# PROJECT FINAL REPORT

**Grant Agreement number:** 608910

**Project acronym:** BRIMEE

**Project title:** Cost Effective and sustainable Bio-Renewable Indoor Materials with high potential for customization and creative design in Energy Efficient buildings

**Funding Scheme:** Collaborative Project

**Period covered:** **from** 1st July 2013 **to** 30th June 2017

**Name of the scientific representative of the project's co-ordinator[1], Title and Organisation:**

Andrea Maria Ferrari, Engineering Manager of RINA Consulting (formerly D'Appolonia) S.p.A.

**Tel:** +39 010 3628148

**Fax:** +39 010 3621078

**E-mail:** andrea.ferrari@rina.org

**Project website address:** http://www.brimee.eu/

[1] Usually the contact person of the coordinator as specified in Art. 8.1. of the Grant Agreement.

## 4.1 Final publishable summary report

### *4.1.1 Executive summary*

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. 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-Crystalline Cellulose (NCC) based foam, strengthened with natural derived resins, providing mechanical strength and lightweight performances. 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. 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 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 RINA Consulting, 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.

### *4.1.2 Project context and objectives*

In line with 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, more and more attention is paid to 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. 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). Consequently, 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.

In this context, beside good and consistent thermal and acoustic performance over time, a high performance and marketable insulation material should 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. The BRIMEE project aims exactly at developing 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. In particular, BRIMEE project focuses on 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. Additionally, the expanded materials that have been 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.

More in details, the **main objective of 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 and lightweight performances. Functional characterization to the Cellulose basis is exploited to confer to the material additional functionalities, such as fragrance release, anti-bacteria or 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:

- 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 limited environmental impact. Thanks to the reclamation of waste streams, the overall environmental impact can be considered as positive, accounting limited disposal.

As depicted in the following figure, BRIMEE NCC foam panels are suitable to be applied within three fully operational components:

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

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

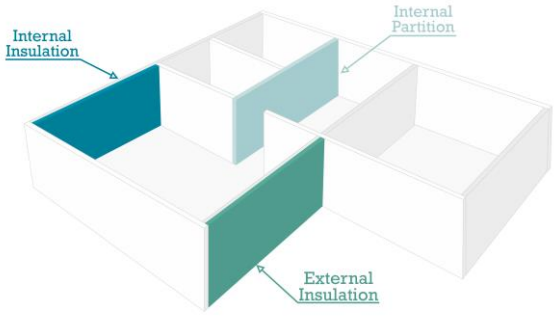


**Figure 1. BRIMEE aimed applications in the built environment**

In addition, the project has demonstrated the innovation through three demo buildings located in different climatic zones, Spain, Czech Republic and Italy.


**Figure 2. BRIMEE Project demonstrators**

### *4.1.3 Main Scientific &Technical results*

The overall results and achievements of the BRIMEE project are aligned with the expectations, and according to the 48 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. Moreover, 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. The main results achieved within the project are summarised in the following.

**S&T Results – 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.

In particular, the use of the NCC foam panels has been described as external insulation, internal insulation and partitions. In all these uses, the key areas that the CE market products must consider are as follows:

- Mechanical Resistance and Stability;
- Safety in case of fire;
- Hygiene, health and the environment;
- Safety and accessibility in use;
- Protection against noise
- Energy economy and heat retention;
- Sustainable use of natural resources.

A list of expected and desired functionalities for the three main application areas were identified as provided in the following table.

**Table 1 Functionalities maps: the different panel applications in a nutshell**

| | | **Internal application on external wall** | **Partition wall** | **External application on external wall** | | |
|---|---|---|---|---|---|---|
| | | | | **Panel as ETICS core** | **Panel as veture** | **Panel as self-supporting element** |
| **BWR 1** Mechanical stability | Mechanical stability | No functionality assigned (non-load-bearing component) | No functionality assigned (non-load-bearing component) | No functionality assigned (non-load-bearing component) | No functionality assigned (non-load-bearing component) | No functionality assigned (non-load-bearing component) |
| | Reduced heat radiation absorption and emission | + | + | + | + | + |
| | Reduced heat release rate (HRR) – i.e. non-combustible surface material | + | + | + | + | + |
| | Mould safe – does not provide surface where mould could growth | + | | | + | + |
| | Self-cleaning | + | + | | + | + |
| | Antibacterial | + | + | | + | + |
| | Water repellent | + | + | | + | + |
| | Controlled water absorption | | | + | | |
| | Selective water vapour resistance | + | | + | + | + |
| | Harmful substances absorbent (air cleaning) | + | + | | | |
| | Oxygen producing | + | + | | | |
| | Wind load resistance | | | | | + |
| | Impact resistance (soft body impact) | | | | | + |
| | General mechanical strength | + | + | + | + | + |
| | Sound absorption | + | + | | | |
| | Sound insulation (without mass) | | + | | | + |
| | Low thermal conductivity or switchable thermal conductivity | + | | + | + | + |
| | Thermal accumulation | + | + | + | + | + |
| | Airtightness | | | | | + |
| | Thermal energy generation and use | + | + | + | + | + |
| | Daylight accumulation and use | + | + | | + | + |
| | Low environmental footprint | + | + | + | + | + |
| | High recyclability | + | + | + | + | + |

| | | Internal application on external wall | Partition wall | External application on external wall | | |
|---|---|---|---|---|---|---|
| | | | | Panel as ETICS core | Panel as veture | Panel as self-supporting element |
| *ADDITIONAL REQUIREMENTS* | | | | | | |
| | Aesthetic finishing / Decoration | + | + | | + | + |
| | Fragrance release / Odour control | + | + | | | |
| | Electricity generation and use | | | | + | + |
| | Resistance to weathering<br>- Precipitations<br>- temperature variations<br>- UV | | | | + | + |
| | Scratch resistance | + | + | | + | + |
| | Impact resistance | + | + | | + | + |

**S&T Results – Panel Design**

The panels are developed and the main features of the panel declined on the application are provided. The design is based on 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.

In particular, two different solutions for the application of NCC foam panels within internal partition walls have been developed with different technical characteristics in terms of components and thermo-structural behaviour, investigated through CAE, energy, thermal and structural modelling. 3D CAD libraries for both the identified alternative options have been prepared, as shown in the figures below.

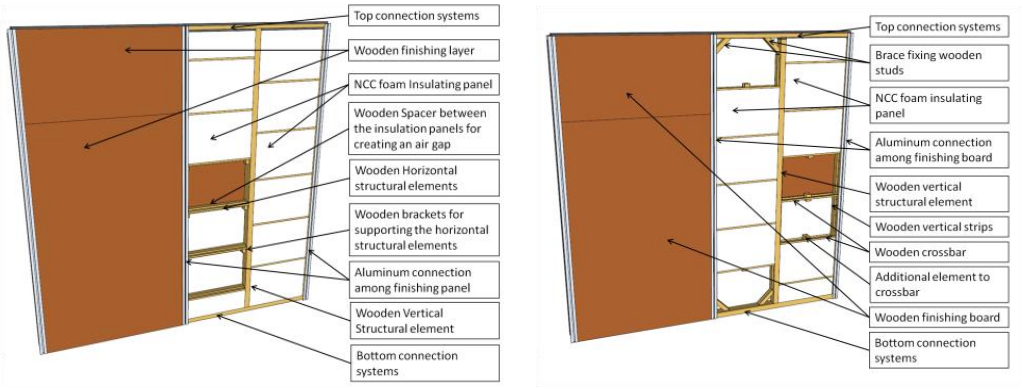


**Figure 3 BRIMEE Eco-innovative Panel - Solution 1 and Solution 2 - General composition**

NCC foam material can be applied as panels suitable for three fully operational components: internal and external insulation as well as internal partition. Detailed procedures for the new eco-innovative panels installation, customised for the three different applications, have been developed, as summarized in the schemas below. In case of external walls application, two different approaches have been selected for NCC foam panels installation, namely ventilate facades and cavity walls.


**Figure 4 Internal partition walls**

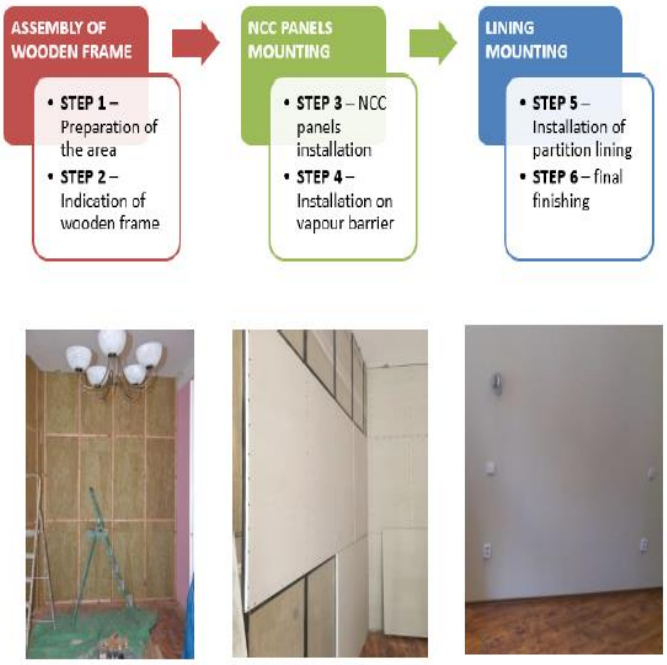


**Figure 5 Internal insulation walls**

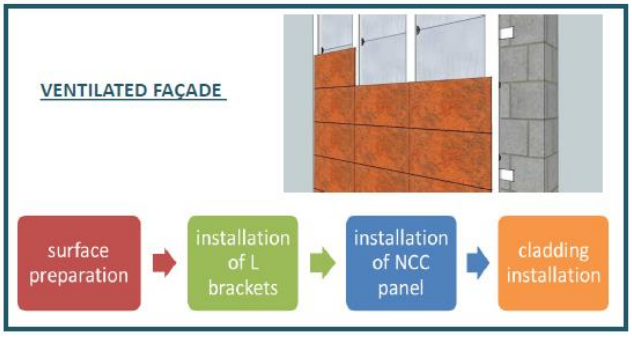


**Figure 6 External Insulation walls – Ventilated facades**

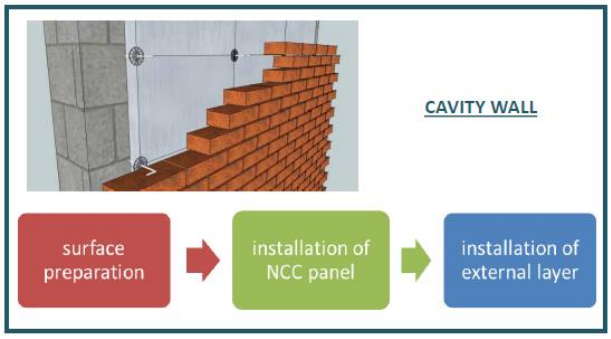


**Figure 7 External Insulation walls – Cavity walls**

## S&T Results – Material Development

The recipe for the foamed NCC core material is deployed and formalized. The production routine implemented, permitting to optimize the microstructure and reducing the energy consumption. The formulation is optimized, to maximize the use of renewable and natural derived materials, achieving at the same time good mechanical performances. A further action of upscaling has been performed, the materials are currently available foamed in A2 dimensions (40 x 60 x 1 cm).

More in details, NCC foam was obtained through controlled freezing of the NCC material followed by solvent exchange of NCC suspensions in water. Foam formulations, and foam formation process were improved during the project, leading to increased strength and significantly decreased foam costs. The final formula for NCC foams contains 90% pulp and xyloglucan and 10% NCC. The formulas is "whipped" and frozen at only -20°C, following by solvent exchange with ethanol and drying. The resulted virgin and isotropic foams have density of 30-40 Kg/m$^3$, good mechanical performance, and are also flexible and durable.

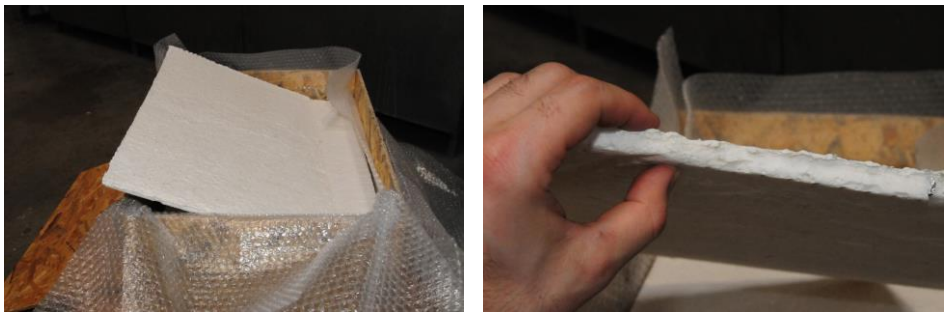

**Figure 8 BRIMEE NCC foam panels**

**S&T Results – Processing Development**

In parallel with the development of the material, the recipe is formalized and established also for the process steps, the raw materials and the intermediates and processing stuff to achieve the products. The following upscaling steps are performed thanks to the approach, finalized to minimizing the energy expenditure 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 and supporting therefore the generation of an overall sustainable process concept. The design of the up-scaled production went in two directions: a pilot line, to demonstrate the batch production of larger (A2) samples, and a longer term, pilot industrial line, oriented to respect the 100 kg/day of NCC foam panels, characterized by a higher level of automation. Such a system has been conceived and designed, yet the costs for its integration and prototyping lay well beyond the project financial capabilities.

More in details, the pilot line able to produce 8 NCC foam panels per day in the form of sheets at dimensions of 0.6 m x 0.4 m x 0.01 m was set up and tested. The NCC foaming line can mainly be subdivided in the following four steps:

- Mixing and foaming: The NCC suspension, pulp suspension (for reducing the required portion of comparatively expensive NCC) and additives as raw materials are mixed in a mixer until a liquid foam of the desired density is obtained.
- Freezing: The foam is poured into moulds of a desired shape and frozen at -20 °C.
- Solvent exchange: In a two-stage procedure, the water enclosed in the frozen foam is removed by using ethanol as solvent.
- Drying: In an oven the residual water and the solvent used are removed leaving a solid, dry cellulosic foam.

**Figure 9 BRIMEE foaming plant PFD and 3D plant layout**

In order to further analyse the industrial potential of the innovative insulating material, a conceptual design related to a foaming plant with a capacity of 100 kg/day of material has been developed, customised to increase the plant automation level.

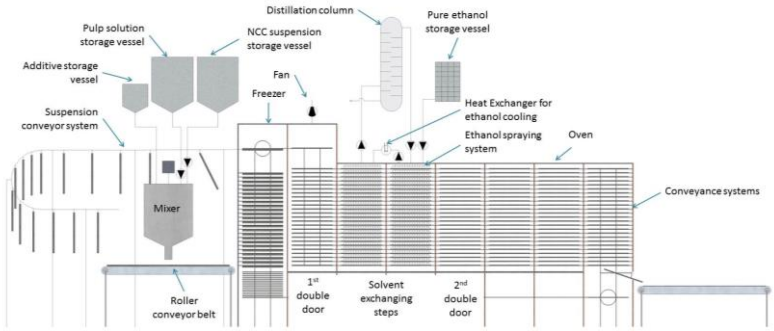


**Figure 10 BRIMEE foaming plant PFD (100 kg/day)**

## S&T Results – Testing

The material samples 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. Main results are summarised in the following.

The materials developed prove to perform well in terms of **thermal conductivity** and **sound absorption**. In particular, the NCC foam materials, with a thermal conductivity of around 0.035-0.041 W/mK, results classifiable as insulation material. Performances are in fact in the range of products available on the market. Moreover, the foam results suitable as sound absorber in the high frequency region. Low frequency absorption cannot be achieved, mainly due to the low density.

Considering the **chemical emissions**, the NCC white flexible foam material is **suitable for indoor use from the indoor air quality (IAQ) point of view**. This positive result is achieved thanks to the strong efforts of all the BRIMEE consortium, during the course of the project, seeking adequate composition and manufacturing process, resulting in a material not emitting harmful substances. In particular, this result is achieved avoiding the crosslinking steps, and selecting additives supporting the suppression of flame, not containing volatile or bromine compounds. The evaluation was exemplary carried out according to the German AgBB scheme based on the LCI-concept (AgBB – Committee for health-related evaluation of construction products; LCI – *Lowest Concentration of Interest*).

With reference to the **fire resistance** properties, the tests performed on the different NCC foam materials show that the behaviour of the material is drastically affected when the resin infiltration is not performed. In effect, only the black NCC foam material achieved the fire resistance **class E**, required for building applications (conservative value, due to the small sample dimensions: full scale tests on products cannot be performed). Other types of additives and fire retardants need to be identified in the future for granting better performances for the NCC white foam.

**Water absorption** and **vapour transmission** tests are performed over various untreated and waterproof treated NCC foam materials. Considering water absorption, based on the results obtained, it can be concluded that it is highly essential to modify the extremely high hydrophilic nature of the untreated NCC foam materials by either applying various thermal and/or chemical treatment or by successfully tuning their nature. The achieved results show substantial improvement with respect to their water absorption. Moreover, two options

that can be used to implement further **improvement of the hydrophilic nature of NCC foam materials**, are identified.

- Option 1 - Modification of the hydrophilic nature of initial NCC foam materials by:
    a. Applying various treatments (thermal, chemical)
    b. Altering the nature of the NCC foam (changing the surface topology and chemistry)
- Option 2 - Further modification and improvement of the waterproof agent by:
    a. Depositing various combined nanoparticle on NCC foam surface ($TiO_2$-ZnO-$SiO_2$ multicomponent nanoparticle formulation)
    b. Using another nanoparticle synthesis method

Considering the vapour transmission, the materials show a high moisture transfer in tests with a reduction in the rate of water vapour transmission through the material in case of coated NCC foam materials. However, the vapour permeability of the material is not in itself a concern, in fact breathing insulation is required in building systems.

In conclusion, positive testing results are achieved in all the tested characteristics, although it is not possible to obtain one single material resuming all the positive achievements and performances sought. In particular, the NCC foam materials result to have good performances in terms of thermal insulation, sound absorption and chemical emissions, limited performances are achieved in terms of fire resistance and water absorption. In order to overcome such limits, guidelines and solutions are identified as starting points for future development of NCC foam materials able to fulfil all the required properties and to be successfully implemented as a constituent in the building industry.

**S&T Results – Demonstrators**

Installation and monitoring activities in the three selected demo sites, Brno (Czech Republic), Bergamo (Italy) and Seville (Spain) have been performed, permitting the testing of the results under real working conditions. A short description of the three demonstrators and the main results achieved are summarised in the following table.

**Table 2 BRIMEE demonstrators description and results**

| **Czech Republic Demo** | |
|---|---|
|  | Brno, located in the southeast of landlocked Czech Republic, has an oceanic/humid continental climate, characterised by hot summer and cold winter temperatures. Typically, daily mean winter temperatures are ~-2.5°C and daily mean summer temperatures are ~19°C. A historic 4 storey building, built at the turn of the 19th/20th century is the location for the Brno demonstration project. This UNESCO protected building is typical of the time, with 3.5 meter ceilings, 60 cm load bearing walls, 30 cm partition walls and no out of inner insulation. Since UNESCO protected and due to façade regulations, its historical appearance has not to be modified with a retrofitting intervention. In particular, due to these restrictions and the necessity of a public authorization to alter external facades, the demonstration panels, both NCC foam and mineral wool panels, have been applied to internal parts of the walls. The actual site of this demonstration project is on the second floor on the exposed walls of the end of terrace building. |

- Internal air temperature readings at both the NCC foam and mineral wool installations appear to be influenced more by factors other than external air temperature (e.g. central heating). This indicates a good thermal performance against the influences of cooling and over-heating by outside temperature changes.
- Heat flux values are greater both on the internal surface and behind the insulation panel in the mineral wool installation. Such findings show a greater heat loss from mineral wool insulation than from NCC foam.
- Relative humidity at the surface measurement points are lower in the NCC installation, indicating the need for a greater temperature drop than the one required in the mineral wool installation before the dew-point is reached.
- Unexpected results in the relationship between RH and surface temperature are shown in both NCC foam and mineral wool installations suggesting NCC foam does not behave any different to other insulation materials. Further analysis here is needed before conclusions can be made on the cause of this behavior.
- In the oceanic/humid continental climate NCC foam insulation performs better the mineral wool; particularly with regards to heat loss and potential condensation.

**Italian Demo**

The city of Bergamo, located in the Lombardy region of northern Italy, experiences a humid subtropical climate characterised by daily mean temperatures ranging between ~2.7°C in the winter and ~22.8°C in the summer. Unlike much of Italy, that experiences dry summer weather, this region experiences summers often wetter than the winters. An extension to a 1970s single floor office building comprising of three storeys that join to the original traditionally build office at the ground floor forms the location of this demonstration site. In particular, a small office room on the ground floor serves as the specific location for installation of both NCC foam and mineral wool panels.

- Both insulation materials contribute to comfortable internal air temperatures despite some considerable diurnal and seasonal variability in external air temperatures.
- Measured positive heat flux values behind the insulation materials are larger in the mineral wool installation, indicating greater heat transfers out of the building. There is no significant difference in measured heat flux at the internal surfaces during the warmer months, however, in the colder months the HFPi in the NCC foam installation is more positive than the equivalent mineral wool value. combined with the lower HFPb value this suggests the NCC foam retains heat and prevents it's loss through the walls behind and into the outside air.
- Relative humidity measurements for mineral wool are consistently greater than, or equal to, NCC foam relative humidity values despite surface temperatures remaining within 1°C of the corresponding NCC foam measurement. Combined with lower measured internal air temperature at mineral wool, this suggests the dew point will be more easily reached than in the NCC foam installation.
- All factors remain within ranges for good occupant health and comfort through both colder and warmer transitional months.
- Data indicates NCC foam to perform as well as alternative insulation materials in the humid subtropical climate experienced in Bergamo.

| Spanish Demo | |
|---|---|
|  | Located in the Andalusia region of southern Spain, Seville experiences a subtropical Mediterranean climate with wet winters and drier summers. Daily mean temperatures reach ~28°C in the summer and ~11°C in the winter months. The demo site consists of a prefabricated module manufactured in Dragados factory in Las Cabezas de San Juan. This structure is in turn a demonstration module for the construction of a school in Andalusia. In this scenario, the BRIMEE NCC panels are used to replace a section of mineral wool as insulating core of glass fibre reinforced concrete (GRC) panels. |
| • The set-up has suffered from problems with the sensing equipment manifesting themselves in anomalous spikes or periods of no measurement. Addressing these issues and having a longer pilot period at this site would allow a better analysis of NCC foam performances compared to mineral wool.<br>• Surface relative humidity results for both NCC foam and mineral wool remain within a range considered to be comfortable for occupants and below values that could cause concern for condensations or mould growth.<br>• Heat flux measurements show that daytime fluxes from the outside to the inside are greater than the losses of heat that occur during the night. These significant variations in the heat flux reflect the big changes in internal and external air temperatures and suggest that both insulation materials react to temperature range maintaining a comfortable indoor temperature.<br>• In the subtropical Mediterranean climate of Seville NCC performs as well as mineral wool with regards to thermal performance and eventual occupants health issues and condensation phenomena. | |

**S&T Results – Business Model**

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. In particular, two Business Models, tailored for the BRIMEE NCC foam and eco-innovative panels, have been designed in accordance with partners wishes. The two different Business Models, analysed through the Business Model Canvas methodology, are provided below.

**BM1 – BRIMEE FOAM MATERIAL**

**KEY PARTNERS**

- MELODEA for NCC extraction
- SILCART for the foaming process
- Established partnerships between MELODEA and providers of recycled streams

**KEY ACTIVITIES**

- Production processes (NCC extraction and Foam production)
- R&D and optimization
- Testing
- Certification

**KEY RESOURCES**

- *Physical*: production plant and distribution networks
- Financial: initial investments
- *Human:* engineers and building materials scientists
- *Intellectual:* know-how (patents), partnerships

**VALUE PROPOSITION**

- New bio-based renewable insulating foam material based on NCC
- Good technical performance, low emissions
- Healthy and effective product
- Use of waste of pulp and paper industry
- Customizable product
- Easy installation

**CUSTOMER RELATIONSHIP**

- Co-creation of value with customers
- Promotion of the product underlining its eco-friendliness
- Quick respond to customers' requests

**CHANNELS**

- *Communication*: Consortium industrial partners' networks, project dissemination/promo material and activities (social media, events, brochure, video, etc.)
- *Distribution*: direct sales, distributors, retailer, companies with BRIMEE license

**CUSTOMER SEGMENTS**

- Composites processors
- Panel developers
- Panels installers
- Construction companies
- Operators of intermediate materials into BI, seeking for environmentally safe and eco-friendly products

**COST STRUCTURE**

- Fixed Costs (salaries, etc.)
- Variable costs (e.g. costs of raw materials)
- Marketing

**REVENUE STREAMS**

- Selling of foam material
- Licensing
- Consulting

**Figure 11 BM1: BRIMEE foam material**

**BM2 – Panels Design implementing BRIMEE foam**

**KEY PARTNERS**

- MELODEA and SILCART (foam material suppliers)
- Suppliers of other raw materials
- Designers and architects
- Foam material suppliers working under license

**KEY ACTIVITIES**

- Foam integration into eco-innovative panels
- Logistics
- Installation/training to installers
- Customization of design
- Marketing/promotion

**KEY RESOURCES**

- *Physical*: availability of raw materials
- *Financial*: investments for smart coating up-scaled plant
- *Human:* installers, engineers and architects
- *Intellectual:* partnerships, customer database

**VALUE PROPOSITION**

- Main components are bio-based
- Innovative and sustainable insulation
- Energy efficient product
- High quality of indoor environment
- Customizable product
- Easy installation
- Good thermal and acoustic performances
- Smart coating providing a multifunctional product

**CUSTOMER RELATIONSHIP**

- Co-creation of value with customers
- SW tool (for the future)
- Promotion of the product underlining its eco-friendliness

**CHANNELS**

- *Communication*: Consortium industrial partners' networks, project dissemination/promo material and activities (social media, events, brochure, video, etc.)
- *Distribution*: direct sales, distributors, retailer, companies with BRIMEE license
  - *E*-shop for the smart coating

**CUSTOMER SEGMENTS**

- Installers
- ESCO managers
- Building owners

**COST STRUCTURE**

- Production costs (raw materials, etc.)
- Marketing
- Other operating costs

**REVENUE STREAMS**

- Selling of the panel
- Licensing
- Consulting/training

**Figure 12 BM2: Panels design implementing BRIMEE panel**

### *4.1.4 Potential impact*

The BRIMEE project activities at the Month 48 concluded in accordance to the expectations. Each result 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 result 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. In particular, the final result is a panel, nice and appealing for the inhabitants, with a strong natural – renewable basis.

The BRIMEE project is expected to have a strong impact in terms of energy savings, boosting the application of sustainable and energy efficient solutions to the construction sector. To this aim, exploitation and business modelling activities have been clearly targeted at defining the project Exploitable Results and their impact and use for consortium business. Indeed, final results of the BRIMEE project have been completely identified, characterized and prioritized according to the TRL achieved. This allowed the consortium to paying the attention on the results more close to the market and partners took advantage of last project meetings in order to discuss and evaluate the appropriate agreements on the use of the foreground after the project end.

**Table 3 BRIMEE Project Key Exploitable Results description and achieved TRL**

| # | Key Exploitable Result | Leader | Short Description | Achieved TRL |
|---|---|---|---|---|
| 1 | Customized **Foam material** for BRIMEE applications | MELODEA + HUJI | NCC foam obtained through controlled freezing of the NCC material followed by solvent exchange of water suspensions of NCC formulations. The final formula for NCC foams contains 90% pulp and xyloglucan and 10% NCC. | **6** |
| 2 | **Process** for **Foam Integration** into panel at Pilot scale | SILCART | Up-scaled plant for producing NCC foam panels. The line is divided in the following four steps: Mixing and foaming, Freezing, Solvent exchange and Drying. | **5** |
| 3 | **Panels Design** implementing BRIMEE foam | BGTEC | ECO-innovative panelling solutions using the natural materials – wooden supporting structure adjusted to the panel dimensions and finishing wooden based board covered by photocatalytic multifunctional coating (KER #5). | **5** |
| 4 | **Protocols** and **Guidelines** for **panels Production** and **Use** | RCONS | Protocols and guidelines for NCC foam panels' production and use, including detailed technical characterization and description of the panels and related production processes, step-by-step procedures and troubleshooting tables. | **-** |
| 5 | BRIMEE panels **functionalities treatment** | AMS | Final treatment of panels with coating application, which can provide surface properties to the panel for better energy efficiency, antibacterial properties or odour release characteristics. | **6** |

More in details, the identification of the potential exploitation routes (product, project and service based exploitation routes) through the BFMULO analysis have been refined within the third reporting period and prepared the ground for the appropriate set up of agreements among the Partners on the use of the foreground after the project. The main insights from Business Model activities have been provided. Potential synergies among projects working in the same field/topics have been identified.

In conclusion, the assessment of NCC foam performances in the three different regions where demos are installed show that BRIMEE insulation performances are comparable, if not superior, than those of standard insulation materials in terms of thermal performance and eventual occupants health issues and condensation phenomena. Partners are well aware of the limitations of the BRIMEE white foam in fire and water resistance. Solutions to these issues are already identified, and have been the subject of tests, addressing at lab scale the water permeability and fire suppression. Partners agree on the necessity to perform further activities of development and demonstration in order to stabilise the formulations, upscale the process and optimise the overall costs for the final product.

Moreover, dissemination, communication and awareness generation activities were foreseen throughout the entire project life and were crucial to ensure a proper market uptake after its completion. They involved tasks related to the general dissemination of the project results as well as focused actions taken to ensure the relevance and the applicability of the outputs. The communication strategy targeted to policy makers at EU and MS level and to key stakeholders within the energy efficiency in buildings community had thus the following main objectives:

- To define a strategy for communicating, influencing policymakers and other stakeholders based on the project results;
- To ensure a widespread and effective dissemination of project results to the relevant target groups;
- To share the technical results of the project with the stakeholders and the scientific community as well as other potential beneficiaries in order to promote the research and receive useful inputs;
- To draw attention to the contribution of the project to the issues of public interest;
- To ensure project visibility and maximize the awareness of the project outcomes amongst the stakeholders and beneficiaries throughout European Union.

The idea behind the BRIMEE dissemination methodology was to maximize the benefits of the project not only to project partners but also to the external entities interested in acquiring a direct access and adopting the specific RTD results. To ensure a maximum efficiency of the dissemination activities, BRIMEE focused on the specifically defined target groups. A targeted approach eliminated a wide distribution of general information to an unspecified audience, which might have been of little use. To provide added value, information dedicated to each target group was tailored to their specific interest in the BRIMEE outcomes. Therefore, BRIMEE focused on the dissemination tasks, tools and media most suitable to serve the above purpose. The BRIMEE dissemination work was implemented at three levels:

- **European level**: The main dissemination effort was focused on the European group of stakeholders as well as other beneficiaries e.g. various networks, technology platforms, and encompassed communicating information acquired from the BRIMEE Demo buildings as well as issues of European wide interest. This dissemination level also includes the European research and academia community towards whom deferent communication channels and tools were applied as well as international scientific, professional and non-professional journals;

- **National level:** The main dissemination effort was focused on decision makers in the construction industry and national owners associations, national associations of professionals, national technology platforms and clusters. This level also includes financial organizations involved in construction or investors operating on national level;

- **Regional/local level:** The development and deployment of eco-innovative panelling systems and the set up a local supply chain of components shall be in principle built upon a local approach involving local stakeholders and end-users. Therefore, the dissemination tasks addressed the groups regional/local stakeholders centered around demo buildings for which own local dissemination approach were developed and implemented by relevant partners benefitting from the available dissemination materials and established contacts with the local stakeholders.

### *4.1.5 Contact information*

For additional information concerning the BRIMEE Project please visit the website or contact:

**RINA Consulting (formerly D'Appolonia) S.p.A. (Project Coordinator)**
Contact: Andrea Maria Ferrari
Phone: +39 010 3628148
Fax: +39 010 3621078
E-mail: andrea.ferrari@rina.org

**Project website**
http://www.brimee.eu/

#### Project consortium

The table below shows a list of all the project partner with the relative contact information.

**Table 4. Project consortium**

| No | BENEFICIARY NAME | CONTACT |
|---|---|---|
| 1 | RINA Consulting (formerly D'Appolonia) S.p.A. | andrea.ferrari@rina.org<br>daniela.reccardo@ rina.org<br>laura.giovanelli@ rina.org<br>giulia.veardo@ rina.org |
| 2 | DRAGADOS | emartind@dragados.com<br>gmunozc@dragados.com<br>mjsegarra@dragados.com |
| 3 | BERGAMO TECHNOLOGIE SP ZOO | anna.bogacz@bergamo-tecnologie.eu<br>gianni.cassera@bergamo-tecnologie.eu |
| 4 | BUILDING RESEARCH ESTABLISHMENT | garvins@bre.co.uk |
| 5 | BUNDESANSTALT FUER MATERIALFORSCHUNG UND -PRUEFUNG | matthias.richter@bam.de<br>wolfgang.horn@bam.de<br>oliver.jann@bam.de |
| 6 | MELODEA LTD | shaul@melodea.eu<br>Tord.Gustafsson@blatraden.se<br>yuval@melodea.eu |
| 7 | ZAVOD ZA GRADBENISTVO SLOVENIJE | sabina.jordan@zag.si<br>friderik.knez@zag.si |
| 8 | PROIGMENES EREVNITIKES & DIAHIRISTIKES EFARMOGES (AMS) | constantinos.tsoutis@amsolutions.gr<br>thanasis.morozinis@amsolutions.gr |
| 9 | FRAUNHOFER-GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V | stephan.kabasci@umsicht.fraunhofer.de<br>juergen.stein@umsicht.fraunhofer.de |
| 10 | THE HEBREW UNIVERSITY OF JERUSALEM | shoseyov@agri.huji.ac.il<br>sigal.sharon@mail.huji.ac.il |
| 11 | BBGK ARCHITEKCI. | marek.sobol@bbgk.pl<br>jan.brzozowski@bbgk.pl |
| 12 | SILCART SPA | marianna.marini@silcartcorp.com |
| 13 | FENIX TNT SRO | petra.novotna@fenixtnt.cz |
| 14 | INSTITUTUL DE CERCETARI ELECTROTEHNICE | p.anghelita@icpe.ro |
| 15 | STOWARZYSZENIE ARCHITEKTOW POLSKICH | dz@sarp.org.pl<br>11@pro-arte.com.pl |

## 4.2 Use and dissemination of foreground

### *4.2.1 Dissemination Activities (Section A)*

| TEMPLATE A1: LIST OF SCIENTIFIC (PEER REVIEWED) PUBLICATIONS, STARTING WITH THE MOST IMPORTANT ONES | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| NO. | Title | Main author | Title of the periodical or the series | Number, date or frequency | Publisher | Place of publication | Year of publication | Relevant pages | Permanent identifiers[2] (if available) | Is/Will open access[3] provided to this publication? |
| 1 | Bionanocomposite Films from Resilin-CBD Bound to Cellulose Nanocrystals | A. Rivkin, T. Abitbol, Y. Nevo, R. Verker, S. Lapidot, A. Komarov, S.C. Veldhuis, G. Zilberman, M. Reches, E.D. Cranston, O. Shoseyov | Industrial Biotechnology | Vol. 11, No. 1 | Mary Ann Liebert Inc. | | 01/02/2015 | 44-58 | | No |
| 2 | Some Aspects about Indoor Environmental Quality | Paula Anghelita | EEA - Electrical Enginnering, Electronics, Automatics | 63 | ELECTRA | | 30/10/2015 | 93-100 | | Yes |

[2] A permanent identifier should be a persistent link to the published version full text if open access or abstract if article is pay per view) or to the final manuscript accepted for publication (link to article in repository).

[3] Open Access is defined as free of charge access for anyone via Internet. Please answer "yes" if the open access to the publication is already established and also if the embargo period for open access is not yet over but you intend to establish open access afterwards.

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 3 | Nanocellulose, a tiny fiber with huge applications | T. Abitbol, A. Rivkin, Y. Cao, Y. Nevo, E. Abraham, T. Ben-Shalom, S. Lapidot, O. Shoseyov | Current Opinion in Biotechnology | Vol. 39 | Elsevier Limited | | 30/06/2016 | 76-88 | | No |
| 4 | Thermal insulation for integration in buildings based on cellulose fibres from industrial waste | Sabina Jordan | Mineral | Vol. X No. 49 | Business Media Ltd. | | 01/02/2017 | 28-29 | | No |
| 5 | Nowy materiał z nanocelulozy do zastosowania w budownictwie (Nanostructured material for use in buildings) | Marek Sobol - BBGK | Materialy Budowlane | N/A | Sigma-Not sp. z o.o. (peer reviewing rules at http://www.materialybudowlane.info.pl/dla-autorow-i-recenzentow.html) | | 30/06/2017 | N/A | | Yes |

| TEMPLATE A2: LIST OF DISSEMINATION ACTIVITIES | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| NO. | Type of activities[4] | Main leader | Title | Date/Period | Place | Type of audience[5] | Size of audience | Countries addressed |
| 1 | Flyers | INSTITUTUL DE CERCETARI ELECTROTEHNICE | RRR - Restoration, Renovation, Rehabilitation Conference | 03/10/2013 | Bucharest, Romania | Scientific community (higher education, Research) - Industry - Civil society - Policy makers | 100 | Romania |
| 2 | Oral presentation to a scientific event | MELODEA LTD | Nano Israel | 24/03/2014 | Tel Aviv, Israel | Scientific community (higher education, Research) | 80 | Israel |
| 3 | Exhibitions | MELODEA LTD | NanoCell Workshop | 20/05/2014 | Washington, US | Industry | 350 | Israel, US |
| 4 | Exhibitions | MELODEA LTD | The pop visit to Israel | 26/05/2014 | Jerusalem, Israel | Policy makers | 8 | Israel |
| 5 | Flyers | INSTITUTUL DE CERCETARI ELECTROTEHNICE | Healing Architecture Conference | 12/06/2014 | Bucharest, Romania | Scientific community (higher education, Research) - Industry - Civil society | 75 | Romania |
| 6 | Oral presentation to a scientific event | MELODEA LTD | TAPPI Conference | 23/06/2014 | Vancouver, Canada | Scientific community (higher education, Research) - Industry | 350 | Canada, Israel |
| 7 | Oral presentation to a scientific event | THE HEBREW UNIVERSITY OF JERUSALEM. | E-TERMIS COnference | 13/09/2014 | Poland | Scientific community (higher education, Research) - Industry | 730 | Central - Eastern Europe |

[4] A drop down list allows choosing the dissemination activity: publications, conferences, workshops, web, press releases, flyers, articles published in the popular press, videos, media briefings, presentations, exhibitions, thesis, interviews, films, TV clips, posters, Other.

[5] A drop down list allows choosing the type of public: Scientific Community (higher education, Research), Industry, Civil Society, Policy makers, Medias, Other ('multiple choices' is possible).

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 8 | Flyers | INSTITUTUL DE CERCETARI ELECTROTEHNIC E | Energy Efficiency: A resource unused/less used | 25/09/2014 | Bucharest, Romania | Scientific community (higher education, Research) - Industry - Civil society - Policy makers | 75 | Romania |
| 9 | Exhibitions | FRAUNHOFER-GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V | Simulation von Proteinshaumen | 26/09/2014 | Bonn, Germany | Scientific community (higher education, Research) - Industry | | Germany |
| 10 | Oral presentation to a scientific event | THE HEBREW UNIVERSITY OF JERUSALEM. | Scientific meeting at KTH and Holman | 28/09/2014 | Sweden | Scientific community (higher education, Research) | | Sweden |
| 11 | Flyers | INSTITUTUL DE CERCETARI ELECTROTEHNIC E | National Conference on HORIZON 2020 | 04/10/2014 | Bucharest, Romania | Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias | 150 | Romania |
| 12 | Oral presentation to a scientific event | D'APPOLONIA SPA | AMANAC Workshop | 09/10/2014 | Chambery, France | Scientific community (higher education, Research) - Industry | | France, Italy, UK, Spain, Germany |
| 13 | Exhibitions | INSTITUTUL DE CERCETARI ELECTROTEHNIC E | TIB 2014 - INVENTIKA 2014 | 15/10/2014 | Bucharest, Romania | Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias | 150 | Romania |
| 14 | Exhibitions | D'APPOLONIA SPA | SMAU Milano 2014 | 22/10/2014 | Milan, Italy | Scientific community (higher education, Research) - Industry - Civil society | | Italy |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 15 | Organisation of Conference | INSTITUTUL DE CERCETARI ELECTROTEHNIC E | Seminar Consortia on National Programme PN III and HORIZON 2020 | 28/10/2014 | Bucharest, Romania | Scientific community (higher education, Research) - Policy makers | 50 | Romania |
| 16 | Organisation of Workshops | D'APPOLONIA SPA | E-Hub Workshop | 02/11/2014 | Genoa, Italy | Scientific community (higher education, Research) - Industry - Policy makers | 35 | Italy |
| 17 | Flyers | INSTITUTUL DE CERCETARI ELECTROTEHNIC E | Visit to University Polytechnic of Timisoara | 03/11/2014 | Timisoara, Romania | Scientific community (higher education, Research) | 5 | Romania |
| 18 | Oral presentation to a scientific event | THE HEBREW UNIVERSITY OF JERUSALEM. | AMBA - Advanced Materials for Biomedical Applications | 18/11/2014 | Belgium | Scientific community (higher education, Research) - Industry | | Belgium |
| 19 | Oral presentation to a scientific event | THE HEBREW UNIVERSITY OF JERUSALEM. | NanoBio&med 2014 | 18/11/2014 | Barcelona, Spain | Scientific community (higher education, Research) - Industry | | Spain |
| 20 | Oral presentation to a scientific event | THE HEBREW UNIVERSITY OF JERUSALEM. | Scientific meeting in Holman | 06/01/2015 | Holman, Swedden | Scientific community (higher education, Research) | | Sweden |
| 21 | Oral presentation to a scientific event | D'APPOLONIA SPA | CompIC 2015 | 03/02/2015 | Amsterdam, the Netherlands | Scientific community (higher education, Research) - Industry | | The Netherlands |
| 22 | Flyers | INSTITUTUL DE CERCETARI ELECTROTEHNIC E | Thermography seminar | 16/02/2015 | Otopeni, Romania | Scientific community (higher education, Research) | | Romania |
| 23 | Flyers | D'APPOLONIA SPA | Smart Puglia 2020 - International buyer meeting | 24/02/2015 | Bari, Italy | Scientific community (higher education, Research) - Industry - Policy makers - Medias | 500 | Italy |
| 24 | Flyers | INSTITUTUL DE CERCETARI ELECTROTEHNIC E | International Trade fair Construct EXPO 2015 | 26/03/2015 | Bucharest, Romania | Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias | 500 | Romania |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 25 | Oral presentation to a scientific event | FENIX TNT SRO | Sustainable Construction Conference | 22/04/2015 | Brno, Czech Republic | Scientific community (higher education, Research) - Industry | | Czech Republic |
| 26 | Exhibitions | FENIX TNT SRO | IBF - International Building Fair | 22/04/2015 | Brno, Czech Republic | Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias | 44318 | Czech Republic |
| 27 | Flyers | FENIX TNT SRO | Addressing the energy efficiency of building | 23/04/2015 | Brno, Czech Republic | Scientific community (higher education, Research) - Industry | | Czech Republic |
| 28 | Exhibitions | INSTITUTUL DE CERCETARI ELECTROTEHNIC E | International Trade Fair of Renewable Energy and Energy Efficiency in Constructions - RoEnergy South-East Europe | 06/05/2015 | Bucharest, Romania | Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias | 200 | Romania |
| 29 | Oral presentation to a wider public | PROIGMENES EREVNITIKES & DIAHIRISTIKES EFARMOGES | DesignLAB 2015 | 15/05/2015 | Athens, Greece | Scientific community (higher education, Research) - Industry - Civil society | 5000 | Greece |
| 30 | Flyers | INSTITUTUL DE CERCETARI ELECTROTEHNIC E | Healthy Building 2015 | 18/05/2015 | Eindhoven, Netherlands | Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias | 366 | Netherlands |
| 31 | Exhibitions | ZAVOD ZA GRADBENISTVO SLOVENIJE | Sustainable Construction Conference | 21/05/2015 | Brdo pri Kranju, Slovenia | Scientific community (higher education, Research) - Industry - Policy makers - Medias | 120 | Slovenia |
| 32 | Flyers | INSTITUTUL DE CERCETARI ELECTROTEHNIC E | EURO Constructii 2015 | 25/05/2015 | Bucharest, Romania | Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias | 360 | Romania |
| 33 | Flyers | INSTITUTUL DE CERCETARI ELECTROTEHNIC E | International Conference Innovative Technologies for nZEBs | 28/05/2015 | Bucharest, Romania | Scientific community (higher education, Research) - Industry - Civil society - Policy makers | 100 | Romania |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 34 | Flyers | INSTITUTUL DE CERCETARI ELECTROTEHNICE | WREC XIV - World Renewable Energy Congress | 08/06/2015 | Bucharest, Romania | Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias | 500 | Romania |
| 35 | Oral presentation to a scientific event | MELODEA LTD | TechConnect world innovation conference and expo | 14/06/2015 | Washington, USA | Scientific community (higher education, Research) - Industry - Medias | 200 | USA, Europe |
| 36 | Oral presentation to a wider public | STOWARZYSZENIE ARCHITEKTOW POLSKICH | SARP's NAtional Board Meeting | 19/06/2015 | Kazimierz Dolny, Poland | Scientific community (higher education, Research) | 50 | Poland |
| 37 | Oral presentation to a scientific event | MELODEA LTD | Tappi Nano | 22/06/2015 | Atlanta, USA | Scientific community (higher education, Research) - Industry - Medias | 600 | USA, Europe |
| 38 | Posters | STOWARZYSZENIE ARCHITEKTOW POLSKICH | Polish Council of Architecture | 01/07/2015 | Warsawa, Poland | Scientific community (higher education, Research) - Policy makers | | Poland |
| 39 | Oral presentation to a scientific event | THE HEBREW UNIVERSITY OF JERUSALEM. | Living Materials Workshop | 16/07/2015 | Talloires, France | Scientific community (higher education, Research) - Industry | | France |
| 40 | Oral presentation to a scientific event | THE HEBREW UNIVERSITY OF JERUSALEM. | 2nd International Symposium on Bacterial NanoCellulose | 09/09/2015 | Gdansk, Poland | Scientific community (higher education, Research) - Industry | | Poland |
| 41 | Flyers | INSTITUTUL DE CERCETARI ELECTROTEHNICE | 36th AVIC Conference - Effective ventilation in high performance buildings | 23/09/2015 | Madrid, Spain | Scientific community (higher education, Research) | | Spain |
| 42 | Oral presentation to a scientific event | INSTITUTUL DE CERCETARI ELECTROTEHNICE | SWIC 2015 | 01/10/2015 | Bucharest, Romania | Scientific community (higher education, Research) | | Romania |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 43 | Oral presentation to a scientific event | FENIX TNT SRO | Information day on cPPP partnership Energy-effective buildings (EeB) | 07/10/2015 | Prague, Czech Republic | Scientific community (higher education, Research) - Industry | | Czech Republic |
| 44 | Exhibitions | STOWARZYSZENIE ARCHITEKTOW POLSKICH | Cracow Biennale of Architecture | 14/10/2015 | Krakow, Poland | Scientific community (higher education, Research) - Industry - Policy makers - Medias | | Poland |
| 45 | Exhibitions | INSTITUTUL DE CERCETARI ELECTROTEHNICE | TIB 2015 - INVENTIKA 2015 | 14/10/2015 | Bucharest, Romania | Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias | 400 | Romania |
| 46 | Oral presentation to a wider public | STOWARZYSZENIE ARCHITEKTOW POLSKICH | UIA II Region President meeting | 15/10/2015 | Krakow, Poland | Scientific community (higher education, Research) - Policy makers | 40 | Poland |
| 47 | Oral presentation to a scientific event | THE HEBREW UNIVERSITY OF JERUSALEM. | BIOFABRICATE 2015 | 21/10/2015 | New York, USA | Scientific community (higher education, Research) - Industry | 230 | USA, Europe |
| 48 | Flyers | INSTITUTUL DE CERCETARI ELECTROTEHNICE | Conference on Advanced Building Skins 2015 | 03/11/2015 | Bern, Switzerland | Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias | | Europe |
| 49 | Flyers | STOWARZYSZENIE ARCHITEKTOW POLSKICH | Polish Council of Architecture | 17/11/2015 | Warsawa, Poland | Scientific community (higher education, Research) - Policy makers | 10 | Poland |
| 50 | Videos | MELODEA LTD | Greenbuild Nova Innovation Competition | 18/11/2015 | Washington, USA | Scientific community (higher education, Research) - Industry - Medias | 200 | USA, Europe |
| 51 | Flyers | INSTITUTUL DE CERCETARI ELECTROTEHNICE | RENEXPO 2015 | 18/11/2015 | Bucharest, Romania | Scientific community (higher education, Research) - Industry - Civil society - Medias | 300 | Romania |
| 52 | Flyers | D'APPOLONIA SPA | RESTRUCTURA | 26/11/2015 | Turin, Italy | Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias | | Italy |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 53 | Oral presentation to a wider public | STOWARZYSZENIE ARCHITEKTOW POLSKICH | SARP's National Board Meeting | 11/12/2015 | Warsawa, Poland | Scientific community (higher education, Research) | 50 | Poland |
| 54 | Posters | STOWARZYSZENIE ARCHITEKTOW POLSKICH | The award ceremony of SARP Award of Honor Polish Cement in architecture | 11/12/2015 | Warsawa, Poland | Scientific community (higher education, Research) - Civil society - Policy makers - Medias | 350 | Poland |
| 55 | Posters | STOWARZYSZENIE ARCHITEKTOW POLSKICH | General Assembly of Association of Polish Architects | 12/12/2015 | Warsawa, Poland | Scientific community (higher education, Research) | 200 | Poland |
| 56 | Oral presentation to a scientific event | THE HEBREW UNIVERSITY OF JERUSALEM. | MRS Boston 2015 | 29/12/2015 | Boston, USA | Scientific community (higher education, Research) - Industry | | USA, Europe |
| 57 | Oral presentation to a scientific event | D'APPOLONIA SPA | AMANAC Workshop: ECO-SEE Indoor Environmental Quality | 18/02/2016 | Munich, Germany | Scientific community (higher education, Research) | 41 | Germany |
| 58 | Oral presentation to a scientific event | MELODEA LTD | Nano Israel 2016 | 22/02/2016 | Tel Aviv, Israel | Scientific community (higher education, Research) - Industry | 1000 | Israel |
| 59 | Oral presentation to a wider public | STOWARZYSZENIE ARCHITEKTOW POLSKICH | SARP's National Board Meeting | 01/03/2016 | Warsawa, Poland | Scientific community (higher education, Research) | | Poland |
| 60 | Oral presentation to a scientific event | D'APPOLONIA SPA | EeB PPP Impact Workshop | 18/04/2016 | Brussels, Belgium | Scientific community (higher education, Research) | | Europe |
| 61 | Exhibitions | FENIX TNT SRO | IBF 2016 - International Building Fair | 20/04/2016 | Brno, Czech Republic | Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias | 45000 | Czech Republic, Europe |
| 62 | Posters | STOWARZYSZENIE ARCHITEKTOW POLSKICH | The award ceremony of ?SARP?s Prize of the Year | 11/05/2016 | Warsawa, Poland | Scientific community (higher education, Research) | | Poland |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 63 | Oral presentation to a scientific event | THE HEBREW UNIVERSITY OF JERUSALEM. | TED Paris 2016 | 16/05/2016 | Paris, France | Scientific community (higher education, Research) | | France |
| 64 | Oral presentation to a scientific event | MELODEA LTD | TechConnect world innovation conference and expo | 22/05/2016 | Washington, USA | Scientific community (higher education, Research) - Industry - Medias | 200 | USA, Europe |
| 65 | Oral presentation to a scientific event | MELODEA LTD | TechConnect world innovation conference and expo | 22/05/2016 | Washington, USA | Scientific community (higher education, Research) - Industry - Medias | 200 | USA, Europe |
| 66 | Oral presentation to a wider public | STOWARZYSZENIE ARCHITEKTOW POLSKICH | SARP's National Board Meeting | 03/06/2016 | Kazimierz Dolny, Poland | Scientific community (higher education, Research) | | Poland |
| 67 | Organisation of Conference | D'APPOLONIA SPA | AMANAC Workshop - Bridging the gap between research and market uptake | 23/11/2016 | Milan, Italy | Scientific community (higher education, Research) - Industry - Civil society | 60 | Europe |
| 68 | Organisation of Conference | FENIX TNT SRO | BRIMEE Conference at Brno demo building | 25/01/2017 | RECTORATE BRNO UNIVERSITY OF TECHNOLOGY, Brno (Czech Republic) | Scientific community (higher education, Research) - Industry - Civil society | | Europe |
| 69 | Organisation of Conference | STOWARZYSZENIE ARCHITEKTOW POLSKICH | Circular Economy in the building construction sector - NCC as a generator of a new economy in building industry | 17/05/2017 | Warsaw, Poland | Scientific community (higher education, Research) - Industry - Civil society | 50 | Europe |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 70 | Posters | ZAVOD ZA GRADBENISTVO SLOVENIJE | The World Sustainable Energy Days (WSED) | 01/03/2017 | Wels | Scientific community (higher education, Research) - Industry - Civil society - Policy makers | 700 | Europe |
| 71 | Flyers | INSTITUTUL DE CERCETARI ELECTROTEHNIC E | ECOBUILD 2017 | 07/03/2017 | London | Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias | 30000 | Europe |
| 72 | Flyers | INSTITUTUL DE CERCETARI ELECTROTEHNIC E | International Architecture and Engineering Forum/ SHARE Bucharest 2017 | 21/03/2017 | Bucharest, Romania | Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias | 200 | Europe |
| 73 | Oral presentation to a scientific event | THE HEBREW UNIVERSITY OF JERUSALEM | The Nordic Wood Biorefinery Conference | 28/03/2017 | Stockholm, Sweden | Scientific community (higher education, Research) - Industry | | Europe |
| 74 | Oral presentation to a wider public | STOWARZYSZENI E ARCHITEKTOW POLSKICH | SARP? National Board Meeting and President?s Council | 31/03/2017 | Wroc?aw, Poland | Scientific community (higher education, Research) | 50 | Poland |
| 75 | Posters | ZAVOD ZA GRADBENISTVO SLOVENIJE | 1st International Conference on Construction Materials for Sustainable Future | 19/04/2017 | Zadar, Croatia | Scientific community (higher education, Research) - Industry | | Europe |
| 76 | Flyers | FENIX TNT SRO | Scientific Council in the Center of transport research | 20/04/2017 | Brno, Czech Republic | Scientific community (higher education, Research) - Industry | 50 | Czech Republic |
| 77 | Flyers | FENIX TNT SRO | Scientific Council in the Center of transport research | 20/04/2017 | Brno, Czech Republic | Scientific community (higher education, Research) - Industry | 50 | Czech Republic |
| 78 | Exhibitions | FENIX TNT SRO | International Building Fair in Brno | 26/04/2017 | Brno, Czech Republic | Scientific community (higher education, Research) - Industry - Civil society - Medias | 45000 | Europe |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 79 | Exhibitions | INSTITUTUL DE CERCETARI ELECTROTEHNICE | The X-th. International Symposium on ADVANCED TOPICS IN ELECTRICAL ENGINEERING/ ATEE 2017 | 24/04/2017 | Bucharest, Romania | Scientific community (higher education, Research) - Industry - Policy makers | 250 | Europe |
| 80 | Exhibitions | INSTITUTUL DE CERCETARI ELECTROTEHNICE | Hannover Messe 2017 | 23/04/2017 | Hanover, Germany | Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias | 225000 | World |
| 81 | Organisation of Conference | STOWARZYSZENIE ARCHITEKTOW POLSKICH | Circular Economy in the building construction sector - NCC as a generator of a new economy in building industry | 17/05/2017 | Warsawa, Poland | Scientific community (higher education, Research) - Industry | 40 | Europe |
| 82 | Flyers | INSTITUTUL DE CERCETARI ELECTROTEHNICE | EURO CONSTRUCTII 2017 | 23/05/2017 | Bucharest, Romania | Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias | 500 | Europe |
| 83 | Oral presentation to a wider public | STOWARZYSZENIE ARCHITEKTOW POLSKICH | UIA II Region Presidents Meeting | 01/06/2017 | Baku, Azerbejian | Scientific community (higher education, Research) - Policy makers | 40 | Region of International Union of Architects |
| 84 | Flyers | INSTITUTUL DE CERCETARI ELECTROTEHNICE | International Conference on Energy Performance and Related Installations - The Holistic Approach: From Building to Sustainable Urban Design | 08/06/2017 | Bucharest, Romania | Scientific community (higher education, Research) - Industry - Policy makers | 230 | Europe |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 85 | Organisation of Workshops | BERGAMO TECNOLOGIE SPZOO | New products and approaches towards energy efficiency of buildings | 12/06/2017 | Bergamo, Italy | Scientific community (higher education, Research) - Industry | 30 | Europe |
| 86 | Exhibitions | INSTITUTUL DE CERCETARI ELECTROTEHNICE | Conference Energy production at the place of consumption- Active energy buildings | 21/06/2017 | Targoviste, Romania | Scientific community (higher education, Research) - Industry - Policy makers | 40 | Europe |
| 87 | Oral presentation to a wider public | STOWARZYSZENIE ARCHITEKTOW POLSKICH | SARP National Board Meeting | 23/06/2017 | Kazimierz Dolny, Poland | Scientific community (higher education, Research) | 50 | Poland |

### *4.2.2 Exploitation Activities (Section B)*

| **TEMPLATE B1: LIST OF APPLICATIONS FOR PATENTS, TRADEMARKS, REGISTERED DESIGNS, ETC.** | | | | | |
|---|---|---|---|---|---|
| Type of IP Rights[6]: | Confidential Click on YES/NO | Foreseen embargo date dd/mm/yyyy | Application reference(s) (e.g. EP123456) | Subject or title of application | Applicant (s) (as on the application) |
| Patent | NO | 31/08/2017 | Registration n. WO2015114630[7] | POROUS NANOCRYSTALLINE CELLULOSE STRUCTURES (https://patentscope.wipo.int/search/en/detail.jsf?docId=WO2015114630&recNum=1&maxRec=&office=&prevFilter=&sortOption=&queryString=&tab=PCT+Biblio) | Yissum Research Development Company of the Hebrew University of Jerusalem Ltd. |

[6] A drop down list allows choosing the type of IP rights: Patents, Trademarks, Registered designs, Utility models, Others.

[7] https://patentscope.wipo.int/search/en/detail.jsf?docId=WO2015114630&recNum=1&maxRec=&office=&prevFilter=&sortOption=&queryString=&tab=PCT+Biblio

**Part B2**

| Type of Exploitable Foreground[8] | Description of exploitable foreground | Confidential Click on YES/NO | Foreseen embargo date dd/mm/yyyy | Exploitable product(s) or measure(s) | Sector(s) of application[9] | Timetable, commercial or any other use | Patents or other IPR exploitation (licences) | Owner & Other Beneficiary(s) involved |
|---|---|---|---|---|---|---|---|---|
| Commercial exploitation of R&D results | NCC foam was obtained through controlled freezing of the NCC material followed by solvent exchange of water suspensions of NCC formulations. Foam formulations and foam formation process were improved during the project, leading to increased strength and significantly decreased foam costs. The final formula for NCC foams contains 90% pulp and xyloglucan and 10% NCC. The formulas is "whipped" and frozen at only -20°C, following by solvent exchange with ethanol and drying. The resulted virgin and isotropic foams have density of 30-40 Kg/m3, good mechanical performance, and are also flexible and durable. The capacity to include into the process a step of resin infusion brings to consolidation of the foam and to the processing in accordance to specific features: rigidity or elasticity, fire resistance and other functionalities. The differentiation of the foam properties in response to the need of the applications is the baseline to permit the generation of the foam as a platform product, suitable to be implemented in a wide array of end uses, and to solve specific aspects of application | Yes | | Customized Foam material for BRIMEE applications | Building industry, composites processors, panels developers | 2022 | The processes (NCC and its integration into panels) are protected by patent owned by MEL-HUJI. | Owner: MEL - HUJI Beneficiary: SILCART, DAPP, FRAUNHOFER |

[9] A drop down list allows choosing the type of foreground: General advancement of knowledge, Commercial exploitation of R&D results, Exploitation of R&D results via standards, exploitation of results through EU policies, exploitation of results through (social) innovation.

[9] A drop down list allows choosing the type sector (NACE nomenclature) : http://ec.europa.eu/competition/mergers/cases/index/nace_all.html

| Type of Exploitable Foreground[10] | Description of exploitable foreground | Confidential Click on YES/NO | Foreseen embargo date dd/mm/yyyy | Exploitable product(s) or measure(s) | Sector(s) of application[11] | Timetable, commercial or any other use | Patents or other IPR exploitation (licences) | Owner & Other Beneficiary(s) involved |
|---|---|---|---|---|---|---|---|---|
| General advancement of knowledge | The production process is a core aspect of the final products since through it and its improvements, the materials can be designed and fine-tuned to achieve the performances required by the application. The controllability, safety and scalability of the process are all central issues and aspects to be ensured through attentive and multidisciplinary set up of the process. The design of the up-scaled production of NCC foam panels was developed within the project, and a pilot line able to produce 8 NCC foam panels per day in the form of sheets at dimensions of 0.6 m x 0.4 m x 0.01 m was set up and tested. The NCC foaming line can mainly be subdivided in for steps: mixing and foaming, freezing, solvent exchange and drying. In order to further analyse the industrial potential of the innovative insulating material, a conceptual design related to a foaming plant with a capacity of 100 kg/day of material has been developed, customised to increase the plant automation level. | Yes | | Process for Foam Integration into BRIMEE panel at Pilot Scale | foam producer (internal or external) to the project | 2022 | The processes are protected by patents owned by HUJI-MEL. Additional aspects could be protected. | Owner: SILCART Other partners were involved in the implementation of the foam production pilot plant: HUJI and MELODEA, from the side of the scientific development of innovation; RINA CONSULTING and FRAUNHOFER, concerning the scale up of the process. The conceptual design of the further up-scaled plant (capacity equal to 100 kg/day of materials) was engineered by RINA Consulting. |

[9] A drop down list allows choosing the type of foreground: General advancement of knowledge, Commercial exploitation of R&D results, Exploitation of R&D results via standards, exploitation of results through EU policies, exploitation of results through (social) innovation.

[11] A drop down list allows choosing the type sector (NACE nomenclature) : http://ec.europa.eu/competition/mergers/cases/index/nace_all.html

| Type of Exploitable Foreground[12] | Description of exploitable foreground | Confidential Click on YES/NO | Foreseen embargo date dd/mm/yyyy | Exploitable product(s) or measure(s) | Sector(s) of application[13] | Timetable, commercial or any other use | Patents or other IPR exploitation (licences) | Owner & Other Beneficiary(s) involved |
|---|---|---|---|---|---|---|---|---|
| Commercial exploitation of R&D results | The concept is based on the idea of taking advantage of NCC panels for creating ECO solutions using the natural materials ? wooden supporting structure adjusted to the panel dimensions and finishing wooden based board covered by photocatalytic multifunctional coating (KER #5). The particular components was specified then, on the basis of the drawings and performed simulation, the final design was validated. Regarding internal insulation system and partition walls, NCC panels is installed between wooden supporting frame, adjusted to the specific dimensions, creating kind of cells for inserting the insulation material. External solutions instead are based on two approaches, using protected from weather conditions NCC panels as a core insulation in ventilated façade or in cavity walls. | Yes | | Panel Design implementing BRIMEE foam | Producers of sandwich panels, insulation systems, partition walls, etc.and architects and builders | 2022, when the production of the foam, considered to be the limiting step, can become assessed and applicable for the industrial relevant environment | Up to now, patents are not applied for this result however, IP expenses could be expected | Owner: BGTEC<br>Beneficiaries: BBGK, SARP |
| Exploitation of R&D results via standards | Known the essence and working specificities of the different types of panels, design and materials, the protocols and guidelines give directives for their implementation into real cases and new-built/retrofitted cases. The innovation is associated to the implementation of the foam into the practices of the construction industry and to the relevant aspects to be covered when dealing with materials implementation. The protocols and guidelines are to be also exploited as a support for marketing activities, providing ideas and | No | | Protocols and Guidelines for BRIMEE panels production and use | building/facility owners, architects, engineers and building designers as well as material producers | Project conclusion (June 2017) | Not needed to protect | Owner: DAPP<br>Beneficiaries: BGTEC, SILCART, MEL, HUJI<br>The protocols and guidelines have been prepared by RINA CONSULTING thanks to the know-how developed during the project. In particular, all the partners involved in the different aspects of |

[9] A drop down list allows choosing the type of foreground: General advancement of knowledge, Commercial exploitation of R&D results, Exploitation of R&D results via standards, exploitation of results through EU policies, exploitation of results through (social) innovation.

[13] A drop down list allows choosing the type sector (NACE nomenclature) : http://ec.europa.eu/competition/mergers/cases/index/nace_all.html

| Type of Exploitable Foreground[12] | Description of exploitable foreground | Confidential Click on YES/NO | Foreseen embargo date dd/mm/yyyy | Exploitable product(s) or measure(s) | Sector(s) of application[13] | Timetable, commercial or any other use | Patents or other IPR exploitation (licences) | Owner & Other Beneficiary(s) involved |
|---|---|---|---|---|---|---|---|---|
| | concrete basis for designers and developers on the actions to be implemented, focused on this type of materials. protocols and guidelines for NCC foam panels production and use include: detailed technical characterisation and description of the panels as well as of the production processes; instructions for BRIMEE products production and installation phase, including details about the step by step procedures; troubleshooting tables to clearly present potential problems, possible causes and actual corrections. | | | | | | | the project (core material, building materials, construction and operation of the built environment) have been involved in the guidelines and protocols development. |
| Commercial exploitation of R&D results | The smart coating technology is getting more and more popular the last years, as it can provide special characteristics or improve energy performance of buildings without the need for large investment or major changes on building?s envelope. From the other side, this technology, as is available in the market today, provides only the availability of one property (e.g. insulating, antibacterial) and not the ability to have more than one property the same time. On the contrary, eco-innovative panels developed within the framework of BRIMEE project are treated with a final layer of coating, which can provide multiple surface properties to the panel for better energy efficiency by implementing PCMs in the coating as well as antibacterial properties or odour release characteristics. These characteristics will give an added value to the properties of the panel and benefits for the final customer, as energy gain and better thermal performance from PCMs, better indoor environment from the odour release, improved health because of the antibacterial characteristic and reduced maintenance cost. | Yes | | BRIMEE panels functionalities treatment | Industries that produce panels by adding coating to their final product and retail customer | 2018/2020 | No need for any patent.A secrecy agreement AMS signed with the ones aware of the production process | This technology was developed in the framework of BRIMEE project by AMSolutions with the valuable support of ZAG, RINA CONSULTING and SILCART who helped in the development and testing. BGTEC and FENIX supported AMSolution in the demo site application. Owner: AMS Beneficiaries: BGTEC, ZAG, SILCART, FENIX, RINA Consulting |

### *4.2.2.1 Additional Template B2: Overview table with exploitable foreground*

| ADDITIONAL TEMPLATE B2: OVERVIEW TABLE WITH EXPLOITABLE FOREGROUND | |
|---|---|
| **Description of Exploitable Foreground** | **Explain of the Exploitable Foreground** |
| **Customized Foam material for BRIMEE applications.** NCC foam was obtained through controlled freezing of the NCC material followed by solvent exchange of water suspensions of NCC formulations. Foam formulations and foam formation process were improved during the project, leading to increased strength and significantly decreased foam costs. The final formula for NCC foams contains 90% pulp and xyloglucan and 10% NCC. The formulas is "whipped" and frozen at only -20°C, following by solvent exchange with ethanol and drying. The resulted virgin and isotropic foams have density of 30-40 Kg/m$^3$, good mechanical performance, and are also flexible and durable. The capacity to include into the process a step of resin infusion brings to consolidation of the foam and to the processing in accordance to specific features: rigidity or elasticity, fire resistance and other functionalities. The differentiation of the foam properties in response to the need of the applications is the baseline to permit the generation of the foam as a platform product, suitable to be implemented in a wide array of end uses, and to solve specific aspects of application. | The achieved foam product in the BRIMEE project will serve as pilot scale proof of concept of the ability to use NCC for foam based applications. Under a market perspective point of view, this innovative material is meant to be used in specific applications in the building industry or as a core for composites. In general, forecasted buyers of the foam are composites processors, panels developers or other types of operators of intermediate materials into the building industry.<br>Despite the improvements achieved during the course of the project, the price of the NCC foam results yet too high for expecting to be available for marketing (expected cost of about 70 €/m$^2$). Therefore, it will be important to identify high-end, niche markets where the product cost is less significant and hence facilitates the market penetration in the next five years. The foam formulation and processes for NCC foam manufacturing and integration into panels are currently protected by patent owned by MEL – HUJI. Further efforts and research in the future will be focused on:<br>- Increasing the competitiveness of BRIMEE NCC foam material by reducing its specific cost;<br>- Optimizing the foam formulations for improving NCC foam panels technical features;<br>- Optimizing the foaming process with particular reference to freezing, solvent exchange and solvent recycling steps;<br>- Extending the use of BRIMEE material to new market segments. |
| **Process for Foam Integration into BRIMEE panel at Pilot Scale.** The production process is a core aspect of the final products since through it and its improvements, the materials can be designed and fine-tuned to achieve the performances required by the application. The controllability, safety and scalability of the process are all central issues and aspects to be ensured through attentive and multidisciplinary set up of the process. The design of the up-scaled production of NCC foam panels was developed within the project, and a pilot line able to produce | The new process for foam integration into panels foster lightweight and bio-based materials for building insulation market. the market is strictly linked to the volumes associated to the foam production and this value is expected to be extremely relevant, in particular if compared to the technical foam production (currently entirely oil derived). Taking as a reference the European market, 5 to 20 plants seem to be a reasonable number of plants installation from the medium to the long term, in order to cover the EU needs of |

| | |
|---|---|
| 8 NCC foam panels per day in the form of sheets at dimensions of 0.6 m x 0.4 m x 0.01 m was set up and tested. The NCC foaming line can mainly be subdivided in for steps: mixing and foaming, freezing, solvent exchange and drying. In order to further analyse the industrial potential of the innovative insulating material, a conceptual design related to a foaming plant with a capacity of 100 kg/day of material has been developed, customised to increase the plant automation level. | materials expected as per the forecasts. However, since costs for building, start up and operation of the further up-scaled production line (100 kg/day of material) is estimated around 5M€ and the costs of raw materials (and in particular, water suspension of NCC formulation) as well as of operating fluids are currently a relevant part of the OPEX, a new project can be focused on increasing the cost effectiveness of the product and the related production process. The process for NCC foam manufacturing and integration into panels is currently protected by patents, covering the most relevant aspects, owned by HUJI – MELODEA. Additional aspects, currently covered by secrecy, could be protected in the future. According to the acceptance by the EU and WO patents, the Freedom to Operate (FTO) is ensured for the actions of scale up and industrial exploitation. |
| **Panel Design implementing BRIMEE foam.** The concept is based on the idea of taking advantage of NCC panels for creating ECO solutions using the natural materials-wooden supporting structure adjusted to the panel dimensions and finishing wooden based board covered by photocatalytic multifunctional coating (KER #5). The particular components was specified then, on the basis of the drawings and performed simulation, the final design was validated. Regarding internal insulation system and partition walls, NCC panels is installed between wooden supporting frame, adjusted to the specific dimensions, creating kind of cells for inserting the insulation material. External solutions instead are based on two approaches, using protected from weather conditions NCC panels as a core insulation in ventilated façade or in cavity walls. | Customers are either the producers of sandwich panels, insulation systems, partition walls, that can manufacture or introduce NCC foam panels in their systems, or architects and builders that can be up-taking this design in order to implement it into the plans of the installations, and therefore produce the parts in accordance to the requirements. Architects and designers will be able to offer end users new environmentally friendly material, made of natural resources and assuring healthy indoor climate. The future plans should be concentrated on increasing dimensions and availability of the insulation panels. Moreover, costs to be incurred to ensure the industrial application of such panels: from protection of the IPR and of the design, to the detailed design refinement, and the integration of side actions like promotion and branding, oriented to favour the penetration of the BRIMEE panel concept into the world of associations of builders and of building materials, to promote its application and extend the knowledge of the benefits achievable. |
| **Protocols and Guidelines for BRIMEE panels production and use.** Known the essence and working specificities of the different types of panels, design and materials, the protocols and guidelines give directives for their implementation into real cases and new-built/retrofitted cases. The innovation is associated to the implementation of the foam into the practices of the construction industry and to the relevant aspects to be covered when dealing with materials implementation. The protocols and | The protocols and guidelines are to be exploited as a support for marketing activities, providing ideas and concrete basis for designers and developers on the actions to be implemented, focused on this type of materials. After the end of the projects, several investments could be performed related to the continuous development and updating, such as the implementation of newer products design and features according to new developments by the partner. Moreover, additional costs could be related to the |

| | |
|---|---|
| guidelines are to be also exploited as a support for marketing activities, providing ideas and concrete basis for designers and developers on the actions to be implemented, focused on this type of materials. protocols and guidelines for NCC foam panels production and use include: detailed technical characterisation and description of the panels as well as of the production processes; instructions for BRIMEE products production and installation phase, including details about the step by step procedures; troubleshooting tables to clearly present potential problems, possible causes and actual corrections. | implementation of BRIMEE protocols and guidelines into a Software Tool.<br>Considering the price range of this results, it is granted free access even if some costs could be related to the documents updates. Up to now, the end users can consult them from web services for free, permitting therefore to extend the number of users and to address specific targets related to specific categories. In case of Software tool development instead, it could be sold at annual fee, granting access, continuous update and improvement of the features. Since it is associated to the sale of panels (that remains the top level revenues generator), the expected market is not extremely wide. |
| **BRIMEE panels functionalities treatment.** The smart coating technology is getting more and more popular the last years, as it can provide special characteristics or improve energy performance of buildings without the need for large investment or major changes on building?s envelope. From the other side, this technology, as is available in the market today, provides only the availability of one property (e.g. insulating, antibacterial) and not the ability to have more than one property the same time. On the contrary, eco-innovative panels developed within the framework of BRIMEE project are treated with a final layer of coating, which can provide multiple surface properties to the panel for better energy efficiency by implementing PCMs in the coating as well as antibacterial properties or odour release characteristics. These characteristics will give an added value to the properties of the panel and benefits for the final customer, as energy gain and better thermal performance from PCMs, better indoor environment from the odour release, improved health because of the antibacterial characteristic and reduced maintenance cost. | For time being, there are no competitors in the market with a similar specific product. However, the potential competitors would be the companies involved in the paint and coating industry, including building, shipping and automotive industries. In order to ensure the secrecy of the production procedure and the recipe of the matrix of the coating, there is no need for any patent. The most sufficient way is to sign a secrecy agreement with everyone aware of those confidential information. Under a market perspective, a strategy could not be detailed in depth at this stage since the scale-up procedure of the technology is not finalized. However, the reduction of the production cost from the lab-scale production to pilot-scale production it is expected to reach 20%. In general, for the market-uptake of this results, AMS plan to launch an e-shop for selling the selective coating during the first quarter of 2018 and, at the same time, to start having the product available for retail customers at physical shops through distributors. Moreover, AMS plan to finalize up-scale activities within one year. |

## 4.3 Report on societal implications

Replies to the following questions will assist the Commission to obtain statistics and indicators on societal and socio-economic issues addressed by projects. The questions are arranged in a number of key themes. As well as producing certain statistics, the replies will also help identify those projects that have shown a real engagement with wider societal issues, and thereby identify interesting approaches to these issues and best practices. The replies for individual projects will not be made public.

| **A General Information** *(completed automatically when **Grant Agreement number** is entered.* | |
|---|---|
| | 608910 |
| | Cost-effective and sustainable Bio-renewable Indoor Materials with high potential for customization and creative design in energy efficient buildings |
| | Andrea Maria Ferrari, Engineering Manager of RINA Consulting (formerly D'Appolonia) S.p.A. |

| **B Ethics** | |
|---|---|
| **1. Did your project undergo an Ethics Review (and/or Screening)?**<br>• If Yes: have you described the progress of compliance with the relevant Ethics Review/Screening Requirements in the frame of the periodic/final project reports?<br>Special Reminder: the progress of compliance with the Ethics Review/Screening Requirements should be described in the Period/Final Project Reports under the Section 3.2.2 *'Work Progress and Achievements'* | ***No*** |
| **2. Please indicate whether your project involved any of the following issues (tick box) :** | |
| **RESEARCH ON HUMANS** | |
| • Did the project involve children? | No |
| • Did the project involve patients? | No |
| • Did the project involve persons not able to give consent? | No |
| • Did the project involve adult healthy volunteers? | No |
| • Did the project involve Human genetic material? | No |
| • Did the project involve Human biological samples? | No |
| • Did the project involve Human data collection? | No |
| **RESEARCH ON HUMAN EMBRYO/FOETUS** | |
| • Did the project involve Human Embryos? | No |
| • Did the project involve Human Foetal Tissue / Cells? | No |
| • Did the project involve Human Embryonic Stem Cells (hESCs)? | No |
| • Did the project on human Embryonic Stem Cells involve cells in culture? | No |
| • Did the project on human Embryonic Stem Cells involve the derivation of cells from Embryos? | No |
| **PRIVACY** | |
| • Did the project involve processing of genetic information or personal data (eg. health, sexual lifestyle, ethnicity, political opinion, religious or philosophical conviction)? | No |
| • Did the project involve tracking the location or observation of people? | No |

| | |
|---|---|
| **RESEARCH ON ANIMALS** | |
| • Did the project involve research on animals? | No |
| • Were those animals transgenic small laboratory animals? | No |
| • Were those animals transgenic farm animals? | No |
| • Were those animals cloned farm animals? | No |
| • Were those animals non-human primates? | No |
| **RESEARCH INVOLVING DEVELOPING COUNTRIES** | |
| • Did the project involve the use of local resources (genetic, animal, plant etc)? | No |
| • Was the project of benefit to local community (capacity building, access to healthcare, education etc)? | No |
| **DUAL USE** | |
| • Research having direct military use | No |
| • Research having the potential for terrorist abuse | No |

# C Workforce Statistics

**3. Workforce statistics for the project: Please indicate in the table below the number of people who worked on the project (on a headcount basis).**

| Type of Position | Number of Women | Number of Men |
|---|---|---|
| Scientific Coordinator | 1 | 1 |
| Work package leaders | 4 | 5 |
| Experienced researchers (i.e. PhD holders) | | |
| PhD Students | | |
| Other | 22 | 45 |

| | |
|---|---|
| **4. How many additional researchers (in companies and universities) were recruited specifically for this project?** | |
| Of which, indicate the number of men: | |

## D Gender Aspects

| | | |
|---|---|---|
| **5. Did you carry out specific Gender Equality Actions under the project**? | ○<br>X | Yes<br>No |

**6. Which of the following actions did you carry out and how effective were they?**

| | | | | Not at all effective | | | | Very effective |
|---|---|---|---|---|---|---|---|---|
| | | ❑ | Design and implement an equal opportunity policy | ○ | ○ | ○ | ○ | ○ |
| | | ❑ | Set targets to achieve a gender balance in the workforce | ○ | ○ | ○ | ○ | ○ |
| | | ❑ | Organise conferences and workshops on gender | ○ | ○ | ○ | ○ | ○ |
| | | ❑ | Actions to improve work-life balance | ○ | ○ | ○ | ○ | ○ |
| | | ○ | Other: | | | | | |

**7. Was there a gender dimension associated with the research content – i.e. wherever people were the focus of the research as, for example, consumers, users, patients or in trials, was the issue of gender considered and addressed?**

| | | | |
|---|---|---|---|
| | | ○ | Yes- please specify |
| | | X | No |

## E Synergies with Science Education

**8. Did your project involve working with students and/or school pupils (e.g. open days, participation in science festivals and events, prizes/competitions or joint projects)?**

| | | | | |
|---|---|---|---|---|
| | | X | Yes- please specify | Students participating in events and conferences |
| | | ○ | No | |

**9. Did the project generate any science education material (e.g. kits, websites, explanatory booklets, DVDs)?**

| | | | | |
|---|---|---|---|---|
| | | X | Yes- please specify | Website, training materials and guidelines, project videos |
| | | ○ | No | |

## F Interdisciplinarity

**10. Which disciplines (see list below) are involved in your project?**

| | | | | | |
|---|---|---|---|---|---|
| | | ○ | Main discipline[14]: 2. ENGINEERING AND TECHNOLOGY | | |
| | | ○ | Associated discipline[14]: 2.1 Civil engineering (architecture engineering, building science and engineering, construction engineering, municipal and structural engineering and other allied subjects) | ○ | Associated discipline[14]: 2.3 Other engineering sciences (such as chemical, aeronautical and space, mechanical, metallurgical and materials engineering, and their specialised subdivisions; forest products; applied sciences such as geodesy, industrial chemistry, etc.; the science and technology of food production; specialised technologies of interdisciplinary fields, e.g. systems analysis, metallurgy, mining, textile technology and other applied subjects) |

[14] Insert number from list below (Frascati Manual).

## G Engaging with Civil society and policy makers

| | | |
|---|---|---|
| **11a Did your project engage with societal actors beyond the research community?** *(if 'No', go to Question 14)* | ○<br>X | Yes<br>No |

**11b If yes, did you engage with citizens (citizens' panels / juries) or organised civil society (NGOs, patients' groups etc.)?**

| | | | |
|---|---|---|---|
| | | ○ | No |
| | | ○ | Yes- in determining what research should be performed |
| | | ○ | Yes - in implementing the research |
| | | ○ | Yes, in communicating /disseminating / using the results of the project |

| | | |
|---|---|---|
| **11c In doing so, did your project involve actors whose role is mainly to organise the dialogue with citizens and organised civil society (e.g. professional mediator; communication company, science museums)?** | ○<br>○ | Yes<br>No |

**12. Did you engage with government / public bodies or policy makers (including international organisations)**

| | | | |
|---|---|---|---|
| | | ○ | No |
| | | ○ | Yes- in framing the research agenda |
| | | ○ | Yes - in implementing the research agenda |
| | | ○ | Yes, in communicating /disseminating / using the results of the project |

**13a Will the project generate outputs (expertise or scientific advice) which could be used by policy makers?**

| | | | |
|---|---|---|---|
| | | ○ | Yes – as a **primary** objective (please indicate areas below- multiple answers possible) |
| | | ○ | Yes – as a **secondary** objective (please indicate areas below - multiple answer possible) |
| | | ○ | No |

**13b If Yes, in which fields?**

| | | | | | |
|---|---|---|---|---|---|
| Agriculture | | Energy | | Human rights | |
| Audiovisual and Media | | Enlargement | | Information Society | |
| Budget | | Enterprise | | Institutional affairs | |
| Competition | | Environment | | Internal Market | |
| Consumers | | External Relations | | Justice, freedom and security | |
| Culture | | External Trade | | Public Health | |
| Customs | | Fisheries and Maritime Affairs | | Regional Policy | |
| Development Economic and Monetary Affairs | | Food Safety | | Research and Innovation | |
| | | Foreign and Security Policy | | Space | |
| Education, Training, Youth | | Fraud | | Taxation | |
| Employment and Social Affairs | | Humanitarian aid | | Transport | |

| 13c If Yes, at which level? | | | |
|---|---|---|---|
| | | ○ | Local / regional levels |
| | | ○ | National level |
| | | ○ | European level |
| | | ○ | International level |

## H Use and dissemination

| | |
|---|---|
| **14. How many Articles were published/accepted for publication in peer-reviewed journals?** | **5** |
| **To how many of these is open access[15] provided?** | **2** |
| **How many of these are published in open access journals?** | **2** |
| **How many of these are published in open repositories?** | |
| **To how many of these is open access not provided?** | **3** |
| **Please check all applicable reasons for not providing open access:** | |
| X publisher's licensing agreement would not permit publishing in a repository<br>❑ no suitable repository available<br>❑ no suitable open access journal available<br>❑ no funds available to publish in an open access journal<br>❑ lack of time and resources<br>❑ lack of information on open access<br>❑ other[16]: …… | |

| | | |
|---|---|---|
| **15. How many new patent applications ('priority filings') have been made?** *("Technologically unique": multiple applications for the same invention in different jurisdictions should be counted as just one application of grant).* | | **1** |
| | Trademark | **0** |
| | Registered design | **0** |
| | Other | **0** |
| **17. How many spin-off companies were created / are planned as a direct result of the project?** | | **0** |
| ***Indicate the approximate number of additional jobs in these companies:*** | | |

**18. Please indicate whether your project has a potential impact on employment, in comparison with the situation before your project:**

| | | | | |
|---|---|---|---|---|
| | ❑ | Increase in employment, or | ❑ | In small & medium-sized enterprises |
| | ❑ | Safeguard employment, or | ❑ | In large companies |
| | ❑ | Decrease in employment, | ❑ | None of the above / not relevant to the project |
| | X | Difficult to estimate / not possible to quantify | | |

[15] Open Access is defined as free of charge access for anyone via Internet.
[16] For instance: classification for security project.

| | |
|---|---|
| **19. For your project partnership please estimate the employment effect resulting directly from your participation in Full Time Equivalent (*FTE = one person working fulltime for a year*) jobs:** | *Indicate figure:* |
| Difficult to estimate / not possible to quantify | X |

# I Media and Communication to the general public

**20. As part of the project, were any of the beneficiaries professionals in communication or media relations?**

| | | | | | |
|---|---|---|---|---|---|
| | | ○ | Yes | X | No |

**21. As part of the project, have any beneficiaries received professional media / communication training / advice to improve communication with the general public?**

| | | | | | |
|---|---|---|---|---|---|
| | | ○ | Yes | X | No |

**22 Which of the following have been used to communicate information about your project to the general public, or have resulted from your project?**

| | | | | |
|---|---|---|---|---|
| | X | Press Release | ❑ | Coverage in specialist press |
| | ❑ | Media briefing | X | Coverage in general (non-specialist) press |
| | ❑ | TV coverage / report | ❑ | Coverage in national press |
| | ❑ | Radio coverage / report | ❑ | Coverage in international press |
| | X | Brochures /posters / flyers | X | Website for the general public / internet |
| | X | DVD /Film /Multimedia | X | Event targeting general public (festival, conference, exhibition, science café) |

**23 In which languages are the information products for the general public produced?**

| | | | | |
|---|---|---|---|---|
| | ❑ | Language of the coordinator | X | English |
| | ❑ | Other language(s) | | |

***Question F-10*:** Classification of Scientific Disciplines according to the Frascati Manual 2002 (Proposed Standard Practice for Surveys on Research and Experimental Development, OECD 2002):

**FIELDS OF SCIENCE AND TECHNOLOGY**

1. NATURAL SCIENCES

1.1 Mathematics and computer sciences [mathematics and other allied fields: computer sciences and other allied subjects (software development only; hardware development should be classified in the engineering fields)]

1.2 Physical sciences (astronomy and space sciences, physics and other allied subjects)

1.3 Chemical sciences (chemistry, other allied subjects)

1.4 Earth and related environmental sciences (geology, geophysics, mineralogy, physical geography and other geosciences, meteorology and other atmospheric sciences including climatic research, oceanography, vulcanology, palaeoecology, other allied sciences)

1.5 Biological sciences (biology, botany, bacteriology, microbiology, zoology, entomology, genetics, biochemistry, biophysics, other allied sciences, excluding clinical and veterinary sciences)

2 ENGINEERING AND TECHNOLOGY

2.1 Civil engineering (architecture engineering, building science and engineering, construction engineering, municipal and structural engineering and other allied subjects)

2.2 Electrical engineering, electronics [electrical engineering, electronics, communication engineering and systems, computer engineering (hardware only) and other allied subjects]

2.3. Other engineering sciences (such as chemical, aeronautical and space, mechanical, metallurgical and materials engineering, and their specialised subdivisions; forest products; applied sciences such as geodesy, industrial chemistry, etc.; the science and technology of food production; specialised technologies of interdisciplinary fields, e.g. systems analysis, metallurgy, mining, textile technology and other applied subjects)

3. MEDICAL SCIENCES

3.1 Basic medicine (anatomy, cytology, physiology, genetics, pharmacy, pharmacology, toxicology, immunology and immunohaematology, clinical chemistry, clinical microbiology, pathology)

3.2 Clinical medicine (anaesthesiology, paediatrics, obstetrics and gynaecology, internal medicine, surgery, dentistry, neurology, psychiatry, radiology, therapeutics, otorhinolaryngology, ophthalmology)

3.3 Health sciences (public health services, social medicine, hygiene, nursing, epidemiology)

4. AGRICULTURAL SCIENCES

4.1 Agriculture, forestry, fisheries and allied sciences (agronomy, animal husbandry, fisheries, forestry, horticulture, other allied subjects)

4.2 Veterinary medicine

5. SOCIAL SCIENCES

5.1 Psychology

5.2 Economics

5.3 Educational sciences (education and training and other allied subjects)

5.4 Other social sciences [anthropology (social and cultural) and ethnology, demography, geography (human, economic and social), town and country planning, management, law, linguistics, political sciences, sociology, organisation and methods, miscellaneous social sciences and interdisciplinary , methodological and historical S1T activities relating to subjects in this group. Physical anthropology, physical geography and psychophysiology should normally be classified with the natural sciences].

6. HUMANITIES

6.1 History (history, prehistory and history, together with auxiliary historical disciplines such as archaeology, numismatics, palaeography, genealogy, etc.)

6.2 Languages and literature (ancient and modern)

6.3 Other humanities [philosophy (including the history of science and technology) arts, history of art, art criticism, painting, sculpture, musicology, dramatic art excluding artistic "research" of any kind, religion, theology, other fields and subjects pertaining to the humanities, methodological, historical and other S1T activities relating to the subjects in this group]