of the gained insights from November 2022 until November 2023.

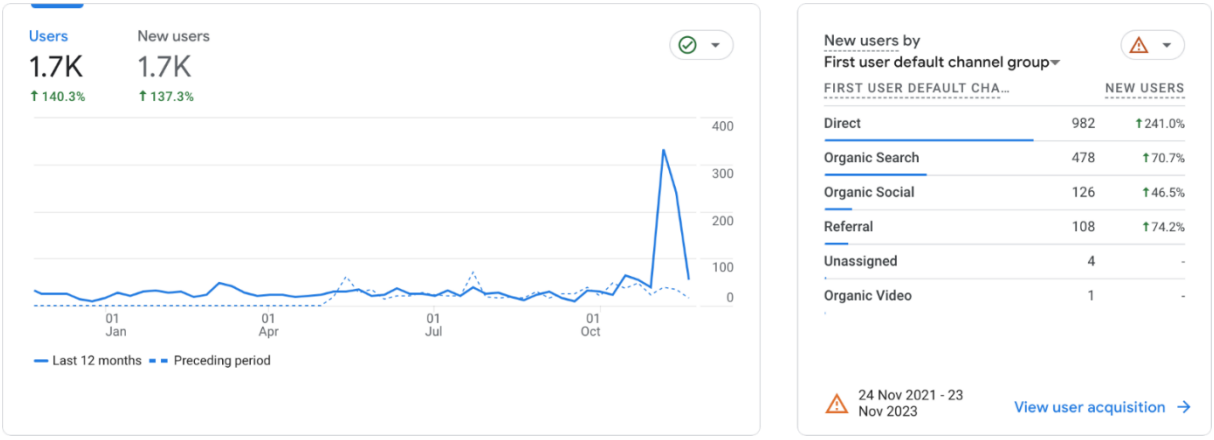

Figure 18. Google Analytics Overview

We had 1.7K visitors during the last 12 months. 982 of them reached the site via direct acquisition, meaning they visited the site by entering the URL directly. 478 users reached our website through organic search (e.g. Google) and 126 via Social Media posts (e.g. LinkedIn).

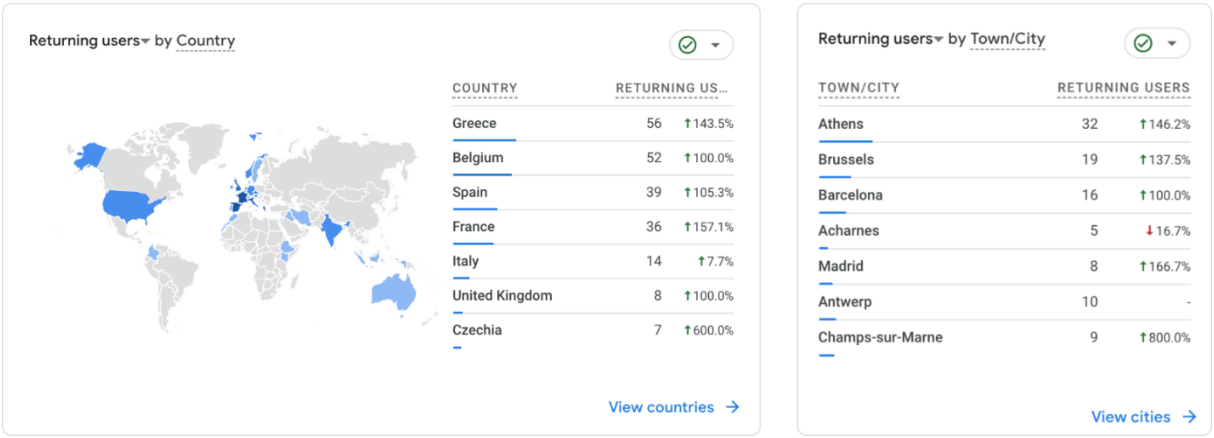

Figure 19. Returning visitors per country and town

The number of returning visitors is shown per country and town, as these numbers indicate a match with the actual location of the countries involved in and/or contributing to the BIGG project.

V.2. Dissemination Key Performance Indicators

Table 4. Dissemination Key Performance Indicators

Dissemination Key Performance Indicators		Status
D-KPI#1	Number of industry-oriented events, workshops and conferences (w/o scientific publication) in which BIGG partners will present the project; At least active participation (presentation) in 12.	Achieved: 15/12
D-KPI#2	Number of actions organized by standardization bodies and regulators to which BIGG will participate; At least in one meeting at 3 different entities.	Achieved
D-KPI#3	Number of entities which are members of building-related associations that will be informed by the project and its results; 150 organisations after one year, and approx. 350-400 at the end of the project.	Achieved
D-KPI#4	Number of scientific publications in conferences, events and journals (prioritizing quality vs quantity and promoting joint publications); At least 10 publications.	7/10 (+ 2 written, not submitted yet)
D-KPI#5	Number of white papers published (scientific and/or industrial); At least 3.	2/3
D-KPI#6	Number of public events organized by BIGG; At least 4.	Achieved: 4/4
D-KPI#7	Number of training sessions organized for buildings professionals; 3 webinars (in English): one for each business cases group or 2 webinars if all business cases are presented together at M18-20 and M36; At least 6 trainings will be organised at a national level for the local building experts involved in the project (one for each business case). Local external stakeholders might be also invited to these trainings and we will also consider the organization of another 6 trainings specifically for them.	Achieved
D-KPI#8	Number of large-scale dissemination campaigns; 2 campaigns at M19 (once 1st evaluation results are available) and at M35 (with final results).	Achieved

D-KPI#1 Number of industry-oriented events, workshops and conferences in which BIGG partners will present the project

Throughout these 3 years, BIGG presented the project on 15 different events, taking part of both online and physical workshops. More details can be found in *Section III.8.*

- Sustainable Places 2021: 29th September – 1st October 2021, Rome (Italy)
- SmartGridComm 2021: 27th October 2021, Online
- Climatherm – Energy 2022: 25th – 27th February 2022 (Greece)
- Energy & Utilities 2022 Forum: 27th May 2022, Madrid (Spain)
- CIB W78 – World Building Congress 2022: 27th – 30th June 2022, Melbourne (Australia)

- 3rd Energy Engineering Congress: 6th - 7th July 2022, Barcelona (Spain)
- EUSEW 2022 – Networking Village: 26th – 29th September 2022, Brussels (Belgium)
- Webinar "Data-driven innovations for monitoring the performance of buildings": 16th March 2023, online
- Imec ITF Flanders 2023: 17th May 2023, Flanders (Belgium)
- Beyond Expo: 24th – 26th May 2023, Thessaloniki (Greece)
- InEExS Cluster Collaboration Workshop: 12th June 2023, online
- International Fair of Thessaloniki TIF-HELEXPO: 16th September 2023, Thessaloniki (Greece)
- Technical workshop "Innovation & Usability – Designing tomorrow's energy efficiency services for building users": 25th October 2023, online
- Built4People Stakeholders Forum: 3rd October 2023, online
- 10th ACM International Conference on Systems for Energy-Efficient Buildings, Cities, and Transportation (BuildSys 2023): 15th and 16th November 2023, Istanbul (Turkey)

D-KPI#2 Number of actions organized by standardization bodies and regulators to which BIGG will participate

Diverse actions have been carried out throughout the duration of the project in relation with standardization bodies and regulators:

- **buildingSMART** - IFC (Industry Foundation Classes) (https://www.buildingsmart.org/): CSTB have participated in a regular basis to the Summit of buildingSMART. buidingSMART bi-annual summit are the occasion for all the IFC standard technical community to exchange and brainstorm on the current and future evolutions of the standards. Attending these events allows staying at the state of the art of these standards.
- **LDAC** - Linked Data in Architecture and Construction (https://www.linkedbuildingdata.net/ldac/index.html): CSTB attended the LDAC Conference 2022. The whole community of Building Linked-data actors join every year for this conference. Attending this event allows staying in touch with the very last development and share our own work or experience.
- **Smart Appliances REFerence (SAREF) ontology**: CIMNE has interacted several times with the InterConnect project, especially with one of its partners, TNO, as they are in charge of the development of the SAREF ontology. Their communications were focused on smart buildings, connecting ontology and standardized communication. It is worth mentioning that Inetum, HERON and IMEC have kept an active communication with the InterConnect project.
- **Ontology Engineering Group of the Artificial Intelligence department** of Universidad Politécnica de Madrid (UPM): CIMNE has been in active collaboration and exchange of information on the BIGG ontology with the Ontology Engineering Group of the Artificial Intelligence department of Universidad Politécnica de Madrid (UPM), which is one of the main participants in the development of SAREF core, SAREF4BLDG, SAREF4CITY, SAREF4AGRI. The collaboration was formalised through a 6 monthly CIMNE's researcher stay in UPM (from September 2022 to March 2023), during which an extensive transfer of information on the BIGG ontology was done, including specific contributions from BIGG that could be used for further extension of the SAREF family of standards. Those contributions, once approved and included in SAREF, would extend its capability to cover the full scope of BIGG tools and use cases.
- **Standardization workshop** "Leveraging on standardisation for building data aggregation and analytics". In November 2022, BIGG organized a standardization workshop with the sister projects MATRYCS and BuiltHub, hosted by BuildUp.

D-KPI#3 Number of entities which are members of building-related associations that will be informed by the project and its results

According to the GA, at least 150 members of building-related associations had to be informed about the project and its results after one year, and between 350 and 400 at the end of the project.

- **ECTP members**: ECTP counts more than 150 members from the European Construction sector, but also other sectors from the whole supply chain of the Built Environment, including big construction companies, universities, RTOs and SMEs, among others. Throughout the project, ECTP members were informed about the project through news on the ECTP website and regular messages. BIGG has been also included in the ECTP projects database with more than 500 other European funded projects, with a special section as project where ECTP is involved.

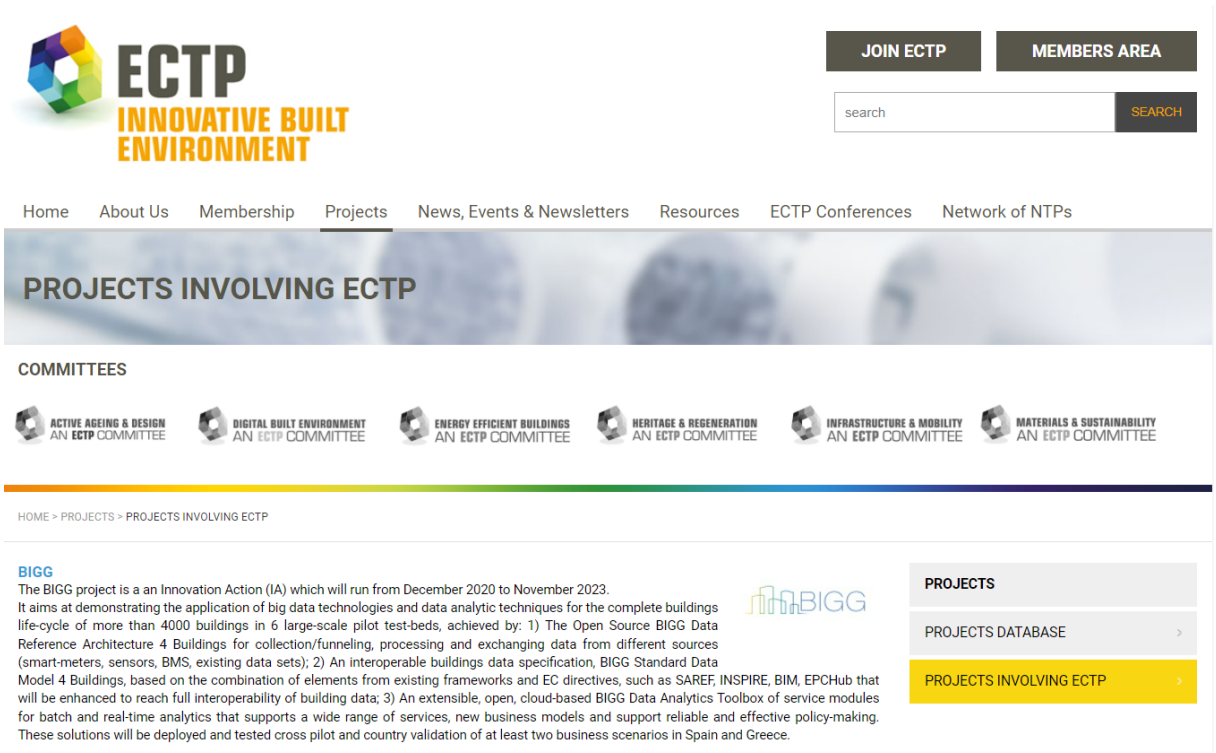

Figure 20. BIGG on "Projects involving ECTP" section on ECTP website

- **EUSEW Networking Village 2022**. During the exhibition, 10 different organisations approached the stand interested by the project: Siemens, PTEC (Spanish Construction Technology Platform), Galicia Institute of Technology, ICLEI, Limay Capital, EUTRIP, Cognition World, ODC, Smart Energy Lab, e-SAFE
- **BuildUp and Construction**: More than 20 articles have been published on the platforms, reaching from 500 to 1200 readers for each article.
- **BuildUp**: In addition to the articles published on the platform, BuildUp hosted the standardization workshop organized by BIGG. Therefore, its community formed by 16k members and 600 subscriptions on the YouTube channel received information about the project and could watch the recording of the workshop.
- **Zenodo community**: The public deliverables as well as the White Papers were published in the community created on Zenodo.org "*H2020 project BIGG: Building Information aGGregation, harmonization and analytics platform* (https://zenodo.org/communities/bigg_h2020)". In total, the community counted more than 200 views and more than 270 downloads as of November 30.
- **Brochure "Smart Buildings EU-funded innovations" from SmartBuilt4EU project** (https://smartbuilt4eu.eu/): BIGG was included in the brochure which was distributed

among several events and its SBIC – Smart Building Innovation Community composed of more than 300 members.

- **Leonardo Energy**, an initiative from the European Copper Institute, hosted the workshop organized by BIGG "*UNLOCKING BUILDING EFFICIENCY: THE SCALABLE AND STANDARDIZED TOOLKIT FOR EnPC MANAGEMENT. Measure and verify energy efficiency while ensuring the accuracy of savings calculations*" (*more information on D-KPI#6*). Leonardo Energy disseminated the invitation among its community of 10k subscriptors.
- **Built4People community**: As BIGG participated in a session during the Annual Built4People Stakeholders Forum 2023, the more than 200 members of the Built4People community were informed about the project.

Those mentioned above are just some of the groups that were informed about the project, in addition to all the visitors to the website and social media profiles, as well as those attending the different events organized by BIGG or where the project has had its space to be introduced. More information about this can be found at *D-KPI#8*.

D-KPI#4 Number of scientific publications in conferences, events and journals

7 scientific publications have been published throughout the duration of the project:

- *Physics-informed Recurrent Neural Networks for the identification of a generic energy buffer system*, Proc. 10th IEEE Data-Driven Control and Learn. Sys. Conf. (DDCLS 2021). Manu Lahariya, Farzaneh Karami, Chris Develder, Guillaume Crevecoeur.
- *A data-driven method for unsupervised electricity consumption characterisation at the district level and beyond*, Energy Reports, Volume 7, November 2021, Pages 5667-5684, Elsevier. Gerard Mor, Jordi Cipriano, Giacomo Martirano, Francesco Pignatelli, Chiara Lodi, Florencia Lazzari, Benedetto Grillone, Daniel Chemisana.
- *Physics informed neural networks for control oriented thermal modeling of buildings*, Applied Energy, Vol. 314, 15 May 2022, pp. 1-10. Gargya Gokhale, Bert Claessens, Chris Develder.
- *Physics Informed LSTM Network for Flexibility Identification in Evaporative Cooling Systems*, IEEE Transactions on Industrial Informatics, May 2022. Manu Lahariya, Farzaneh Karami, Chris Develder, Guillaume Crevecoeur.
- *A novel system for providing explicit demand response from domestic natural gas boilers*, ELSEVIER. Applied Energy Vol. 317 (2022) 119038, July 2022. Georgios I. Tsoumalis, Zafeirios N. Bampos, Pandelis N. Biskas, Stratos D. Keranidis, Polychronis A. Symeonidis, Dimitrios K. Voulgarakis.
- *Dynamic horizon selection methodology for model predictive control in buildings*, ELSEVIER. Energy Reports 8 (2022) 10193-10202, November 2022. Gerard Laguna, Gerard Mor, Florencia Lazzari, Eloi Gabaldon, Arash Erfani, Dirk Sae lens, Jordi Cipriano.
- *Real-World Implementation of Reinforcement Learning Based Energy Coordination for a Cluster of Households*, In Proc. 4th ACM SIGEnergy Workshop on Reinforcement Learning for Energy Management (RLEM 2023), at ACM BuildSys 2023, Istanbul, Turkey, 12 Nov. 2023. Gargya Gokhale, Niels Tiben, Marie-Sophie Verwee, Manu Lahariya, Bert Claessens, Chris Develder.

In addition, two scientific papers have been written, even though they haven't been submitted yet:

- *Harmonizing input data for Digital Building Twin: Energy Efficiency Use Case*. The abstract has been submitted (and approved) to the 2024 EC3 Conference. The full paper will be submitted in December 2023.
- *Linked Data framework for Geospatial Cross-sectional buildings energy benchmarking.*

D-KPI#5 Number of white papers published

Two White Papers have been pubished, with the main goal of disseminating the project's results:

- "*Validation of the BIGG Data Analytics Toolbox over the BIGG Data Reference Architecture in 6 Business Cases in Spain and Greece*" published on July 2023. Throughout this White Paper, the six business cases are introduced, including the main details about each use case. The technical solution proposed is presented, together with some results and the analysis of each solution, with the aim of understanding how BIGG has helped with the challenges found.
- "*The need for harmonizing input data and AI Toolbox revolution in context of smart building management*" published on October 2023. Proper implementation of new technologies on big data needs standardization of input data coming from different sources. The uniqueness of the BIGG concept lies in its creation and utilization of a distinctive Ontology. This Ontology is designed to facilitate semantic interoperability of data and empower big data analytics within buildings. In this White Paper the aim, advantages and key components of the harmonization layer of BIGG are explored.

The White Papers can be found on the project's website (https://www.bigg-project.eu/category/white-paper/), as well as on the Zenodo community (https://zenodo.org/communities/bigg_h2020/), on BuildUp and Construction 21 International.

D-KPI#6 Number of public events organized by BIGG

- **Workshop "Energy Information and monitoring services of the Generalitat of Catalonia"**. The first public event organized by BIGG took place on 29th September 2021. ICAEN presented the project to representatives of departments of the Generalitat de Catalunya and had 15 attendees including some larger entities. Several BIGG functionalities and their integration with the total number of applications that we use for energy and bill management were presented.

Figure 21. Slide presenting BIGG (in Catalan) during the workshop

- **Standardization workshop "Leveraging on standardisation for building data aggregation and analytics"**. The second event organized by BIGG was the standardization workshop held online on 8th November 2022. It was hosted by BuildUp and counted with the participation of the siter projects MATRYCS and BEYOND. The event consisted of a pitch of the 3 projects followed by a roundtable focused on

standardization. The event had 51 registrants and 32 attendees. For more information, please refer to *Section* IV.4.

Figure 22. Banner of the standardization workshop "Leveraging on standardisation for building data aggregation and analytics"

- **Webinar "UNLOCKING BUILDING EFFICIENCY: THE SCALABLE AND STANDARDIZED TOOLKIT FOR EnPC MANAGEMENT. Measure and verify energy efficiency while ensuring the accuracy of savings calculations**". The third event organized by BIGG took place online on 27th June 2023. The online webinar was organized within the Zero-Emission Buildings Academy launched in partnership between Leonardo Energy (European Copper Insitute), ECTP and BPIE. During the webinar, the BIGG project was presented focusing on the business case 4 about Energy Performance Contract management (EnPC) optimization. The webinar had 263 registrants and 99 attendees. More information about the event as well as the recording can be found here: https://www.bigg-project.eu/the-recording-of-our-webinar-unlocking-toolkit-for-enpc-management-building-efficiency-the-scalable-and-standardized-is-now-available-online/

Figure 23. Banner of the webinar "Unlocking building efficiency: the scalable and standardized toolkit for EnPC management"

- **BIGG Final Event "Data aggregation and harmonization for a sustainable built environment**". The fourth and final event organized by the project has been the BIGG

Final Event, which was held online on 24th November 2023. During the event, the six business cases were introduced: the technical solution proposed was presented, together with some results and the analysis of each solution, with the aim of understanding how BIGG has helped with the challenges found. Then, a session was dedicated to explore the aim, advantages and key components of the harmonization layer of BIGG; as well as to discuss the different ontologies developed within 3 other invited projects: ENERGATE, DigiBUILD and MODERATE. To conclude, 3 innovative LIFE projects InEExS, AUDIT-TO-MEASURE and EU-MORE were introduced. These projects take part in the #SmartEnergyClsuter together with BIGG and other projects with the common objective of achieving a sustainable and efficient energy system. The event had 78 registrants, 41 attendees and 18 panellists. More information as well as the recording and the presentation of the event can be found here: https://www.bigg-project.eu/bigg-final-event-recording-and-slides/

Figure 24. Banner of the BIGG Final Event "Data aggregation and harmonization for a sustainable built environment"

D-KPI#7 Number of training sessions organized for buildings professionals

According to the Grant Agreement, 3 webinars had to be organized in English, one for each business cases group, or 2 webinars if all business cases were presented together. Among the Consortium, it was decided to organize 2 webinars: the first one, which was initially planned for M18-M20, was postponed to M22-M23, and the second one was organized at M36. The decision to postpone the first training session was due to the fact that the original date coincided with the summer holidays period, thus it was postponed to September-October to reach a greater audience.

- **1st Webinar in English** was held online on 27th June 2023 and coincides with the webinar "UNLOCKING BUILDING EFFICIENCY: THE SCALABLE AND STANDARDIZED TOOLKIT FOR EnPC MANAGEMENT. Measure and verify energy efficiency while ensuring the accuracy of savings calculations". More information can be found on D-KPI#6
- **2nd Webinar in English** was held on 24th November 2023 as part of the BIGG Final Event "Data aggregation and harmonization for a sustainable built environment". During the event, there was a session focused on the Introduction to the Business Cases, where each of the business cases and use cases were introduced, followed by a Q&A session with the audience.

Furthermore, at least 6 training sessions had to be organized at a national level for the local building experts involved in the project, which meant one training session for each business case:

- **Training session Business Case 1** “Benchmarking and energy efficiency tracking in public buildings” (25/10/2023). 74 participants from different departments, public companies and organisations which in combination represent close to 68% of the energy bill of the Catalan government. The session was used to train the users of the platform in how to manage the current building information and how to add new EEM to the existing buildings. The information gathered will already be used to inform on the Catalan government energy efficiency targets with a continuously update database.
- **Training session Business Case 2** “Energy certification in residential and tertiary buildings” & **Training session Business Case 3** “Building life-cycle – From planning to renovation” (03/07/2023). The training session of these two business cases was a complementary session of the Business Case 1. The online session gathered 8 professionals of two types of profiles: developers of an environmental management system (similar to Business Cases 1, 2 & 3 but for environmental management), and technicians that will be in charge of collecting the data, mapping, etc. (following a similar approach to the whole BIGG project).

  There is a team in Generalitat de Catalunya developing an overall environmental management system, which correlates quite well with the work carried out in Business Cases 1, 2 & 3 (going beyond the energy focus). Therefore, the meeting had two objectives: knowledge transfer and future collaborations. The main section was knowledge transfer. Based on the experience in developing the Business Cases 1, 2 & 3, ICAEN and CIMNE explained all the steps taken, why they took them and the main data sources that were used, summarising how they built their solutions and the parallel work that they carried out (mapping, data model, etc.). The future collaboration’s part focused on what can be done to share common data to prevent bothering users with having to record data in more than one system.
- **Training session Business Case 4** “Energy Performance Contract-based savings in commercial buildings” (10/11/2022) **& Business Case 5** “Buildings for occupants: Comfort case” (1/12/2022). The first training session was referred to a team of CORDIA’s managers and was organized for the 10th of November by Energis, HELEXIA and CORDIA. The participants were fifteen (15) managers, who are responsible for different contracts of the company. The second training session was referred to a team of engineers from different departments (operation, energy and IoT) and was held on the 1st of December. The participants were twenty-two (22) engineers with different expertise.

  The main goals from the training were: a detailed presentation for the platform’s capabilities, tools and uses; and a description of the data processing and the outputs (reports, figures, comparisons etc).

  The main difference for the two sessions were, that the second one was more analytic and quite interactive. The most of attendees were interested in the use of the platform and the benefits from its application and above all, they expressed some queries for its operation and the difference from the platform that they already use.
- **Training session Business Case 6** “Electricity and Gas demand-response” (13/4/2022). 17 people, including gas boiler installers and technicians, attended this training session in Volos, Greece. During the session, the BIGG Project concept and the domX Heating Controller Solution were presented. The focal point was energy efficiency through smart heating solutions for end consumers. domX focused on providing information about the settings of the domX Heating controller that can improve the energy savings while optimizing user comfort. It was also presented the mock-ups for the new Mobile App Design for the Heating Controller, giving a tutorial presentation for the Control Management Dashboard developed for BIGG.

D-KPI#8 Number of large-scale dissemination campaigns

Two large-scale dissemination campaigns were planned, the first one took place from M23 to M25, and the second one started on M35 until the end of the project (M36) with the aim of promoting the final results. These campaigns targeted public authorities and buildings and smart cities stakeholders, as well as the ECTP members. The main objective of the dissemination campaigns was to spread the results of the project as well as promote the events and workshops organized by BIGG.

The first large-scale dissemination campaign aimed at increasing the visibility of the project and reaching a greater audience, in order to promote the BIGG results and attract people to take part in the BIGG community on LinkedIn. The campaign was composed of an active promotion on the website and on social media channels (Twitter and LinkedIn), the newsletter published in November 2022 and the press release released in December 2022. The press release was also published on BuildUp and Construction 21 International (1319 reads). The campaign also included the dissemination via the ECTP website, including messages in the periodical newsletters of ECTP sent to their 155 members.

The second large-scale dissemination campaign focused on promoting the main outputs of the project. The campaign consisted in an active promotion via the website and the social media channels, with several posts, including news, the final newsletter, the final press release and the launch of the 7 videos about the business cases. In the context of the videos, a YouTube channel was also created, with the aim of storing all the videos. As done previously, the press release was also distributed through BuildUp and Construction 21 International (148 reads). The newsletter, as well as the press release, were also disseminated among the ECTP members and published on their website. The campaign also included an active promotion of the Final Event through all the channels previously mentioned. Furthermore, BIGG as part of the #SmartEnergyCluster, also promoted the Final Event among the 20 projects that shape the cluster, which supported the project by publishing the news on their respective websites and spreading the word among their networks.

VI. LONG-TERM AVAILABILITY OF BIGG RESOURCES

As most project results are planned for public dissemination, the consortium shall ensure that all public material produced will remain accessible at least 3 to 5 years after project completion (beyond that date, it shall be considered outdated). This section details where the various resources produced are stored and can be accessed in the next years.

Table 5. Accessibility of BIGG resources for the coming years

Project resources	Location of resource
Communication material	- BIGG website: Prints
Public deliverables	- BIGG website: Deliverables - BIGG Zenodo community
Videos	- BIGG website: Videos - BIGG YouTube channel
Newsletters	- BIGG website: Newsletters - ECTP website
Press releases	- BIGG website: Press releases - BuildUp - Construction 21 International
White Papers	- BIGG website: White Papers - BIGG Zenodo community - ECTP website
Publications in journals and conference proceedings	- *A data-driven method for unsupervised electricity consumption characterisation at the district level and beyond*: Proc. 10th IEEE Data-Driven Control and Learn. Sys. Conf. Gerard Mor, Jordi Cipriano, Giacomo Martirano, Francesco Pignatelli, Chiara Lodi, Florencia Lazzari, Benedetto Grillone, Daniel Chemisana. (https://www.sciencedirect.com/science/article/pii/S2352484721007988?via%3Dihub) - *Physics-informed Recurrent Neural Networks for the identification of a generic energy buffer system*: Energy Reports, Volume 7. Manu Lahariya, Farzaneh Karami, Chris Develder, Guillaume Crevecoeur (http://users.atlantis.ugent.be/cdvelder/papers/2021/lahariya2021ddcls.pdf) and BIGG website (https://www.bigg-project.eu/physics-informed-recurrent-neural-networks-for-the-identification-of-a-generic-energy-buffer-system/) - *Physics informed neural networks for control oriented thermal modeling of buildings:* Applied Energy, Vol. 314. Gargya Gokhale, Bert Claessens, Chris Develder (https://www.sciencedirect.com/science/article/abs/pii/S0306261922002884) and BIGG website (https://www.bigg-project.eu/physics-informed-neural-networks-for-control-oriented-thermal-modeling-of-buildings/)

	- *Physics Informed LSTM Network for Flexibility Identification in Evaporative Cooling Systems:* IEEE Transactions on Industrial Informatics. Manu Lahariya, Farzaneh Karami, Chris Develder, Guillaume Crevecoeur (https://ieeexplore.ieee.org/document/9771395) - *A novel system for providing explicit demand response from domestic natural gas boilers:* ELSEVIER. Applied Energy Vol. 317. Georgios I. Tsoumalis, Zafeirios N. Bampos, Pandelis N. Biskas, Stratos D. Keranidis, Polychronis A. Symeonidis, Dimitrios K. Voulgarakis (https://www.sciencedirect.com/science/article/abs/pii/S0306261922004421) - *Dynamic horizon selection methodology for model predictive control in buildings:* ELSEVIER. Energy Reports 8. Gerard Laguna, Gerard Mor, Florencia Lazzari, Eloi Gabaldon, Arash Erfani, Dirk Saelens, Jordi Cipriano (https://www.sciencedirect.com/science/article/pii/S2352484722014585?via%3Dihub) and BIGG website (https://www.bigg-project.eu/dynamic-horizon-selection-methodology-for-model-predictive-control-in-buildings/) - *Real-World Implementation of Rein- forcement Learning Based Energy Coordination for a Cluster of Households:* In Proc. 4th ACM SIGEnergy Workshop on Reinforcement Learning for Energy Management (RLEM 2023), at ACM BuildSys 2023. Gargya Gokhale, Niels Tiben, Marie-Sophie Verwee, Manu Lahariya, Bert Claessens, Chris Develder. (https://doi.org/10.1145/3600100.3625681)


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