BRIMEE PROJECT 1st PERIODIC REPORT SUMMARY

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The challenge of today lies in the accomplishment of sustainable and low-energy buildings, which can combine at the same time the thermal insulation properties with healthy, comfortable, accessible and safe indoor environment.
Reduction of the energy demand through the use of insulating materials still remains a challenge for European architects and building designers as well as materials producers. Beside good and consistent thermal and acoustic performance overtime, a good and marketable insulation material should in fact be self-extinguishing, not degradable, unshrinkable or non-settling, safe during handling and installation, low cost and should not pollute the indoor building environment, while having a low embodied energy, proven through LCA assessment.
The main aim of the BRIMEE project is therefore to combine the development of better performing insulation materials for improving buildings energy performance and having as final overall objective a significant reduction of buildings operational energy, in combination with the capability not to emit harmful substances and to act as an absorber for indoor pollutants.
The innovation is based on a Nano-Cristalline Cellulose (NCC) based foam, strengthened with Natural derived resins, providing consolidation of the 3D network and lightweight structure. Preliminary work performed by some of the BRIMEE project partners demonstrated that innovative NCC based material strengthened with modified natural derived resin, can be developed in the shape of a foamed product, combining performances of mechanical strength, light weight, thermal and noise insulation, self extinguishing, without emission of noxious VOC and sound structural characteristic to build self-supporting composite elements.
To the natural derived fire suppressive additives implemented in the matrix of the nanostructured insulating composite, additional performances are requested, as water tightness: specific developments to the cellulose materials are embedded thanks to functionalization, directly implemented at the nanoscale level. Additional functionalities from the bulk or the surface of the materials, such as fragrance release, IR radiation management or anti-bacteria, are further objectives of the project, implemented according to techniques directly transferrable to building procedures.
Thanks to advanced processing developed and refined within the project, the NCC material can be profitably extracted from the waste streams of the pulp and paper industry, therefore increasing the sustainability of the end product, at no compromise on its performances.
Although the BRIMEE product family is applicable for the envelope and interior partitions of both new and existing buildings, most of the impact and the largest market is represented by buildings built before 1975 and requiring retrofitting. This is considered the initial market to be addressed, in line with EU priorities and recent action plans and directives, and confirming the approach to increase the value of building stock, improving the quality of life for the inhabitants and reducing the overall environmental footprint of the building process.
The final aim of the project is therefore to produce panels that can be well acceptable from building designers, architects, and the end users, thanks to their joint active involvement into the project, concurring to the development of a product representing a real marketable solution for the end users.

The concepts of overall sustainability and cost for the materials are matter of discussion and represent an item of design, as well ensuring the applicability into the built environment. Therefore, the following standards are addressed for testing:

- ISO 16000-part 3, 6, 9, 10, 11 concerning the different compounds and sampling methods
- FprCEN/TS 16516 (2013): Construction products – Assessment of release of dangerous substances
- EN 12087 and 12429 - Humidity control
- EN 1364, 1365, and 1366 - Fire resistance
- EN 1934 and EN ISO 6946 - Thermal resistance
- EN ISO 3668 - sustain a coating
- EN 16205 - Noise absorption
- EN 1605 - Shape retention

Once the results will be assessed, the constituent materials, and the final products will be potential breaking elements for ensuring effective heat insulation, quality and natural features for interiors, and additional functionalities if applied in exteriors, contemporarily granting quality of the indoor air and benefit of the end users.
The project is run thanks to a strategically European-spread consortium, involving the active cooperation of materials scientists, developers and transformers, firms expert in the development of advanced built environment solutions, designers and architects, cooperating together under the coordination of D'Appolonia, with the common goal of developing innovation that can be effectively implemented into real scale, marketable products representing a success solution for the insulation and air quality a European level.

PROJECT CONTEXT AND OBJECTIVES

1. Project context

The BRIMEE project aims at the development of a novel class of insulating materials, based on renewable porous framework constituted of a 3D network of nano cellulose reinforced with natural derived resin. The raw materials can be derived from non-food biomasses, wood residuals and slurries from wastewater treatment systems as the intended process is flexible in input. However the preferred source will be pulp&paper industry waste with the final purpose to achieving marketable products and industrial production methods based on advanced nanomaterials derived from renewable resources.
The project operates in response to the need, felt by the inhabitants of either new construction or existing buildings, to improve the performances of the thermal and noise insulation, without compromising on the quality of the air.
The accomplishment of sustainable and low-energy buildings, which can combine at the same time thermal insulation properties with a healthy, comfortable, accessible and safe indoor environment represents a serious challenge. Health and sustainability are interrelated in many ways. Simply improving thermal insulation in rehabilitation programmes will reduce the conditions that are likely to generate unhealthy environments (e.g. related to thermal discomfort, moulds

and moisture). To fully benefit from the extra insulation levels, additional measures have to be taken: as an example improved air-tightness. Moreover, the path towards future low-energy use, or even energy autonomous or energy-positive buildings, has to be followed without running the risk of introducing a negative impact on human health.

. Beside good and consistent thermal and acoustic performance over time, a good and marketable insulation material should in fact possess additional features: be self extinguishing, not degradable, unshrinkable or non-settling, safe during handling and installation, low cost and should not pollute the indoor building environment, while having a low embodied energy. Indeed the indoor environment is becoming an issue as in highly sealed energy efficient buildings a number of problems arise such as those related to SBS (Sick Building Syndrome).

A single insulation material combining all the above properties would represent a real breakthrough in the resolution of the above issues. The ones currently available suffer from various technological and environmental drawbacks, originating either from the conditions of manufacturing processes applied for their production or from the technical and environmental inefficiencies of the primary raw materials used for their synthesis.

Currently, most applied insulation materials belong to the two main classes: fibrous mineral materials and expanded polymeric ones. In addition to these, natural derived materials are gaining more and more market shares: all of them have good properties that are necessarily balanced to meaningful drawbacks, mainly associated to their poor fire resistance, and the long-term emission of borate additives, necessary to fulfil the fire-proofness required from standards.

The synthetic organic (fossil-derived) insulation products (extruded polystyrene, expanded polystyrene, polyurethane) have a very high efficiency in thermal insulation, due to the closed cell structure; as drawback, they may degrade under exposure to direct sunlight and high humidity. Furthermore, they emit VOC into the indoor building environment, suffer from thermal drift and do not have good acoustical properties. Furthermore, the overall energetic and CO2 balance is rather negative for these materials, due to the energy expenditure of foaming process (either chemical or physical foaming) and their load of fire suppressing agents (typically borates).

Stone wool and Glass wool composed of fibers pressed in mats are the mineral counterpart of organic expanded insulation. Their capability to provide thermal insulation due to their low density and the capacity to trap air is elevated, and they are inherently non-flammable; as drawback they are subject to the phenomenon of fibre release, especially during installation, and can lead to formaldehyde out-gassing, during the whole life time of the materials. Such last problem is overcome by bio-degradable formaldehyde-free organic binders: however, they can be decomposed over time, resulting in slow degradation of insulation performances.

According to this background, the BRIMEE project has been developed with a strong vision to develop materials that can combine the different benefits of the current state of the art insulation materials, combining the insulation (thermal and noise barrier effects) with a whole bio-based origin, leading to a final material and product that is healthy and effective. Additionally, the expanded materials to be developed are intended as the core of innovative composite panels, in that they have sound structural performances: this witness for an entirely new method of designing the panels, and new types of applications and structural performances that can be demanded, therefore extending the potential for implementation.

2. Project Objectives

The main objective of the BRIMEE project is the development of a new generation of insulation materials and products, to improve buildings energy performance without emitting harmful substances and acting as an absorber for indoor pollutants. The material solutions developed within BRIMEE are based on a Nano-Cristalline Cellulose (NCC) based foam, strengthened with a bio-based resins which provides mechanical strength, lightweight performances and furthermore self extinguishing features. Functional characterization to the Cellulose basis is exploited to confer to the material additional functionalities from the bulk, such as fragrance release, water repellence or anti-bacteria, IR radiation reflectance. Thanks to an advanced processing pioneered by our partners, the NCC material can be profitably extracted from the waste streams of the pulp and paper industry, readily available across EU-27 and being today an environmental issue for paper mills.
The key benefits of the BRIMEE product/process can be synthesized in the following:

- Complete elimination of blowing agents/hazardous solvents for the production
- Use of renewable materials: NCC extracted from renewable, non food cellulose sources, or profitably extracted from wastes of the paper industry, bonded via natural based resins
- Functionalization with natural derived compounds, capable of capturing the polluting elements, transforming the bulk of insulating materials from emitters of noxious chemicals into a sink, absorbing them throughout their life cycle
- Low-temperature process, involving water and a totally closed loop solvent and acid exchange loop, ensuring reduced embedded energy and limited environmental impact. Thanks to the reclamation of waste streams, the overall environmental impact can be considered as positive, accounting limited disposal
- Graded performances, permitting the complete tailoring of the mechanical, thermal and chemical responses of the materials to the required applications

In details, the following objectives can be drawn for the BRIMEE materials:

- reduction by at least 60% of the embodied energy when compared with traditional foamed materials (EPS 108 MJ/kg, XPS 95 MJ/kg)
- sound reduction index in air Rx above 40 dB
- higher insulation properties when compared to traditional foamed panels, below 0.025 W/mK (density between 35-75 kg/m^3)
- Mechanical performances, compression strength between 0,6 and 3.0 MPa, shear strength between 0.5 and 1.2 MPa, graded density between 35 and 75 kg/m^3
- CO_2 footprint for the end material between 0.8 and 1.5 kg/kg, inferior by more than 50% to the standard values for expanded foam thanks to the natural derivation of the basic constituent. The material in itself is CO_2 neutral, CO2 is generated through the energy requirement of the material
- durability in excess of 50 years considering properties such as thickness, moisture absorption, compressive strength; thermal conductivity and reaction to fire
- Reduction of total cost of ownership by at least 30% considering a life cycle perspective (manufacturing, installation and use)

As depicted in the following picture, three fully operational components are expected to be delivered at the end of the project, providing convincing demonstration of the applicability of BRIMEE material as panels suitable for:

- Outer insulation, to be applied for the building external envelope;
- Internal insulation, to be applied on the internal surface of the envelope;
- Internal partitions

Such differentiated applications and products have to be tailored and designed on purpose having in mind the final use conditions, and the differentiated functionalities to be imparted.

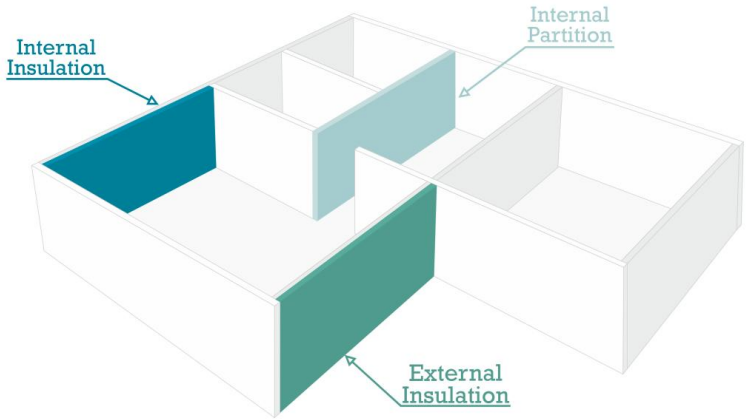

Figure 1: BRIMEE aimed applications in the built environment

A key role to ensure the maximum efficiency is played by architects and creative designers that are the main actors when it comes to refurbishing of multi-storey and multi-owner buildings. Owners can increase the overall value of their property by appropriate design of their living space modifying volumes through partitions, increasing thermal and acoustic comfort and quality of the indoor environment.
In accordance to the above listed technical objectives, the following industrial and socio-economic medium to long term objectives are identified, addressing the targeted retrofitting of existing buildings and a consistent share of the new-built environment:

- overall retrofitting cost up to 120 Euro/m^2 considering the whole life cycle and total cost of ownership, allowing a return on investment shorter than 7 years
- Create business opportunities worth 4 Billion Euro, if we consider a market penetration of 5% within 5 years after project completion, mobilising new cooperation schemes between Les and SMEs through licensing mechanisms that would enable local custom-fit panel manufacturing by moulding and pre-casting SMEs (as better detailed in section 3)
- Generate/maintain 27000 skilled jobs, considering that according to the practice in the sector each employee in the enlarged construction value chain mobilise around 150 kEuro of turnover

PERFORMED WORK AND MAIN RESULTS ACHIEVED SO FAR

1. Work Performed

In agreement with the expectations and the GANTT chart (Figure 2 below) the activities of the BRIMEE project for the first 18 Months have been performed in accordance to the contractual terms, and have seen the collaboration of the different partners in order to achieve the challenging results as expected. In some cases, the targets have been achieved, in some other the achievements are below the expected targets, still the progress of the work lets foresee forward achievement of the expectations, still work is expected to be done.

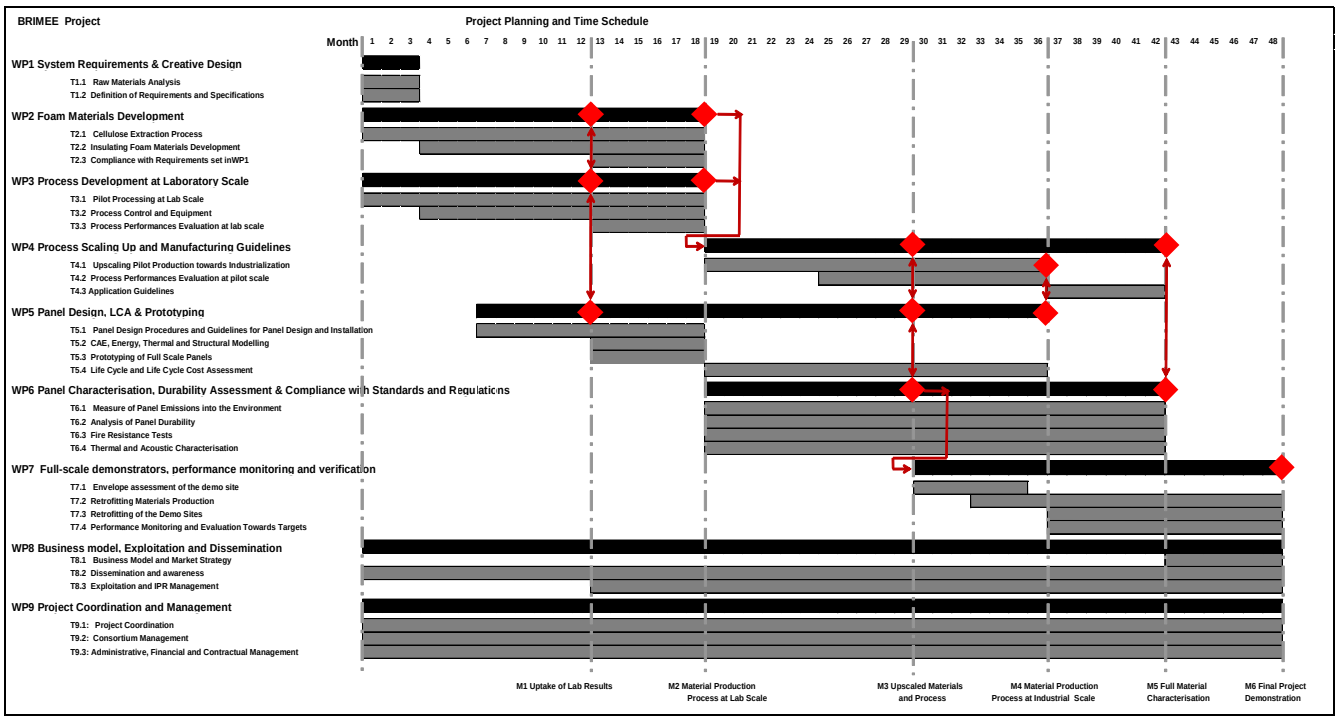

Figure 2: BRIMEE GANTT chart

In particular, the following lists summarizes in executive way the achievements within the different workpackages active in the first period (M1 – M18):

- WP1: System Requirements and Creative Design. The actions have been concentrated in the first 3 months of the project, with the operative involvement of the whole consortium partners. The two main deliverables have been duly submitted at M3, providing to the project the fundamental basis for granting common understanding and generation of a shared ontology among the partners. The Conceptual design, specifying at high level the performances expected, as well as the testing required and the functions preferred to the different applications (extended from the initial 3 to 6, in accordance to the maximized exploitation of the materials capacities, extended to flooring, roofing and cladding). Aspects of interest for the end users acceptance, the aesthetic quality and design aspects are duly accounted and considered.

- WP2: Foam Materials Development. The activities of this Workpackage are focussing on the development of materials that can represent the real asset for the BRIMEE project. The activities have been focussed, in the first 18 Months, in the development of the foam, consolidation and definition of the optimal level of additives, in close relationship with the activities performed in the WP3, focussed on the development of the process. The two activities can not be disjoined, and the development of materials follow the processing conditions, in a continuous feedback loop oriented to optimize the performances and to grant the maximum efficiency. The most relevant result on the period, is the fully standardized and consolidated methodology leading to the production of A4 samples of foam, in three different conditions: white foam (only cellulose nanoparticles, naturally bound by the molecular bonds, density below 30 kg/m3); yellow foam (cellulose nanoparticles consolidated by natural based polyurethane materials, excellent rigidity and mechanical resistance, poor fire resistance, density in the range 100 – 150 kg/m3); black foam (the yellow foam with additional infusion of fire suppression elements, leading to extremely interesting mechanical and thermal performances, density in the range 150 – 170 kg/m3). Additionally to the development of the foam, and definition of the compatibility with external layers of skin materials, virtually with any consolidation resin, the activities have been also focussed in the development of functional additives, oriented to granting the final performances of the material adequate to the ambitions of the project. Although the samples have been developed only at small scale level, the expertise of partners in nanomaterials and nanofunctions permitted to achieve extremely interesting results, in particular for the functions of heat reflection, IR radiation management, fragrance release and odour absorption. Also the chromatic effects and the surface interaction with traditional building materials (mortars, paints) have been tested.
- WP3: Process development at laboratory scale. As anticipated within the WP2, the counterpart of the material has been developed within the processing, deploying the activities finalized to the achievement of a stable, controllable, efficient and replicable process for the obtainment of a cellulose foam. The step of consolidation with resin has been put aside at the beginning of the project, focussing the attention on the achievement of a “white foam” having the required performances. The process is based on a number of steps, each of them has been codified and simplified, in order to achieve the final foam samples, and to provide the basis for the future upscale. This very last aspect has been the core of the work in the second half of the first period: in particular the two steps where the highest criticality (in terms of expected energy consumption and process hazard) are associated to the materials modification, namely the solvent exchange and the freezing of the foam. Specific tests and experimentations permitted to raise the freezing temperature, therefore maintaining the control on the foam structure, and reducing the amount of energy required (as a matter of fact, permitting to pass from the liquid nitrogen to a industrial refrigerator to cool the material). The system for ethanol washing and solvent exchanging is conceptually designed as well, permitting to address the economization and reduction of the volume of solvent to be employed. As well, similar optimization has been performed on the acidic washing, enabling conceptual recovery of the whole amount of sulphuric acid (at lab scale more than 90% is actually recycled). Intelligence on the concurrent

methodologies currently active in different parts of the world (mainly Scandinavia and Canada) permits to assess the methods employed in BRIMEE project to be still unique and leader according to the results achieved.

- WP4: Process scaling up and manufacturing guidelines. The activities have so far only initiated, as concerns the follow-up of the laboratory scale processing developed in WP3. As a matter of fact, preparatory work, as the production of moulds, and the set up of pilot line for freezing materials has been predisposed, ready to be applied to larger size panels production. The activities in this WP are expected to be run with cooperation with the NCC Foam project (GA 604003).
- WP5: Panels Design, LCA and Prototyping. The preliminary design of the panel has been developed, thanks to the expertise and innovative ideas generated through joint applications of designers / architects, and partners active in the building industry. The draft design is furthermore expected to be evolved due to the refinement of the functionalities and the specific characterizations of the panels. In parallel to the design, testing of the materials is running within the WP6, with the objective to assess the results as soon as they are delivered, and to steer the design features in accordance to the specific requirements of the project. The process has been analysed (at the lab scale, and the first step of upscaling), in order to address the aspects of Life Cycle Assessment and to pave the ground for the future analytics. The partners have already identified and planned a schedule for the development of the new panels, and therefore to address the single items leading to the final overall impacts assessment. On such preliminary drawings and intermediate features of the core materials, the performances of the final panels in simplified environment have been tested, permitting therefore to anticipate the final performances, and to support the design phase, in accordance to the mechanical and thermal insulation capacity.
- WP6: Panels characteristics, durability assessment and compliance with standards and regulations. Although originally scheduled to start at M18, activities of testing the materials performances have been anticipated (from Month 18 as foreseen in the DOW to Month 6) thanks to the good progress occurred in WP2 and WP3. The foam samples made available to the laboratories responsible for the testing, permitted in particular the achievement of testing dedicated to the environmental performances (VOC release), mechanical and fire reactions. The first results provided good compliance with the expectations, in particular with respect to the foam performances, due to the self extinguishing and reduced flame propagation. The structure development in order to permit the further increase of the performances of the foam has been studied, and according to the developments in the foam processing a closer and smaller porosity size permitted to foresee a further increase into the features of the final products. Still, improvements have been identified, as for the density and the homogeneity of the products, leading to clear areas where to focus the work into the future developments of the project.
- WP7: Full scale demonstrators, performance monitoring and verification. The official starting date for WP7 is M30. In the first 18 Months, only minor activities have been initiated, oriented to the assessment of the type and functionalities for the demonstrators to be installed, and the specific issues to be addressed in the final demo sites (those already identified, and additionally other cases where to grant high visibility to the project results).

- WP8: Business model, exploitation and dissemination. The activities within the workpackage are aimed to support the effective implementation of the results and to address the aspects of communication and exploitation of the project, supporting the partners into the process of management of the knowledge generated. Activities initiated with the start of the project and covered the three main aspects of IPR management, modelling of the business to be applied and generating awareness towards the exterior of the activities performed and results achieved. The dissemination has been planned for the whole project. Website is released online and constantly updated, serving as a repository and as platform for communication among partners. Basic dissemination material is developed (leaflet, poster, roll-up) and taken as a basis for future modification in accordance to the project achievement and evolution. Partners initiated to attend to fairs, with a plan to increase the presence to such events in all the cases where it can create added value. Concerning exploitation the partners have autonomously assessed and characterized own exploitable results and on this basis built the Exploitation Strategy seminar, performed with the support of an expert and leading to the development of an advanced PUEF document. This will constitute the basis for the future developments and continuous monitoring and update of the knowledge.

2. Results Achieved

The overall results and achievements of the BRIMEE project are aligned with the expectations, and according to the 18 Months term, are relevant for the scientific and technological development of the materials and processing, testing of the performances and design indications finalized to the achievement of the relevant functionalities. The following are the main results achieved:

- Conceptual Design: the panels are conceptually developed and the ideas on the different types of applications, end use, functionalities (among the ones developed within the project) are assessed. The end applications (flooring, roofing, partitions, internal or external insulation) influence on the features and specifications are addressed, as well as the foam benefits on the overall composite structure.
- Panel Design: is progressing after having achieved a first draft result, providing the main features of the panel declined on the application. The design is based on early modelling and simulation results, as well as on the results of the testing that steer the aimed final performances in use conditions. The design is as well influenced on the expected production capacities, leading to the development of smaller panels, easier to handle and assemble in the end applications, compromising the benefits of larger panels with a higher flexibility and ease of design.
- Materials development: the receipt for the foamed NCC core material is deployed and formalized. The production routine implemented, permitting to optimize the microstructure (isotropic foam in substitution of the directional foam, according to an evolution in the method for producing the foam), and reducing the energy consumption. The formulation is optimized, to maximize the use of renewable and natural derived materials, achieving at the same time mechanical rigidity and fire resistance. As it is at the term of the 18 Month, the material is considered to be ready for the further action of upscaling, and in accordance to the early results of the testing (on materials at reduced scale) the performances are considered to be aligned with the

requirements. The improvements to be further performed are expected to be achievable thanks to the knowledge matured in the processing, and the fine-tuning of the process parameters e.g. to reduce the materials density, or the composition of the resins in order to achieve specific performances in the composites. As a basic achievement, the materials are currently available foamed in A4 shape, and the first step of improvement towards the upscale, already planned and with engineered and developed moulds, is oriented to doubling the surface, achieving therefore A3 size. In addition to the basic formulation, the processing to impart hydrophobicity to the NCC foam is deployed to achieve performances compliant with building sector also in presence of water. The surface or bulk functionalization is furthermore developed, exploiting different types of nanomaterials to impart features of thermal management (Phase change materials), IR radiation reflection and fragrance release, in relation to intermediates and coverings (plasters, paints) standard in the building industry. Early samples have been tested, to steer the directions of the upscaled production.

- Processing Development: in parallel with the development of the material, the receipt is formalized and established also for the process steps, the raw materials and the intermediates and processing stuff to achieve the products. The basis for the following upscaling steps are established thanks to the approach, finalized to minimizing the energy expenditure (migrating from liquid nitrogen to industrial freezing unit) and to confine in a narrow space the dangerous steps involving flammable solvents. Additionally, the overall sustainability is granted thanks to the programme for recovering the solvents or reagents (etOH, sulphuric acid) and supporting therefore the generation of an overall sustainable process concept. Such approach, leading to recovery of more than 80% of the work fluids already in lab scale, together with counter-current washing design, permits to foresee that also the future developments in pilot scale will be sustainable. The design of the upscaled production will go in two directions: a pilot line, to demonstrate the batch production of larger (A3) samples, and a longer vision industrial line, oriented to producing in continuous the foam in freezing tunnel, characterized by an higher level of automation, and elevated costs both for the equipments and the raw materials.
- Testing: the material samples (in specific dimensions as required by the text fixtures, and in compliance with the availability from the samples materials production at lab scale)have been made available to the laboratories under the specific features and dimensions to permit the validation of the different fields of performances, as required by the project ambitious testing programme. Due to the difficulties in materials availability, the priority has been given to the tests providing a basis to the applicability of the materials in the building sector and the specific requirements as provided by the BRIMEE project. Therefore, materials fire resistance, vapour emissions in air, density and the mechanical performances have been investigated with priority as the basic features. Results have provided useful feedbacks to the materials surface functionalization, and are addressing the question on the methods to improve the final performances at sustainable application methods.
- Demonstration strategy has just initiated at this stage, but the relevant expertise of the partners let already foresee a clear planning of the activities. Brno and Madrid demo sites are foreseen for the interiors, plus smaller scale demo installations at the premises of the partners willing to showcase the results of the project to potential

customers and stakeholders. The issues of materials provisions and primary transformation will be addressed within the course of the project and the aspects of sourcing and costs associated taken into due consideration in order to permit the achievement of the ambitious results within the timeframe of the demonstration, permitting as well the testing of the results under working.

- Virtual analysis: on the mechanical, thermal and acoustic performances, and on the overall sustainability of the whole product, calculated on the environmental performances. The results are so far limited to setting the basis for the future calculations, and the preliminary, local scale modelling aspects, deployed within the current results for the panels design and the projections of the production facilities and methodologies.
- Business Model: the results achieved within the first 18 Months permitted to enable a complete overview of the feasibility of industrial exploitation of the results. In particular, the whole consortium has set up a strategy for developing a business model acting as a single value-chain, leveraging on the key advantages of the innovative materials/products, and working to reduce the limitations so far identified, almost all associated to the costs for the new materials. Partially in resolution of the last issue, also the potential extension of the application field towards different end uses and applications seems to be a suitable route. This in fact is expected to provide clear demonstration of real case application, in solutions where the cost is less an issue and high quality materials play a central role, the volumes associated can stand for reduced costs of the raw materials and the processing, and the advertising expected to generate a natural support to traditional sectors to effect transition towards new solutions.

Such technical results are coupled with transversal enabling results, permitting to organize the work in terms of exploitation, in particular assigning responsibilities and methods for exploitation to each of the results deemed valid for exploitation, to address the standards and the typical features and barriers in the built environment, and to control the flows of information towards the dissemination activities, maximising the benefits of the awareness generated in the community of the Energy Efficiency in buildings, at no risks for unwanted leakage of knowledge.

EXPECTED FINAL RESULTS AND THEIR POTENTIAL IMPACT AND USE

The BRIMEE project at the Month 18 is running in accordance to the expectations, and some of the key activities are in advance with respect to the foreseen scheduling.
Each of the fields of results so far achieved is expecting to generate real impact for the partners, and returns in terms of applied knowledge: materials, products, real implementation and application of the materials under tested operating conditions.
The key expected result the project is aiming to reach, is the demonstration of the industrial feasibility and sustainability of an insulation panel that is not only efficient in terms of thermal and sound barrier capacity, but at the same time can be implemented in the built environment with good acceptance on the end users and at no negative impacts on the indoor air quality. To do so, the activities and the results so far achieved are aligned with the expectations, and cover the main elements for the industrial feasibility, but the most relevant item to be performed, and which is at the centre of the development for the second period is related to the perceived quality, the overall sustainability and the real scale implementation of results.

The final expectation is a panel, nice and appealing for the inhabitants, suitable to be installed in interiors, with a strong natural – renewable basis, and with good characteristics of inertness towards the atmosphere. As ideal project outcome, thanks to the representation of the whole product value chain, the installation of such type of solutions, either in new construction or in refurbishment solutions, can be favoured. The role of the materials scientists, the results of testing and model analytics, as well as the concrete support provided by architects is expected to build a strict relation and strong visibility of the BRIMEE approach towards the construction world. Impacts expected span from the value generated to the end users and construction companies, up to the innovation acceptance within a sector still led by traditional solutions, and the benefit for the end users in their daily quality of life.