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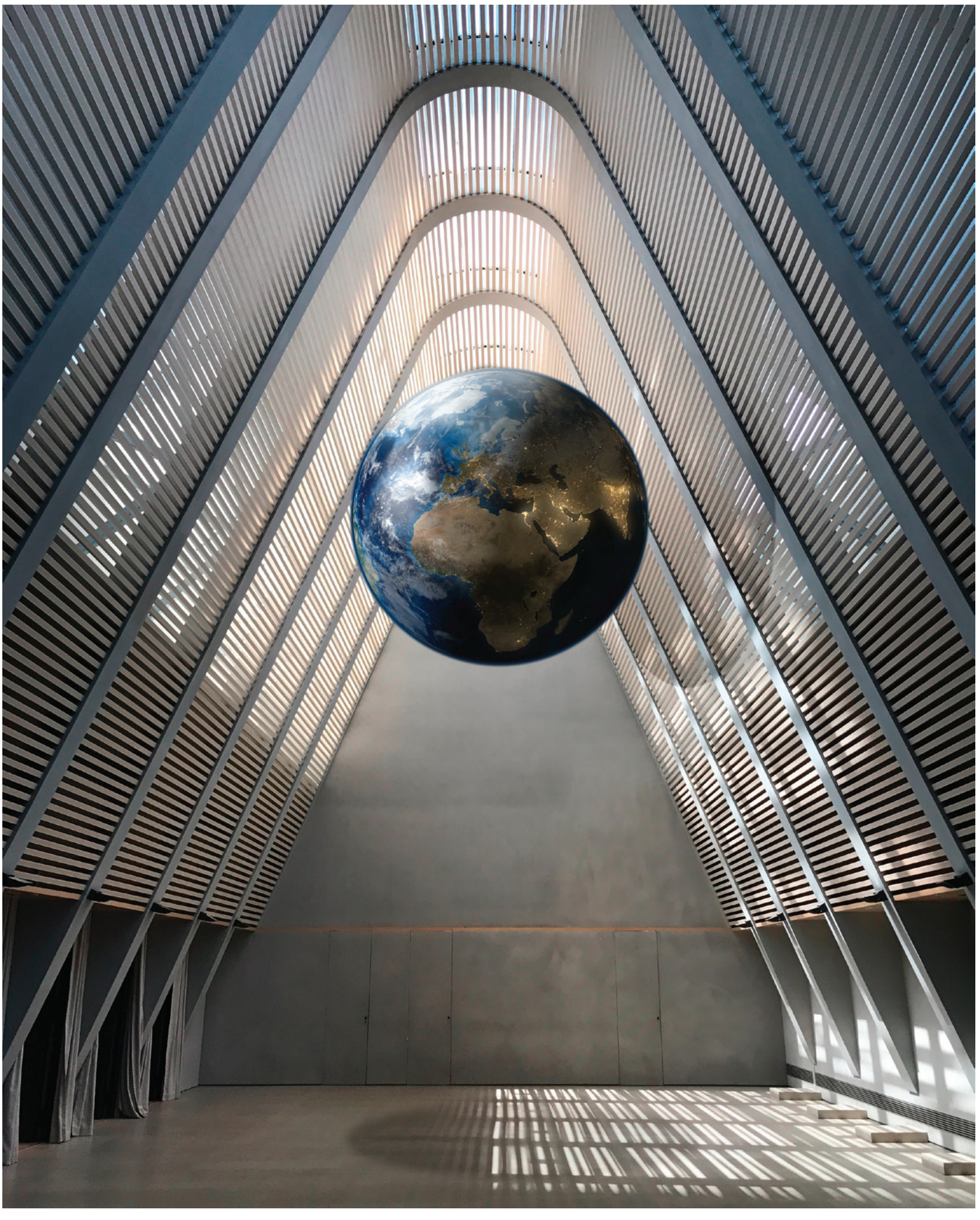
IMPROVE



MEZeroE
Measuring Envelope systems
for Zero Energy buildings

It's time to improve our building paradigm.
Find out how the MEZeroE ecosystem proposes
to do so, and be part of these new synergies.

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IMPROVE

The action of inhabiting has long been a rather banal act. To put it simply, it has always been about protecting oneself from the natural elements. Over time, of course, this act has developed, particularly in a search for comfort and economic efficiency. Today, the situation is quite different. Living has become an act at the very heart of all sustainable concerns. It is no longer possible to build as we have always done. Nor can we rely on the massive use of energy resources to fill the gap left by building in a way that was never particularly concerned with ecological efficiency.

Today, it is time for improvement. We need to improve the way we use our resources. We have to improve the way we build our houses. We need to improve the way we live in them and make them efficient in terms of energy and CO_2 impact.

To do this, the building industry is improving its products and processes. Thermal insulation and energy production to be sure, but also the emissions from materials, their lifetime and environmental impact to weather dynamics are all reflections of what our industry needs to achieve. The task is far from simple. This industrial overhaul requires new processes and infrastructures. The main objective being: to test, test and test again. Testing the efficiency of these materials and devices will allow the industry to improve its products and to bring to market innovative solutions adapted to the climatic and energy challenges that architects and the whole society now face.

In this second issue of MEZeroE, we open the doors of these testing laboratories and lead you on a journey behind the scenes of construction designed to highlight these testing platforms and services.

The improvement referred to here is not only about these core issues of energy efficiency. It is also about being able to improve the safety and health of the occupants of the structures in this responsible building paradigm. For, as we will see, sustainability and efficiency in the field of building must imperatively take into account the human dimension in terms of health, well-being and comfort. An organic way of building which must thus tend towards a more thorough and thoughtful human integration.

TODAY ↘

CONSTRUCTION SECTOR CONTRIBUTES TO

50%
of the landfill waste

40%
of the drinking water pollution

20%
of the atmospheric pollution

37%
energy related CO_2 emissions

36%
global energy demand

For the moment, even if ecological awareness is more than palpable, we have to admit that construction is still far from what it should be. But what, precisely, should it be?

It is often easy to put an ideal definition on paper. But this exercise must be done. If economic, industrial, engineering, architectural or practical constraints will inevitably challenge this ideal definition in the field, the fact of being able to refer to it will make it possible to remember not to lose sight of our goals. In the 21st century, construction must be synonymous with change. Easy to say, and already said many times. But what change? As the foundation of our societal, cultural and economic system, construction will have to generate changes that impact all these layers.

At the societal level, construction should therefore be a commitment. A commitment to exemplary building practices. In this sense, public project owners - the state, cities, municipalities - must demonstrate their resolve by creating works whose influence will serve as an example. In the case of private buildings, it is up to the architects and owners to influence each other. Asking for the most sustainable and efficient solutions is a right. Today, it is even a duty.

TOMORROW ↗

ZERO

energy building

The energy transition is also and above all a question of societal and political commitment. If the challenges are already huge today, the next generations will have to face them in much more complex and problematic proportions. More than that, they will have to live in an era marked by a carbon footprint that is already devastating before they can even act. So it is up to us to pave the way as much as we can to reduce carbon emissions.

On the European scene, policy levers are beginning to be activated in a relevant way, encouraging the industry to reposition itself in a responsible manner. The Commission has proposed aligning the rules on the energy performance of buildings with the European green market and to decarbonize the EU's building stock by 2050. This proposal will make it easier to renovate homes, schools, hospitals, offices and other buildings across Europe to reduce greenhouse gas emissions and energy bills, thereby improving the quality of life of millions of Europeans. The adopted revision of the Energy Performance of Buildings Directive thus translates the Commission's strategy on the renovation wave into concrete legislative action. As a reminder, one of the key objectives of the European Green Deal is to fundamentally transform the economic system so that by 2050 the Member States will be carbon neutral, with an intermediate objective in 2030 of reducing the EU's greenhouse gas emissions by 55% compared to their 1990 level.

Finally, from an economic point of view - a dimension often used as an excuse for the slowness with which sustainable construction moves forward - construction should be seen for what it really is: a sustainable and financially virtuous engine. Within the MEZeroE ecosystem, the beginnings of this new system are taking shape. Industrial players, innovative start-ups and researchers are moving forward together, according to a collaborative model based on the exchange of services, openness, transparency and knowledge sharing.
This is what construction should be.

Join the MEZeroE network to be part of this transformation and contribute to what construction is becoming.

Image © Velux

One Single entry-point

At the heart of the MEZeroE ecosystem is a single entry-point offering open access to any architects, builders, members of industry – large or small, or anyone else with an interest in developing, testing, or using innovative construction materials for nearly Zero-Energy Buildings (nZEB). If you are a stakeholder dealing with such challenges as fragmentation or slowness, this platform, thanks to three open innovation services and test beds, will help you identify the innovations best suited to your needs.

Three Open Innovation Services (OIS)

OIS 1
Standard framework procedures for certification and marking

OIS 1 is a portal for information, advice and guidance on such topics as procedures for certification, marking, and norms.
It's a consultancy service, ideally suited to helping to ensure that each client is on exactly the right track.

OIS 2
Cost-effective measurement & verification smart kit for living labs

OIS 2 has been designed to provide data from real-buildings in use, guidance and advice on cost-effective testing procedures as well as characterization processes to clients for their products in nearly real-life conditions, such as living labs.

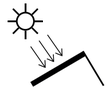
OIS 3
Guidance for open innovation life cycle management

With OIS 3, clients have access to expert guidance on open innovation, using a digital platform, on the life cycle management of their products. This means that they will be able to exploit "open innovation" dynamics: partnerships, open resources, knowledge, know-how and technologies in order to develop joint innovative projects.

Open to innovation

Building of wooden structure
Rothoblass Headquarter
© Rothoblass

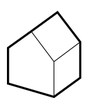
Nine Pilot Measurement & Verification Lines (PM & VL)



PM&VL 1

Safety, performance and efficiency characterisation of building integrated photovoltaic, thermal and hybrid (photovoltaic and thermal) systems

This line is dedicated to photovoltaic, thermal and hybrid photovoltaic/thermal modules. With a focus on the safety of the occupants, it makes it possible to assess the behaviour of these products when they are exposed to fire (heat emission, smoke emission, etc.) and their mechanical behaviour (with wind, rain, etc.). Regarding their efficiency, it enables the measurement of their performances in controlled lighting conditions at different angles of incidence. Moreover, it makes it possible to measure modules in real outdoor conditions and to contrast them with their indoor equivalents, which allows the closest possible predictive data.



PM&VL 2

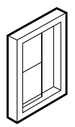
Building envelope/IEQ (Indoor Environmental Quality) interaction facing health requirements

The PM&VL offers a complete characterization of all the envelope parts and their effects on internal occupants in real operating conditions. Hygro-thermal behaviour of complex facade systems and materials, as well as the performance of acoustic and transparent components, can be measured. In addition, the VOC emissions from materials can be measured within the pilot line.

PM&VL 3

Reliability of BIPV products, using accelerated tests for stability and quality of materials/products for outdoor use

This pilot line complements PM&VL 1. It provides an infrastructure to test BIPV systems in conditions which replicate – to the greatest extent possible – their real-world equivalents. It allows our industrial partners to understand how their PV products will behave over the years in terms of electrical efficiency, based on how and where they are installed in a building.



PM&VL 4

Dynamic glass systems facing efficiency requirements. A set of experimental and analytical tools to validate the performance of newly developed dynamic glazing elements

This pilot line is dedicated to window manufacturers. It makes it possible for them to understand precisely how their dynamic glass will behave in terms of light comfort and the insulation properties of the glass. It also ensures that these characteristics align with international standards.

PM&VL 5

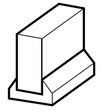
Building/user interaction characterisation facing efficiency requirement

Most facade products will have an impact on all four components of the indoor environment. These are the thermal, acoustic and visual aspects as well as indoor air quality. Installing an operable window will affect the amount of daylight, the indoor temperature will be influenced due to solar radiation and heat transmission through the window. The air quality will be influenced by the tightness of the window and by the window operation thanks to dilution ventilation. Finally, the acoustic environment will be influenced by noise penetration from the outside. One part of PM&VL5 will attempt to characterize all four components in relation to the advanced facade component (or the entire facade) and subsequent effect on indoor environmental quality and the building occupants' comfort.

PM&VL 6

Multilayer dry nEESs (nZEB Enabler Envelope Solutions) characterization facing Health and Safety requirements

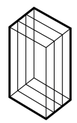
The concept at the base of this pilot line is to have a multidisciplinary approach in order to cover all the health and safety requirements of structural elements and envelope solutions with full-scale tests, numerical modelling and the energy performance analyses. The tests and analyses conducted by the PM&VL6 can contribute to the development and implementation of innovative solutions in the market of dry envelope systems, by supporting manufacturers and raising awareness among potential customers for innovative, safe and sustainable solutions.



PM&VL 7

Mechanical and durability tests of connectors and their influence on vibroacoustic, thermal and microclimate comfort

This line is specialized in complex testing of connectors and joined elements (connections) in nZEB envelopes like, for example, the polyurethane flexible joints between various envelop components; the steel connectors installed between structural elements and envelope panels made of bricks joined with steel wires; membranes and tapes, which bond with each other or can also be bonded also to other envelope materials; sandwich panels, or a window joint. Among other things, it tests the impact of environmental, chemical, biological and mechanical factors (durability) on the reduction of safety in the use of connections and the loss of vibroacoustic and thermo-humidity parameters of nZEB elements due to the effects of these deteriorating factors.



PM&VL 8

Enables a full-scale performance evaluation of the thermal and optical characteristics as well as comfort criteria of transparent, multi-functional facade elements

The PM&VL 8 is focused on testing transparent materials like window and glass facade elements. It has been conceived to evaluate the thermal and visual performances and comfort of the people living and working inside the building.

PM&VL 9

Fire safety, hygro-thermal and acoustic characterisation of wooden-based prefab facade systems

This line, which is specifically dedicated to wood-based materials, tests their behaviour when they are exposed to fire and humidity. It also considers the occupants' exposure to sound and to the acoustic characteristics of the materials.

Measure & verify

Framed by multiple standards and certifications, the construction industry is today confronted with the most significant technological evolutions. If the first concern of manufacturers is to make their innovations compliant with current standards and certifications, it is also necessary to anticipate that, in the near future, these already-stringent prerequisites may evolve.

The series of tests provided by the MEZeroE PMV lines make it possible to ensure that all the materials and the envelope components' uses will be compliant to the building norms and will fulfil their technical requirement in terms of performance, lifetime, safety and health. These various verification standards obviously take into account increasingly stringent structural requirements and energy performance criteria. At the same time, these standards are likely to evolve, notably under the impulse of the creation of new materials and devices by the construction industry. In this context, the agility shown by MEZeroE laboratories is a powerful asset, notably by playing a key interface role between industrial innovation and the regulations that allow it to be put on the market. The PMV lines offer the following tests and characterizations, which can be classified into three categories.

LIFETIME RELIABILITY TESTS

This battery of tests allows taking into account factors and constraints in terms of humidity, temperature, thermal cycle, UV light and salt fog. Calorimetric aspects are also evaluated by measuring the temperature difference between two environments, heat flux, thermal conductivity, condensation and hygro-thermal behaviour.

MECHANICAL TESTS

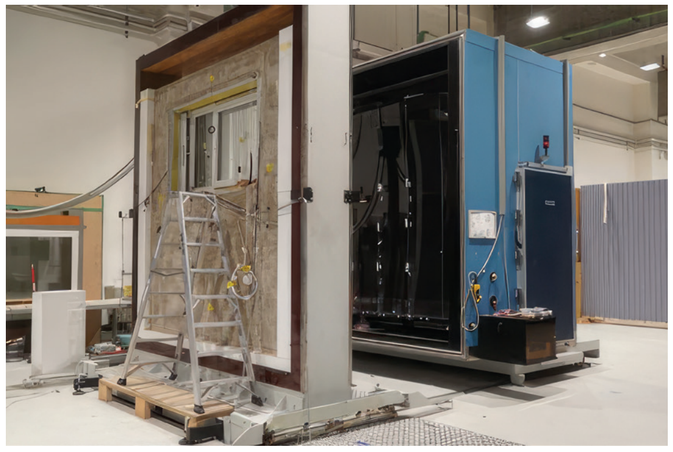
These tests target stresses in terms of mechanical load (wind, snow), dynamic mechanical load (load + vibration, wind, transport) and acoustic influence (sound). The mechanical impact (resistance to the impact of any load, stones, people, hail, etc.) is also evaluated, as well as the cracking at low temperatures.

CHARACTERISATION & DIAGNOSIS TESTS

These tests include the characterisation of VOC (volatile organic compounds) emissions from materials using emissions test chambers. The sun simulator is used to measure the efficiency of PV modules. Heat transfer is also tested, as well as electrical safety tests to assess fire risks. Tensile strength and elongation tests are performed to measure the strength of a joint for example. Finally, to verify what is happening at the interface of two materials or inside the materials, FTIR (Fourier-transform infrared spectroscopy) and SEM (scanning electron microscopy) tests by microscope are conducted.

Eurac Facade Laboratory:
testing of innovative envelope systems
© Eurac Research - Fabrizio Giraldi

Testing of fire resistance in walls
© Tecnalia Research & Innovation



Testing of active/passive facades
© Eurac Research

In the current energy and construction context, the building envelope is at the heart of multiple issues. For new buildings as well as for existing ones, the facade and the elements of the envelope play a major role in their efficiency and sustainability. For new buildings, the most efficient technologies in terms of thermal insulation or energy production are used, for example in the case of active facades integrating BIPV devices. For older buildings, the main challenge is to carry out energy renovations that limit heat loss to the greatest extent possible. This can be achieved by replacing insulation and by integrating double or even triple glazing together with more efficient heat and electricity production systems by choosing adapted materials and devices, depending on the climatic conditions and the environment where the building is.

In all cases, whatever the climatic conditions and mechanical solicitations that the material will face during its lifetime, the choice of these products and technologies can cause various problems. To list some of them, we can identify the resistance to the elements and external constraints and the presence of condensation which can lead to the appearance of humidity and then mould within the home. To deal with these challenges, it is necessary to test the different materials developed by the building industry in climatic chambers and labs to understand the mechanism of degradation and to make predictable models as well as in external condition simulations to be the closest possible to real conditions.

Test, certify, market

Within the MEZeroE ecosystem, the presence of PVML lines is one of the project's greatest assets. The organization's living labs throughout Europe specialize in these tests, with the aim of enabling industrial players to test their materials and products. This process should then give them the opportunity to adapt and understand the behaviour their products will have over time in given conditions. In parallel, this testing process within the living labs plays a fundamental role in all the steps to be taken by manufacturers to certify their products. While some of the MEZeroE laboratories are accredited to deliver a selection of these certifications directly, others make it possible to provide all the necessary data and information to obtain them from the relevant authorities.

Testing of adhesives and sealants
© Tecnalia Research & Innovation

Building material testing
© Eurac Research - Ivo Corrà

Testing of glass elements
© Tecnalia Research & Innovation

Join the community

Within the framework of the MEZeroE project, everything is implemented with the aim of giving birth to a community in which a collaborative spirit of mutual aid and knowledge sharing prevails. By bringing together industrial and economic players of all sizes, scientific research centres, including custom testing laboratories, as well as players active in the fields of engineering, architecture and real estate, the MEZeroE ecosystem provides its members with access to a complete knowledge management environment as well as customized training. A virtuous collaborative dynamic, governed in particular by the exchange of services and know-how.

By removing the barriers and compartmentalization that often impede the progress of industrial actors, start-ups and academic or scientific players, the MEZeroE community intends to create the necessary framework conditions for the emergence of a committed constructive and architectural paradigm, capable of taking up the sometimes-problematic environmental and ecological challenges specific to the development of sustainable housing.

From first idea to market through collaborative innovation

For the construction industry, bringing a new product or an innovative material to market requires many steps and multidisciplinary know-how. Sustainable prototypes must be tested, improved and then certified before finally being made available to engineers, architects and building owners. This is a long chain of complex actions which, to be successful, requires the knowledge of many actors while taking advantage of agile and adaptive processes. Within the MEZeroE community, these are the values that drive and guide the work of its members.

Fire testing © Tecnalia Research & Innovation. PV integration Lab © Eurac Research - Ivo Corrà. Flexible PV © Heliatek. Window frame production line @ Velux. Tests on road and rail noise barriers - CE Marking - ETA © Tecnalia Research & Innovation. Volatile Organic Compounds Lab © Eurac Research - Annelie Bortolotti. Acoustic manikin: binaural head with artificial mouth© Eurac Research - Matteo Pellegatti. Solar Carve Tower © Focchi project - Timothy Schenck Ph. Wooden house @ Riko.

A plural, complete and open ecosystem, what to bring and what to benefit from

For each member, depending on its profile and its position within the construction market, different advantages can be identified. As a property owner, for example, it is possible to access the latest information and data as well as feedback on new nZEB envelope products. For start-ups and entrepreneurs active in areas of sustainable innovation, a number of test and research facilities are available. In addition, various support measures are offered for testing and certification protocols to facilitate the market launch of new products. Manufacturers have access to data from large-scale tests on real buildings and to an overview of how their products are perceived by users and residents. This valuable feedback can then be used to refine the product through consumer interaction. In the end, whatever the profile of the community members, MEZeroE also and above all offers the possibility to get acquainted with the technological development trends in the field of sustainable construction and, in return, to provide useful information on the market needs and the technical options to be considered in order to achieve mature products quickly.

Technical requirements

SAFETY

Requirements categories under EU Regulation 305/11	Requirements implementation
Mechanical resistance and stability	Statics, durability, seismic resistance
Safety in case of fire	Reaction to fire, fire resistance, propagation
Safety and accessibility in use	Building as a safe to use system

In order to drive initiatives that can help redefine the building industry and to establish an ecosystem where design and construction of near zero-energy buildings are a part of the landscape, each MEZeroE partner has to consider the safety implications of every innovation.

In fact, matters related to the safety of the projects are central to the dialogues among the consortium members. Key focal points of many of the measurement and verification lines (PM&VL) described elsewhere in these pages concern themselves with safety. And it makes sense. The safety of the occupants of any building depends on the interactions among an impressive range of materials, processes, and technologies. All the stakeholders are keenly aware that their developments – no matter how innovative they might be – are only useful to the building process if they can be produced, installed, and used safely. There is a keen awareness of the safety requirements outlined in EU and national regulations, including those related to mechanical resistance and stability (covering such challenges as statics, durability, and seismic resistance), safety in case of fire (reaction to fire, fire resistance, and propagation), and, importantly, safety and accessibility in use (the entire building as a safe-to-use system).

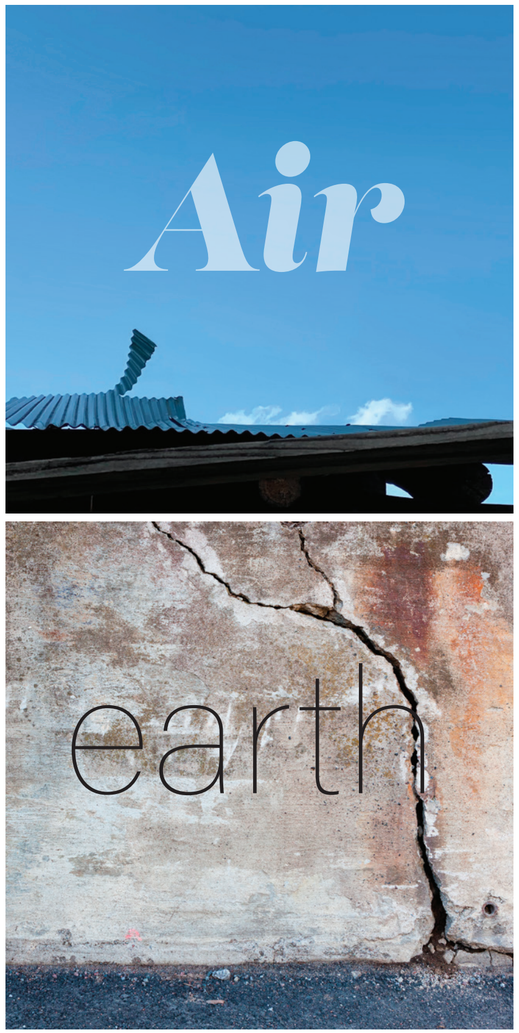
It is thrilling to experience the consortium members' innovative approaches to keeping us safe in our shelters from everything the environment might throw at us, regardless of the natural or man-made source of the risks we face.

PM&VL1

PM&VL6

PM&VL7

PM&VL9



Fire © Tecnalia.
Water © Greenteg Air and Earth by Shutterstock

FIRE There are members of the MEZeroE consortium who dedicate considerable parts of their energies and resources to improving the fire safety of their building materials, from the insulating foam for walls, roofs, and floors to pre-fabricated wooden components to the timber used in the construction of nZEB envelopes.

WATER Uncontrolled water and moisture can threaten the structural integrity and performance of the building envelope and – by extension – the health and safety of its occupants. To mitigate these risks, MEZeroE partners test each part of the system to control the water and the moisture in the building envelope, with a focus on moisture diffusion, surface condensation, rain water entry, and every other issue that can compromise the building's energy performance and the indoor environmental quality, with their implications on the safety of the occupants.

AIR/WIND Building envelopes in every part of Europe will, at some point, be exposed to high winds. Obviously, some regions are more likely to experience very strong winds than others but the buildings should be designed and constructed to offer wind-resistance and wind-driven water-resistance appropriate to the location and, of course, the protection of the occupants.

EARTH Recent news items from devastated regions around the world have illustrated the importance of the roles building envelopes can play in resisting the destructive power of seismic activity and other natural calamities. Many of the tests the MEZeroE partners apply to their innovations are created with an awareness of the risks caused by an occasionally unstable planet.

Technical requirements

HEALTH

Requirements categories under EU Regulation 305/11	Requirements implementation
Hygiene, health, environment	High IEQ, water tightness, vapour permeability
Protection against noise	Airborne sound insulation, soundscape, vibration

While the quality of a building may, in particular, be evaluated by taking into account its overall performance in line with the 2050 strategy, the measures related to the health and well-being of the inhabitants are just as important. Within the framework of the projects carried out in the MEZeroE ecosystem, an important focus is placed on these health dimensions.

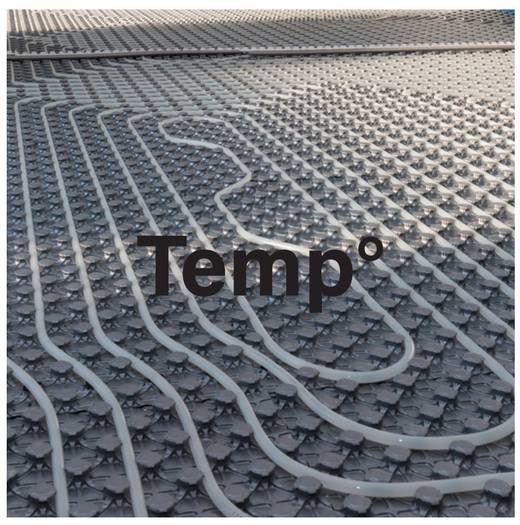
Sustainability must also – and above all – be defined by the impact that a building generates on the people most directly concerned, specifically, its inhabitants. At first glance, a relatively simple observation can be made: a healthy building will have a healthy impact on its occupants.

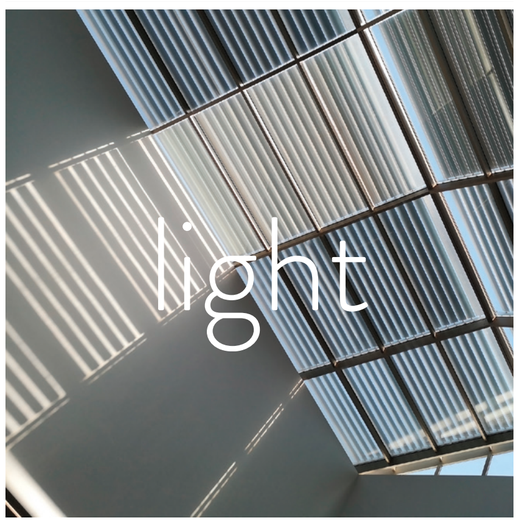
But what is a healthy building? On what criteria should such a notion be defined? And before we consider them, we have to ask what different health impacts should be noted concerning the construction. These questions will be answered by highlighting the different testing processes that the MEZeroE ecosystem benefits from to measure these various aspects.

PM&VL2

PM&VL6

PM&VL8





Health: what are the impacts on the front line?

This often seems to be a secondary issue in the construction industry, but the materials and manufacturing methods used to build a house will generate real impacts on the health of future occupants. Among the first health risks to be mentioned is the organic volatility that escapes from certain materials. To understand the impact of this problem, let's mention a central biological fact: every day, a human being breathes an average of 8000 litres of air. Now, let's add to that a second component reflecting our current lifestyle: as sedentary people, we spend a very important part of the day indoors, at home or in professional places. If it is easy to imagine the pollution that can be present in the air outside, for example in an urban environment, the air pollution inside remains rather unknown. And yet, it is frequent that the interior context of the spaces in which we spend up to 90% of our daily time is usually more polluted than the air outside.

Among the first culprits to be targeted are volatile organic compound emissions (VOCs). Different sources can be identified for these emissions, including the materials that have been used to manufacture our home or our furniture, as paints, glues and adhesives for example. Once the materials are in our home, they release all these organic chemicals into the indoor air we breathe. Respiratory irritations, allergies, headaches and also dizziness are all undesirable side effects linked to the presence of these pollutants.

Among the tracks to be privileged in a healthy and respectful construction of the interior environment, we can in particular mention ecological and natural materials. Local wood, raw clay or solvent-free paint are all examples, both for the building's framework and for its internal elements and coatings. At the same time, it is important to remember that timber construction also requires special attention, since moisture problems can, in the absence of adequate measures, prove to be particularly risky. The causes of such a problem are many and varied and may include a lack of ventilation, water infiltration or the presence and accumulation of water vapor. Factors that, by exacerbating the phenomenon of condensation specific to each habitat, can then lead to the development of mould and fungi with, once again, a significant negative health impact.

In order to control these phenomena and to avoid their appearance, PM&VL 2 provides testing solutions to characterize the chemicals that can be emitted by these materials and could potentially be toxic for human health.

Well-being, the other dimension to consider

In addition to the health and physiological impacts that the construction materials and processes used may have on the inhabitants, their well-being represents a second dimension that must be considered just as carefully. In this context, it is a question of understanding the impacts that a dwelling generates in terms of living experience, comfort and well-being.

At first glance, three main areas of interest can be identified in this regard: acoustics, luminosity and thermal comfort. Is the house soundproofed too much or too little? If the house is poorly insulated, the occupant can quickly suffer from external noise or noise from the neighbourhood. The same is true if the insulation limits sound too substantially. Deprived of the slightest noise, a living environment can also become oppressive. In terms of luminosity, a home also requires a studied approach. Too much or too little natural light, the possibility of varying the intensity of the light entering the room or not and the exposure of the facades are all elements to be taken into account with regard to the comfort of the inhabitants. Finally, thermal comfort is another source of well-being to be considered. Too hot, too cold, not enough possibility to adjust the temperature; these parameters necessarily play a role in our well-being.

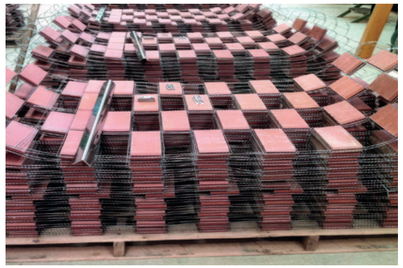
PM&VL5

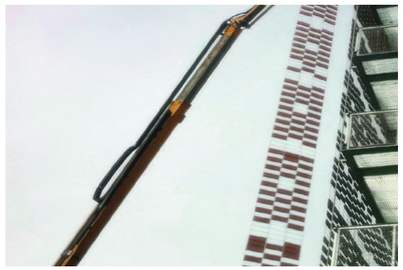
PM&VL6

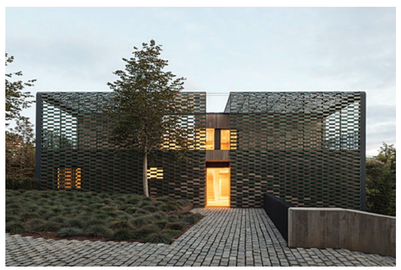
PM&VL9

Organic Buildings

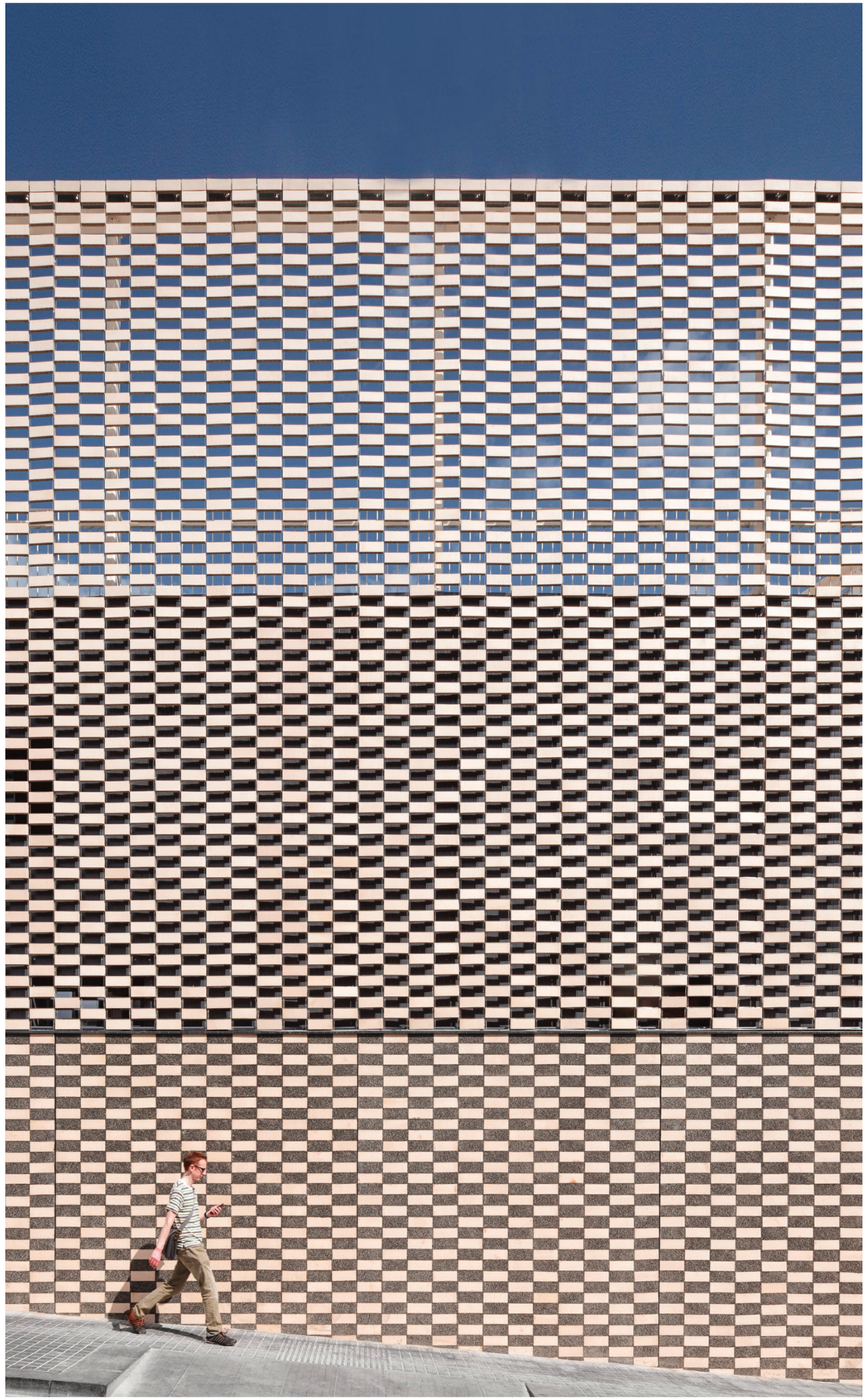
In the end, we realize that a healthy building owes a large part of its sustainable performance to its environmental and health impact. In addition to construction, whose manufacturing processes and ecological materials used must aim for zero CO_2 emissions, the entire life cycle of a building must also be included in the equation. This is called climate neutrality, a specific dimension closely linked to the energy and ecological measurement of a building during its entire life cycle, both in terms of use and maintenance or renovation. And as explained, this dimension must now include notions related to the health and well-being impact on its occupants. Within the MEZeroE community, this dimension is approached with the same priority and importance as all those on which its activity is based.







Ceramic architectural skin by Flexbrick ®



Technical requirements

EFFICIENCY

Requirements categories under EU Regulation 305/11	Requirements implementation
Energy economy, heat retention	nZEB, SRI, air permeability
Sustainable use of natural sources	GPP, envelope circular economics

To test the efficiency and performance of glazed elements, the MEZeroE ecosystem has actively developed the positioning of its affiliated test laboratories. In terms of available tests, these laboratories allow for the verification of U- and G-values, fundamental components in the certification of the performance of glazed facade elements.

What are they? Let's start with the U-value, which we can define as follows: it is the heat transmission coefficient and is therefore one of the most important parameters in the calculation of the thermal insulation of buildings. This value is used to evaluate the quality of thermal insulation of a building element. Therefore, it is an essential part of the certification and standardization process, especially in order to meet the legal requirements set by the regional authorities that regulate the construction market. The G-value, which is also known as total solar energy transmittance, is used to measure the transmission of heat from the sun's rays through a window. In general, the following three factors can be mentioned in the influence of thermal insulation: heat transmission between the interior air and the element, heat conduction within an element, and heat transmission between the element and the exterior air.


PM&VL1


PM&VL3


PM&VL4


PM&VL5


PM&VL6


PM&VL7

Emission, performance, energy by Shutterstock.
Permeability © Tecnan

Active glass, the new sustainable technology challenge

Moving towards the construction of climate-neutral buildings, whose manufacture does not generate CO_2 emissions, requires a fundamental architectural and engineering rethink. A key point in the process is the design of so-called active facades. In addition to their obvious roles of protecting the occupants against the external elements and limiting heat loss, they also – and above all – address the issue of making the building envelope a sustainable energy-producing element. To achieve this ambitious goal, several technologies are to be favoured, such as BIPV devices and electrochromic glass.

BIPV (Building Integrated Photovoltaics) modules are a revolution in the photovoltaic industry, making it possible to overcome aesthetic and architectural constraints to maximize solar energy production. Within the MEZeroE community, these technologies are widely explored and promoted, notably through various industrial partners active in this field. The concept of BIPV technologies consists of benefiting from products and facade elements equipped with photovoltaic cells. Not only glass facades, but also building elements of various colours and textures can be exploited for their energetic and structural roles.

BIPV (Building Integrated Photovoltaics
© Shutterstock

Testing of active/passive facades
© Eurac Research - Fabrizio Giraldi

Testing of facade element
© POLIMI, Politecnico, Milano

Facade testing, a cutting-edge science

To verify and measure the quality of materials developed by the construction industry on each of these different factors, the laboratories affiliated with the MEZeroE project benefit from all the systems and infrastructures as well as the necessary testing protocols. This technical characteristic is fundamental to being verified through dedicated tests, especially for glass modules, since a window with poor insulation can let out up to ten times more heat than the surrounding walls. This, of course, depends on the quality of the frame and the tightness of the seals that ensure the closure, and especially the glazing. Within the MEZeroE ecosystem, PM&VL 1, 2 and 3 provide test solutions to measure BIPV's performances and reliability as well as the U-value of facade building elements, including windows. Then, another value is also taken into account: the G-value, or the glazing's ability to let in the sun's energy, of which about half is visible light. This is another decisive factor in terms of energy performance for glass elements. Once again, MEZeroE's test labs can verify this essential value. Some of the laboratories are also able to certify the tested products.

BUILDING - USER

INTER—ACTION

Interestingly, the exploration of how occupants ultimately interact with the buildings where they live and work is a relatively recent phenomenon. For the members of the MEZeroE consortium, this building/user interaction is squarely at the centre of their research focus, which makes perfect sense.

Every part of the ecosystem involves how well the design and construction of a building – whether for residential or commercial applications – meets the users' needs and how easily and comfortably these occupants can engage with the building and the numerous points of intersection between building envelope and user.

This has driven the MEZeroE consortium to explore these interfaces – including such issues as thermal (temperature and humidity) and visual (lighting) comfort, ease of occupancy and a whole range of social/behavioral dynamics. Thanks to the open access nature of the ecosystem, consortium members – as they develop testing for each new innovation – have a chance to confirm that their own contributions work in concert with the solutions proposed by their collaborators in the building envelope system under development.

Clearly, the acceptance of the innovations by the people and organizations that will ultimately live and work in a building is a fundamental target of the research. Any breakthrough – no matter how fresh and creative – has to be embraced by the occupants, something which is always top of mind for the consortium researchers.

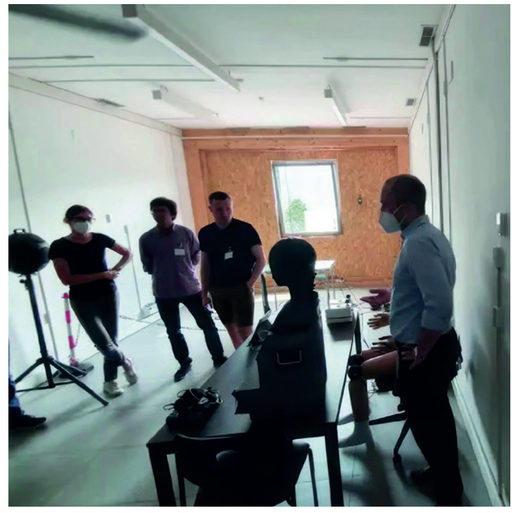
PM&VL2

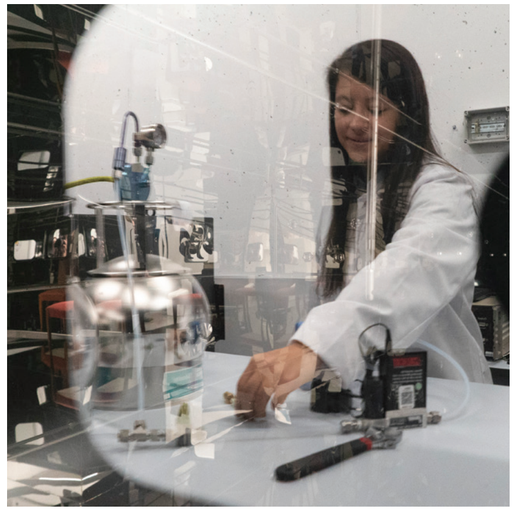

PM&VL4


PM&VL5


PM&VL8


PM&VL9





Performance of innovative facade solutions © Eurac Research - Annelie Bortolotti.
Canister connected to the chamber to collect samples from the air inside © Eurac Research - Annelie Bortolotti

Complementary goals: energy efficiency and meeting users' needs

Every test is designed with a pair of complementary goals in mind: one is the energy efficiency of the building envelope; the other is how well it meets the needs of the people who will ultimately live and work in the building. After all, a building that approaches the coveted near-zero-energy status defined in MEZeroE's mission can only be deemed successful if its occupants feel well – physically and mentally – and if they can interact comfortably with the technology that makes the system so efficient. Already at the PM&VL stage, the designers and researchers develop test-chains geared toward the examination of how to optimize the building/user interactions, including mutual behavioral control, through the Internet of Things (IoT) and artificial intelligence (AI) solutions that are squarely based on the building envelope itself and on the needs of the users.

Studies with human participants
© Eurac Research - Annelie Bortolotti

Tests that monitor and predict

The tests are designed to predict and monitor all of the parameters that define indoor environmental quality but just as importantly, they do the same concerning the well-being of the occupants. When the development reaches the living lab stage, the energy use and system operation will be monitored fastidiously and, when their performance doesn't match the expectations, remedial actions can be taken. Of course, the behavior of the people living and working in the living labs will be monitored and their reactions to the environment, quantitatively and qualitatively, will be evaluated. Ultimately, as the researchers analyse the impact of the building envelope systems both on the indoor environmental quality and the well-being of the occupants, adaptations will be made with an idea of optimizing not only the users' experience but also the energy use. And it all happens, efficiently and effectively, before the innovations reach the marketplace.

A cornerstone of the MEZeroE ecosystem

The focus on user and building integration is a cornerstone of the MEZeroE ecosystem. As we've mentioned, it is incumbent on the consortium to contribute to an industry and a society whose new buildings are not only paragons of energy efficiency but also inviting, exciting places to live and work. And our dedicated paradigm – from the academic research facilities to the test benches to the living labs – has been created to help inform a brighter, healthier future for our planet.

Facade System Interactions Lab
© Eurac Research - Annelie Bortolotti

KUBIK experimental building
© Tecnalia Research & Innovation

© Universität Innsbruck

Building Energy Efficiency Pilot
© Politecnico Milano

MEZeroE

Measuring Envelope systems
for Zero Energy buildings

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