TIMEPAC

Towards Innovative Methods
for Energy Performance Assessment and Certification of Buildings

Deliverable 4.5

Training materials for Training Scenario 3 – Advanced methods and tools for holistic energy renovation of buildings

Lead Beneficiary: CYPE

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Executive summary

This report provides an overview of the training activities organised under Task 4.5 "Training Scenario 3 - Advanced Methods and Tools for Holistic Energy Renovation of Buildings." These activities were aimed at enhancing the knowledge of professionals in the building sector regarding advanced methodologies and digital tools like Building Information Modelling (BIM) and Energy Performance Certificates (EPCs) for energy-efficient renovations. The training sessions focused on aligning with the EU's decarbonisation goals, particularly those outlined in the recast Energy Performance of Buildings Directive (EPBD).

The primary objective of the training activities was to deliver hands-on training to a broad audience, including architects, engineers, urban planners, and policymakers, equipping them with the skills needed to integrate BIM, EPCs, and other digital tools into renovation projects. The training was designed to enhance collaboration among various stakeholders and foster a better understanding of how digital technologies can support long-term energy efficiency and decarbonisation strategies.

Two key training events were conducted: an online webinar held on March 5th, 2024, titled "Advanced Methods and Tools for Holistic Energy Renovation of Buildings," and two in-class training sessions on May 23rd and 30th, 2024, at La Salle Campus in Barcelona. The webinar focused on the integration of BIM and EPCs for energy assessments, while the in-class training activities provided practical experience in using BIM workflows for energy renovation, emphasising the creation of enhanced EPCs and the application of renovation passports.

The engagement and feedback from participants were highly positive. Attendees from both the webinar and in-class training expressed a strong interest in applying the knowledge gained to their professional work. Participants appreciated the relevance of the content, the ease of the registration process, and the overall structure of the sessions. Feedback indicated that the majority of participants had their expectations fully met, particularly regarding the use of BIM to improve EPCs and support decarbonisation efforts.

The training activities successfully achieved their objectives, providing participants with theoretical knowledge and practical tools to improve building energy assessments. The content aligned well with the EPBD's goals, and the outcomes demonstrated that the participants were well-prepared to apply these advanced methods in their professional practices. The positive feedback from attendees highlights the effectiveness of the training and its role in promoting sustainable energy renovation practices in the building sector.

In conclusion, this task emphasised the importance of continued professional development in this field, particularly in the adoption of digital technologies like BIM and EPCs. These tools are essential for supporting the EU’s decarbonisation goals, and the success of these training activities highlighted the need for ongoing education and collaboration among building professionals to drive sustainable building renovation strategies.

1 Introduction

1.1 Purpose and target group

The primary purpose of Task 4.5 “Training Scenario 3 - Advanced methods and tools for holistic energy renovation of buildings" was to deliver the results of the Transversal Deployment Scenarios (TDS) through training activities to a wide range of professionals in the building sector.These activities focused on integrating advanced methodologies and digital tools for energy renovation projects, in particular “TDS 1- Generaging EPCs with EPC data” and “TDS 3- Creating building renovation passports from data repositories".

The training sessions focused on the use of digital innovations like Building Information Modelling (BIM), Energy Performance Certificates (EPCs), and Building Renovation Passports (BRPs). These tools are essential for evaluating and improving the energy performance of buildings, ensuring compliance with the EPBD recast objectives. The sessions also addressed interoperability challenges and proposed guidelines to address them using current technologies.

The target audiences for this training included professionals in the architecture, construction, and engineering fields, as well as policymakers, urban planners, and stakeholders involved in building energy performance assessments. Participants were expected to have a basic understanding of energy efficiency principles and building renovation processes.

This training provided hands-on experience with tools such as BIM and EPC generation platforms, preparing participants to implement holistic and sustainable building renovation strategies. The training also aimed to promote collaboration among professionals, policymakers, and technology providers, enhancing their understanding of the critical role digital tools play in achieving long-term energy efficiency and decarbonisation goals, in line with the recent EPBD recast.

1.2 Deliverable structure

The rest of this report is organised into the following sections:

- Section 2, "Online training activity," provides a comprehensive overview of the webinar conducted on March 5th, 2024.
- Section 3, "In-class training activity," offers a thorough account of the training sessions held on May 23rd and 30th, 2024.
- Section 4, "Conclusion," presents insights drawn from the training activities.

1.3 Contribution of partners

CYPE led Task 4.5 and, in collaboration with ICAEN and La Salle - URL, organised the online training activities and the in-class training in Barcelona.

1.4 Relations to other project activities

The outputs of the Transversal Deployment Scenarios carried out in WP2 were presented in the training activities organised within this task. The activities have been disseminated through the project website, TIMEPAC Academy platform, and TIMEPAC's social media channels.

2 Online training activity

2.1 Introduction

On March 5th, 2024, the webinar titled "Advanced methods and tools for holistic energy renovation of buildings" addressed innovative strategies and tools designed to enhance the energy efficiency of building renovations, aligning with the objectives set out in the recast Energy Performance of Buildings Directive (EPBD). This webinar focused on how advanced Building Information Modelling (BIM) techniques and data integration can support these ambitious goals by providing more accurate and comprehensive assessments of building energy performance (Figure 1).

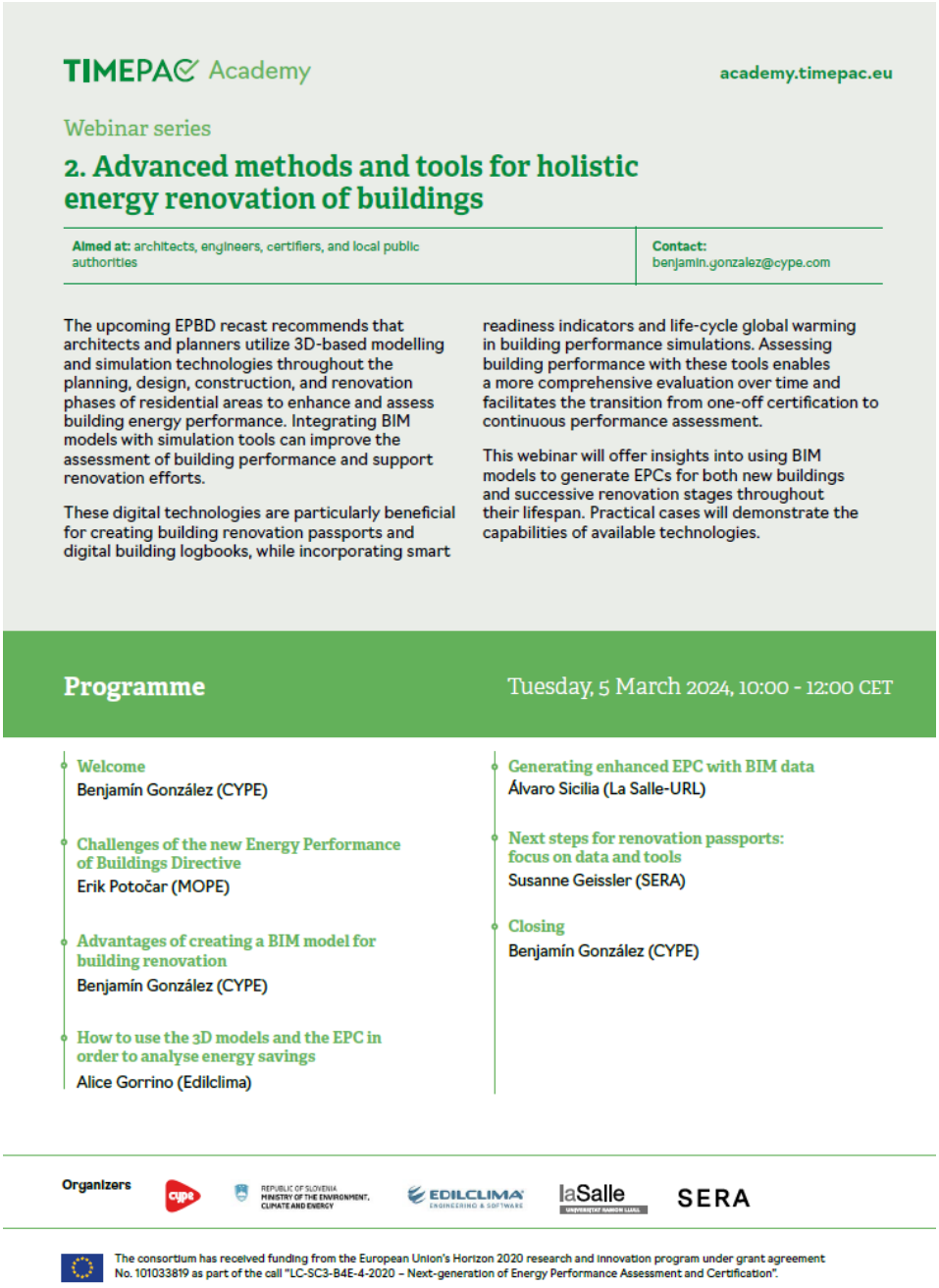

Figure 1. Announcement of the webinar on the TIMEPAC Academy website

The webinar aimed to highlight the potential of leveraging BIM data to generate enhanced Energy Performance Certificates (EPCs), ensuring that renovation efforts are informed by precise and reliable information. Discussions focused on how the project's guidelines facilitate the integration of BIM data into EPC generation tools, overcoming challenges related to data interoperability and cross-disciplinary collaboration. By incorporating detailed information on building geometry, materials, and thermal properties, these advanced methods ensure that EPCs are accurate and actionable for long-term energy planning.

Furthermore, the sessions explored the broader application of these methods, emphasising the role of digital tools in creating holistic renovation strategies that align with the EU's climate goals. The integration of BIM data with other sources, such as climatic data and renewable energy potential, was discussed as a means to provide a more comprehensive analysis of the built environment, thereby supporting large-scale rehabilitation efforts .

2.2 Structure and content

The webinar included the following sessions:

Session 1: Challenges of the new Energy Performance of Buildings Directive (EPBD)

This session provided an in-depth overview of the new Energy Performance of Buildings Directive (EPBD) and its role in the EU's climate strategy. The directive introduces measures for improving energy efficiency, decarbonising the building sector, and establishing zero-emission buildings by 2030. Key strategies discussed included the Life Cycle Global Warming Potential (GWP) indicator and the Smart Readiness Indicator (SRI). The session also highlighted the significance of renovation passports, which offer customised roadmaps for building decarbonisation, and explored the importance of integrating solar energy optimisation in both new and existing buildings. The EPBD's goals aim to modernise the building industry and ensure sustainable renovations.

Lecturer: https://academy.timepac.eu/en/lecturers/erik-potocar

Presentation: https://academy.timepac.eu/en/lecture-materials/10/50/18

Link to the webinar recording: https://academy.timepac.eu/en/lecture-materials/10/50/47

Session 2: Advantages of creating a BIM model for building renovation

This session explored the benefits of Building Information Modelling (BIM) for renovation projects, in particular how it enhances collaboration, coordination, accuracy, and sustainability. BIM can integrate multiple disciplines and stakeholders, even when using different tools, and relies on open standards like IFC for data sharing. The session also showcased how BIM models improve simulations for energy, fire, and acoustic design, while helping manage budgets and bills of quantities. Additionally, the potential for extending BIM into digital twins was discussed, highlighting its role in optimising building performance throughout the lifecycle by combining static and real-time data.

Lecturer: https://academy.timepac.eu/en/lecturers/benjamin-gonzalez

Presentation: https://academy.timepac.eu/en/lecture-materials/10/51/19

Link to the webinar recording: https://academy.timepac.eu/en/lecture-materials/10/51/48

Session 3: How to use 3D models and the EPC in order to analyse energy savings

During this session, the use of 3D BIM models and EPCs for energy savings analysis were explored, demonstrated through a case study. The process involved exporting BIM models as IFC files and importing them into EPC tools. The success of the analysis depended on accurately modelling building envelopes, spaces, and thermal zones, and correctly associating materials and thermal properties. Additional data on building categories and climatic conditions were required. The session highlighted

the importance of precise BIM representations to ensure accurate energy performance assessments and effective renovation measures.

Lecturer: https://academy.timepac.eu/en/lecturers/alice-gorrino

Presentation: https://academy.timepac.eu/en/lecture-materials/10/54/20

Link to the webinar recording: https://academy.timepac.eu/en/lecture-materials/10/54/49

Session 4: Generating enhanced EPC with BIM data

This session outlined how Building Information Modelling (BIM) data can be leveraged to generate enhanced Energy Performance Certificates (EPCs). It introduced a guideline detailing the integration of Open Interoperability BIM data into EPC generation tools to improve energy performance assessments. The session identified Architectural, Analytical, and MEP models as essential components. By ensuring precise data on building geometry, materials, thermal properties, and HVAC systems, enhanced EPCs can provide reliable energy evaluations. The discussion also highlighted challenges such as data interoperability and the need for cross-disciplinary collaboration to fully harness BIM's potential in EPC generation.

Lecturers: https://academy.timepac.eu/en/lecturers/alvaro-sicilia and https://academy.timepac.eu/en/lecturers/adirane-calvo

Presentation: https://academy.timepac.eu/en/lecture-materials/10/52/21

Link to the webinar recording: https://academy.timepac.eu/en/lecture-materials/10/52/50

Session 5: Next steps for renovation passports: focus on data and tools

This session focused on advancing renovation passports, particularly by integrating data and tools to meet the goals of the EPBD recast. Renovation passports were presented as tailored roadmaps for energy-efficient renovations that complement EPCs. The session emphasised incorporating detailed data on building performance and renovation history to ensure effectiveness. It also covered the use of advanced digital tools for data analysis, addressing challenges like ensuring data interoperability. Furthermore, the discussion highlighted the importance of aligning renovation passports with broader EU sustainability goals and fostering collaboration among building owners, policymakers, and technology providers to drive the widespread adoption of renovation passports.

Lecturer: https://academy.timepac.eu/en/lecturers/susanne-geissler

Presentation: https://academy.timepac.eu/en/lecture-materials/10/53/22

Link to the webinar recording: https://academy.timepac.eu/en/lecture-materials/10/53/51

2.3 Quality assurance and feedback from the audience

Quality assurance for this webinar was carried out through a structured questionnaire that included various aspects of the course (see Annex A "Evaluation form for online training activity"). It provided insights into participants' expectations, satisfaction, and their opinions on the relevance of the content presented. A total of 28 participants completed the questionnaire at the end of the session.

The audience's feedback was vastly positive. The majority of respondents (22 out of 28, or 79%) indicated that their expectations were fully met regarding the content and implementation method of the course, as shown in Figure 2. This suggests that the course effectively addressed the topics and methods anticipated by most participants. However, about one-fifth (6 of them, being 21%) stated that their expectations were only partly met, highlighting potential areas for improvement in either

the depth of content or the delivery method. Notably, no participants reported that their expectations were not met.

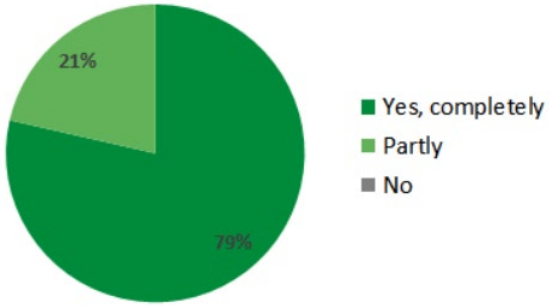

Figure 2. Results for the question "Were your expectations regarding the content and implementation method of the advanced methods and tools for holistic energy renovation of buildings webinar met?"

The survey indicates that 71% of participants (20 out of 28) felt they had completely acquired new and relevant information regarding enhancing EPCs for building decarbonisation (Figure 3). This demonstrates that most of the content introduced new concepts or expanded participants' understanding of EPCs. However, nearly one-third (29%, or 8 out of 28) only partly acquired new information, suggesting a possible gap in knowledge transfer or a need for deeper exploration of certain topics. Again, none reported not acquiring any new information, which is a positive sign for content relevance.

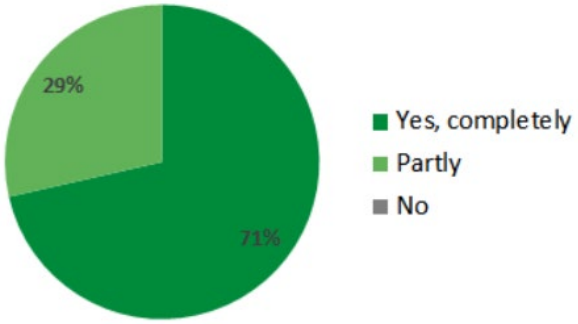

Figure 3. Results of the question "Did you acquire new information on enhancing EPCs to make them useful instruments for the decarbonisation of the building stock?"

The same percentage (79% or 22 out of 28) of participants who were satisfied with the course overall also saw BIM as an extremely useful tool for enhancing EPCs, as seen in Figure 4. This reflects strong confidence among participants in the role of BIM technology in future EPC development and building energy renovation processes. A smaller portion, 21% (6 out of 28), consider that BIM is partly useful, which might indicate some hesitancy or lack of confidence in their ability to apply BIM effectively, or that further clarification on its applications is needed. No participants expressed that BIM is not useful, affirming the importance of BIM in energy-efficient building renovation.

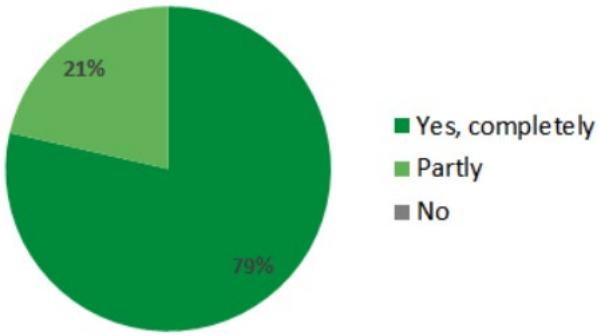

Figure 4. Results of the question "Do you consider BIM as a useful tool for future enhancement of EPC?"

The webinar presentations were well-received, with all sessions receiving ratings above 4 out of 5. The highest-rated session, "Generating enhanced EPC with BIM data" by Álvaro Sicilia and Adirane Calvo (4.54), indicates this particular session's strong relevance and effectiveness in addressing key topics. While still positively rated, the lowest-rated session, "Challenges of the new Energy Performance of Buildings Directive" (4.14) suggests that some participants may have found it less impactful compared to the other sessions, most probably because it detailed general or introductory contents on the topic. The overall average rating of 4.34 shows that the content and delivery of the webinar met or exceeded participants' expectations (Table 1).

Table 1. Session ratings for the online training activity

Session	Rating
Challenges of the new Energy Performance of Buildings Directive	4.14
Advantages of creating a BIM model for building renovation	4.32
How to use the 3D models and the EPC in order to analyse energy savings	4.32
Generating enhanced EPC with BIM data	4.54
Next steps for renovation passports: focus on data and tools	4.39
Average of all sessions	4.34

Two sessions were deemed most relevant by an equal number of participants: "Challenges of the new Energy Performance of Buildings Directive" and "How to use the 3D models and the EPC in order to analyse energy savings," each receiving 7 votes (or 25% each) (Figure 5). This indicates the interest in both the regulatory framework and practical applications of EPC in energy savings analysis. The session on generating enhanced EPCs with BIM data also garnered strong relevance with 6 votes (21% of the total). Fewer participants found the renovation passport session and BIM model creation session as relevant, indicating a possible gap between their professional practice and these specific topics. Nevertheless, the varied interest in the different presentations and overall divided preferences, might indicate a broad range of professionals and disciplines.

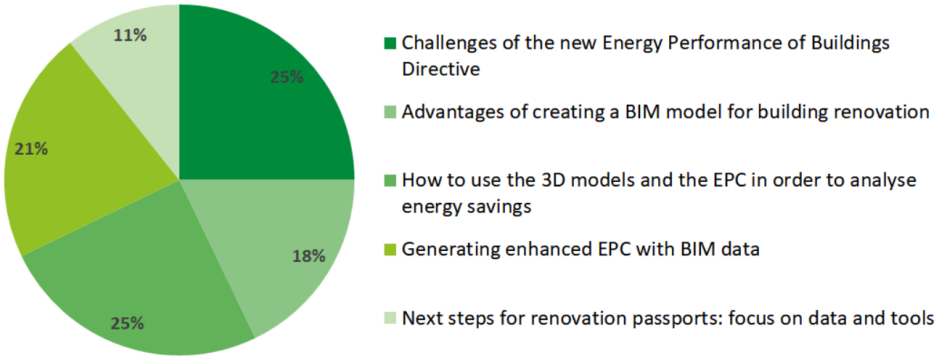

Figure 5. Results of the question "Which session was the most relevant for your professional practice?"

When asked about the stages in the EPC data flow assessment improvement, the majority of participants (13 votes, or 46%) identified the **generation** stage as the most critical one. This suggests that ensuring accurate and comprehensive data generation is a primary concern for professionals. The **analysis** stage also received considerable attention with 36% (10 votes), reflecting the importance of interpreting EPC data to guide renovation efforts. **Storage** and **exploitation** were seen as less critical, with only 3 and 2 votes, respectively (11% and 7%), likely indicating that these important stages are viewed as secondary compared to data generation and analysis (Figure 6).

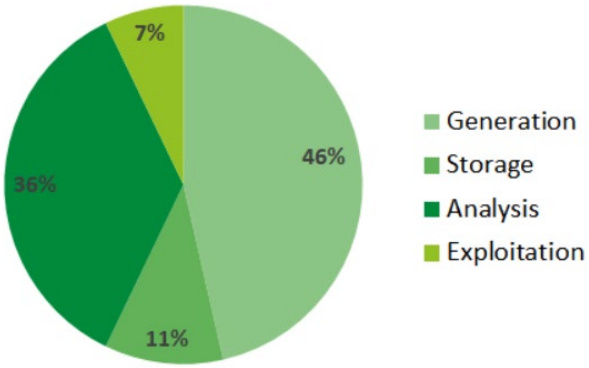

Figure 6. Results of the question "Within the EPC data flow, which stage of this continuous cycle do you consider most critical to improving building assessment?"

The responses to questions about the TIMEPAC Academy website provided valuable insights into how attendees had discovered the webinar, the ease of the registration process, their interest in acquiring the guidelines, and their intentions for future participation. The majority, 15 participants, learned about the event through an email from a TIMEPAC partner, while 4 heard about it from a friend, 3 through social media, and 6 from other sources.

Most participants, 26 in total, found the registration process straightforward and user-friendly, although 2 experienced some difficulties. Additionally, 27 out of the 28 respondents, expressed interest in receiving a digital copy of the TIMEPAC guidelines for EPC generation from BIM models.

As for future involvement, the response was also highly positive, with 27 participants indicating they plan to join other TIMEPAC webinars, while only 1 did not intend to participate further. This feedback highlights the effectiveness of TIMEPAC partners' email communication in attracting attendees, the general ease of registration, and strong interest in continued engagement with TIMEPAC Academy.

3 In-class training activity in Spain

3.1 Introduction

An on-site course on "Advanced Methods and Tools for Holistic Energy Renovation of Buildings" was was announced in the TIMEPAC Academy in English and Spanish languages (Figure 7). It took place on May 23rd and May 30th, 2024, at the La Salle Campus Barcelona (Figure 8).

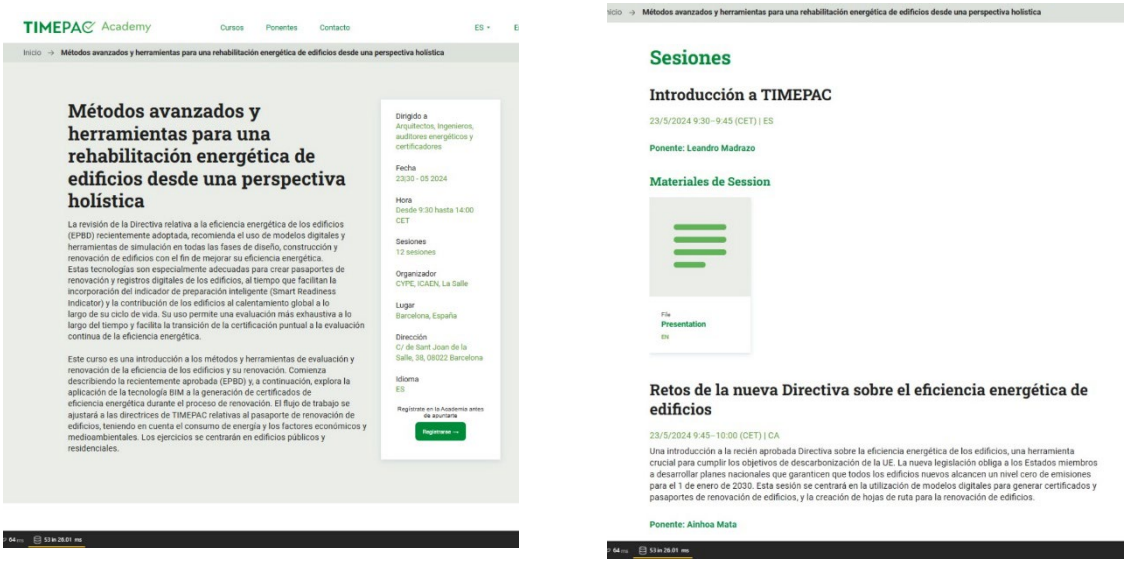

Figure 7. Announcement of the in-class course on the TIMEPAC Academy website in Spanish language

This course followed the online training activity held on May 5th and aimed to deepen the participants' understanding of the Energy Performance of Buildings Directive (EPBD), with a focus on integrating Building Information Modelling (BIM) and Building Renovation Passports. The workshop was a practical hands-on training activity, specifically targeting the practical application of these advanced tools and methods in the context of energy-efficient building renovations.

Figure 8. A snapshot of one of the in-class training sessions

The main aim of the training was to equip participants with the skills needed to use BIM workflows for creating accurate Energy Performance Certificates (EPCs) and implementing Building Renovation Passports. Through a combination of lectures, demonstrations, and hands-on exercises, the course introduced participants to the TIMEPAC project's guidelines for integrating open interoperability BIM standards into EPC generation. The sessions showcased practical applications, including how to assess building energy performance and plan phased renovation strategies in line with the EPBD's long-term decarbonisation goals. Key topics covered included generating digital models, validating existing building data, and managing information within a Common Data Environment (CDE) to ensure interoperability and accuracy.

The course was attended by 30 participants from diverse professional backgrounds, including architects, engineers, energy consultants, and public sector officials. The training was designed to foster collaboration between these stakeholders and empower them to adopt advanced digital solutions for enhancing energy performance in buildings, thereby contributing to the EU's climate objectives (Table 2).

Table 2. Organisations participating in the in-class training activity

Organisations	
brossarquitectes	PGI Engineering
ERF	Juan Carlos Díaz (architect)
UPC	SUNO enginyeria de serveis energètics SCCLP
JG Ingenieros	AFTER
DEKRA Services S.A.	La Salle - URL
Agència de l'Habitatge de Catalunya	ECOPENTA
3EA ENERGIA	María Luisa Rodríguez-Marin (Architect)
CYPE Ingenieros, S.A.	ICAEN

3.2 Structure and content

The in-class activity was organised into the following sessions, held over the course of two days:

DAY 1 - Thursday, May 23rd, 2024

Welcome Session – Introduction of TIMEPAC

In the introductory session of the workshop, the TIMEPAC project was presented. Participants were introduced to its connection with the newly approved Energy Performance of Buildings Directive (EPBD). The session outlined the Transversal Deployment Scenarios developed within TIMEPAC and their significance in addressing energy efficiency and building renovation. It highlighted the integration of advanced methods and tools to align with the EPBD's goals, emphasising how TIMEPAC aims to support sustainable building practices. The course objectives and key strategies for optimising energy performance through innovative solutions were also presented.

Lecturer: https://academy.timepac.eu/en/lecturers/leandro-madrazo

Presentation: https://academy.timepac.eu/en/lecture-materials/14/131/102

Session 1: Challenges of the new Energy Performance of Buildings Directive

This session focused on the significant changes introduced by the recast of the Energy Performance of Buildings Directive (EPBD), highlighting the roles of Building Information Modelling (BIM) and Building Renovation Passports (BRP). The EPBD is a critical legislative instrument designed to help achieve the EU's decarbonisation goals, with a key requirement that all new buildings be zero-emission by 2030. Key tools such as BRP and digital innovations like BIM, the Smart Readiness Indicator (SRI), and the Digital Building Logbook were highlighted for their role in tracking and managing energy performance. These technologies are crucial for facilitating deep renovation, updating energy performance certificates (EPCs), and ensuring compliance with the EPBD recast ambitious objectives, which include achieving zero-emission buildings by 2050. The session also addressed the importance of national renovation plans, which Member States must develop to reduce primary energy consumption and meet EU targets. The integration of digital technologies like BIM was discussed as crucial for the accurate monitoring and management of energy efficiency in buildings, ensuring compliance with the EPBD recast strict requirements.

Lecturer: https://academy.timepac.eu/en/lecturers/ainhoa-mata

Presentation: https://academy.timepac.eu/en/lecture-materials/14/81/103

Session 2: Generating enhanced EPC with BIM data

This session addressed the long-term objective of integrating Building Information Modelling (BIM) with Energy Performance Certificates (EPCs), while acknowledging the significant challenge of interoperability between modelling and simulation tools. The presentation introduced a set of guidelines developed by the TIMEPAC project to facilitate the generation of EPCs from BIM models using current technologies and open interoperability standards. These guidelines encompassed BIM workflows for different scenarios, including creating new BIM models and validating existing ones. They outlined the necessary steps for ensuring that the BIM model contains the required data and is generated in a way that enables seamless importation into EPC tools, such as CYPETHERM, Edilclima EC700, and ETU software. The guidelines focused on three core model types: Architectural, Analytical, and MEP (mechanical, electrical, and plumbing). The session also highlighted practical applications of BIM-EPC integration, emphasising the improved quality of input data for energy

assessments. Finally, challenges were discussed, such as ensuring data interoperability and collaboration across stakeholders.

Lecturers: https://academy.timepac.eu/en/lecturers/alvaro-sicilia

https://academy.timepac.eu/en/lecturers/adirane-calvo

https://academy.timepac.eu/en/lecturers/benjamin-gonzalez

Link to the materials: https://academy.timepac.eu/en/lecture-materials/14/82/105

Session 3: Creating a realistic BIM model – case study municipal building

In this session, two BIM workflows were demonstrated using the Common Data Environment (CDE) platform BIMserver.center. First, an analytical model was generated from floor plans using IFC Builder and linked to the CYPETHERM HE Plus energy certification program. In the second workflow, a model created in Revit was verified and processed with the Open BIM Analytical Model program to produce another analytical model. Both examples centred on a public building undergoing rehabilitation, highlighting the use of BIM methodologies for generating energy efficiency certificates and optimising renovation processes through the generation of detailed analytical models. By focusing on a real-world rehabilitation project, the workflows demonstrated BIM's effectiveness in enhancing renovation processes and building sustainability, with more effective energy assessment and compliance with energy efficiency standards.

Lecturers: https://academy.timepac.eu/en/lecturers/alvaro-sicilia

https://academy.timepac.eu/en/lecturers/adirane-calvo

https://academy.timepac.eu/en/lecturers/benjamin-gonzalez

Link to the materials: https://academy.timepac.eu/en/lecture-materials/14/83/106

DAY 2 - Thursday, May 30th, 2024

Session 4: Certification along the renovation processes

In this session, the importance of managing energy data for buildings to support the decarbonisation goal by 2050 was emphasised. The Energy Performance of Buildings Directive (EPBD) proposed the use of the Digital Building Logbook as a central repository for building data, including energy certificates and renovation passports. The logbook was presented as critical for enabling informed decision-making by property owners, financial institutions, and public authorities. In the context of Catalonia, different access points to the energy certificate registry were discussed, such as a certificate search tool with interactive hypermaps, the Building's EPC Observatory, and open data. The session also addressed the importance of maintaining high data quality, ensuring coherence between energy certificates and other building documents. Furthermore, national renovation plans were emphasised as vital for establishing baseline performance, proposing minimum standards, and monitoring progress toward zero-emission buildings. Challenges related to data integration and improving the accuracy of building certificates were discussed, with suggestions for enhancing the transparency and accessibility of energy data through open platforms.

Lecturer: https://academy.timepac.eu/en/lecturers/ainhoa-mata

Presentation: https://academy.timepac.eu/en/lecture-materials/14/85/107

Session 5: Building renovation passport

In this session, the concept of the Building Renovation Passport was introduced as a tool to promote deep building rehabilitation in line with the draft Energy Performance of Buildings Directive (EPBD) 2024. A definition of the passport was provided, describing it as a long-term roadmap for renovation based on in-situ energy audits. Key elements such as trigger points, sustainability evaluation, and costs were discussed. Examples from various EU countries were presented, showcasing different approaches to implementing Building Renovation Passports, including models from France, Germany, and the Netherlands. The benefits and challenges of implementing this tool across Europe were also assessed, focusing on its role in reducing energy consumption, enhancing renovation processes, and improving data accessibility through digital tools like the Digital Building Logbook. Finally, the obstacles to widespread adoption, such as cost and complexity, were evaluated within the European context.

Lecturers: **https://academy.timepac.eu/en/lecturers/adirane-calvo**

Presentation: https://academy.timepac.eu/en/lecture-materials/14/86/108

Session 6: Generating BIM for a step-by-step renovation of a residential building

In this session, the Life Cycle Assessment (LCA) methodology was presented to evaluate the environmental impacts of buildings throughout their life cycle, from raw material extraction to waste management. The key steps of LCA—goal definition, inventory analysis, impact assessment, and interpretation—were explained. The methodology was applied to assess energy consumption, material use, and waste generation, with the aim of identifying potential improvements in environmental and energy performance. Environmental indicators such as global warming potential (GWP) and human health impacts were used to quantify the results. Following this, a practical exercise focused on generating thermal models for a residential building was conducted using the CYPETHERM HE Plus program. The models were created to calculate the building's energy consumption and certification (EPC) in both its current phase and after implementing improvement measures. Each improvement was analysed from energy, economic, and environmental perspectives using CYPETHERM Improvements Plus and the CYPE Cost Database to evaluate economic viability and environmental impact indices for each proposed measure.

Lecturers: https://academy.timepac.eu/en/lecturers/marta-chafer

Presentation: https://academy.timepac.eu/en/lecture-materials/14/87/109

3.3 Quality assurance and feedback from the audience

Quality assurance for this course was implemented through a structured questionnaire that encompassed various aspects of the course (see Annex B "Evaluation form for in-class training activity"). The questionnaire was completed at the end of the last session by 15 attendants.

The survey results revealed positive feedback regarding participant satisfaction, the course's content, and its implementation. Of the attendees, the majority—10 out of 15, or 67%—reported that their expectations were completely met, while 5 (33%) indicated that their expectations were partly fulfilled. Notably, no one expressed dissatisfaction with the course (Figure 9).

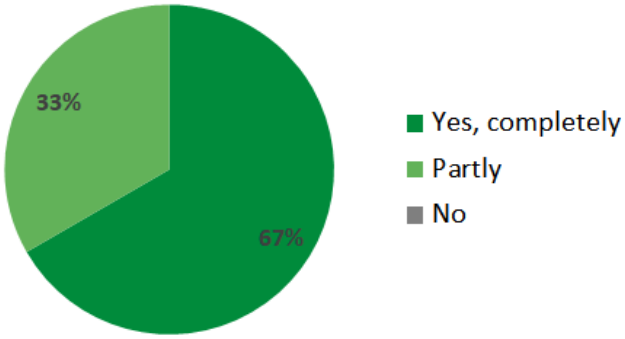

Figure 9. Results for the question: "Were your expectations about the content and format of the Advanced Methods and Tools for Building Energy Rehabilitation from a Holistic Perspective course met?"

Participants also indicated they had gained new insights, particularly on enhancing Energy Performance Certificates (EPCs) to better support decarbonisation efforts. Twelve participants (80% of the total respondents) felt they had completely acquired new information in this area, while 3 (representing 20%) felt they had gained partial insights (Figure 10). Similarly, when asked about the usefulness of Building Information Modelling (BIM) in improving EPCs, all participants agreed that it was beneficial, with 9 of them (60%) fully endorsing its future utility and 6 (40% of them) expressing partial agreement, as shown in Figure 11. In both questions, none of the participants had a negative response.

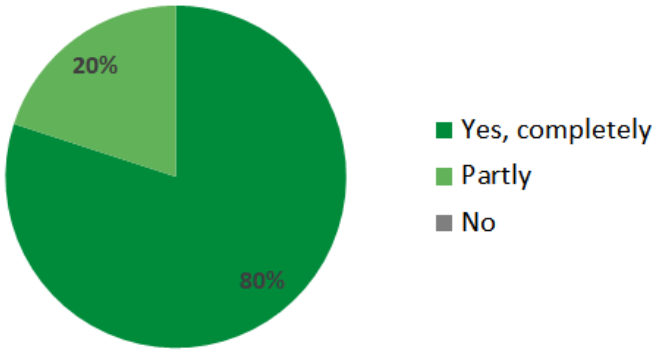

Figure 10. Results for the question: "Have you acquired new information about improving EPCs to make them useful tools for decarbonising the real estate stock?"

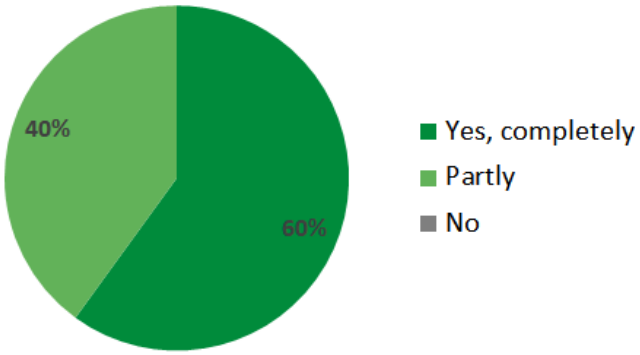

Figure 11. Results for the question: "Do you see BIM as a useful tool to improve EPCs in the future?"

In terms of specific course sessions, attendees provided high ratings across the board, with an overall average score of 4.37 out of 5. Sessions that received particularly strong feedback included "Challenges of the New Directive on the Energy Efficiency of Buildings" and "Certification Throughout the Renewal Process," both of which received an average rating of 4.60. Additionally, the practical session on "Generation of a BIM Model for Step-by-Step Renovation of a Residential Building" was also well-received, scoring 4.53, as shown in Table 3.

Table 3. Session ratings for the online training activity

Session	Rating
Introduction to TIMEPAC	4.40
Challenges of the new Directive on the energy efficiency of buildings	4.60
Generation of EPC improved with BIM data	4.27
Creation of a BIM model for the generation of the certificate: a municipal building	4.00
Review of exercises	4.20
Certification throughout the renewal process	4.60
Building renovation passport	4.33
Generation of a BIM model for the step-by-step renovation of a residential building	4.53
Average of all sessions	4.37

When asked which session was most relevant to their professional practice, the majority of participants (9, which represented 60% of the total) selected the session on the challenges of the new energy efficiency Directive (EPBD), reinforcing its practical applicability. Other sessions that stood out for their relevance included "Generation of a BIM Model for Step-by-Step Renovation of a Residential Building" and "Creation of a BIM Model for Certificate Generation: A municipal building.", as seen in Figure 12.

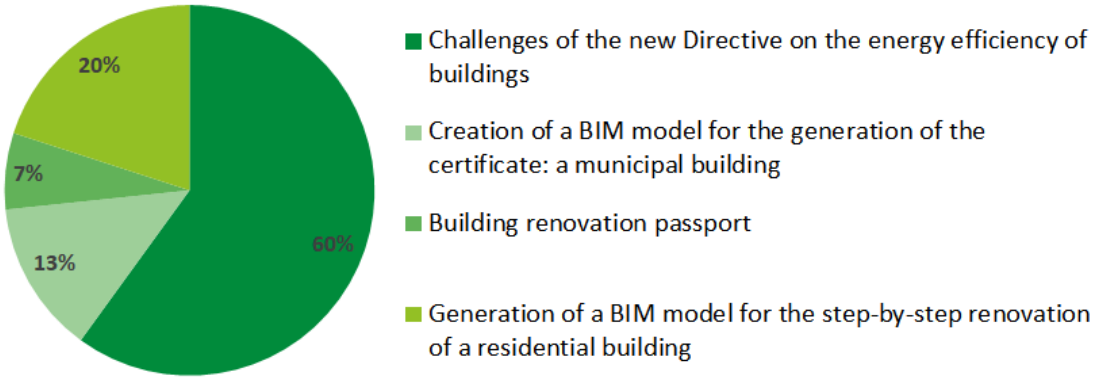

Figure 12. Results for the question: "Which session was most relevant to professional practice?"

In discussing the EPC data flow, participants identified the "Analysis" stage as the most critical for improving building assessments, with 7 attendees (46% of the total) selecting this phase as their top priority. Other stages, such as "Exploitation" and "Generation," were also noted, though to a lesser degree (Figure 13).

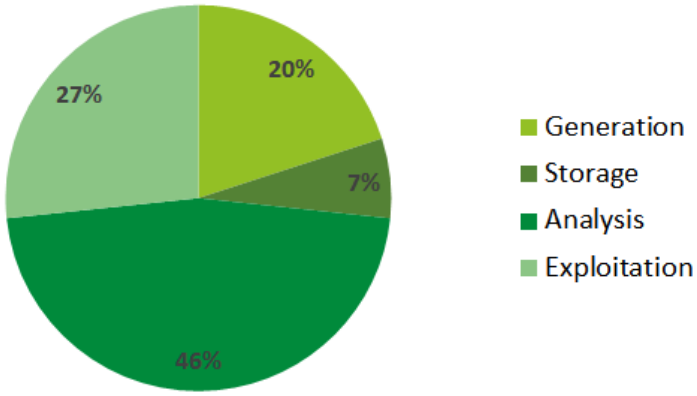

Figure 13. Results for the question: "Within the EPC data flow (Generation, Storage, Analysis and Exploitation), which stage of this continuous cycle do you consider most critical to improving building assessment?"

The effectiveness of email outreach from TIMEPAC members was highlighted, as 10 participants learned about the course through this method. A smaller number discovered the course through other sources, including social media and word of mouth.

Regarding the course environment, participants gave the facilities a strong average rating of 4.4 (with a 9 out of 15 rating with a maximum score), reflecting satisfaction with comfort and functionality. The positive physical environment likely contributed to the overall learning experience.

Looking ahead, many participants expressed intentions to apply the tools and knowledge gained in their professional activities. Responses ranged from a definitive "Yes" to more conditional answers, with several participants indicating they would need further training or integration with their current systems. Some noted the challenge of working across multiple software platforms but still expressed a desire to incorporate the course's teachings into their workflow.

In summary, the course received overwhelmingly positive feedback, with participants not only gaining valuable knowledge but also planning to implement what they learned in their professional practices. The high ratings across sessions, the strong interest in future application, and the positive feedback

on the course's relevance all point to its success. Additionally, the role of email communication in attracting participants was reaffirmed, making it a key strategy for future outreach.

4 Conclusion

The training activities, comprising both a webinar and an in-class course, provided essential insights and hands-on experience aligned with the objectives of Task 4.5, "Advanced methods and tools for holistic energy renovation of buildings." These sessions catered to professionals and stakeholders in building performance assessment, energy efficiency, and renovation planning.

Both the webinar and the in-class training received highly positive feedback from participants. In total, 74% of attendees (for both online and in-class activities) stated that their expectations were completely met, while the remaining 26% had their expectations partly met. Similarly, 100% of the webinar and in-class participants considered BIM a useful tool for future EPC enhancements (either completely or partly). Across the sessions, participants gave an average score of 4.34 for the webinar and 4.40 for the in-class training, indicating a high level of satisfaction. This positive reception underscores the relevance of the content and the quality of delivery across both training formats, emphasising the effectiveness of combining theoretical concepts with practical applications in the learning process.

The webinar was well-received, with 22 out of 28 participants indicating that their expectations were completely met (with the remaining 6 stating theirs were partly met), and 20 confirming that they had completely acquired new information on enhancing EPCs for decarbonisation purposes (the remaining 8 partly did). Sessions on generating enhanced EPCs with BIM data, using 3D models for energy savings analysis and on explaining the new challenges of the EPBD were particularly valued positively, as they received the highest scores and were deemed the most relevant to participants' professional practice. The stage of EPC data generation was seen as the most critical stage in improving building assessments, with 13 participants voting for it.

Similarly, the in-class training also yielded positive outcomes, with 10 of 15 participants stating that their expectations were fully met (while the remaining 5 had their expectations partly met), and 12 completely acquired new information regarding EPCs and decarbonisation (and the rest, 4 of them, partly did). Both the session on the "Challenges of the new Directive on the energy efficiency of buildings" and the one on "Certification throughout the renovation process" were especially well-received, scoring 4.60 and with the first being the most relevant for 9 participants. Moreover, participants highlighted BIM as an effective tool for improving EPCs, with 9 of the attendees fully endorsing it. The step-by-step renovation of residential buildings using BIM was another key session, receiving positive evaluations and reinforcing the importance of practical applications.

Feedback from both the webinar and in-class activities showed strong support for the continued evolution of BIM and EPC integration, with participants showing a high level of satisfaction and interest in applying the newly acquired knowledge to their professional work. This reinforces the importance of ongoing professional training and collaboration between stakeholders to achieve the EPBD objectives and ensure the successful integration of advanced tools in building renovation and energy efficiency.

In conclusion, the training activities conducted under Task 4.5—both the online and the in-class sessions—successfully provided professionals with advanced knowledge and practical tools to address the challenges of energy renovation in buildings and energy efficiency. Through a focus on BIM, EPCs, and renovation passports, participants gained valuable insights into innovative methodologies and their application in achieving the EPBD's decarbonisation goals. The vast positive feedback highlights the relevance and effectiveness of the training in enhancing participants' skills and knowledge. As the building sector continues to evolve, these training initiatives highlight the importance of continuous learning, collaboration, and the adoption of innovative technologies to drive sustainable and energy-efficient renovations.

Annex A – Evaluation form online training activity

Advanced methods and tools for holistic energy renovation of buildings

March 5, 2024

- Were your expectations regarding the content and implementation method of the advanced methods and tools for holistic energy renovation of buildings webinar met?

- Yes, completely
- Partly
- No

- Did you acquire new information on enhancing EPCs to make them useful instruments for the decarbonisation of the building stock?

- Yes, completely
- Partly
- No

- Do you consider BIM as a useful tool for future enhancement of EPC?

- Yes, completely
- Partly
- No

- We kindly ask you to evaluate all sessions presented at the advanced methods and tools for holistic energy renovation of buildings webinar.

- Challenges of the new Energy Performance of Buildings Directive (Erik Potočar)
☺☺☺☺☺
- **Advantages of creating a BIM model for building renovation** (Benjamín González)
☺☺☺☺☺

- How to use the 3D models and the EPC in order to analyse energy savings (Alice Gorrino)
☺☺☺☺☺

- Generating enhanced EPC with BIM data (Álvaro Sicilia and Adirane Calvo)
☺☺☺☺☺
- **Next steps for renovation passports: focus on data and tools** (Susanne Geissler)
☺☺☺☺☺

- Which session was the most relevant for your professional practice?

- Challenges of the new Energy Performance of Buildings Directive (Erik Potočar)
- Advantages of creating a BIM model for building renovation (Benjamín González)
- How to use the 3D models and the EPC in order to analyse energy savings (Alice Gorrino)
- Generating enhanced EPC with BIM data (Álvaro Sicilia y Adirane Calvo)
  Next steps for renovation passports: focus on data and tools (Susanne Geissler)

- Within the EPC data flow—generation, storage, analysis, and exploitation— which stage of this continuous cycle do you consider the most critical for improving building assessment

- Generation
- Storage
- Analysis
- Exploitation

- Where did you find out about TIMEPAC Academy?

- Email from a TIMEPAC partner
- Email from a friend
- TIMEPAC website
- Social media
- Other

- Was the registration on the website easy?

- Yes
- No

- Do you want a digital copy of the TIMEPAC Guidelines for the generation of EPCs from BIM models?

- Yes
- No

- Are you planning to participate in other TIMEPAC webinars?

- Yes
- No

Final comments and remarks

Annex B – Evaluation form in-class training activity

Advanced methods and tools for energy rehabilitation of buildings

Thursday 23 and Thursday 30 May 2024

- Have your expectations about the content and format of the *Advanced Methods and Tools for Building Energy Rehabilitation from a Holistic Perspective* course been met?

- Yes, completely
- Partially
- No

- Have you acquired new information about improving CEEs to make them useful tools for decarbonising the real estate stock?

- Yes, completely
- Partially
- No

- Do you see BIM as a useful tool to improve CEE in the future?

- Yes, completely
- Partially
- No

- Please evaluate all sessions presented in the Advanced Methods and Tools for Building Energy Rehabilitation course from a holistic perspective:

- **Introduction to TIMEPAC** (Leandro Madrazo)

☺☺☺☺☺

- Challenges of the new Directive on the energy efficiency of buildings (Ainhoa Mata)

☺☺☺☺☺

- Generation of CEE improved with BIM data (Álvaro Sicilia - Adirane Calvo - Benjamín González)

☺☺☺☺☺

- Creation of a BIM model for the generation of the certificate: a municipal building (Benjamín González)

☺☺☺☺☺

- Review of exercises (Benjamín González)

☺☺☺☺☺

- Certification throughout the renewal process (Ainhoa Mata)

☺☺☺☺☺

- Building renovation passport (Adirane Calvo)

☺☺☺☺☺

- **Generation of a BIM model for the step-by-step renovation of a residential building** (Benjamín González - Marta Chàfer)

☺☺☺☺☺

- Which session was most relevant to professional practice?

- Introduction to TIMEPAC (Leandro Madrazo)
- Challenges of the new Directive on the energy efficiency of buildings (Ainhoa Mata)
- Generation of EPC improved with BIM data (Álvaro Sicilia - Adirane Calvo - Benjamín González)
- Creation of a BIM model for the generation of the certificate: a municipal building (Benjamín González)
- Review of exercises (Benjamín González)
- Certification throughout the renewal process (Ainhoa Mata)
- Building renovation passport (Adirane Calvo)
- Generation of a BIM model for the step-by-step renovation of a residential building (Benjamín González - Marta Chàfer)

- Within the EPC data flow (generation, storage, analysis and exploitation), which stage of this continuous cycle do you consider most critical to improving building assessment?

- Generation
- Storage
- Analysis
- Exploitation

- How did you find out about the TIMEPAC Academy?

- Email from a TIMEPAC member
- Email from a friend
- TIMEPAC website
- Social media
- Other

- Was it easy to register on the website?

- Yes
- No

- How would you rate the comfort and functionality of the facilities during the course?

☺☺☺☺☺

- Do you plan to use the tools seen in the course in your professional activity?

Final comments and observations
