EBENTO Final Results

Partner Insights on 45 Months of Building Renovation Innovation

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1 INTRODUCTION

To mark the project's conclusion, partners shared their perspectives through the *EBENTO Final Results – Partner Insights Series* (articles) and *From Pilots to Practice* (video interviews). Reflecting on the journey from October 2022 to the present, these stories highlight major achievements, lessons learned, and the future potential of EBENTO's digital tools and Energy Performance Contracting solutions. Additionally, *EBENTO Results on the Ground* captures the experiences of residents and pilot leaders in Athens, Tallinn, Valencia, and Manchester—demonstrating how EBENTO has improved comfort, reduced energy consumption, and built confidence in renovation projects.

2 ETRA: Coordinating Innovation to Build a Smarter and More People-Centred Future for Building Renovation

Delivering a European Innovation Action requires much more than developing new technologies. It means bringing together organisations with different expertise, aligning diverse perspectives, overcoming technical and regulatory barriers, and ensuring that innovative ideas become practical solutions capable of creating long-term impact.

As coordinator of the EBENTO project and leader of its communication, dissemination and exploitation activities, ETRA has been at the heart of this process. Over the project's 45-month journey, the organisation has not only coordinated a multidisciplinary consortium across Europe but has also led the development of some of EBENTO's flagship digital solutions, helping transform an ambitious concept into a fully operational One-Stop-Shop ecosystem for building renovation.

"Our role was to ensure that all technical developments came together as one coherent ecosystem while keeping people, not technology, at the centre of the project."



Figure 1 - Members of the EBENTO consortium at the ETRA headquarters.

Coordinating a Diverse Consortium Around a Common Vision

EBENTO brought together software developers, research centres, universities, legal experts, facility managers and pilot sites from different European countries. According to ETRA, this diversity became one of the project's greatest assets.

"The diversity is essential in a project as complex as EBENTO. Industrial partners provide technical expertise, but aspects such as users' needs, legal frameworks and socio-economic challenges can only be addressed by involving organisations with complementary expertise."

The pilot sites played a particularly important role, allowing the consortium to validate the platform under real operating conditions while involving citizens, building managers and local authorities throughout the development process.

Beyond the consortium itself, ETRA also highlights the value of engaging external experts from different countries, whose knowledge helped refine both the technical developments and the project's strategic direction.



Figure 2 - Anais Martínez, project manager, presenting advancements of the EBENTO project.

Building the Digital Backbone of EBENTO

Alongside its coordination role, ETRA was responsible for developing several of EBENTO's core digital components.

These include the EBENTO One-Stop-Shop platform itself, the 3D Dynamic Map, the Energy Efficiency, Comfort and Environment (ECE) module, the Economic Simulator, and the Energy

Performance Contracting (EnPC) modules. The organisation also led the integration of all technical components into a single digital ecosystem capable of supporting the complete building renovation process.

One of the project's major technical milestones was successfully connecting real pilot buildings to the platform.

"The whole integrated EBENTO solution bridges technical simulations with real-time monitoring and data ingestion, creating a comprehensive ecosystem to support renovation decisions."

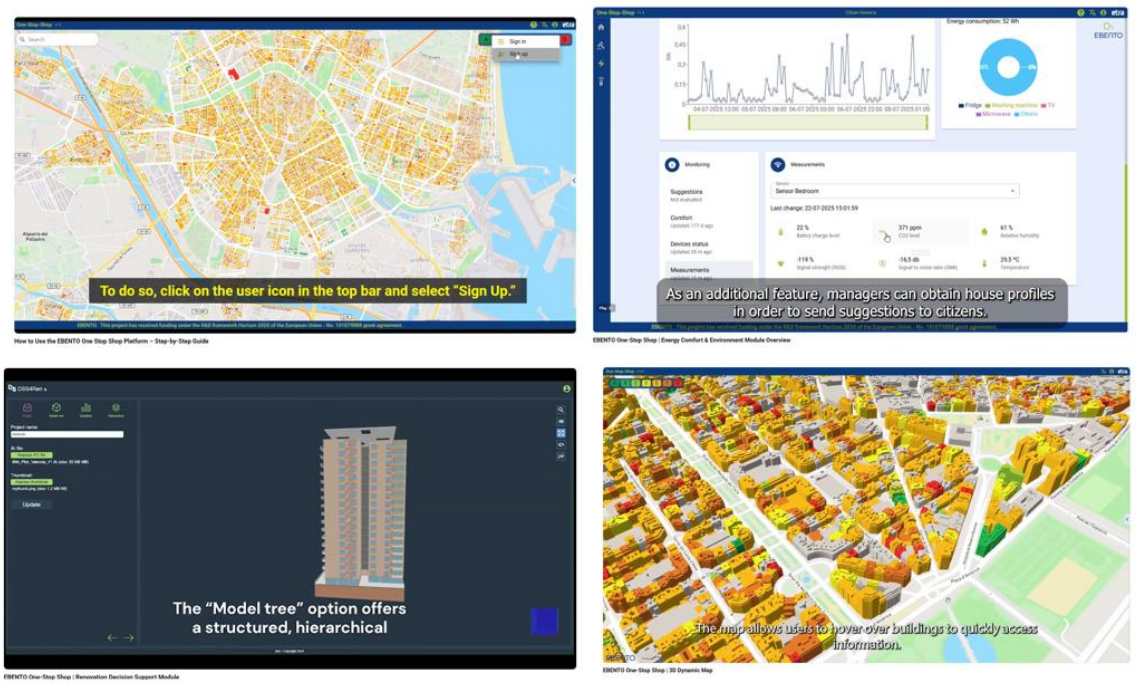


Figure 3 - EBENTO One-Stop-Shop and modules demo videos.

Several algorithms developed during the project are now expected to become part of ETRA's commercial portfolio, including advanced demand response functionalities, comfort assessment tools and intelligent monitoring services.

Turning Complex Data into Practical Decision Support

One of EBENTO's flagship innovations is its 3D Dynamic Map, designed to make building energy information easier to understand for both professionals and citizens.

Surprisingly, according to ETRA, the greatest challenge was not the software itself.

"The Dynamic Map was not primarily a technical challenge—it became a puzzle of different legislations and data transparency rules across Europe."

While countries such as Spain provide open access to cadastral information and Energy Performance Certificates, other countries impose restrictions or require payment to access similar datasets. In many cases, property records and energy certificates also follow completely different structures.

"We had to adapt the tools to each country's legislation and data availability."

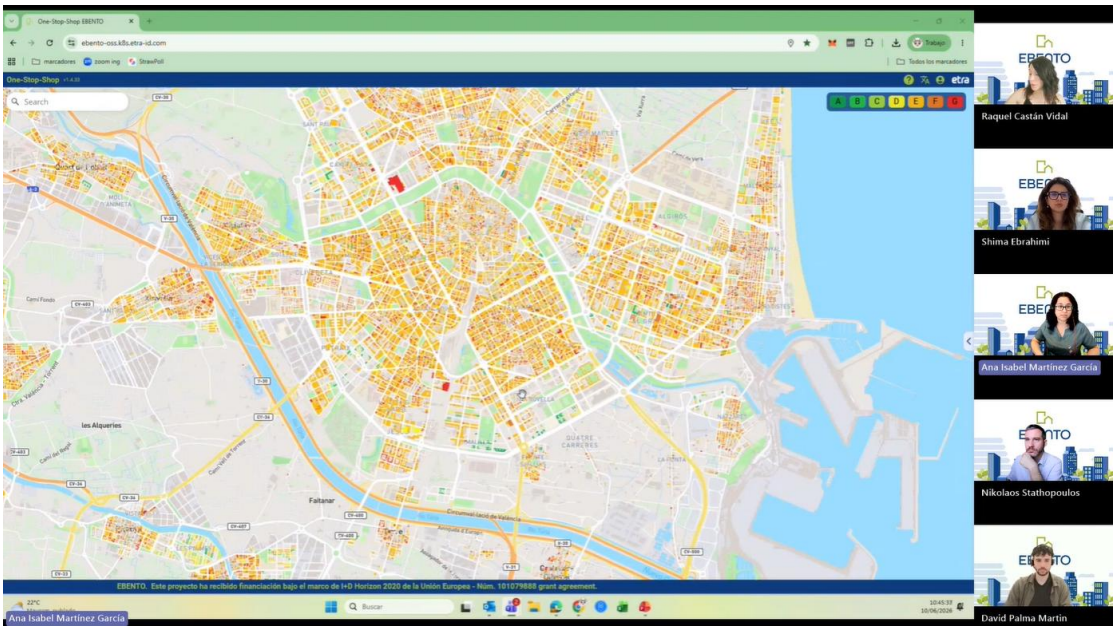


Figure 4 - EBENTO One-Stop-Shop webinar.

This flexibility has allowed the platform to accommodate national differences while maintaining a consistent user experience.

Integrating an Entire Digital Ecosystem

Perhaps one of the most demanding aspects of the project was integrating the numerous technical modules developed by different partners into a single operational platform.

To achieve this, ETRA implemented an iterative integration and testing strategy based on proven methodologies.

"Once each module had been validated individually, technical partners created a comprehensive set of tests to verify both data flows and interfaces."

The process involved multiple development cycles during which technical issues were identified, corrected and re-tested until the entire ecosystem functioned as intended.

At the same time, pilot partners continuously validated the platform using real buildings and real data.

"This iterative process allowed us not only to solve unexpected technical problems, but also to make the platform more intuitive by incorporating suggestions from partners and simplifying highly technical information."

Communicating Innovation Through Stories

As leader of communication and dissemination, ETRA recognised early that technical excellence alone would not guarantee impact.

Instead of focusing exclusively on project achievements, the team shifted its strategy towards people-centred storytelling.

"Our key strategy was moving from simply providing information to fostering active engagement through impactful storytelling and strategic clustering."



Figure 5 - EBENTO Talks series.

This approach gave rise to initiatives such as EBENTO Talks, the Partner Insights Series, From Pilots to Practice videos and guided visits to pilot buildings, helping citizens better understand the practical benefits of renovation.

At European level, ETRA also strengthened collaboration with other Horizon projects through the Network of Building Renovation Projects and partnerships with initiatives such as Built4People.

One particularly memorable milestone came during the EU Sustainable Energy Week (EUSEW), when the European Commissioner for Energy visited the EBENTO stand.

"Hosting the Commissioner validated our work at the highest policy level and reinforced the relevance of the project within the European energy transition."

By the end of the project, EBENTO had generated more than 80,000 social media impressions, produced 24 specialised videos, organised webinars and workshops, and created communication materials designed to support future adopters.

Delivering Impact Beyond Technology

For ETRA, the project's greatest achievement is not a single tool but the integrated EBENTO ecosystem itself.

Buildings account for around 36% of CO_2 emissions in the European Union, while approximately 75% of the existing building stock remains energy inefficient. Against this backdrop, EBENTO demonstrates how digital technologies can support more effective renovation planning and better decision-making.



Figure 6 - Site visit at the Spanish building.

Across the pilot sites, the platform helped evaluate renovation scenarios capable of reducing CO_2 emissions by between 24% and 77%, while electricity consumption fell by up to 27%

depending on the building. Just as importantly, occupants reported significant improvements in indoor comfort, with feelings of discomfort reduced by as much as 67%.

"The whole integrated solution offers a comprehensive set of tools to reduce energy consumption while significantly improving people's comfort."

Lessons for Future European Innovation Projects

Reflecting on the project, ETRA identifies several lessons that extend well beyond EBENTO itself.

From a technical perspective, modular system architectures proved essential for managing complexity and ensuring future scalability.

"In a project of this ambition, the architecture must be modular, with each tool having a clear responsibility and well-defined interfaces."

Pilot validation also emerged as a critical success factor.

"Real pilot conditions reveal issues that cannot be identified during internal development, including data availability, device connectivity and workflow challenges."



Figure 7 - Internal workshop about the EBENTO One-Stop-Shop.

From a communication perspective, the team found that meaningful engagement matters more than simply reaching large audiences.

"Quality beats quantity when building engagement. Trust grows through transparency, proximity and by giving citizens direct access to understandable information."

ETRA also encourages future Horizon Europe projects to involve end-users from the very beginning and to build long-term digital legacies through open repositories, practical guidance and continuous collaboration.

Looking Beyond EBENTO

Although the project has officially concluded, ETRA sees EBENTO as the starting point for a much longer journey.

The organisation plans to continue developing the platform for at least the next three years, improving existing modules, introducing new Energy Performance Contracting models and expanding the 3D Dynamic Map to additional European countries.

Among the project's Key Exploitable Results are the One-Stop-Shop platform, the DSS4Ren renovation simulator, the Energy Efficiency, Comfort and Environment module, the Energy Performance Contracting module and the Economic Simulator.

"We want to continue adapting these tools to real market needs and transform them into market-ready solutions that can support cities, energy communities and building owners across Europe."



Figure 8 - Energia 13 building, one of the Estonian pilot sites.

At the same time, ETRA will maintain EBENTO's digital legacy through an Open Science Hub, public repositories, training resources and the project's Replication Handbook, ensuring that the knowledge generated remains available long after the project has ended.
Looking back on almost four years of collaboration, ETRA believes EBENTO's greatest legacy goes beyond technology.

"EBENTO should be remembered not just as a suite of digital tools, but as a replicable framework proving that technical excellence and social equity go hand in hand."

By coordinating one of Europe's most ambitious digital renovation initiatives, ETRA has helped lay the foundations for a future where building renovation is not only smarter and more efficient, but also more accessible, transparent and centred on the people it is ultimately designed to serve.

3 HYPERTECH: Building the Digital Backbone Behind EBENTO's Renovation Intelligence Platform

When the EBENTO project was launched in 2022, one of its key ambitions was to simplify and accelerate building renovation decision-making through digitalisation, interoperability and data-driven intelligence. Achieving this vision required more than innovative tools—it required a robust technical foundation capable of connecting data, simulation models and user-oriented services within a single ecosystem.

This is where HYPERTECH partner played a pivotal role.

As EBENTO's Technical Coordinator, HYPERTECH led the design and implementation of the project's technical backbone, helping transform a complex set of requirements, use cases and business scenarios into a scalable and interoperable One-Stop-Shop (OSS) platform. Through its work on system architecture, digital twins, data management and renovation decision support, the company helped create the technological framework that underpins the entire EBENTO ecosystem.



Figure 9 - HYPERTECH, METLEN and ETRA partners in an EBENTO meeting.

"We applied a thinking-by-design approach by starting from users, use cases and business scenarios rather than from isolated technical modules. This ensured that the OSS evolved as a modular system grounded in real workflows rather than purely technical assumptions."

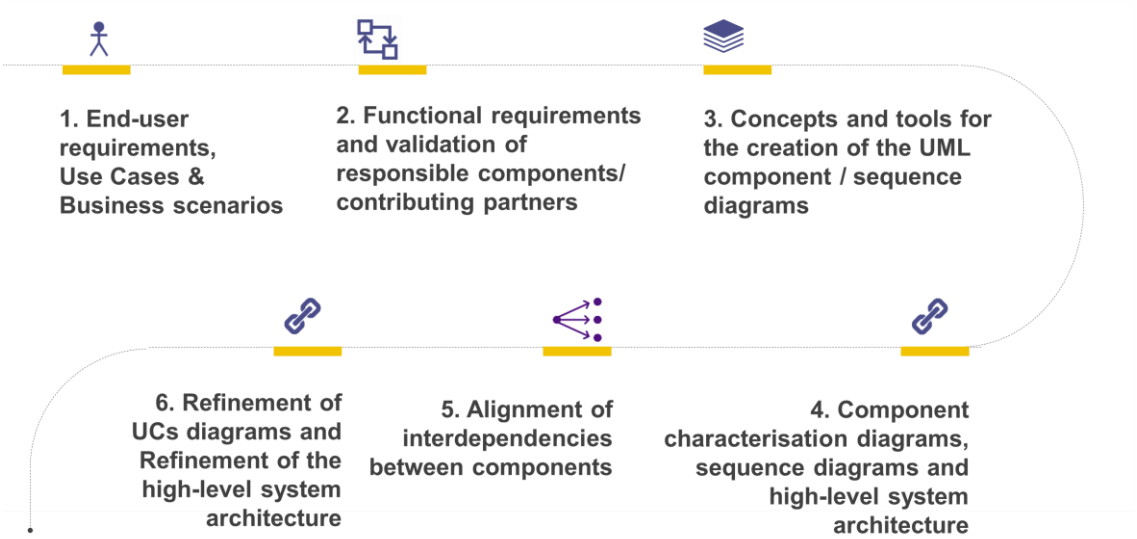


Figure 10 - Methodology for defining the EBENTO system architecture.

From Concept to Functioning Platform

For HYPERTECH, one of the most significant moments during the project was the transition from conceptual design to implementation.

The architecture definition process was developed through a series of iterative steps involving user requirements, functional specifications, UML modelling, component interdependencies and continuous consortium feedback. This collaborative process allowed all technical partners to align their developments around a shared vision.

According to HYPERTECH, a major milestone was reached with the successful completion of the Digital Twin, Common Data Environment (CDE) and DSS4Ren prototypes.

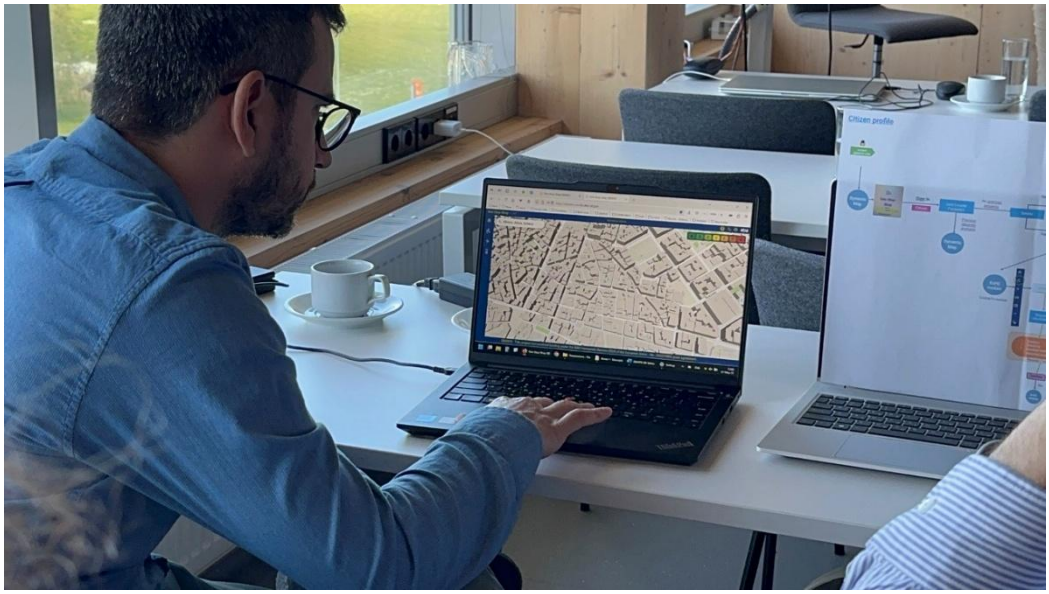


Figure 11 - Nicolas Stathopoulos of HYPERTECH testing the EBENTO OSS.

"This demonstrated that EBENTO was no longer only a system concept, but a functioning technical environment capable of supporting renovation assessment through BIM, simulation and KPI-driven decision support."

Making Complex Renovation Decisions Simpler

One of the most impactful outcomes of EBENTO has been the integration of the BIM-based Digital Twin framework, the Common Data Environment and the DSS4Ren renovation assessment module.

Building renovation projects often face a common challenge: information is scattered across multiple tools, formats and stakeholders, making decision-making slow and inefficient. HYPERTECH's work addressed this challenge by creating a structured digital environment where building information can be collected, managed and transformed into actionable insights.



Figure 12 - Overview DSS4Ren module, part of the EBENTO OSS.

The Digital Twin framework combines static BIM data with dynamic information such as energy performance, indoor environmental conditions and weather data. At the same time, the Common Data Environment ensures that information can be stored, processed and shared consistently across different components and stakeholders.

"Instead of keeping geometry, materials, HVAC systems, energy data, indoor conditions and weather information in disconnected files or tools, EBENTO's Digital Twin framework brings them together within one structured representation."

The result is a more integrated and transparent renovation process, where users can evaluate different renovation strategies based on clear performance indicators.

Turning Advanced Simulation into Practical Decision Support

Another key achievement has been the development of DSS4Ren, EBENTO's Renovation Decision Support module.

Rather than requiring users to interact directly with complex simulation engines, DSS4Ren guides them through a simplified workflow. Users can review a building baseline, select renovation measures, generate alternative scenarios and compare resulting energy, comfort and economic performance indicators.

For HYPERTECH, this user-oriented approach represents one of the project's greatest strengths.

"Simulation tools create far more value when they are embedded in a guided user workflow, with clear KPI outputs and intuitive interfaces, rather than being treated as standalone expert applications."

By translating sophisticated technical analyses into understandable recommendations, DSS4Ren helps bridge the gap between engineering expertise and real-world renovation decision-making.

Lessons for Future European Innovation Projects

The journey was not without challenges.

Bringing together diverse pilot sites, technical modules, user expectations and national contexts into a single coherent architecture required continuous coordination and refinement. HYPERTECH addressed these challenges through an agile development approach supported by technical workshops, use-case discussions and iterative architecture reviews.

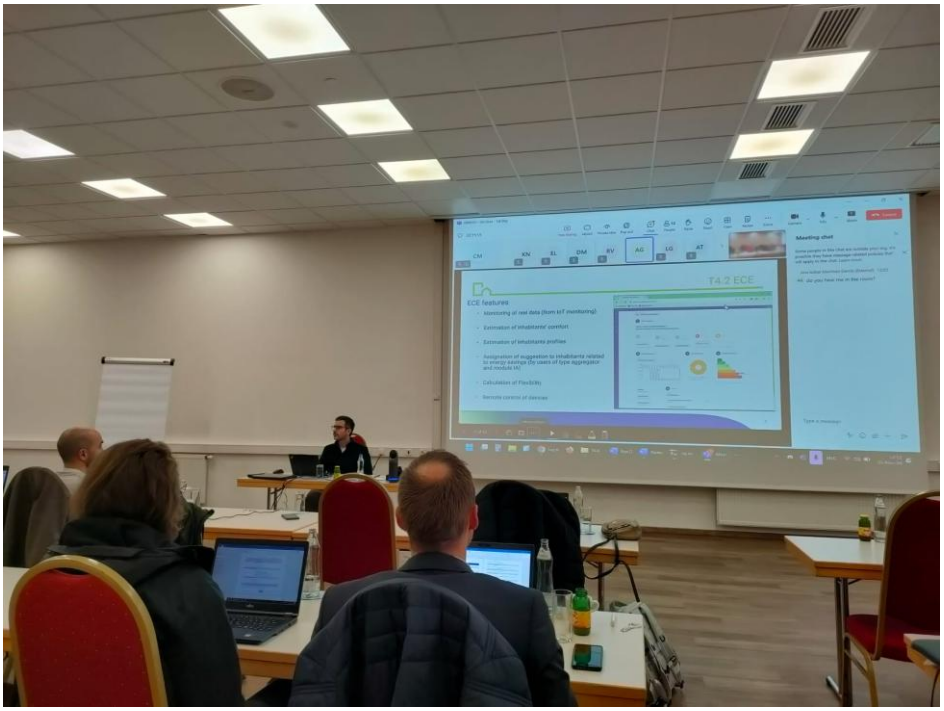


Figure 13 - Nicolas Stathopoulos of HYPERTECH presenting the EBENTO OSS.

One of the main lessons learned was the importance of establishing a common understanding of data flows, responsibilities and user needs from the very beginning.

"Technical scalability starts with methodological clarity. Before building advanced services, the consortium needed a shared understanding of use cases, actors, data flows and dependencies."

The team also emphasises the importance of investing early in a common data layer, which can significantly reduce integration and validation challenges later in the project lifecycle.

Looking Beyond EBENTO

Although the project is reaching its conclusion, HYPERTECH sees EBENTO as a starting point rather than an endpoint.

The knowledge, methodologies and technologies developed throughout the project are already informing the company's future work in digital renovation services, building intelligence solutions and performance-driven energy management.

In particular, the Digital Twin framework, Common Data Environment and DSS4Ren concepts provide a strong foundation for next-generation services that combine interoperable building data, simulation-based assessment and user-friendly decision support.

As Europe continues to accelerate the renovation of its building stock, HYPERTECH believes that integrated digital ecosystems such as EBENTO will become increasingly important.

“The project has created a strong basis for solutions that combine interoperable building data, simulation-driven assessment and user-oriented interfaces.”

By helping transform fragmented building information into actionable renovation intelligence, HYPERTECH has contributed to one of EBENTO’s central ambitions: making smarter, data-driven building renovation accessible and scalable across Europe.

4 IEECP: Building the Business and Legal Foundations for a New Generation of Energy Performance Contracting

Across Europe, improving the energy performance of residential buildings is no longer just a technical challenge—it is also a financial and legal one. While innovative renovation technologies continue to emerge, many projects struggle to move forward because existing business models, contractual frameworks and financing mechanisms are not designed for the residential sector.

Within the EBENTO project, the Institute for European Energy and Climate Policy (IEECP) has played a central role in addressing these barriers. Drawing on its expertise in energy policy, business models and impact assessment, IEECP led the development of EBENTO's Energy Performance Contracting (EnPC) framework, designed innovative contract models, analysed legal barriers across Europe and developed the project's socio-economic impact assessment methodology.

"Our objective was to create contractual and business frameworks that make performance-based renovation more accessible, particularly for SMEs, smaller ESCOs and residential building owners."



Figure 14 - Dimitra Tzani and Indriany Lionggo (IEECP team) in an EBENTO meeting.

Rethinking Energy Performance Contracting for the Residential Sector

Traditional Energy Performance Contracts have successfully supported energy efficiency projects in large commercial and public buildings. However, they have struggled to gain

traction in residential renovation, where projects are smaller, payback periods are longer and investment risks are perceived to be higher.
Recognising these limitations, IEECP led the development of an enhanced EnPC framework capable of addressing today's energy market realities.
Rather than relying solely on guaranteed energy savings, the new models developed within EBENTO integrate additional value streams such as demand response services, flexibility revenues and indoor comfort guarantees.

"This work directly addresses one of the most persistent structural problems in the European renovation market: conventional Energy Performance Contracts are designed for large, well-capitalised actors and leave SMEs and smaller ESCOs effectively locked out."

The result is a family of five contract types, each tailored to different market needs and levels of risk, allowing organisations to progressively adopt performance-based contracting without requiring significant upfront financial capacity.
By broadening the value proposition beyond energy savings alone, these models create new business opportunities while making renovation investments more attractive.



Figure 15 - Indriany Lionggo presenting IEECP progress.

Making Renovation More Bankable

One of EBENTO's key ambitions has been to reduce the financial barriers that prevent large-scale residential renovation.
According to IEECP, one of the most promising innovations lies in combining traditional energy savings with revenues generated through building flexibility.

"A concrete innovation is the integration of implicit and explicit demand response services into Energy Performance Contracts."

Instead of depending exclusively on reduced energy bills, building owners and Energy Service Companies (ESCOs) can also generate value by providing flexibility services to the electricity system.

"These additional revenue streams reduce dependence on energy savings alone, shorten payback periods and improve the financial viability of projects that would otherwise remain marginal."

Combined with EBENTO's One-Stop-Shop platform, the new contract models simplify contractual management while reducing transaction costs and administrative burdens that have historically discouraged smaller market actors from participating.

Navigating Europe's Complex Legal Landscape

Developing innovative business models was only one part of the challenge.
Because EBENTO operates across Spain, Greece, Estonia and the United Kingdom, IEECP also carried out an extensive legal analysis to understand how Energy Performance Contracts are regulated within different national frameworks.
One of the project's most important findings was that there is still no harmonised legal definition of Energy Performance Contracting across Europe.

"The biggest legal obstacle is the fragmentation and legal ambiguity of how Energy Performance Contracting is classified under national law."

Depending on the country, the same contract can be considered a service agreement, a financial lease or a public-private partnership, each carrying different legal and financial implications.
Beyond contractual classification, the project also explored emerging legal questions surrounding indoor comfort guarantees, flexibility revenues and data protection requirements associated with continuous building monitoring.
To address these challenges, IEECP developed a comprehensive contractual framework based on European standards while providing country-specific guidance that supports practical implementation.

"The result is a legal and contractual framework that is rigorous enough to be enforceable while remaining accessible for SMEs and other market actors."

Building Trust Through Transparent Impact Assessment

Innovation only succeeds if investors, building owners and public authorities trust the results. As leader of EBENTO's impact assessment activities, IEECP developed a comprehensive methodology to verify both the economic and social impacts of renovation projects.
The framework combines financial indicators—such as investment costs, return on investment, payback periods and flexibility revenues—with social indicators including thermal comfort, indoor air quality, affordability, user acceptance and job creation.

"Investor confidence in energy renovation depends above all on the credibility of what is measured and how."

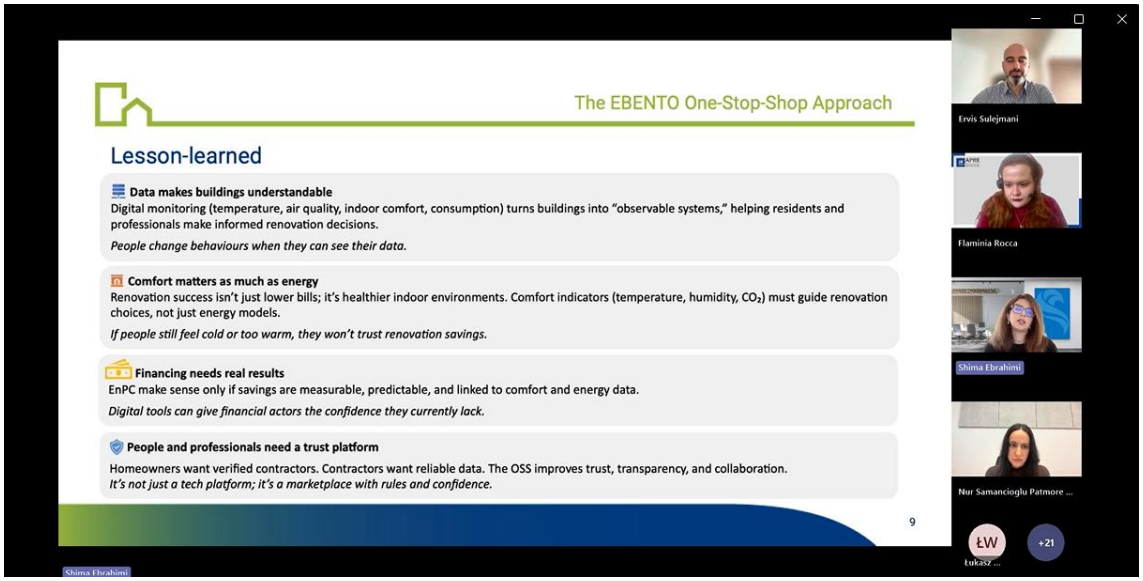


Figure 16 - Shima Ebrahimi participating in a cluster event.

Rather than treating impact assessment as a final reporting exercise, EBENTO integrates continuous monitoring directly into the One-Stop-Shop platform, enabling transparent verification throughout the lifetime of renovation projects.

"Verification in EBENTO is not a one-off end-of-project evaluation but an ongoing process integrated into the platform."

This continuous approach strengthens confidence among investors while providing building owners with reliable evidence of performance over time.

Lessons for Future European Projects

Looking back on the project, IEECP believes one of the biggest lessons is that innovative business models, legal frameworks and pilot implementation should evolve together from the very beginning.

Developing advanced contractual concepts is not enough if they cannot be demonstrated under real operational conditions.

"Future projects should align pilot implementation, business model development and impact assessment as early and as closely as possible."

The project also highlighted the importance of designing contractual frameworks that reflect the multiple benefits of renovation, including comfort, flexibility and wider socio-economic impacts—not simply reductions in energy consumption.

"Future EnPC models need to move beyond a narrow focus on energy savings."

Continuing EBENTO's Legacy

Although EBENTO is coming to an end, IEECP sees its outcomes as the starting point for a new generation of performance-based renovation services.

The enhanced contractual models, legal methodologies and impact assessment frameworks developed during the project will continue to support future European research initiatives, policy advice and market development activities.

The organisation also plans to build upon the project's findings to further explore innovative financing mechanisms, demand-side flexibility, socio-economic impact assessment and regulatory frameworks capable of accelerating residential renovation across Europe.

As Europe moves towards a more flexible, digital and decarbonised energy system, IEECP believes that successful renovation will depend not only on better technologies, but also on smarter contracts that fairly distribute risks, reward performance and create confidence for all stakeholders.

By redefining how Energy Performance Contracting can work in the residential sector, IEECP has helped lay the business, legal and financial foundations needed to make Europe's renovation ambitions a practical reality.

5 JOANNEUM RESEARCH: Redefining Energy Performance Contracting for Europe's Renovation Future

As Europe seeks to accelerate the renovation of its residential building stock, one challenge remains particularly difficult to overcome: making renovation projects financially attractive for homeowners, investors and service providers.

While technical solutions for improving energy efficiency are increasingly available, many renovation projects still struggle to secure investment due to long payback periods, fragmented decision-making and limited business incentives.

Within the EBENTO project, JOANNEUM RESEARCH (JR) set out to address this challenge by rethinking one of the most established financing mechanisms in the energy sector: Energy Performance Contracting (EnPC).

Through its work on innovative business models, socio-economic assessment and stakeholder analysis, JR helped develop a new generation of EnPC concepts designed to support the energy transition while creating additional value for building owners and residents.



Figure 17 - Clemens Mayer of JR presenting EBENTO new business models in a summer school.

Moving Beyond Traditional Energy Performance Contracting

From the outset of EBENTO, JOANNEUM RESEARCH focused on the development of innovative business models capable of making residential renovation more economically viable.

A major achievement was the creation of an enhanced Energy Performance Contracting model that extends beyond the traditional focus on energy savings.
The concept incorporates additional revenue streams generated through flexibility services, demand response participation and comfort-related benefits, creating a more comprehensive and attractive business proposition for renovation projects.

"A key result was the definition of an enhanced EnPC concept that goes beyond classical energy savings by integrating flexibility revenues, demand response, and comfort-related value into the business model."

This work became one of the foundational elements of EBENTO's business model strategy and was further validated through scientific dissemination at the REAL CORP conference, where the concept was presented and published in the conference proceedings.
For JR, this represented a significant milestone in the project.

"By integrating flexibility revenues and comfort aspects into the EnPC logic, we helped to sharpen the project's core business model concept early on."

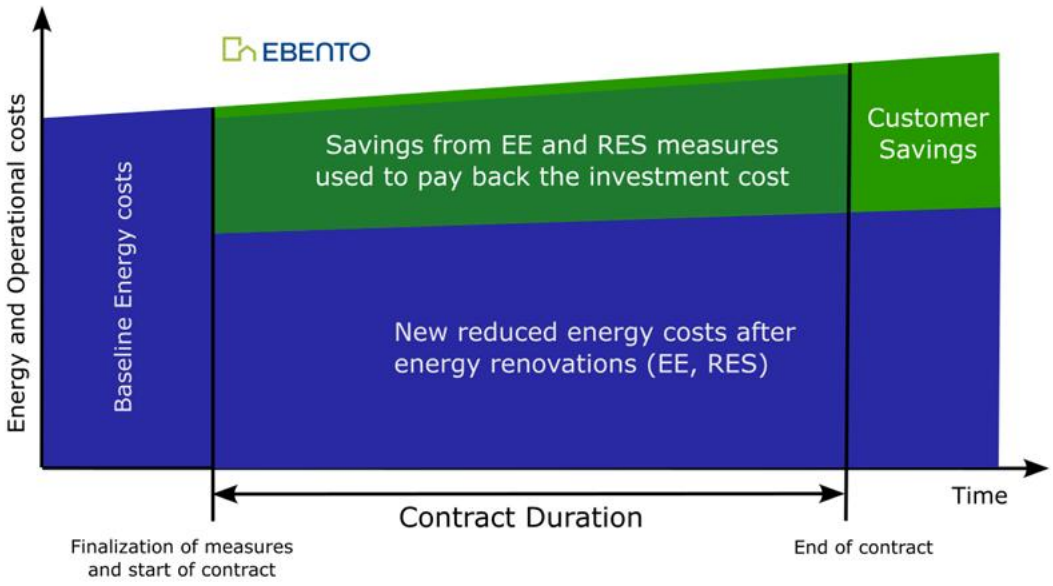


Figure 18 - Energy savings and cost of a typical EnPC.

Tackling the Financial Barriers to Renovation

Across Europe, one of the main obstacles to large-scale residential renovation remains economic feasibility.

Traditional Energy Performance Contracting models often rely exclusively on future energy savings to recover investment costs. However, in many residential settings, these savings alone are insufficient to generate attractive returns within a reasonable timeframe.

JR's research highlighted the importance of expanding the value proposition.

"The market outlook showed that payback periods in residential renovation are often very long, making it difficult to refinance investments through energy cost savings alone."

By incorporating flexibility revenues generated through both implicit and explicit demand response schemes, the enhanced EBENTO model offers new pathways for improving project profitability.



Figure 19 - Clemens Mayer of JR presenting EBENTO in the exhibition area of the World Sustainable Energy Days 2024 in Austria.

"A concrete example is the development of a new EnPC concept that integrates implicit and explicit flexibility services. By considering flexibility revenues and energy cost savings alongside traditional energy savings, the model shows a

pathway to shorten payback periods and make EnPCs more attractive for residential buildings."

This approach aligns closely with the evolving European energy landscape, where buildings are increasingly expected not only to consume energy efficiently but also to actively contribute to grid flexibility and system stability.

Creating Value Beyond Energy Savings

While economic viability is essential, JOANNEUM RESEARCH's work also highlighted the importance of considering broader societal benefits.
The team's socio-economic analyses revealed that residents often value comfort and quality-of-life improvements as much as, or even more than, direct energy savings.

"Beyond energy savings, the most relevant qualitative benefits identified are increased comfort and higher property value."

Renovation measures can significantly improve indoor living conditions by creating more stable temperatures throughout the year, reducing discomfort during both winter and summer months. These improvements directly enhance wellbeing for residents while also increasing the attractiveness and long-term value of properties.
This finding reinforces a key message emerging from EBENTO: successful renovation strategies should communicate multiple benefits, not just reduced energy consumption.

The Power of the One-Stop-Shop Approach

Among EBENTO's many innovations, JR considers the combination of the One-Stop-Shop (OSS) model and enhanced Energy Performance Contracting to be one of the project's most impactful achievements.
The renovation journey can often be overwhelming for homeowners due to administrative complexity, technical uncertainty, financing challenges and fragmented information sources.
According to JR, integrating innovative business models within a comprehensive support ecosystem can help overcome these barriers.



Figure 20 - UL and JR partners testing the EBENTO One-Stop-Shop.

"The most impactful result is the combination of the one-stop-shop approach with enhanced EnPC business models. This addresses several major barriers to residential renovation at once: complexity, lack of trust, high transaction costs, financing uncertainty, and the need to communicate benefits beyond energy savings."

By simplifying decision-making and providing coordinated support, the OSS approach increases the likelihood that innovative financing and contracting models can be successfully adopted in practice.

Lessons for Future Innovation Projects

Like many Horizon Europe projects, EBENTO brought together diverse pilot environments with different technical conditions, stakeholder groups and implementation realities.
For JOANNEUM RESEARCH, one of the main challenges was evaluating economic performance consistently across these highly varied contexts.
Moreover, while the project developed innovative EnPC concepts, the pilot activities themselves were not implemented through the full enhanced contracting model, making direct validation more difficult.

"The pilots were not implemented through the enhanced EnPC models with flexibility elements defined in the project, which made it difficult to directly prove the full business model concept within EBENTO."

This experience led to an important lesson for future projects.

"A key best practice is to align pilot implementation, business model development, and impact assessment as early and as closely as possible."

Doing so allows innovative concepts to be tested under real-world conditions while generating robust evidence to support future market uptake and replication.

Building on EBENTO's Legacy

Although the project is coming to a close, JOANNEUM RESEARCH sees significant opportunities to further develop the concepts created within EBENTO.
The enhanced EnPC model provides a foundation for future research and innovation activities focused on demand-side flexibility, performance-based renovation, energy services and socio-economic impact assessment.
A key lesson is that future EnPC models need to move beyond a narrow focus on energy savings.

"Flexibility, comfort, user acceptance and wider socio-economic benefits must be integrated into the business model to improve the viability of renovation projects."



Figure 21 - EBENTO partners visiting one of the buildings of the Tallinn pilot site.

Looking ahead, JR intends to continue building on EBENTO's findings through new research initiatives and policy-oriented projects that explore innovative financing and contracting mechanisms for residential renovation.

As Europe works towards its climate and energy goals, JOANNEUM RESEARCH believes that the future of renovation will depend not only on better technologies, but also on smarter business models capable of turning ambitious energy targets into financially viable opportunities for citizens, investors and communities alike.

6 University of Ljubljana: Putting People at the Centre of Europe's Renovation Transition

As Europe accelerates efforts to decarbonise its building stock, technological innovation alone is not enough. Successful renovation depends just as much on people, organisations, financing mechanisms and local realities as it does on digital tools and energy performance improvements.
This people-centred perspective has been at the heart of the University of Ljubljana's contribution to the EBENTO project.
Through the combined expertise of the Laboratory of Energy Policy at the Faculty of Electrical Engineering (UL FE) and the Institute for Innovation and Development (IRI UL), the University brought together engineering, social science and innovation management perspectives to help ensure that EBENTO's solutions were not only technically robust, but also aligned with the needs and expectations of citizens, communities and market actors. "Our goal was to help make EBENTO's solutions better aligned with the realities of citizens, communities and stakeholder organisations," explains the team.



Figure 22 - UL FE, IRI UL and JR partners in an EBENTO meeting.

Bridging Technology and Human Behaviour

While many project partners focused on technical developments, the University of Ljubljana played a key role in understanding the human, organisational and financial dimensions of building renovation.

The team developed interview guidelines and analytical frameworks that were used across participating countries to explore stakeholder perspectives on renovation, Energy Performance Contracting (EnPC) and emerging business models. Their work provided valuable insights into the barriers, motivations and enabling factors that influence renovation decisions.

As the project progressed, this early stakeholder research became increasingly important.



Figure 23 - Katarina Kern presenting EBENTO in an event.

"An important milestone was when the early qualitative research began to feed more clearly into later stages of EBENTO," the team recalls.

"It became an important foundation for understanding stakeholder needs, barriers and enabling conditions, and later also for assessing the project's socio-economic impacts."

By combining technical engineering knowledge with qualitative research methods, the University helped ensure that EBENTO remained focused not only on what is technically possible, but also on what is feasible and acceptable in practice.

Unlocking the Potential of Energy Performance Contracting

Among the many innovations explored within EBENTO, the University of Ljubljana considers the project's work on Energy Performance Contracting (EnPC) in residential buildings to be one of its most significant contributions.

Across Europe, improving building energy efficiency requires more than innovative technologies. It also requires business models and financing mechanisms capable of making renovation attractive, affordable and manageable for building owners and residents.

"Even promising solutions will not achieve wider uptake unless they reflect and address stakeholder motivations, concerns, capacities and local realities," the team explains.

EBENTO helped advance understanding of how EnPC models could be adapted to the residential sector, where their adoption remains limited despite their significant potential.

The relevance of this work is already visible beyond the project itself. In Slovenia, public initiatives such as the Eco Fund's support schemes for deep renovation projects involving Energy Service Companies (ESCOs) demonstrate growing recognition of the challenges EBENTO has been addressing.

"EBENTO tackled a real gap that public actors have recently also been trying to solve," the team notes.

Renovation Is a Social Process

One of the strongest messages emerging from the University's work is that successful renovation is fundamentally a social process.

Through stakeholder engagement activities and socio-economic impact assessments, the team found that technology alone cannot drive change. Citizens need guidance, trust and support throughout the renovation journey.

"One of the most important lessons from EBENTO is that innovative renovation solutions do not work on their own," the researchers explain.

"Even when a tool, model or service is well designed, people still need support in understanding it, using it and connecting it to their own situation."

This insight has reinforced the importance of combining digital tools with advisory services, mediation mechanisms and local support structures.

The University points to its experience with One-Stop-Shop renovation services as a particularly successful example of this approach. These models bring together municipalities,

financial institutions, technical experts and citizens into a single support ecosystem, helping residents navigate every step of the renovation process.



Figure 24 - UL FE, IRI UL and JR partners in an EBENTO meeting.

"Our experience shows that successful home renovation is not driven only by digital tools, but by trust, local presence and coordinated guidance throughout the entire customer journey."

From Passive Citizens to Active Participants

A key question for Europe's renovation wave is how to encourage citizens to become active participants in improving their homes.

For the University of Ljubljana, the answer lies in trust, communication and empowerment.

"People need to feel that renovation is happening with them, not to them," the team explains.

Their research within EBENTO revealed that participation increases when benefits are tangible, responsibilities are clear and trusted intermediaries help guide the process. Conversely, uncertainty, lack of transparency and distrust often discourage engagement.

"Participation grows when communication is clear, benefits are concrete, trusted intermediaries are involved, and someone within the building or community helps mobilise others."



Figure 25 - UL FE and IRI UL presented EBENTO in a cluster event.

This people-centred perspective has become a defining element of the University's work and offers valuable lessons for future renovation initiatives across Europe.

Lessons for Future Horizon Europe Projects

Reflecting on the project, the University highlights the importance of combining technological innovation with strong local support structures.

Working across multiple pilot sites and diverse implementation contexts presented challenges, particularly in maintaining consistency while respecting local realities. The team addressed this through flexible methodologies, stakeholder engagement and qualitative analysis that complemented more traditional technical and economic assessments.



Figure 26 - EBENTO team at the Tallinn pilot site visit.

Their main recommendation for future innovation projects is clear:

"One best practice we would recommend is to combine digital innovation with strong local, human-centred support structures."

The researchers also emphasise the critical role of municipalities as trusted local actors capable of increasing citizen engagement and ensuring the long-term sustainability of project outcomes.

Building on EBENTO's Legacy

Although EBENTO is coming to an end, the University of Ljubljana is already building on the knowledge generated throughout the project.

The lessons learned are being applied in several new European initiatives, including the EffiComfort project, which is exploring innovative Comfort-as-a-Service models for public and residential buildings, and Renov-AID, which is developing integrated One-Stop-Shop support services for residential renovation in Slovenia.

These initiatives continue the work started in EBENTO by focusing on people-centred renovation processes, stakeholder engagement, innovative financing mechanisms and practical support services.

Looking ahead, the University remains committed to ensuring that Europe's renovation transition is not only technologically advanced, but also socially inclusive and responsive to the needs of citizens.

“Successful renovation is driven by trust and local presence,” the team concludes. “Digital innovation is important, but it achieves real impact only when it is combined with support systems that help people turn intention into action.”

Through its unique combination of engineering expertise, social science research and stakeholder engagement, the University of Ljubljana has helped ensure that EBENTO’s legacy extends beyond technology—towards a more human-centred approach to energy renovation across Europe.

7 CEMOSA: Turning Building Data into Actionable Renovation Intelligence

As Europe seeks to accelerate the renovation of its building stock, one of the biggest challenges remains the fragmentation of information. Building data is often scattered across different sources, making it difficult for owners, facility managers and public authorities to make informed decisions about energy efficiency investments.

Within the EBENTO project, CEMOSA has played a key role in addressing this challenge by helping create the digital foundations that enable smarter renovation planning and building performance management.

Acting both as an end-user and facility manager, as well as a technical partner responsible for developing Building Information Modelling (BIM) models for several pilot sites, CEMOSA has contributed to transforming complex building data into practical tools that support renovation decisions.

“CEMOSA has participated in EBENTO both as an end-user and facility manager and as a technical partner in the construction of BIM models for the pilots in Spain, Greece and the United Kingdom”, explains its team.



Figure 27 - EBENTO Meeting at the CEMOSA Headquarters in Málaga.

Building the Digital Foundations of EBENTO

At the heart of CEMOSA’s contribution was the development of BIM models for several of the project’s pilot buildings.

These models provide a detailed digital representation of each building, including geometry, construction materials, HVAC systems and occupancy profiles. They serve as the foundation for the renovation simulations performed through the DSS4Ren module within EBENTO's One-Stop-Shop (OSS) platform.

By creating accurate and information-rich BIM models, CEMOSA helped ensure that the platform could generate reliable renovation scenarios and calculate expected energy performance improvements.



Figure 28 - Valencia pilot site visit.

The company also actively participated in the validation and testing of the OSS platform, as well as in assessing its impact and replication potential.

For CEMOSA, one of the most important milestones came when the Valencia pilot was successfully integrated into the EBENTO platform.

"The implementation of the Valencia pilot within the EBENTO OSS platform represented the materialisation of technical specifications into a real tool."

This marked the transition from conceptual design and modelling activities to the practical validation of a fully operational digital environment.

Bringing Together Disconnected Building Data

According to CEMOSA, one of EBENTO's most significant achievements is its ability to centralise information that is traditionally fragmented across multiple sources.

Building managers often need to work with data from BIM models, energy certificates, sensors, monitoring systems and public databases, all of which are typically disconnected.

"Currently, one of the main obstacles to energy renovation in Europe is that this information is fragmented across multiple public and private sources."

EBENTO addresses this challenge by integrating BIM models, real-time IoT sensor information, cadastral records and energy performance data into a single digital platform.



Figure 29 - Building Information Modelling in EBENTO.

This creates a common environment where stakeholders can analyse a building's current performance, explore renovation options and evaluate the potential outcomes of different interventions.

"EBENTO resolves this issue by centralising data and enabling actors such as facility managers, ESCOs and public institutions to visualise a building's current energy status, simulate renovation scenarios and link the results to performance contracts within the same digital environment."

For CEMOSA, this integrated approach has the potential to increase transparency, reduce uncertainty and build confidence among building owners and renovation stakeholders.

Beyond Traditional Building Management Systems

One of the most interesting aspects of EBENTO from a facility management perspective is how it expands the capabilities traditionally offered by Building Management Systems (BMS).

Conventional BMS platforms focus primarily on real-time monitoring and operational control. While valuable, they rarely provide tools for renovation planning, economic assessment or contract management.
The EBENTO OSS platform takes a broader approach.

"Traditional BMS systems are primarily oriented toward the real-time operational control of facilities, but they offer a limited vision regarding future scenario simulation, contractual management, or the integration of different building data sources."

By combining BIM models, simulation tools, performance monitoring and Energy Performance Contracting mechanisms within a single platform, EBENTO provides a more comprehensive view of building performance.

"The EBENTO platform integrates these dimensions into a single environment, allowing not only monitoring but also renovation simulation, visualisation of the economic impact of improvements and management of associated performance contracts."

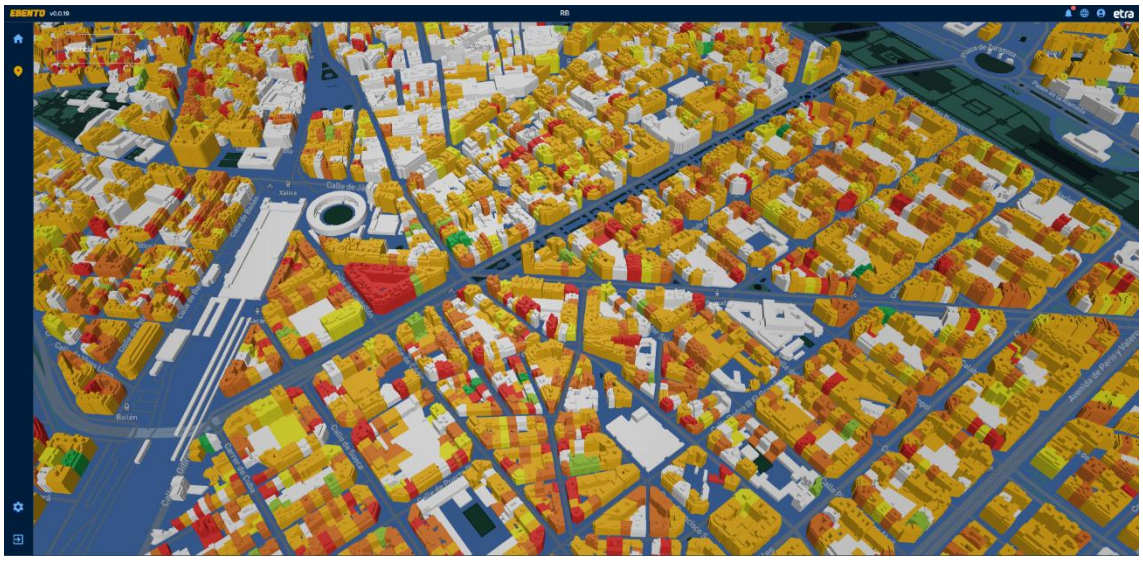


Figure 30 - EBENTO One-Stop-Shop overview.

This holistic perspective has the potential to significantly enrich the way renovation projects are planned and managed in the future.

Lessons from Digitalising Buildings

Throughout the project, CEMOSA gained valuable insights into the challenges of building digitalisation.

One of the main technical difficulties involved ensuring that BIM models contained the information required by the platform's simulation modules. This required multiple rounds of review and coordination with technical partners to align modelling requirements with simulation needs.

"The main challenge was integrating BIM models within the OSS platform while ensuring they contained sufficient information on materials, construction layers, HVAC systems and occupancy profiles to support reliable simulations."

This experience reinforced one of the project's key lessons: digital tools are only as effective as the data that supports them.

"One of the main lessons learned is the importance of having high-quality baseline data in order to make the most of digital tools."

The availability, quality and standardisation of building information remain critical factors for successful digitalisation and renovation planning.

Recommendations for Future Projects

Based on its experience in EBENTO, CEMOSA recommends that future Horizon Europe projects invest significant effort in understanding pilot buildings from the earliest stages of development.

The company emphasises the importance of clearly identifying the information required by future tools and services before implementation begins.

"Characterising the pilots at a very early stage of the project and understanding from the outset the input data required by the different tools is essential."

This early preparation can significantly improve validation activities, reduce implementation risks and maximise the value generated by pilot projects.

Expanding Energy Performance Services Beyond Traditional Contracts

Looking ahead, CEMOSA sees significant opportunities to build on the knowledge and tools developed through EBENTO.

The project has expanded the company's perspective on building performance management, moving beyond traditional Energy Performance Contracts (EnPC) toward more integrated approaches that combine energy efficiency, comfort and digital monitoring.

"The EnPCs considered in EBENTO have made it possible to expand the scope of traditional contracts, incorporating not only energy saving guarantees but also comfort conditions, indoor air quality and demand response mechanisms."



Figure 31 - EBENTO consortium at the CEMOSA Headquarters in Málaga.

CEMOSA plans to explore how these concepts can be incorporated into its future service portfolio, allowing the company to offer new performance-based services supported by digital platforms capable of monitoring, verifying and managing contractual commitments.
The company also intends to transfer the expertise gained through EBENTO across different departments and continue participating in research and innovation initiatives focused on building energy efficiency.

As the renovation sector increasingly embraces digitalisation, CEMOSA believes that integrated platforms such as EBENTO will play a critical role in transforming how buildings are assessed, renovated and managed.

By connecting data, simulation and performance management within a single environment, the company has helped demonstrate how digital innovation can support more informed, transparent and effective renovation decisions across Europe.



8 From Pilots to Practice: EBENTO Results on the Ground — Valencia Pilot

This interview is part of the "From Pilots to Practice: EBENTO Results on the Ground" series, showcasing how EBENTO solutions were tested and applied in real-life environments across Europe.
In this interview, Alejandro Alonso from Valencia Sostenible shares the journey of the Valencia pilot, from its initial objectives to the solutions tested and the results achieved. He reflects on the challenges addressed throughout the pilot and highlights the importance of collaboration with local stakeholders and citizens in turning innovative renovation approaches into practical solutions.
The video addresses the following aspects:

- The objectives and main challenges of the Valencia pilot
- How local users, citizens and stakeholders were engaged
- The EBENTO solutions tested and implemented
- Key results and achievements
- Lessons learned and best practices from the pilot experience
- How the Valencia pilot contributes to broader European building renovation goals
- The pilot's legacy and future plans beyond the EBENTO project

LINK TO THE VIDEO: https://youtu.be/pBlojsMisNM?si=sZlhXgCPgu5ghGbb





Figure 32 – Images from the Final Interview with Alejandro Alonso.

9 From Pilots to Practice: EBENTO Results on the Ground — Tallinn Pilot

This interview is part of the “From Pilots to Practice: EBENTO Results on the Ground” series, showcasing how EBENTO solutions were tested and applied in real-life environments across Europe.
In this interview, Ergo Pikas from Tallinn University of Technology shares the story of the Tallinn pilot, which focused on demonstrating EBENTO’s One-Stop-Shop approach for deep renovation in a typical Estonian apartment building. The pilot explored innovative solutions to improve energy efficiency, including the use of prefabricated modular insulation elements and the integration of photovoltaic (PV) panels. With around 90% of Estonia’s apartment buildings built before 1990, the results of this pilot have the potential to support the renovation of thousands of similar buildings across the country.
The video addresses the following aspects:

- The objectives and main challenges of the Tallinn pilot
- How residents and stakeholders were involved throughout the process
- The innovative renovation solutions tested through EBENTO
- Key results and achievements
- Lessons learned from the pilot experience
- The pilot’s contribution to European energy efficiency and building renovation goals

LINK TO THE VIDEO: https://youtu.be/DiTWYZbs6V4?si=Gx7byA9of_RICusv





Figure 33 – Images from the Final Interview with Ergo Pikas.

10 From Pilots to Practice: EBENTO Results on the Ground — Athens Pilot

This interview is part of the “From Pilots to Practice: EBENTO Results on the Ground” series, showcasing how EBENTO solutions were tested and applied in real-life environments across Europe. In this interview, Dimitrios Fotis from METLEN shares the experience of the Athens pilot and the team's journey throughout the project. The Athens pilot explored innovative approaches to support the transition towards more energy-efficient and user-centred buildings, while engaging local stakeholders and testing EBENTO solutions in a real-life environment. Throughout the project, the team gained valuable insights into the opportunities and challenges of implementing innovative renovation solutions and collaborating with different actors.

The video addresses the following aspects:

- The objectives and challenges of the Athens pilot.
- How users and local stakeholders were engaged throughout the project.
- The EBENTO solutions and activities implemented.
- The main results, achievements, and lessons learned.
- The pilot's contribution to the transition towards more sustainable and energy-efficient buildings.
- Future opportunities for continuing and replicating the knowledge gained through the project.

LINK TO THE VIDEO: https://youtu.be/VstZljOWCUY?si=6YH-WxKZmvlEitR_



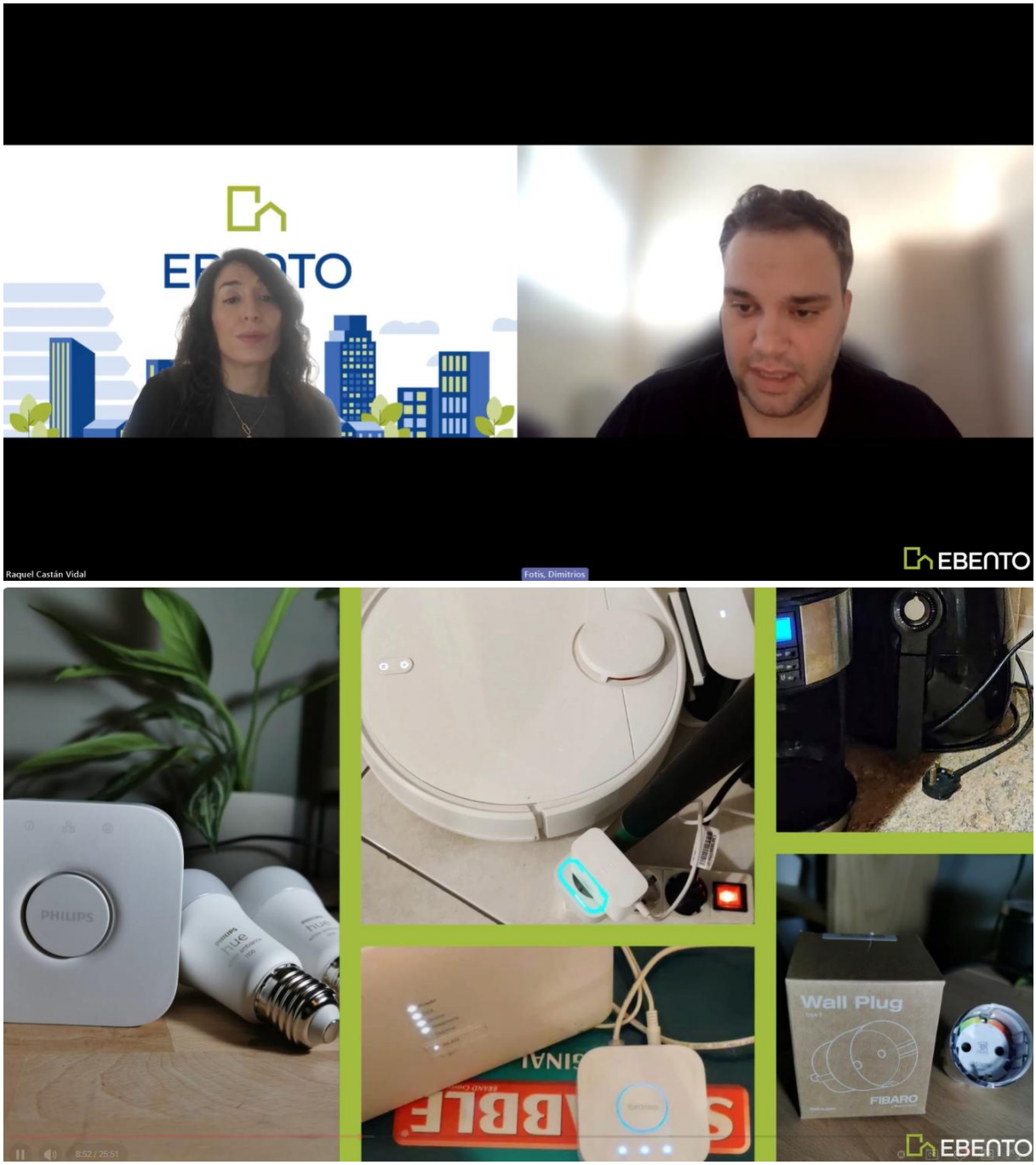


Figure 34 – Images from the Final Interview with Dimitrios Fotis.

11 From Pilots to Practice: EBENTO Results on the Ground — Manchester Pilot

This interview is part of the “From Pilots to Practice: EBENTO Results on the Ground” series, showcasing how EBENTO solutions were tested and applied in real-life environments across Europe.
In this interview, Aldous Everard (CarbonCoop) shares the story of the Manchester pilot, based in the Levenshulme neighbourhood. Building on an existing area-based retrofit scheme, the pilot focused on empowering residents to make informed renovation decisions while demonstrating how digital tools and community engagement can support the energy transition. Working closely with homeowners, local residents, and energy champions, the pilot combined EBENTO's Decision Support System (DSS4Ren) and One-Stop-Shop (OSS) platform with practical retrofit activities. The project explored how data-driven renovation planning, stakeholder collaboration, and citizen participation can help improve the energy performance of existing homes while addressing the challenges of retrofitting existing housing stock.
The video addresses the following aspects:

- The objectives and challenges of the Manchester pilot
- How residents, homeowners, and local energy champions were engaged throughout the project
- How EBENTO's Decision Support System (DSS4Ren) and One-Stop-Shop (OSS) platform supported retrofit decision-making
- The main results, achievements, and lessons learned from the Levenshulme pilot
- The importance of community engagement in delivering successful home renovation projects
- How the pilot contributes to European energy efficiency goals and demonstrates a model that can be replicated in other communities

LINK TO THE VIDEO: https://youtu.be/tvif_ou16ns?si=yTO-c0t3iR9gSX1X


EBENTO
From Pilots to Practice: EBENTO Results on the Ground
Insights from Aldous Everard, Carbon Coop
Manchester, UK
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Aldous - Carbon Co-op
Raquel Castán Vidal
EBENTO



Figure 35 – Images from the Final Interview with Aldous Everard.



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