SUstainable solutions for affordable REtroFIT of domestic buildings

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Technology Transfer Plan 2

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1 Publishable summary

The SUREFIT Project has successfully developed and demonstrated innovative, fast-track retrofitting solutions to enhance energy efficiency in residential and commercial buildings across Europe. Deliverable D9.8: Technology Transfer Plan 2 provides a comprehensive strategy for transitioning these validated technologies from research and demonstration phases to market adoption and commercial implementation.

This document builds upon the findings from **Task 6.1 (Monitoring and Data Collection)** and **Task 6.2 (Performance Analysis and Technology Validation)**, leveraging real-world performance data to assess the effectiveness of the deployed technologies. The extensive monitoring of energy consumption, heating and cooling efficiency, CO_2 emissions, and indoor environmental conditions has provided key insights into the scalability and market readiness of PV vacuum glazing, bio-aerogel insulation, phase change materials (PCM), solar-assisted heat pumps, and integrated PV/T systems.

To facilitate the technology transfer process, a structured approach has been outlined, addressing the following key aspects:

- **Technology Validation**: Confirming the feasibility and efficiency of the SUREFIT solutions based on real-world data collected from the demonstration buildings.
- **Market Readiness & Scalability**: Aligning the technologies with industry needs, addressing cost-effectiveness, and optimizing business models for commercialization.
- **Intellectual Property Protection (IPR)**: Ensuring proper ownership, licensing, and patenting to safeguard innovations while promoting technology adoption.
- **Stakeholder Engagement & Commercial Partnerships**: Collaborating with industry leaders, policymakers, housing associations, and investors to drive large-scale adoption.
- **Regulatory & Policy Support**: Aligning SUREFIT technologies with EU energy efficiency directives and advocating for supportive funding mechanisms.
- **Future Research & Development (R&D)**: Identifying opportunities for further technology refinement, automation, and integration with smart building solutions.

The deliverable concludes with recommendations for large-scale deployment, emphasizing the importance of cost optimization, enhanced market strategies, and continued policy engagement. By following this roadmap, SUREFIT ensures its solutions will continue to drive energy-efficient renovations, reduce carbon emissions, and accelerate Europe's transition to sustainable buildings beyond the project's duration.

2 Introduction

The SUREFIT Project represents a significant advancement in the field of energy-efficient building retrofitting, combining cutting-edge technologies, real-world performance monitoring, and a structured technology transfer approach to maximize impact. This document, Deliverable D9.8: Technology Transfer Plan 2, outlines the key steps taken to assess, validate, and facilitate the transfer of SUREFIT technologies into the market, ensuring their long-term adoption and scalability.

Technology transfer is a critical component of research-driven innovation, allowing scientific advancements to transition from demonstration and validation phases to widespread commercialization and industrial adoption. Within SUREFIT, the transfer process has been carefully structured to ensure that the developed fast-track retrofitting solutions—such as PV vacuum glazing, bio-aerogel insulation, phase change materials (PCM), and solar-assisted heat pumps—can be effectively implemented and commercialized across different building types and climates.

This deliverable builds upon the foundations established in Task 6.1 (Monitoring and Data Collection) and Task 6.2 (Performance Analysis and Technology Validation), leveraging real-world performance data to refine technology readiness, optimize deployment strategies, and outline the necessary steps for wider market adoption. Through extensive performance monitoring, efficiency calculations, and environmental impact assessments, the project has validated the feasibility and economic viability of these retrofitting solutions.

Furthermore, the Technology Transfer Plan highlights the key actions needed to bring SUREFIT technologies to market, including:

- Identifying industry partners for large-scale adoption,
- Securing intellectual property rights (IPR) and licensing opportunities,
- Establishing scalable business models for commercial roll-out,
- Addressing policy and regulatory frameworks to facilitate market entry, and
- Developing training and dissemination materials to increase awareness and adoption among key stakeholders.

By integrating these elements, SUREFIT ensures that its innovations extend beyond the scope of the project, contributing to Europe's energy efficiency goals, reducing CO_2 emissions, and accelerating the transformation of existing buildings into near-zero energy structures. This deliverable provides a roadmap for achieving these goals, paving the way for the next phase of technology commercialization and deployment.

3 Technology Transfer – The Basics

3.1 Definition

Technology Transfer is the heart of every research and entrepreneurial ecosystem. "Technology transfer" indicates the movement of knowledge, skills, know-how, and other valuable assets of the organization which is driven by profit (Solutions, 2022). The definitions and concepts of technology transfer have been discussed in many ways based on the disciplines of research and according to the purposes of the research (Bozeman, 2000).

Technology transfer needs to be understood in terms of three objectives (Hoffman, 1990):

- the introduction of new techniques by means of investment
- the improvement of existing techniques and
- the generation of new knowledge.

In addition, we should keep in mind that technology transfer does not only transfer the technical know-how (knowledge) required to produce a product but also the capacity to master, develop and later produce autonomously the technology underlying the products (Chesnais, 1986).

3.2 The Importance of Technology Transfer

Technology transfer as a process is important for several reasons, such as:

- It develops early-stage intellectual property into tools for direct use by the research community;
- It develops early-stage intellectual property as a basis for new platforms, products, or services to be made into products for public use;
- It helps promote the research institution and its commercial partners;
- It influences the economic performance of nations and firms (Mansfield, 1975);
- It is a strategic mean of meeting challenges posed by the globalization of business.

3.2.1 *Technology Transfer Models*

Technology transfer is a complex, multi-stage process that begins with idea creation and culminates in the commercialization of the transferred technology by the receiving organization.

Technology Transfer can be facilitated through multiple models, each with unique characteristics suited to different innovation and commercialization pathways. Some of the most widely recognized models include:

- The Linear Model: A step-by-step approach from research to commercialization, often used in academia-driven innovation.
- The Open Innovation Model: Encourages collaboration between multiple stakeholders, allowing external inputs to enhance technology development.
- The Licensing Model: Focuses on intellectual property agreements where technology is transferred via patents or licensing deals.
- The Triple Helix Model: Highlights the interaction between universities, industry, and government to drive innovation.
- The Chantramonklasri Model: A structured, feedback-driven framework focusing on continuous validation and adaptation of technology through iterative monitoring and stakeholder engagement.

Among these, the Chantramonklasri Model (1990) is the most representative for SUREFIT because it emphasizes:

- Continuous performance monitoring—a key element in SUREFIT’s methodology.

- Stakeholder feedback loops—aligning with the project’s strategy of engaging policymakers, industry, and researchers.

- Iterative technology refinement—which supports the adaptive improvements made based on real-world demonstration results.

This model ensures that the technology transfer process in SUREFIT is not static but continuously optimized, making it ideal for energy-efficient renovation technologies that require validation across diverse climatic conditions and building types.

4 Stakeholders & Involvement

The most important part in Technology Transfer is to identify the stakeholders involved. A stakeholder is a party that has an interest in a project, a technology or a company and can either affect or be affected by the business or project (Fernando, 2022). Stakeholders are very important in this specific activity of Technology Transfer, since they can finance and adopt the research findings. SUREFIT researchers should identify stakeholders, understand their needs and thoughts and determine how the outcome will address those needs. SUREFIT stakeholders are separated in categories based on their distinct needs:

4.1 Internal Stakeholders

Internal Stakeholders can be considered:

- Those who perform the research (SUREFIT Partners)
- The University faculty of the academic partners
- Students, including those who serve as research assistants
- The EU Commission

The key internal stakeholders of the SUREFIT Project are:

- Instituto de Soldadura e Qualidade (ISQ) – Institute
- Advanced Management Solutions Ltd (AMS) – SME
- University of Nottingham (UNOTT) – University
- SOLIMPEKS Solar Energy Corp. (SOLIMPEKS) – SME
- Winco Technologies (WINCO) – SME
- PCM Products Limited (PCM) – SME
- KÖSTER Lichtplanung Ltd (KOST) – SME
- Fundación Santa María la Real (FMS) – Foundation
- Aalto University (AALTO) – University
- Cândido José Rodrigues, SA (CJR) – SME
- Oncontrol Technologies, LDA (ONCONTROL) – SME

4.2 External Stakeholders

4.2.1 End Users (building owners/users)

This group of stakeholders will be evidently privileged by the research findings since they will be able (when the technology is available to them) to reach the target of near zero energy by reducing heat losses through building envelope, and energy consumption for heating, cooling, ventilation and lighting, while increasing the share of renewable energy in buildings.

4.2.2 Governments/associations/public authorities

This group of stakeholders drives most of our research. We address the government bodies to help define the problems that SUREFIT researchers should solve. We utilize our relationships with these groups to set up meetings, where we can discuss precisely what needs they have and how they could assist and support the researchers. These groups include:

- Local authorities & EU/national/regional public bodies (Câmara Municipal de Mafra endorsed the project with a letter of support);
- Policy makers working in energy and environment departments of local/national/EU governments;
- Energy efficiency building associations (Enercoutim endorsed the project with a letter of support).

4.2.3 Industry

Industry stakeholders bring unique input to the table and often give an opportunity for SUREFIT researchers to expand the scope of their thoughts and their research. In addition, industry partners can get advantage from the technologies that SUREFIT is developing. Furthermore, industry partners can facilitate the dissemination of our results far beyond the immediate reach SUREFIT consortium. this group includes:

- Professionals (engineers, academia, researchers, and students) in areas of energy, building design and construction, building materials, building services and manufacturing;
- Building product/construction companies and SME contractors;
- Management members of the relevant industries;
- Architects and relevant associations (AICCOPT endorsed the project with a letter of support).

4.2.4 Academia

This group (universities, schools, academic institutions) is considered the earliest adopter group and offers a unique help to enhance our dissemination and technology transfer efforts.

4.3 Involvement

Every stakeholder group has its own needs for the technology offered. Therefore, stakeholders will help to guide what research we will undertake. Communication at every stage of research is the key to assisting stakeholders. As results are generated, SUREFIT's consortium will hold workshops, PR Events, training sessions, videos, emails and demo site demonstrations to establish a more interactive way to exchange information and focus on how results might be implemented.

If stakeholders want to use the technology, the Consortium can be consulted and guide the process. If there is need to create EU policy or legislation, SUREFIT partners will assist policy makers to understand fully the concepts and the results. Tools like training materials, guides and fact sheets will be developed.

5 Dissemination of SUREFIT Results

The main goal of WP9 is to communicate all SUREFIT results and create awareness to the stakeholders. A specific and intense communication strategy was developed to make the greatest impact. All members agreed to participate and engage in dissemination activities. All these activities are held under a common visual identity, with key scientific findings translated into simple words for the wide public.

Dissemination will take place:

a) *Internally:* dissemination of the results will be made by publishing and circulating technical documents and memoranda that will be treated as confidential if any commercially sensitive information is included. Dissemination to the Commission will be made by reports as outlined in the Grant Agreement.
b) *General dissemination:* to the industrial, academic, and public will be made through public demonstration, seminars and workshops, open days, publication in journals, conferences, exhibitions, website, newsletters, and media.

5.1 Key Message

Overall, the research results derived from the project are classified as:

(1) technical items including design drawings, testing prototypes, validated simulation/optimisation tool, and simulation/experimental results;
(2) operational items such as the prototypes produced in factories and installed in buildings or the field-trial results; and
(3) social economic items including manufacturing/installation standards, economic and environmental assessment results, and building impact analytical tool/results.

The Key messages of all SUREFIT dissemination activities were adapted to each Stakeholder's viewpoint and follow the 7 Cs of Communication:

Clear

- The Communication goal will be clear.

Concise

- Brief and to the point wording.

Concrete

- Specific, with detailed data.

Correct

- All information will be justified by SUREFIT scientific data.

Coherent

- All points will be connected and relevant to SUREFIT communication objectives.

Complete

- All relevant information will be communicated.

Courteous

- All communicated information will follow the Ethical Guidelines detailed in D10.1.

Figure 1 – 7 Cs of SUREFIT Communication

5.2 Methodology & Frameworks Used

Wilson performed a survey of conceptual dissemination frameworks from which three practical theories occurred: persuasive communication, diffusion of innovation and social marketing (Wilson, 2010).

- *Persuasive communication*, the most popular theoretical approach is based on the Communication-Persuasion Matrix (McGuire, 2012). The matrix describes the process of being persuaded; it consists of five input communication factors and twelve output persuasion steps. The five input factors, which have an impact on the success of the communication, are: source, channel, message, audience, and setting.
- *Diffusion of innovation* (Rogers, 2962) is the second most popular theory. According to Wilson, diffusion of innovation "offers a theory of how, why, and at what rate practices or innovations spread through defined populations and social systems. The theory proposes that there are intrinsic characteristics of new ideas or innovations that determine their rate of adoption, and that actual uptake occurs over time via a five-phase innovation-decision process (knowledge, persuasion, decision, implementation, and

confirmation). The included frameworks are focused on the knowledge and persuasion stages of the innovation-decision process".

- *Social marketing* (Kotler & Zaltman, 1971) represents an approach to planned social change, in which marketing concepts are applied to the problem of promoting social causes.

A **blend** of these frameworks was used throughout SUREFIT dissemination activities.

6 Exploitation of SUREFIT Results

The Article 16 of the Annotated Model Grant Agreement (AGA) sets the framework for the exploitable results of an EU funded project as well as the obligation of the beneficiary towards the exploitation. Based on the Article 28, the beneficiaries must take measures aiming to ensure exploitation of their results — either by themselves (e.g. for further research or for commercial or industrial exploitation in its own activities) or by others (other beneficiaries or third parties, e.g. through licensing or by transferring the ownership of results). This is a best effort obligation: the beneficiaries must be proactive and take specific measures to ensure that their results are used (to the possible extent and justified).
Furthermore, the Article 16 specifically mentions the obligation of each beneficiary to exploit its result, the contribution of the results to standardization and the consequences of non-compliance with the Article 16.

6.1 Exploitable Results of SUREFIT

SUREFIT involves a variety of technologies that include bio-aerogel panels installed with phase change materials, photovoltaic (PV) vacuum glazing windows, heat recovery devices, solar assisted heat pumps/ground source heat pumps, evaporative coolers, integrated solar thermal/PV systems and lighting devices. Some of these technologies were prefabricated for rapid retrofit with minimal disruption to occupants, ensuring high levels of occupant comfort/indoor environmental quality as well as low risk of moisture-related problems/summer overheating. The work programme involved optimal sizing and prefabrication of technologies tailored to building design/ requirements; retrofitting and monitoring buildings in different climates with support of advanced building energy management systems; analysing indoor environment quality, energy use, user behaviour and acceptance of the solutions; developing methodology, guidelines/effective operational tools for rapid retrofitting and decision-making; and finally developing business models involving all relevant actors including, public authorities/investors/users and holistic integration of disciplines across the value chain.

6.1.1 Exploitation Plan

The exploitation plan reported in D9.4 that was submitted in M12 is structured as follows:

i. firstly, the exploitable results and the main owners of these results are identified;
ii. the possible exploitation routes for each one of the exploitable results are presented;
iii. a preliminary characterization of the results is performed;
iv. the exploitation expectations and claims of the partners are identified;
v. a BFMULO analysis is made;
vi. the IPR management is presented;
vii. the Technology Readiness Level (TRL) is identified;
viii. an initial risk assessment is performed.

6.1.2 SUREFIT Research Results Derived

As already mentioned, the research outcomes generated by the project fall into three distinct categories:

1. Technical components, encompassing design blueprints, tested prototypes, validated simulation and optimization tools, as well as both simulation and experimental findings.
2. Operational elements, which include factory-produced prototypes, installations in demonstration buildings, and results from field trials.
3. Socio-economic aspects, covering manufacturing and installation standards, economic and environmental evaluations, and analytical tools assessing building impacts. These items were carefully identified for publication through appropriate routes and approaches.

6.1.3 IPR management

The IPR management is very important since it declares the shares that each partner will claim for every result. This information is available in Table 21 of D9.4“Exploitation plan”.

7 Monitoring and Data Collection (Task 6.1)

Accurate monitoring and data collection were fundamental to the SUREFIT project. The methodology included installing advanced sensors, energy meters, and data loggers in demonstration buildings across Europe, allowing continuous tracking of energy consumption, environmental conditions, and system performance. This process enabled precise assessment and validation of the retrofitting solutions' impact on energy efficiency, indoor comfort, and CO_2 emissions.

7.1 Overview of measurement and data logging facilities installed in demonstration buildings.

Advanced measurement and data logging facilities were installed across demonstration buildings in different European climates. These facilities were crucial in gathering real-time performance data, allowing for an in-depth analysis of energy efficiency, indoor environmental conditions, and renewable energy integration. The monitoring systems were adapted to each site's climatic conditions and retrofitting solutions, ensuring accurate data collection for performance assessment and validation.

Each demonstration site was equipped with a combination of:

- Smart energy meters to monitor real-time electricity and heating consumption.
- Environmental sensors for temperature, humidity, and CO_2 levels.
- Sensors to assess the impact of photovoltaic and solar thermal technologies.
- Data loggers for long-term tracking and remote access to collected information.

7.2 Categories of monitored data:

The monitoring strategy focused on collecting data across multiple parameters to evaluate the impact of interventions. The primary categories of monitored data included:

7.2.1 Energy consumption metrics

- Total electricity consumption before and after retrofitting.
- Heating and cooling energy demand.
- Performance of renewable energy integration (PV/T systems, solar-assisted heat pumps, etc.).

7.2.2 Building environmental parameters (temperature, humidity, light levels, etc.)

- Indoor temperature variations.
- Relative humidity levels.
- Indoor CO_2 concentrations and air quality improvements.
- Light levels, assessing daylight utilization and artificial lighting efficiency.

7.2.3 Solar radiation and climate influence

- Solar radiation levels and their impact on photovoltaic and thermal energy generation.
- Seasonal variations in solar availability.
- Climate-specific effects on insulation and passive cooling strategies.

7.2.4 Role of other partners in data collection

Beyond the lead institutions responsible for site monitoring, all project partners played an essential role in data collection and validation:

- **Technology providers** ensured that their respective retrofitting solutions were properly integrated with the monitoring systems.
- **Academic institutions** assisted with performance analysis and long-term data interpretation.
- **Industry stakeholders** provided input on practical implementation aspects, ensuring that the findings remain relevant for commercialization.

By leveraging a multi-disciplinary collaboration, SUREFIT was able to gather a rich dataset covering various building typologies, climates, and retrofit configurations. The collected data forms the foundation for the performance analysis in Task 6.2.

8 Performance Analysis and Technology Validation (Task 6.2)

Following data collection, extensive performance analysis was conducted to quantify the impact of SUREFIT's retrofitting solutions. This included evaluating heating and cooling efficiencies, renewable energy integration, and indoor environmental improvements. By comparing pre- and post-renovation performance metrics, the analysis provided critical validation of system effectiveness, supporting commercial adoption and further optimization of the technologies.

8.1 Methodology for analysing field trial data

The performance analysis of SUREFIT's retrofitting technologies was conducted using real-time monitoring data collected from the demonstration buildings across Europe. The field trial data was analysed to evaluate the efficiency, energy savings, and environmental impact of the implemented solutions. The analysis methodology followed these key steps:

1. **Data Acquisition and Cleaning:**

- *Data was collected from smart energy meters, environmental sensors, and solar radiation meters installed in the buildings.*
- *The recorded data was cleaned and validated to ensure accuracy, removing any anomalies or inconsistencies.*

2. **Performance Metrics Calculation:**

- *Key performance indicators (KPIs) such as heating and cooling demand, electricity savings, CO_2 emission reduction, and indoor comfort levels were derived.*
- *Comparative analysis was performed against pre-renovation baseline data.*

3. **Statistical and Predictive Analysis:**

- *Advanced statistical models were used to identify trends and correlations.*
- *Predictive modelling was applied to estimate long-term benefits of the retrofitting measures.*

4. **Technology Validation:**

- *The results were cross-checked against expected performance values from laboratory tests and theoretical calculations.*
- *Adjustments were made to optimize system control algorithms where discrepancies were identified.*

8.2 Efficiency calculations:

Efficiency calculations played a key role in measuring the effectiveness of the implemented technologies. Metrics such as heating and cooling system performance, lighting efficacy, total energy savings, and CO_2 emission reductions were assessed. By analysing the collected data, researchers identified improvements in building performance, highlighting the advantages of fast-tracking retrofitting solutions and their potential for widespread implementation.

8.3 Conclusions derived from the challenges encountered and feedback for future stakeholders

The following conclusions were derived from the data and performance analysis, serving as a reference for future projects and guiding the continued development and technology transfer of SUREFIT innovations:

- **Development of user-friendly manuals and training programs** will be essential to educate end-users on system operation and best practices for energy management, ensuring the effective implementation of these innovative technologies in residential buildings.
- **Cost considerations** must be optimized to ensure that the payback periods of the products remain attractive to potential investors, increasing the likelihood of market adoption.
- **Customization for diverse climatic conditions** should be a priority, as the effectiveness of SUREFIT technologies varies depending on geographical and environmental factors, requiring tailored adaptation strategies.
- **Stakeholder engagement and policy alignment will play a key role** in facilitating large-scale adoption, emphasizing the need for collaboration with regulatory bodies, industry leaders, and investors to integrate the technologies into existing energy efficiency frameworks.

9 Technology Transfer Plan

To ensure the successful transfer of the innovative solutions developed within the SUREFIT project, a structured Technology Transfer Plan has been outlined. This plan defines the key steps required to transition the developed technologies from research and demonstration phases to market adoption and broader commercial exploitation. The transfer process includes the following steps:

9.1 Step 1: Monitoring & Performance Evaluation

The first stage of the technology transfer process involved monitoring and analysing the performance of the SUREFIT solutions in real-world conditions as already analysed.

9.1.1 How monitoring results contribute to technology validation for market adoption

The real-world monitoring results served as empirical evidence of their efficiency, energy savings, and CO_2 reduction potential, making a strong case for their adoption in the commercial market.

Key findings highlighted:

- The technologies consistently improved energy performance across all demonstration sites, showcasing their adaptability to different climate zones.
- PV/T and solar-assisted heat pump systems provided a sustainable alternative to fossil-fuel-based heating.
- Advanced insulation materials significantly reduced heat loss and energy demand, proving their effectiveness in both warm and cold climates.
- Improved indoor air quality through ventilation and smart control systems addressed occupant comfort, making the technologies more attractive for building owners and residents.

9.2 Step 2: Market Readiness & Needs Analysis

Following the technical evaluation, the next step will be to assess the market demand and potential adoption of the SUREFIT solutions. This involves:

- Identifying gaps in the renovation and retrofitting market
- Aligning SUREFIT technologies with industry needs and policy frameworks
- Evaluating cost-effectiveness and feasibility of mass adoption

Understanding these market dynamics will be crucial to positioning the developed technologies as viable solutions for energy-efficient building renovations.

9.3 Step 3: Intellectual Property (IP) Protection Strategy

Before engaging in large-scale technology transfer, it is essential to ensure that intellectual property rights (IPR) are properly managed. The strategy is mentioned in detail in the respective deliverable. This step safeguards the interests of the project partners while allowing for structured and secure knowledge transfer.

9.4 Step 5: Stakeholder Engagement & Partnership Building

The successful transfer of technology requires collaboration with relevant stakeholders, including:

- Universities and research institutions for continued development and validation
- Industry partners interested in adopting or commercializing the technologies
- Policymakers and regulatory bodies to support market entry and incentives
- Investors and funding organizations for scaling up implementation

Proactive engagement with these key actors ensures a smoother transition from research outputs to commercially viable solutions.

9.5 Step 6: Roadmap for Technology Deployment

A clear roadmap for the large-scale implementation of SUREFIT technologies is necessary to facilitate long-term impact. This will include:

- Identifying pilot projects for further demonstration in real market conditions
- Defining business models for technology commercialization
- Exploring funding opportunities to support widespread deployment

By following this structured approach, the SUREFIT project ensures that its innovative renovation solutions are effectively transferred to the market, contributing to the broader goal of improving energy efficiency in the European building sector.

9.6 Recommendations for Technology Scalability and Market Readiness

To ensure widespread adoption and long-term impact, the following recommendations have been identified:

1. **Cost Optimization and Industrial Scaling:**

- Reducing manufacturing costs of PV vacuum glazing and bio-aerogel insulation through material advancements.
- Streamlining installation processes to make retrofitting faster and more cost-effective for large-scale applications.

2. **Enhanced Market Integration Strategies:**
- Promoting performance-based energy savings models to incentivize investment in retrofitting solutions.
- Collaborating with municipalities and housing associations to integrate SUREFIT technologies into large-scale renovation programs.

3. **Policy and Regulatory Support:**
- Engaging with EU regulatory bodies to align SUREFIT solutions with existing energy efficiency directives and incentives.
- Advocating for new funding mechanisms that support deep energy renovations in residential and commercial buildings.

4. **Further Research and Development (R&D) Directions:**
- Enhancing AI-driven energy management systems to optimize the integration of PV/T and heat pumps.
- Investigating energy storage solutions to improve self-sufficiency and grid interaction for retrofitted buildings.

9.7 Next Steps for Exploitation Beyond the Project's Duration

With SUREFIT technologies validated and ready for market adoption, the next steps focus on ensuring long-term impact and widespread deployment:

- **Commercial Partnerships and Technology Licensing:**
  - Strengthening collaborations with manufacturers and industry stakeholders to facilitate mass production and distribution.
  - Exploring licensing agreements to enable third-party commercialization of validated SUREFIT technologies.

- **Replication in Large-Scale Demonstration Projects:**
  - Expanding pilot implementations in social housing, commercial properties, and public buildings.
  - Applying for Horizon Europe and national funding programs to support further scaling and innovation.

- **Continued Knowledge Dissemination and Training:**
  - Conducting technical workshops, training programs, and webinars to educate architects, engineers, and policymakers.

  - Publishing best-practice guidelines and case studies to showcase the impact of SUREFIT solutions.

- **Integration into Smart Building and Digital Energy Platforms:**
  - Aligning SUREFIT solutions with smart city initiatives and IoT-based building energy management systems.
  - Exploring opportunities for blockchain-based energy trading models where SUREFIT buildings can participate in local energy markets.

- **Scaling Up Deployment in Residential and Commercial Buildings**:
  - Expanding the adoption of SUREFIT solutions beyond the initial demonstration sites.
  - Partnering with housing associations, municipalities, and property developers to integrate the technologies into future retrofitting projects.

- **Policy and Regulatory Engagement**:
  - Providing data-driven recommendations for energy efficiency policies to support subsidies and incentives for building owners adopting retrofitting technologies.
  - Aligning SUREFIT solutions with EU energy directives to facilitate large-scale adoption.

- **Market Entry Strategies for Commercialization**:
  - Developing business models tailored for different stakeholders (e.g., performance-based contracting for energy savings).
  - Forming strategic partnerships with industry leaders in the construction and renewable energy sectors.

- **Future Research and Funding Opportunities**:
  - Pursuing Horizon Europe and national funding to expand the research into next generation retrofitting technologies.
  - Exploring advancements in smart energy grids, AI-driven building management, and zero-energy building designs.

By following these strategic next steps, the SUREFIT project ensures that its innovations continue to drive energy-efficient, low-carbon renovations across Europe, fostering a sustainable transformation of the built environment allowing concise technology transfer.

10 Commercial Exploitation

The successful implementation of SUREFIT technologies extends beyond research and demonstration - it involves translating validated solutions into commercially viable products **that can be widely adopted in the building sector**. This outlines the pathways for market adoption, industry engagement, and further research and development (R&D) to enhance the commercial potential of the technologies developed in the project.

By leveraging insights gained from performance monitoring and stakeholder feedback, the SUREFIT project has developed a scalable approach to promoting the integration of its innovative retrofitting solutions into real-world applications. The focus is on ensuring cost-effectiveness, ease of installation, and regulatory compliance, making the solutions attractive for building owners, policymakers, and industry professionals.

The following subsections detail how monitoring results have contributed to technology validation, how product refinements and future research directions have been shaped by field performance, and the strategies for facilitating widespread adoption of SUREFIT technologies in the market.

10.1 Insights for product refinement and further R&D.

The monitoring and performance analysis of SUREFIT technologies also revealed areas where further improvements could be made.

Key insights for future product refinement include:

- **Control System Optimization**: The performance of PV/T systems, heat pumps, and shading solutions could be further enhanced through advanced automation and predictive control algorithms.
- **Material Efficiency Enhancements**: Adjustments in the composition of bio-aerogel insulation and phase-change materials (PCM) could improve thermal performance and cost-effectiveness.
- **Scalability Considerations**: While effective in reducing energy demand, some technologies require cost optimization to enhance their commercial feasibility. Research into cheaper material alternatives and modular installation methods could improve marketability.
- **Energy Storage Integration**: Future research should focus on battery storage solutions and their integration with PV/T panels to maximize self-sufficiency in energy production.

By addressing these insights, further R&D efforts can help refine SUREFIT technologies for broader commercial adoption and integration into future energy-efficient building standards.

10.2 Live demonstrations for interested commercial stakeholders.

To facilitate market engagement and industry collaboration, several live, hybrid and online demonstrations were conducted as part of the SUREFIT project. These demonstrations allowed commercial stakeholders, policymakers, and potential investors to witness firsthand the effectiveness of the implemented technologies.

- **Industry Workshops and Webinars**: Engaging architects, engineers, and building owners to showcase the retrofit process and its measurable impacts.
- **Demo Site Visits**: Allowing stakeholders to examine energy performance data in real-time, emphasizing improved heating, cooling, and insulation efficiency.
- **Pilot Project Data Sharing**: Providing detailed reports internally and externally (to industry partners interested in commercializing or integrating SUREFIT technologies into their operations).

These live demonstrations significantly boosted interest in SUREFIT's solutions, paving the way for commercial partnerships and further pilot projects beyond the original demonstration buildings. There demonstrations must continue as a market strategy.

By implementing all these strategies, the SUREFIT project ensures that its technological advancements continue to contribute to the sustainable transformation of the European building sector, driving energy efficiency, emissions reductions, and improved occupant well-being.

11 Conclusion

The SUREFIT Project has demonstrated the effectiveness of its fast-track retrofitting solutions, providing energy-efficient, cost-effective, and scalable renovation technologies for European buildings. Through extensive monitoring, performance validation, and stakeholder engagement, the project has laid a strong foundation for technology transfer and commercial adoption.

The findings highlight significant energy savings, CO_2 emission reductions, and improved indoor comfort, reinforcing the viability of PV/T systems, bio-aerogel insulation, phase change materials (PCM), and solar-assisted heat pumps for large-scale deployment. **To ensure long-term impact, the project outlines a structured approach to technology transfer, focusing on market readiness, IP protection, stakeholder collaboration, and policy alignment.**

By leveraging these insights, SUREFIT's innovative solutions are poised to accelerate energy-efficient building renovations, contributing to Europe's sustainability goals and carbon neutrality targets beyond the project's lifetime.

12 References and Appendices

12.1 References

This section compiles the key documents and technical reports that have informed the findings, performance analysis, and commercialization strategy of the SUREFIT project. The referenced materials provide empirical data, validated performance metrics, and insights into the technological advancements achieved throughout the project.

The following reports have been instrumental in shaping the outcomes of this deliverable:

- **SUREFIT D8.4 Business model**: This document provides a comprehensive overview of the performance monitoring and evaluation results from the demonstration sites, highlighting key findings on energy savings, CO_2 reduction, and efficiency improvements.

- **SUREFIT D5.1 Measured energy use before installation**: Focuses on the initial implementation and integration of retrofitting technologies, detailing the baseline performance of buildings before the application of SUREFIT solutions.

- **SUREFIT D6.1 Monitored Results**: Contains detailed data on technology performance, including measured parameters such as indoor environmental conditions, heating and cooling efficiency, and renewable energy contributions.

- **SUREFIT D7.1 Technology Transfer Plan 1**: Contains the initial analysis on the Technology Transfer strategy for SUREFIT results.

These documents provide the foundation for the technology validation, market readiness assessment, and scalability recommendations outlined in this report.

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